Research on the Construction of Intelligent Agriculture Platform Based on Internet Plus

Yan Gong¹, ²*, Yang Zhang¹

¹Business School, Ho Hai University, Nanjing, Jiangsu, 211100, China
²Business School, Yancheng Teachers University, Yancheng, Jiangsu, 224007, China

*Corresponding author (Yan Gong, E-mail: gongyan0729@126.com)

Abstract

“Internet plus” can effectively improve the operational efficiency of all aspects of agriculture, to achieve the construction of intelligent agriculture platform. By analyzing the environment of intelligent agriculture platform construction in China, combining with the information technology such as internet of things (IoT), cloud computing and big data, we can build "1+N" intelligent agriculture platform which is composed of infrastructure layer, basic data layer, application support layer and application service layer, namely integrated management platform of agricultural information service, agricultural big data system, agricultural IoT monitoring system, agricultural e-commerce system, agricultural product quality safety traceability system, agricultural science and technology service system. Finally, some suggestions are put forward for the future development of China's intelligent agriculture platform.

Keywords: Internet plus, Intelligent agriculture, Information technology, Platform construction

1. INTRODUCTION

Under the new economic circumstance, Chinese economy has entered the important period of growth slowdown and structure adjustment. The government powerfully advocates the development concept of “Internet+” and promotes it as a national strategy, making it the new engine of economic development and the representative power of innovation development. The so-called “Internet+” refers to the new circumstance that by virtue of Web2.0 environment, information communication technology is used to combine Internet with various industries in the society for development, exerting great effects on the production and operation methods of various industries. “Internet+” can provide new ideas, methods, motivations and modes for any traditional industry. Through the organic integration of the aforementioned both, a new ecological development strategy is created in new fields. Since then, the new pattern that Internet promotes economic development opens up and “Internet+” is also gradually attached importance to by various industries.

As an agricultural power, China owns 700 million agricultural population, accounting for 51% of total national population. Thus, the agricultural problems concern national quality, economic development, social stability and national prosperity. Under the circumstance of “Internet+”, the effective, high-quality, energy-saving and environmental-friendly agricultural development can be realized and “Internet+agriculture” also becomes the tendency and certainty for solving Chinese agricultural problems and realizing sustainable development of agriculture. Currently, “Internet+agriculture” is demonstrated as the research and application of intelligent agriculture that mainly focus on constructing intelligent agricultural platforms based on various advanced information and network technology. Furthermore, intelligent agricultural platforms can integrate knowledge bases and model bases of various fields, by means of mechanisms like deduction and analysis, to accomplish the prediction of links including agricultural production, circulation and sales and the provision of intelligent perception, alert, analysis, decision, control and so on. Additionally, intelligent agricultural platforms can realize the better integration of different formats and cross-border modes through Internet so as to firm the agricultural informatization basis with core of agricultural IoT and cloud computing technology, to improve the agricultural informatization service with the support of big data and to realize the great-leap-forward development of agricultural modernization and informatization.

2. ENVIRONMENTAL ANALYSIS OF THE CONSTRUCTION OF INTELLIGENT AGRICULTURAL PLATFORM

2.1. Guidance and support of government policy

Chinese government attaches great importance to informatization development, allocates innovation driven development strategy, network power strategy, national big data strategy, “Internet+” action and so on, places agricultural rural areas to a prominent and important position, and provides powerful policy support for the informatization development of agricultural rural areas. “Agricultural informatization”, a significant symbol that Chinese intelligent agriculture starts to develop, was firstly proposed in No.1 Document of the Central Committee of the Communist Party of China in 2005. Afterwards, the announcement of policy documents like
The 13th Five-Year Plan Outlines of National Economy and Social Development, Strategic Outlines of National Informatization Development, Modernization Planning of National Agriculture (2016-2020), "The 13th Five-Year Plan” National Informatization Planning fully support informatization construction in Chinese agricultural rural areas during the 13th Five-Year, enhance the integration of agriculture and information technology as well as the development of intelligent agriculture. "The 13th Five-Year Plan” National Informatization Development Planning of Agricultural Rural Areas published in September 2016, points out that capital subsidies are provided by Ministry of Agriculture and Ministry of Finance of the PRC to technology like IoT, cloud computing and big data in the 106 national informatization demonstration base of agricultural rural areas that are identified by Ministry of Agriculture; meanwhile, modern information technology like 3G, IoT, sensor network and robots is piloted and developed as the focus so as to promote the experimental demonstration of informatization including agricultural resource management, supervision and alert of agricultural situations, agricultural machine scheduling and supervision of unmanned aerial vehicles and to perfect the operation mechanism and mode of intelligent agriculture.

2.2. Preliminary informatization of agricultural rural areas

In recent years, there has been certain basis of informatization development of agricultural rural areas. The informatization ability is improving with each passing year, providing firm support for the construction of intelligent agricultural platforms. The rapid development of informatization in agricultural rural areas is mainly presented in fields like production, operation, management, service and so on. Information technology including IoT, cloud computing, big data, space information and mobile Internet is applied to aspects of agricultural production, such as online supervision, accuracy operation and digital management, to different extents. E-commerce in agricultural rural areas is emerging successively in East, Middle and West China; the development pattern is forming where agricultural products enter city while the industrial products are delivered to the countryside, a two-way circulation, and the number of producers who sell agricultural products online greatly increases. The construction task of JinNong Project is accomplished perfectly after acceptance and check. As a result, information system has covered seven major businesses including statistical supervision of agricultural industries, supervision evaluation, information management, alert prevention and control, command and dispatch, administrative law enforcement and administrative office affairs. The organizational and working systems of “peasant, agriculture and rural areas” information service are being perfected, consequently diversified and marketized promotion pattern planned by government through inter-department cooperation and participated by the public is formed. Taking construction of projects including “broadband China”, “wireless cities”, “the next generation of Internet”, “integration of telecommunications networks, radio and television networks and Internet” and “broadband access to villages” as the turning point, it is essential to accelerate the construction of basic communication facilities, optical fiber broadband network and mobile communication network and CATV network and construct the information network system that combines wired and wireless networks and covers urban and rural areas in rural areas. As of December 2016, the broadband access rate of Chinese administrative villages has reached 95%; the broadband access ability of rural family has basically reached 4Mbps; the scale of rural netizen has reached 201 million while the annual increase rate has reached 9.5%; the Internet popularity rate in rural areas has reached 33.1%, which is 1.5 percentage points higher than that of 2015. Four-grade network system of province-city-county-village has been established in most provinces and cities, and rural areas have become the major motivation for the development of Chinese Internet.

2.3. Requirement for the development of agricultural modernization

The fundamental solution to agriculture lies in modernization because agricultural modernization is the basis and support for national modernization. As the basic industry in China, agriculture is faced with severe challenges including frequent disasters, vulnerable ecological security and continuous declination of bio-diversity resulting from backward development of agricultural products, small scale of production and operation, difficulty in income increase of peasants, resource shortage and climate changes. As the upgrading of resident consumption structure is accelerated, the structural reform task of agricultural supply side is extremely difficult, requiring information technology to be applied for accurately docking of production and sales, quality benefits and competitiveness of supply to be improved and the core productivity effect of information technology to be sufficiently exerted. Besides, small-scale agricultural operation has existed for a long time but the scale efficiency should be improved urgently. Thus, it is necessary to apply information technology to explore for a road for large-scale agriculture with Chinese characteristics and to sufficiently play the scale effectiveness role of Internet platforms gathering and exaggerating single agricultural household and new operation subject. Furthermore, regarding that the price improvement space for agricultural products is limited and the income increase space of employment transfer is narrowed; the continuous income increase difficulty of peasants is exaggerated, requiring information technology to be applied to promote the mass entrepreneurship and innovation of rural people, to develop new economy in agricultural rural areas and to sufficiently play the role of “Internet+” to open new approaches of peasants’ income increase. In regard to that the resource and
environment restrictions gradually tighten and the agricultural development methods urge for transformation, requiring information technology to be applied to optimize resource allocation, to improve resource utilization rate and to sufficiently play the role of information resources as a new production element. Thus, agricultural modernization construction can accelerate the solution to agricultural development difficulties and provide motivation for intelligent agricultural development.

3. KEY TECHNOLOGIES FOR THE CONSTRUCTION OF INTELLIGENT AGRICULTURAL PLATFORM

Construction of intelligent agricultural platforms requires sufficient use of information technology, including more thorough perception technology, broader interconnection technology and deeper intelligent technology, which provides more effective and intelligent operation of agricultural system in hope of realizing the target of enhanced competitiveness of agricultural products, sustainable development of agriculture, effective use of agricultural resources and environment protection. Currently, under the background of “Internet+”, the key technology that promotes construction of intelligent agricultural platforms involves includes IoT technology, cloud computing technology and big data technology.

3.1. IoT technology

At present, IoT technology in the construction of intelligent agricultural platforms can be classified into three categories including sensor technology, information transmission technology and information decision technology (Fig. 1).

As to sensor technology, it can realize the data collection and supervision of the whole chain of intelligent agriculture. Concentration of O₂, CO₂, CH₄ and C₂H₄ in air is collected; soil temperature, humidity, water contents and fertilization are supervised; technology, such as RFID (radio frequency identification), GPS (global positioning system), GIS (geographic information system), RS (remote sensing system) and AS (agricultural sensor), is used to conduct 24h and instant feedback, analysis and records of information and data, such as animal and plant growth status, activity location, disease alert and supervision, disaster alert and prevention, and to conduct sustainable data collection of procedures, such as picking, harvesting, slaughtering and processing, so as to provide information for the following sales and transaction chains.

Regarding the information transmission technology, it uses sensors to collect parameters and acquire information in real time. After digital conversion and conclusion, parameters and information are transmitted into the intelligent management system through WSN (Wireless Sensor Networks) technology. Sensor networks usually consist of a large number of nodes with limited resources that are randomly allocated in the perception region. The nodes construct the wireless network through the self-organization method, perceive, collect and process the specific information in network-covered areas through collaboration and realize the mutual transmission of data among several devices.

Information decision technology refers to the automatic processing and analysis of animal and plant data and information with the help of technology so as to assist the realization of formulation and allocation of the optimum decision plans that mainly include ES (Expert System), DSS (Decision Support System), intelligent control technology and so on. According to each index demand for growth of animals and plants, the system
remotely controls agricultural facilities, such as the automatic opening or closing of water-saving irrigation, energy-saving oxygenation and environmental protection fertilization, so as to realize the intelligent agricultural production. In addition, the system planning of agricultural industrial zone distribution, reasonable matching of crop breeds, online identification and governance of diseases, scientific guidance of ecological crop rotation and whole-process security traceability of agricultural products can be conducted.

3.2. Cloud computing technology

As the outcome of integrated development of traditional calculation technology and network technology, cloud computing stores data with network technology as the virtual resource pool, characterized by dynamic allocation of resources, self-help of demand service, resource pool and transparency. In Chinese agricultural development, advantages including integrated construction and dynamic allocation of resources according to demands that cloud computing possesses make it more appropriate for being applied to construct business service platforms of agriculture websites and wireless terminals of agriculture service platforms so as to further realize such functions as massive storage of information resources of agricultural rural areas, information search engines for agricultural rural areas, comprehensive data analysis on agricultural decisions, intelligent supervision control of agricultural production process and comprehensive information service for agricultural rural areas (Fig. 2).

![Cloud computing technology architecture in the construction of intelligent agriculture platforms](image)

In agricultural production, there are large quantities of data emerging continuously, so it is essential to use cloud computing technology to store massive data, through which the agricultural information resources of different regions and departments can be integrated through “cloud” for future sharing. Cloud platforms can change the traditional information retrieval modes and provide integrated retrieval for peasants. Clients send the retrieval requests sent by peasants to the cloud so that the resource scheduling center can conduct dynamic allocation of calculation. Since the ability of cloud computing can be infinitely expanded according to demands, information retrieval is no longer limited by hardware conditions and the speed and accuracy of retrieval can be greatly improved consequently. The cloud data center stores and processes data, such as prediction diagnosis and emergency response of weather and disasters, evaluation and management of agricultural resources, prediction and output evaluation of crop growth, which can provide reference for enterprise and government decision-making. Network storage supported by cloud computing can not only reduce the storage costs of agricultural enterprises, but also improve the intelligent supervision and alert levels through the image recognition and analysis ability of cloud computing. As for agriculture users, cloud storage, similar to a huge network server, can provide massive data service for users. Meanwhile, users can obtain necessary resources and service with high effectiveness and low costs through simple clients without necessity for knowing about the technical details of the service.

3.3. Big data technology

Following IoT and cloud computing, big data technology is another subversive technical revolution, which breaks limitations on management of structural data and inherits the advantages of statistics. As for statistical
retrieval, extraction, integration, analysis, interpretation on massive data, the correlation between data and business, the digging analysis on multimedia, immense and complex data and the comparative analysis on historical relevant data should be attached more importance to (Fig. 3). Big data technology will play a greater role in agriculture. Based on years of local weather, crop and soil, management, market circulation and consumption information, more intelligent agricultural service of different variety can be provided through data statistics, case comparison and mode identification.

In the era of big data, agricultural production can be adjusted and controlled not only through establishing comprehensive data platforms but also through recording and analyzing the dynamic changes in agricultural planting and circulation process. Through data analysis, a series of adjustment, control and management measures are formulated, facilitating the effective and orderly development of agriculture. The production process is used to manage the data, such as the data of facility plantation, facility culture and accurate agriculture, so as to improve the accuracy supervision, intelligent decision, scientific management, adjustment and control of the whole production process. Agricultural resource management data, such as soil resource, water resource, agricultural biological resource and production materials, is used to solve the problems, for instance, shortage of agricultural resources and degradation of ecological environment and biological diversity in China. Agricultural ecological environment management data, such as soil, atmosphere, water quality, weather, pollution and disasters, is used to construct data models and business models for comprehensive supervision and accurate management of agricultural ecological environment. Agricultural product and food safety management data, such as production place environment, industrial chain management, pre-production, in-production, post-production, storage and processing, market circulation fields, logistics, supply chain and traceability system, is used to solve the agricultural product and food safety problems and to guarantee the vital interests of honest peasants. Agricultural equipment and facility supervision data, such as equipment supervision, remote diagnosis and service scheduling, is used to solve the intelligent problems of agricultural infrastructure.

4. CONSTRUCTION CONTENTS OF INTELLIGENT AGRICULTURE PLATFORM

Intelligent Agriculture Platform combines information technology such as IoT, cloud computing and big data with traditional agricultural production, and consists of infrastructure layer, basic data layer, application support layer and application service layer. An agricultural intelligent information service system has been established on the platform with “1+N” (an integrated management platform and N application systems) as the core, so as to realize supervisory control and decision analysis of the whole process from agricultural production, transportation, storage to sales. Regarding the infrastructure layer, it provides necessary network hardware.
equipment, including service host, network switching, data storage, video monitoring, sensing of IoT and BeiDou navigation and positioning. As to the basic data layer, it includes basic database, business database, comprehensive database and data warehouse. In regard to the application support layer, it is an integrated management platform of agricultural information service that provides support framework and elementary universal service for all applications of Intelligent Agriculture. It is composed of system integrating standard, unified identity authentication, application system integration, content embedding management and basic information management. With respect to the application service layer, it refers to the N accessible agricultural information application systems, including agricultural big data system, agricultural IoT monitoring system, agricultural electronic commerce system, agricultural product quality safety traceability system, and agricultural science and technology service system in most cases (Fig. 4).

**Figure 4. Overall Architecture of the Intelligent Agriculture Platform**

### 4.1. Integrated management platform of agricultural information service

The integrated management platform of agricultural information service is an unified log-in platform of Intelligent Agriculture, which could realize such functions as single sign on, user authentication, authority management, access control, session management, centralized audit, log management, DLP view management and data layer access by constructing B/S structure and formulating classification grading standards of business navigation menu and syntax rules of menu naming. At the same time, unified data interface standards, unified system UI interface and normative information management system and security mechanism have been established on the platform, with enough access passage reserved. All developed agricultural information sub-platforms or those newly developed can thus be accessed successfully, and information exchange, integrated display and data security can be achieved on the integrated management platform. In addition, the platform can also be used as the window through which summarized information of agricultural products can be delivered to the public. It provides information service of agricultural product introduction, agricultural marketing sales, vegetation process of agricultural products and national agricultural product industry policy for Internet users, and also job placement, official document transmission and processing, online service, mail receiving and sending and other services for agricultural managers.

### 4.2. Agricultural big data system

In order to further promote the process of intelligent agriculture development and to achieve sustainable agricultural development and regional industrial structure optimization, it is necessary to use big agricultural data, relevant big data analysis and processing technology to establish the agricultural big data system, including function modules of data collection, data processing and data application.

Regarding the function design of big data collection, the system is equipped with data collection interface
which can be directly accessed to the sensor of IoT, RFID collector, QR code reader and other equipment. The original data can be structured automatically based on relevant technology. The data collected manually will be verified comprehensively by the system according to the indicators such as GPS coordinate and run time, so as to improve the speed of data collection transmission and the accuracy of data. Moreover, the isolated data stored in paper media, tape, optical disk, private information systems can be collected by the system through extensive access to various data sources, and heterogeneous data can be collected timely through various data interfaces.

The access data received can be processed through middleware technology, standard (ODBC/JDBC) or non-standard data access interface (API) based on the structure and characteristics of access data. Standard data interface and protocol can be used to realize interactive access of all kinds of related databases, and algorithms library, model base and knowledge base of data analysis application can also be provided. The accuracy and reliability of heterogeneous data in the system can be cross checked from different perspectives through artificial intelligence technology based on data dependency. The error in data that can’t be found in the simple system can be observed so as to improve the authenticity, accuracy and availability of data.

Different levels of data applications can be opened by the system for the agricultural users with different data analysis abilities and data requirements. Additionally, the system provides secondary development API and data analysis module for the users with good development capability, so that they can use the mass data on the platform and flexible computing power to develop the products that meet their own data requirements. The system also provides visualized analysis function for the users with poor development capability, allowing them to generate different analytical statements just by dragging the mouse, to further modify the statements in accordance with their own data analysis requirements, and to start their analysis modeling by using the mass data. The system provides personalized data subscription function for the users with poor data analysis ability, consequently they can subscribe for the agricultural data that largely influence their production and life.

4.3. Agricultural IoT monitoring system

The monitoring system of agricultural IoT is mainly aimed at the large-scale agricultural park and the system can meet the modern agricultural development demand of intensive pattern, high yield, efficiency, ecology and safety of water and fertilizer irrigation. The monitoring system consists of such three parts as on-site monitoring subsystem, the wireless network subsystem and the remote monitoring subsystem.

The on-site monitoring subsystem needs to meet the functions of real-time data acquisition, data storage analysis, automatic control and network connection. The environmental data in the production field and equipment status data can be timely collected and uploaded to the cloud in the system through ZigBee wireless network technology and equipment of IoT like sensor, controller and cameras deployed in the production field. By means of smart phone or computer, the users can achieve real-time monitoring of climatic change, soil conditions, crop growth, water and fertilizer use and equipment operation in the agricultural production field. The system will give automatic alarm in the case of any abnormal condition. The producers can then take prevention and control measures timely, or the system automatically cancels the abnormal condition, to effectively avoid the production risk.

Mobile communication technology is connected with Ethernet seamlessly in the wireless network subsystem so as to achieve remote monitoring. The system stores the relevant environmental parameters collected through on-site supervision in the database, and transmits the data to the remote monitoring subsystem through the fixed IP provided by the network service provider. The connection between the site and remote management center can thus be realized, which meets the transmission demand of various data in the monitoring process of agricultural base.

The remote monitoring subsystem combines relevant parameters and video information transmitted in the field monitoring subsystem to complete the collection, storage and display of parameter information. At the same time, the system can automatically or manually control the irrigation, ventilation, cooling, warming facilities and equipment in the production field and send out corresponding control instructions through the wireless network subsystem, by which precision operation can be achieved and labor cost input can be reduced.

4.4. Agricultural e-commerce system

“Internet+” has brought radical change to the traditional agricultural marketing and completely changed the original channel sales model. It enables us to establish the internet direct sales channel from the producer to the demander through agricultural e-commerce system. And various application and information service demands of users on the agricultural supply chain can be met after introducing the models of business-to-business (B2B), business-to-consumer (B2C) and consumer-to-consumer (C2C) to planters and cultivators, processors and consumers.

In terms of application layer, the system provides supply of agricultural means of production, agricultural marketing sales, logistics distribution, e-payment, intellectual product recommendation, agricultural production and other services for agricultural users. The system provides various forms of accessible internet interfaces, such as mobile phone, tablet personal computer, laptop and desktop to improve their experience. Furthermore,
Web Service technology is used to package the functions of commodity information management, order information management and intelligent recommendation module into Web service and achieve SaaS (Software-as-a-Service).

Regarding information service demands layer, the system can capture the platform information of Suning Tesco, JD and Taobao by technological means of web crawler. Besides, it can also analyze the data of sale price of agricultural products, quantity of sale, sales rank and store distribution of agricultural products. Data captured can be compared, analyzed, visually displayed according to the self-defined screening condition, which provides not only accurate agricultural product supply and demand information service for agricultural e-commerce providers, but also a basis on the varieties and production time of agricultural products for the farmers.

4.5. Agricultural product quality safety traceability system

To improve the quality safety and the market competitiveness of agricultural products, and help users to implement brand management of agricultural products, the traceability system of quality safety of agricultural products should be established on the platform, so as to establish and check the trace ability files of agricultural product production and management quality safety.

By virtue of this system, the government departments can supervise and manage the overall process of agricultural product from production, processing, inspection to logistics and sales, fully control the quality and safety condition of agricultural products, and realize quality safety responsibility investigation of agricultural products, so as to ensure the safety of agricultural products (Fig. 5). Farmers and agricultural product production enterprises can carry out scientific production, manage and record information about production inputs, agricultural product inspection, authentication, processing and distribution, and these information can be automatically added to the traceability files of agricultural products. Meanwhile, the system can automatically collect the environmental data, growing period picture information and real-time video of agricultural products through the equipment of IoT like intelligent sensor and cameras deployed in the production field, to enrich the files of agricultural products. Additionally, the independent anti-counterfeit traceability information of agricultural products can form QR code, bar code and 14-bit code in the system through the one-object-one-code technology. The consumers can use mobile phones to scan the QR code or bar code or log in the traceability system and enter 14-bit code to check the relevant data of agricultural products in all links in the form of picture, text and real-time video, including information record of variety, production mode, producer and overall process of products from production to sales. In this way, the consumers can choose and consume the agricultural products in a safe way without worries.

![Figure 5. Process of Agricultural Product Quality Safety Traceability](image)

4.6. Agricultural science and technology service system

The agricultural science and technology service system should be established in order to promote the resources integration of agricultural talents, science and education, information superiority, drive the transformation of agricultural scientific and technological achievements, and allow agricultural producers to better benefit from agriculture science and technology. The system mainly includes the following three functions including agricultural expert service, agricultural technology learning and agricultural information recommendation.
Agricultural expert service, based on the online agricultural expert database and knowledge base, can provide fuzzy diagnosis, progressive diagnosis and picture-guided diagnosis by means of video, picture, text and voice. This system not only can effectively solve the practical problems in agricultural production and livestock breeding, but also is open to the agricultural scientific research institutions, agricultural colleges and universities, planting and cultivating farmers for agricultural technology exchange, telemedicine, remote consultation and emergency processing. In order to meet the demand of most farmers in the production process and agro-technicians in the technical guidance process for practical agricultural technology, the system provides learning methods of watching video, learning skills and searching Wikipedia, and enriches the content and form of rural informationalized service. In regard to agricultural information recommendation, instant message of agricultural policy, market quotation, plant diseases and insect pests forecasting and agro-meteorological hazard warning is delivered to the farmers directionally and accurately, in such a way agricultural information is released in a real-time manner.

5. CONCLUSIONS AND SUGGESTIONS

“Internet+” is featured as cross-border integration, connection to everything and opening ecology. Based on the intelligent agricultural platform construction of “Internet+”, the application of modern information technology including IOT, cloud computing and big data in agriculture can be promoted; the transformation of agricultural production and development methods is accelerated; intelligent agricultural application demonstration projects should be constructed in fields like agricultural production, operation and management, quality security of agricultural products and supervision of agricultural resources and ecology environment in priority; the comprehensive productivity and sustainable developing ability of agricultural production are comprehensively improved; innovation in agricultural technology and production methods is promoted and the comprehensive competitiveness of agricultural industry is enhanced. Additionally, platform construction can enhance the awareness of intelligent agriculture, and then the agricultural transformation from pure manual planting to mechanized large-scale production is realized.

In the current period, the construction of intelligent agricultural platforms in China has been equipped with certain technology and industrialization basis. However, there are still some problems existing in such aspects as the standard system and key technology of intelligent agriculture, which requires the joint efforts of government, agricultural enterprises, agricultural science and research department and relevant industries.

Firstly, uniform technology standards should be formulated. The platform standards and regulations for correlation complementation of research and development functions, sharing and exchange of information and data and correlation between information and business procedures and applications are supported. Standard basic software platforms and application service systems consistent with Chinese intelligent agricultural application requirement are established so as to provide technical support for system integration and large-scale application of intelligent agricultural platforms. Through constructing virtual technology platforms, the logic abstraction and uniform expression of IT resources are realized so as to exert great effects in management and solution delivery of intelligent agricultural data center.

Secondly, perception technology level is improved; the industrialization process of sensors is accelerated to realize volume production, reduce produce price, and improve the stability, reliability and service life of sensors, making it consistent to the requirement of large-scale rural field planting. The independent research and development of plant and soil sensors is accelerated so as to realize the long-term automation supervision of soil moisture content and physiological indexes including micro changes of plant stalks, fruit growth and leaf temperature.

Thirdly, the research on transmission technology should be attached importance to. Accurate control and real-time video are necessary for facility agriculture so information transmission methods should be chosen according to different agricultural environments. The remote measurement and control system based on ZigBee and 4G video can be constructed; the supervision sites of aquaculture disperse and wireless sensors can be used to construct aquaculture traceability system in order to improve the transmission ability of information; considering the complexity of operation environment in agricultural fields, real-time data of agricultural production can be sent through Wi-Fi.

Finally, the rural informatization infrastructure construction is enhanced. Reform of rural broadband optical fiber is initiated to realize the entry of optical fiber into village households; network speed is improved while information expenses are reduced so as to improve the Internet popularity in rural areas, to promote the integration and sharing of information resources, to construct the comprehensive information transmission method including Internet, broadcast network, telecommunication network, sensor network and satellite communications network and to ensure that rural households can acquire necessary agricultural information resources.

Acknowledgement
The author gratefully acknowledges the financial support of Jiangsu key construction disciplines project for applied economy and thanks the anonymous reviewers for their helpful comments on earlier versions of this paper.

References


