Exploration of the Construction of Smart Tobacco Agriculture

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Abstract

Smart tobacco agriculture is an organic combination of scientific thinking, methods, and technology of smart agriculture with the tobacco industry's institutional mechanisms, current problems, and development goals. The construction and implementation of smart tobacco agriculture focuses on the digital transformation of tobacco leaf production, research and development of mechanized equipment for the whole process of tobacco leaf production, and the intelligent upgrade of two major directions, in order to effectively solve the problem of " where to grow tobacco", "who grows tobacco", and "how to grows tobacco" in various tobacco areas across the country providing solutions. The paper elaborated on the development background of smart tobacco agriculture at home and abroad, focusing on the "1+4+N" construction model and construction effects of smart tobacco agriculture in Yunnan Province. In view of the future development and challenges, research on key technologies of tobacco area layout and tobacco growth perception based on satellite remote sensing technology, key technology of intelligent decision-making for tobacco leaf mechanization operation based on multi-source data fusion and prototype equipment development, agricultural machinery equipment operation quality monitoring and analysing, strategic planning and research on innovative development of smart tobacco agriculture require specially attention.

Keywords： smart tobacco agriculture; digital transformation; high-quality development; development and challenges

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What is Smart Agriculture? Zhao Chunjiang, director of the National Agricultural Informatization Engineering Technology Research Center and academician of the Chinese Academy of Engineering, believes that smart agriculture is based on information and knowledge as the core elements. Integrating to realize agricultural information perception, quantitative decision-making, intelligent control, precise input, and personalized service is a new agricultural production mode, which is an advanced stage of agricultural informatization development from digitalization to networking to intelligence. Modern agriculture has three major scientific and technological elements: variety is the core, facilities and equipment are the support, and information technology is the means. Smart agriculture perfectly integrates the above three scientific and technological elements, which is a milestone for agricultural development.

Like big agriculture, tobacco agriculture is in a critical period of development from tradition to modernity. The elements of technological innovation are replacing traditional production elements and increasingly become the primary force driving the development of modern tobacco agriculture. At the same time, agriculture is generally faced with problems such as relying on the sky for food, scattered production, labor shortage, competition for non-tobacco crops, and ecological degradation. These problems are even more prominent in Yunnan tobacco-planting areas affected by the unique climate and ecology. With the double squeeze of the purchase price ceiling and the rapidly rising cost floor, the comparative efficiency of tobacco production is decreasing day by day. "Which kind of tobacco, who will grow tobacco, and how to grow tobacco" has become an urgent need to solve, affecting the sustainable development of the entire industry. At the same time, the upgrade of cigarette consumption has further forced the production level and quality of tobacco raw materials to improve.

Smart tobacco agriculture is an organic combination of the scientific thinking, methods, and technologies of smart agriculture with the institutional mechanisms, current problems, and development goals of the tobacco industry. To develop smart tobacco agriculture, we must adhere to the common values of the "two first" industry, adhere to serving the overall situation, adhere to the strategic direction of high-quality development, and adhere to the orderly advancement of "point, line, surface, and body", not divorced from reality, but not too far beyond the stage. The development of smart tobacco agriculture is to greatly improve land productivity, labor productivity and resource utilization, transform development methods, and promote the modernization of tobacco agriculture through systematic design, innovative methods, transformative technologies, strong systems, and high-quality services. Stabilize the foundation for high-quality development of the industry.

Under this circumstance, Yunnan Tobacco took the lead in proposing to build smart tobacco agriculture and carry out the exploration and practice of digital transformation of tobacco agriculture. The deep integration of technology and tobacco agriculture has formed a new production method of information perception, quantitative decision-making, intelligent control, precise investment, and personalized service throughout the production process of tobacco leaves. The Smart Tobacco Agricultural Science and Technology Innovation Demonstration Incubation Park has accumulated experience and provided a demonstration for the tobacco industry to explore the development of smart tobacco agriculture, and effectively solve the three major problems of "what kind of tobacco", "who will grow tobacco" and "how to grow tobacco" It provides useful experience, realizes the reduction of labor, cost, quality, efficiency and green and sustainable development of tobacco agriculture, and also lays a solid foundation for the national tobacco business to continuously improve the influence, competitiveness and control of the tobacco industry.

1 Development status of smart tobacco agriculture at home and abroad

1.1 Status Quo of Smart Agriculture Development at Home and Abroad

Smart agriculture originated from the application of computers in agriculture in the 1980s. With the continuous deepening and expansion of the cross-border integration of information technology and agricultural industry, the new agricultural production and management methods represented by smart agricultural technology have been vigorously promoted and applied, becoming World consensus on agricultural development [1].

Domestic scholars generally believe that smart agriculture is a new model for the use of information technology to achieve sustainable and intelligent development of agriculture, and it is the future form of agricultural modernization [2-4]. On the whole, China's smart agriculture has made significant progress, and smart agriculture has been fully popularized in Northeast China [5]. However, compared with foreign countries, smart agriculture in developed countries has entered the stage of large-scale and industrialized application, while smart agriculture in China is still in the initial stage of pilot demonstration and industrialization [6]. The application of smart agriculture faces the problems of limited farmers' knowledge, lack of compound professional talents, insufficient government capital investment, low degree of agricultural mechanization, lack of infrastructure

construction, lagging rural informatization, and insufficient information security guarantees [7-9], as well as challenges such as high data acquisition costs, difficult integration of multiple data, and unclear division of responsibilities [10], which hinder the further promotion and application of smart agriculture in China. For example, Deng Yan (2020) pointed out that the lack of construction R&D funds [1], the shortage of agricultural compound talents, and the need to improve the level of informatization application are the prominent problems faced by the development of smart agriculture in Henan Province;Jinliang Chen et al. (2020) pointed out that there is a lack of professional talents in the development of smart agriculture [12]. There are three major problems: the farmers' education system, the lack of a sound agricultural science and technology research and development and extension system, and the poor level of agricultural infrastructure construction.

Foreign scholars have a broad definition of smart agriculture, and believe that smart agriculture is a new type of agricultural production method that uses advanced technology to improve agricultural processes [13]. Foreign scholars have relatively little research on the application status and problems of smart agriculture, and the existing research generally focuses on the analysis of the application of a single smart agricultural technology. For example, Sanika et al., (2020) analyzed the agricultural sensor technology in smart agriculture, and pointed out that sensors are widely used in agricultural production of large farms, which can effectively improve agricultural productivity, cultivated land soil degradation, and efficient use of water resources [14]. However, there are problems such as high investment cost, the need for professional guidance and use, and the long time between data processing and data use, which hinders its further promotion and application; Achilles et al., (2020) regard the Internet of Things and drones as the most important aspects of smart agriculture. Technology analysis, pointing out that UAV systems have been practiced in agricultural activities such as irrigation, fertilization, insecticide, weed management, etc., and have been successfully applied in Europe, the United States and Australia [15]. However, these technologies have not yet formed a business model, and they mainly focus on specific agricultural activities, making it difficult for these two smart agricultural technologies to be adopted by farmers. Angelita et al., (2020) pointed out that most smart agriculture currently relies on the Internet of Things technology, which has the potential to inherit the security defects of the Internet of Things, and the existing smart agriculture solutions generally establish a security mechanism at the application layer, lacking a systematic security system [16].

In recent years, smart agriculture has been included in the development agenda of modern agriculture by developed countries, whether it is Japan's "Next Generation Agriculture, Forestry and Fisheries Creation Technology" based on intelligent machinery + IT in 2015, German digital agriculture in 2016, and European agriculture in 2017. 4.0 (Farming 4.0), the Future Farm Smart Agriculture Project in the United Kingdom, and the Smart Agriculture Research Program in the United States, all of which show that smart agriculture has become the commanding heights of modern agriculture for all countries in the world. According to estimates, in 2023, the global market size of five major sectors of intelligent agricultural machinery and robots, drone plant protection services, agricultural Internet of Things, plant factories and agricultural big data will reach about 426.4 billion yuan, of which the intelligent agricultural machinery and robots have the largest market space, about 1708 The second is the drone plant protection service that can adapt to various terrains, which is about 123.5 billion yuan. In recent years, China has also stepped up efforts to develop smart agriculture and included it in the core content of China's Agriculture 4.0. Over the years, the No. 1 Central Document has mentioned "precision agricultural technology", "agricultural machinery and equipment", "full agricultural informatization and mechanization", "smart agriculture", "smart weather and agricultural remote sensing technology", "agricultural Internet of Things", "smart agriculture". agriculture" etc. The "Internet +" three-year action plan for modern agriculture and the "13th Five-Year Agricultural and Rural Informatization Development Plan" also include smart agriculture as an important strategic plan for the development of modern agriculture in the country. The report of the 19th National Congress of the Communist Party of China put forward that "rural revitalization, industrial prosperity is

the key point, consolidate the foundation of agricultural production capacity, develop high-end agricultural machinery and equipment manufacturing, vigorously develop digital agriculture, implement intelligent agriculture, forestry and water conservancy projects, and promote the Internet of Things experimental demonstration and remote sensing technology application. "General Secretary Xi Jinping emphasized that it is necessary to promote the deep integration of the Internet, big data, artificial intelligence and the real economy, and accelerate the promotion of agricultural digitization, networking and intelligence. The "Opinions of the Central Committee of the Communist Party of China and the State Council on Implementing the Strategy for Rural Revitalization" and "The Outline of the Development Strategy for Digital Rural Areas" proposed to vigorously develop digital agriculture, implement smart agricultural projects and "Internet +" modern agricultural actions, encourage digital transformation of agricultural production, strengthen Agricultural remote sensing, Internet of Things applications, improve the level of agricultural precision; promote the digital transformation of agriculture. Accelerate the promotion of the application of cloud computing, big data, the Internet of Things, and artificial intelligence in agricultural production, operation and management, and promote the comprehensive and in-depth integration and application of new-generation information technology with planting, seed, animal husbandry, fishery, and agricultural product processing industries, and create technological agriculture, smart agriculture, brand agriculture. Build smart agricultural (pastoral) farms and promote precision agricultural (pastoral) operations. The Ministry of Agriculture and Rural Affairs issued the "Digital Agriculture and Rural Development Plan (2019-2025), vigorously developing digital agriculture, implementing the digital village strategy, and promoting the digital transformation of agriculture. The No. 1 Central Document in 2021 is entitled: Opinions on Comprehensively Promoting Rural Revitalization and Accelerating the Modernization of Agriculture and Rural Areas. It is pointed out that it is necessary to realize the effective connection between the consolidation and expansion of poverty alleviation achievements and rural revitalization, accelerate the promotion of agricultural modernization, vigorously implement rural construction actions, and strengthen the party's overall leadership over the "three rural" work. It is proposed to develop smart agriculture, establish a big data system in agriculture and rural areas, and promote the deep integration of new generation information technology and agricultural production and management.

1.2 Status Quo of Tobacco Agriculture Digital Exploration

The construction of tobacco leaf informatization in China started in the 1980s, and its development has generally gone through three stages: the application of informatization in the computerization stage is to meet the acquisition business as the starting point, mainly for the collection, statistics and aggregation of tobacco leaf delivery and sales data. Provide effective means and reliable basis for industry control and enterprise supervision. In the systematization stage, in order to realize the macro management and control of the tobacco leaf business, the National Bureau uniformly develops and implements the industry tobacco leaf management information system, and realizes the information coverage and integration optimization of the main line processes such as tobacco leaf planting planning, planning contract, production process, acquisition, storage and transportation, etc. , providing technical support for the management of tobacco leaves in the industry, promoting the construction of modern tobacco agriculture, and standardizing business development. The integration stage is based on meeting the requirements of modern tobacco agriculture's refined and standardized management, and gradually extends the information management tentacles to both ends of the tobacco supply chain, forming a process that meets the national bureau's tobacco business specifications and core standard processes. It also meets the individual needs of the production area, and the level of intelligence, automation and standardization of tobacco leaf information has been significantly improved. The "Mid- and Long-Term Science and Technology Development Plan for the Tobacco Industry (2021-2035)" systematically planned the development of science and technology in the industry, clarified the key tasks of scientific and technological innovation in the next 15 years,

and laid out a new round of priority themes and major projects. The plan focuses on four major sectors: modern tobacco agriculture, Chinese cigarettes, new tobacco, and technological innovation systems. Among them, modern tobacco agriculture should achieve transformation and upgrading, create new advantages in the development of tobacco agriculture, and lay out three key areas of precision breeding, green tobacco agriculture, and smart tobacco agriculture. In recent years, various parts of the country have explored the construction of smart tobacco. Shiyan, Hubei has proposed construction paths in terms of tobacco smart office, smart education, smart security and smart management [17]; Xiangyang City has actively explored from the perspective of tobacco production and management. The construction of smart tobacco [18]; Ningbo Tobacco tried to explore the construction of e-commerce network of "online ordering, online distribution, online settlement, and online marketing", and created "Internet +" smart tobacco [19]; Liu Guangliang and others proposed to build a tobacco leaf production big data management information system and establish a tobacco agriculture data center based on the big data of tobacco leaf production, which actively promoted the development of smart tobacco agriculture and smart tobacco government affairs [20]. On the other hand, Yunnan Tobacco Business took the opportunity of high-quality development and construction of enterprises to step up the exploration of digital and intelligent transformation and upgrading of enterprises. Yunnan Provincial Bureau (Company) has built a digital platform for tobacco business in Yunnan Province and has achieved initial results. Qujing Municipal Bureau (Company) carried out the exploration of digital tobacco leaf transformation model based on Internet of Things technology, design contract application, seedling raising, ploughing, land preparation, seedling supply, transplanting, clearing ponds, cultivating management, disaster insurance, picking and baking, intensive The digital application scenarios of 14 key links, such as transportation, specialized grading, grading and delivery, package coding, and tobacco leaf logistics, are connected to the government's third-party supervision platform. Online supervision of the running track and running time of the tobacco leaf transport vehicle, the tobacco leaf warehousing point press the password list to take the packet, and the real-time view of the on-site dialogue according to the password packet sampling. The first national agricultural information engineering technology research center for smart tobacco agriculture in the country Yunnan Tobacco Innovation Base and National Agricultural Intelligent Equipment Engineering Technology Research Center Yunnan Tobacco Innovation Base was listed in Honghe Prefecture, Yunnan Province. The integrated production model of "receiving and adjusting" explores the establishment of a core tobacco area smart management system, a "first workshop" monitoring platform, a tobacco leaf production dynamic management system, and a tobacco leaf quality traceability platform; An integrated smart tobacco agricultural science and technology innovation demonstration incubator to explore the establishment of a standardized, mechanized, digital, visualized and intelligent smart tobacco agricultural support system and application system. In accordance with the steps of "mature application, improved R&D, key core breakthroughs, pilot demonstration, and comprehensive promotion", companies in each city focus on the introduction and maturation of mechanized operation equipment in the whole process of tobacco production and operation, and make breakthroughs in the intelligent transformation and integrated development of operation equipment in key links to build wisdom Tobacco Agriculture Big Data Center, with the goal of building a big data scenario-based application system, vigorously develops intelligent grading machines, intelligent baking equipment, and intelligent packaging all-in-one machines, etc., and has now entered the pilot application stage such as the one-stop tobacco farmers service platform APP. The pilot construction of digital tobacco leaves has achieved certain results, accumulating valuable experience for building a smart tobacco agricultural application system.

2 Exploration and practice of smart tobacco agriculture construction

Yunnan Tobacco is positioned in accordance with the five development concepts of "innovation, coordination, greenness, openness and sharing", with the breakthrough point of solving the "three instability" such as instability of tobacco areas, instability of tobacco farmers, and unstable quality of tobacco leaves, focusing

on the digitalization of tobacco production. The transformation, the research and development of mechanized equipment in the whole process of tobacco production, and the intelligent upgrade are made in two directions. In accordance with the steps of "mature application, improved research and development, key core breakthroughs, pilot demonstrations, and comprehensive promotion", complete the introduction and maturation of mechanized operation equipment in the whole process of tobacco production and operation, make breakthroughs in the intelligent transformation and integrated development of operation equipment in key links, and complete the smart tobacco agricultural project. The construction of the data center, the construction of a big data scenario-based application system, and the gradual realization of the goals of reducing labor and cost, improving quality and efficiency, and intelligent management of the whole process of tobacco production.

Relying on the "Double Innovation" base, a smart tobacco agricultural technology service system has been initially formed. In the 13 main links of tobacco production, from seedling raising, land preparation to warehousing and allocation, the whole process of mechanized equipment research and development and intelligent upgrades are carried out, and the focus is on the establishment of tobacco agriculture. The Big Data Center and the Tobacco Leaf Production Decision Command Center, by accelerating the "integration of industrialization and informatization" with mechanization and informatization, innovate and reform the tobacco leaf production mode, optimize the service mode for tobacco farmers, reduce labor and cost, improve quality and efficiency, and contribute to tobacco production. High-quality development creates new space.

2.1 Digital Transformation and Upgrading of Tobacco Leaf Production

2.1.1 Implement smart management of core tobacco areas.

Combined with the new round of tobacco area planning and land transfer work, with the goal of achieving refined land transfer and grid-based management, a "one map" of core tobacco areas of 1.3 million mu in Honghe Prefecture was drawn, and an analysis of the proportion of core tobacco areas was achieved. Analysis of the elevation, slope, and fragmentation of tobacco areas, analysis of the overlap between tobacco crops and tobacco fields, and crop rotation analysis, changing the traditional sporadic and scattered planting management mode, grasping the changing dynamics of tobacco areas in time, providing the basis for tobacco area planning, and alleviating the problem of tobacco areas. Stabilize the speed and promote the gradual realization of intensive and large-scale tobacco production in the tobacco regions of the whole state.

2.1.2 Implement grid dynamic management of tobacco production.

Based on the four administrative dimensions of state, county, township, and village, and the four management dimensions of state company, county company, tobacco station, and area, divide tobacco leaf production grid management responsibility goals and fulfillment assessment network, and establish tobacco farmers, tobacco technicians and tobacco farmers. The relationship between technicians, realize the functions of grid management of tobacco production, three-level calibration of the whole process of tobacco production, mobile Internet benchmarking of grid technicians, and linkage of production assessment rewards and punishments, establish a mobile Internet benchmarking mechanism for tobacco production technology, and realize planting technology. Dynamic setting of service standards and reward and punishment standards, point-to-point reminders, technical guidance, and graded benchmarking. Through the feedback and analysis of benchmarking results, production command and scheduling, production organization management and production data collection, the gridization of tobacco production management is promoted.

2.1.3 Build an intelligent supervision platform for green tobacco production.

Taking the comprehensive random sampling inspection of fresh tobacco leaves in the field and warehouses as the starting point, relying on 10 quick inspection rooms for pesticide residues in tobacco leaves across the state,

build state, county and station three-level tobacco leaf pesticide residue detection big data covering the entire jurisdiction (production staff at all levels) Analyze the intelligent supervision platform, realize on-site analysis and feedback of detection data, and timely find out the reasons, investigate responsibilities, form countermeasures, and make immediate rectifications, move forward the supervision threshold of tobacco pesticide residue management and control, and provide real-time, efficient and accurate decision-making for pesticide residue management and control support.

2.1.4 Build a one-stop service platform for tobacco farmers.

In accordance with the guidance of the National Bureau on promoting the quality improvement of the development of professional tobacco farmers cooperatives, actively absorb and learn from the new business forms and new models of the Internet economy, explore the implementation of the "Didi Agricultural Service" service matching system, and introduce a one-click intelligent matching model between demand and service. Relying on the subsidy, finance, and insurance capital chain, build a one-stop service platform for tobacco farmers with "three functional modules" of professional services, technical guidance, and farmers-friendly services, and establish an operation mode of online connection of information between supply and demand and offline services, to promote the effective transformation of professional services to new ways, industrialization to new models, and tobacco farmers' income to new formats.

2.1.5 Build a tobacco leaf production quality traceability management platform.

Relying on the tobacco leaf production grid, with the help of the core tobacco area intelligent management platform, the tobacco leaf production dynamic management platform, the Honghe tobacco leaf quality big data platform and the intelligent Internet of Things facilities and equipment, the whole process data chain of tobacco leaf production is opened, and the tobacco leaf quality traceability model is constructed to realize the quality of tobacco leaf production. Key influencing factors are monitored throughout the process.

2.1.6 Build a decision-making command center for tobacco production.

The platform focuses on improving the management efficiency at all levels within tobacco production, and aims to realize the visualization, analysis, and decision-making of all factors in the whole process of tobacco production. 6 major modules, including optimized layout of tobacco areas, visual and controllable production, standardized production services, industrial and commercial supply management, and tobacco area disaster management, covering ecological environment, production area distribution, planting layout, tobacco supply, site layout, infrastructure layout, production There are a total of 30 sub-modules such as process, disaster prevention and mitigation, etc., which carry out dynamic data analysis of the whole process of tobacco production.

2.2 Intelligent R&D and Upgrade of Tobacco Leaf Production Machinery

2.2.1 Development and application of remote monitoring system for agricultural machinery operations.

Introduce intelligent monitoring equipment for soil deep ploughing to monitor the operation trajectory, operation area and operation quality of the deep ploughing process, explore the implementation of mechanized operation acceptance and change in the way of subsidy cashing, and realize accurate and fast subsidies from data to data and online to online. Ensure operational standards and financial security.

2.2.2 The research and development of UAV precision plant protection operations.

On the basis of vigorously promoting the plant protection of drones, with the help of the air-space-ground integrated agricultural situation monitoring system, the project cooperation with DJI's drone agricultural business department has realized the precise operation of drones compared with the current traditional operation mode of

drones in various places. Precise planning, quantitative evaluation of operation effects, and setting of operation parameters in different growth periods have realized the "accurate detection, flying in place, uniform application, good effect, assessable and traceable" of UAV plant protection.

2.2.3 Research and development of the tobacco leaf harvesting operation platform.

Relying on the key scientific and technological planning projects of the Yunnan Provincial Bureau (Company), it is proposed to design and develop the tobacco leaf harvesting operation platform according to different tobacco plots, and adopt a modular design, which can realize the horizontal expansion of precise fertilization and precise pesticide application. It is expected that after the completion of the multi-functional expansion and development, the labor can be reduced by one more per mu.

2.2.4 Internal and external quality comprehensive automatic grading (fixed part) machine.

By comprehensively utilizing the spectral model and machine vision model, we have developed a comprehensive automatic grading (fixed part) machine for internal and external quality, which has changed the traditional appearance inspection model, more embodied industrial compatibility, and lays the foundation for in-depth customized production. At present, the first-generation prototype has been manufactured. Through automatic control, 40kg of tobacco leaves can be graded every 30 seconds, and more than 20 tons of tobacco leaves can be graded every day.

3 Key development directions and challenges in the future

3.1 Key development directions

3.1.1 Implement the research on the key technologies of tobacco area layout and tobacco growth perception based on satellite remote sensing technology.

Establish a multi-load high-resolution satellite remote sensing information fusion analysis technology to achievequantitative analysis of physical and chemical, ecological parameters and tobacco field environmental factors; establish a high-resolution satellite remote sensing ground reliability detection technology system for typical tobacco leaf production areas, and realize the high-resolution satellite remote sensing load. Comprehensive inspection of performance, geometric radiometric correction, and analytical parameter accuracy.

Aiming at the inherent laws of flue-cured tobacco physiological parameters and spectral characteristics, a quantifiable monitoring index system for flue-cured tobacco growth is constructed; combined with the tobacco leaf varieties in the study area, the best diagnosis time, spectral characteristics, suitable weather and farmland environmental conditions, etc., focus on the key production links of tobacco leaves To meet the needs of remote sensing information acquisition, establish a localized model and parameter library for spectral monitoring of tobacco leaf growth indicators, analyze the variation law of group parameters in key growth periods of tobacco leaves under different conditions, conduct research on the spectral response mechanism of tobacco leaf canopy, and provide large-scale precision operations for intelligent equipment. Tobacco leaf growth information acquisition and analysis decision-making technical means.

3.1.2 Development of key technologies and prototype equipment for intelligent decision-making of tobacco leaf mechanization operations based on multi-source data fusion.

Research on the adaptive optimization generation technology of ground machinery and UAV operation paths in complex tobacco fields based on deep reinforcement learning and tobacco field electronic maps, improve tobacco yield and reduce operating costs; research ground machinery and UAV operation intelligent scheduling model to improve efficiency. Research on tobacco leaf fertilization, spraying and harvesting and other field operations prescription decision-making technology based on tobacco leaf electronic map, crop remote sensing,

spectral diagnosis and soil test data fusion analysis, and develop prototype prototypes to achieve accurate operations.

3.1.3 Research on key technologies of agricultural machinery operation quality monitoring equipment and analysis application in the main links of tobacco leaf production.

Integrate sensor technology, computer measurement and control technology, satellite positioning technology and wireless communication technology, and research and break through the operation trajectory, operation area, operation area, operation area, etc. Reliable collection technology and terminal equipment for operation quality and other information provide accurate data support for agricultural machinery operation data statistics, operation quality supervision and improvement. Research the automatic analysis and processing and auxiliary decision-making technology of agricultural machinery operation data, and study the precise management and control technology system of agricultural machinery operation subsidies in tobacco leaf production, so as to provide data basis for the subsidies for mechanized operation of tobacco leaf production.

3.1.4 Strategic planning and research on the innovative development of smart tobacco agriculture.

Based on the three levels of scientific and technological services, technical services and tobacco farmers' services, study the in-depth application mode and key supporting technologies of the concept of smart agriculture in various fields of tobacco agricultural production, operation, management and service, and explore the formation of smart tobacco that is suitable for the objective laws of the development of the tobacco industry. The implementation path of agricultural development is to realize the smart tobacco agricultural development system of "one network for scientific and technological services, one map for tobacco leaf production, and one-click service for tobacco farmers". Demonstration sites take the lead in the first trial, take the lead to the surface, and gradually advance, and take the lead in the industry to establish a standardized, mechanized, digital, visualized and intelligent smart tobacco agriculture development model, realize the optimal allocation of production factors and improve the efficiency of production organization, and accelerate the digital and intelligent transformation of the industry. high-quality development.

3.2 Challenges faced

3.2.1 The development of smart tobacco agriculture lacks an overall plan.

The application technology promotion of smart tobacco agriculture has not formed a large-scale system, andthere is a disconnect between project implementation and industrial integration, and it is in the process of transforming production informatization to intelligence. Due to the large demand for funds for infrastructure construction, the construction of information channels needs to coordinate the resources of various regions and departments, and it is necessary to play the leading and coordinating role of business leaders.

3.2.2 There are technical shortcomings in the development of smart tobacco agriculture.

The number of agricultural sensors independently developed in China is less than 10% of the world's, and the stability is poor, the sensitivity of the intelligent perception system is not high, and the accuracy of the terminal remote control system and the execution control command system is insufficient. Tobacco production models and intelligent decision-making have low accuracy, and in many cases, it is time-series control rather than on-demand decision-making control. Most of the current application pilot projects of smart tobacco agriculture remain in the simple transmission and display of information, and lack the means to solve the practical problems of tobacco agriculture.

3.2.3 The integration degree of tobacco agricultural data collection and application is low.

Exploring the factors affecting tobacco diseases and insect pests, mastering the law of tobacco growth and production, and predicting and preventing disaster weather in real time all require the support of data. The more complete the data collected, the higher the possibility of accurate forecasting. At present, the coverage of tobacco agricultural data collection is insufficient, and it lacks accuracy and authority. The degree of integration of tobacco agricultural information data and the degree of standardization of data intelligence are low, and there is a lack of information and data sharing.

3.2.4 There is a shortage of compound high-quality talents in tobacco enterprises.

The development of smart tobacco agriculture in China lacks multi-disciplinary interdisciplinary talents, as well as scientific and technological personnel in the research and development of electronic information technology in tobacco agriculture. Most of the information departments of tobacco enterprises are the function of basic information maintenance. In the industry, there is a large gap in tobacco agricultural technicians, especially the lack of high-level and high-level smart tobacco agricultural talents.

Conflict of Interest Disclosure Statement

The authors have no conflicts of interest to disclose.

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