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The Practical Manifestations and Internal Logic of Digital Technology-Driven Agricultural Modernization Transformation

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Abstract

In the era of digital and intelligent transformation, digital and intelligent technologies have been deeply integrated into the agricultural sector, serving as a core driving force behind the transition from traditional agriculture to modern agriculture and the acceleration of agricultural modernization. These technologies are enabling systematic intelligence-driven empowerment in agriculture, facilitating precise production management and control, and supporting collaborative operations among agricultural stakeholders, thereby profoundly reshaping agricultural production methods, organizational structures, and industrial ecosystems. An in-depth analysis of the mechanisms through which digital and intelligent technologies drive modernization reveals that their core logic lies in propelling an intelligent revolution in agricultural production tools-shifting them from mere extensions of physical labor to expansions of cognitive labor; these technologies have given rise to new production factors that are deeply integrating with traditional factors, driving agricultural growth toward a qualitative leap forward; furthermore, they have given rise to a new class of digital and intelligent agricultural laborers, redefining the roles and capabilities of farmers and providing strong momentum for accelerating the agricultural modernization transition.

Keywords

Digital and Intelligent Technologies; Digital and Intelligent Empowerment; Agricultural Modernization Transformation; Digital and Intelligent Agriculture.

1. Introduction

Agriculture is a foundational sector in national economy. Its modernization is important for keeping food security stable, and it has a close relationship with the overall advancement of Rural Revitalization Strategy which can affect the whole economic and social development in rural areas. This strategy relates to stable economic and social development. Currently, China has a typical agricultural landscape. It is a large country with small-scale farming, and we use the term "Chinese-style agriculture" paradigm[1]. Despite its vast territory and large population, China has limited per capita arable land, so small-scale farmers still play fundamental role in agricultural production. Under these circumstances, we can see that integrating smallholder farming with modern agriculture is hard to achieve. Modern agriculture should have large-scale production and intensive logistics, and it needs market-oriented operations; however, smallholder farmers face practical realities such as fragmented land resources and inadequate production equipment. The fragmentation of land further increases organizational costs. It can reduce coordination efficiency and diminish their financing capacity, while their adoption of modern production technologies and information tools remains low. This makes it hard to break free from the constraints of a "low-level equilibrium" in agricultural production through their own efforts. In his 1964 classic work Transforming Traditional Agriculture, Schultz argued: "The solid foundation of economic growth in developing countries lies in the stable and rapid growth of agriculture. However,

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traditional agriculture has inherent limitations, so it is hard to achieve this goal. Transforming traditional agriculture into modern agriculture is the key to breaking this deadlock"[2]. As agriculture enters a new phase of high-quality development, we should identify new drivers. These can drive transformative changes in quality and efficiency, with dynamics improved as well. The 2024 Central Rural Work Conference emphasized that "scientific and technological innovation should drive agricultural modernization. We should accelerate the establishment of a modern agricultural industrial system, and enable new quality productivity to serve as a powerful driving force for rural revitalization. The 2025 Central Document No. 1 further focuses on "promoting the deep integration of digital and intelligent technologies across the entire agricultural value chain. It should strengthen the leading role of modern agricultural industrial parks, and accelerate the integration and upgrading of rural industries"[3]. For China, a major developing country constrained by increasingly acute human-land conflicts and the fundamental position of small-scale farmers, digital and intelligent technologies have opened new pathways. They can provide full solutions for breaking through the bottlenecks hindering agricultural modernization. The transition from the traditional extensive agricultural model-where production was heavily dependent on natural conditions-to a modern precision agriculture model based on "data-driven farming" has become an inevitable trend for high-quality agricultural development. Against the backdrop of the new era, how to capture the opportunities in the digital and intelligent era and explore the key driving mechanisms has emerged as a critical practical challenge. We should note that this requires resolution.

For a long time, the Chinese government has paid much attention to the three rural issues (agriculture, rural areas and farmers). The agricultural modernization transformation can be a key way to solve these problems and achieve full rural revitalization, and it has become a hot topic in academic discussion. Current research on agricultural modernization transformation mainly takes three different views. The first view looks at technological innovation. It says that technological advancement can be the main power for agricultural modernization. This approach pays attention to the use and application of digital and smart technologies-like the Internet of Things, big data, artificial intelligence (AI), and blockchain-and also smart equipment-including automatic agricultural machinery, smart irrigation systems, agricultural drones, and sensor networks-in agricultural production activities [4]. For example, smart decision-making systems use remote sensing, soil sensing and meteorological data. They can improve water and fertilizer application, help build early warning systems for pests and diseases, and adjust sowing density. In this way, resource use efficiency and per-unit yield[5]; or we can use "smart agricultural machinery + big data platform". This allows full digital and smart monitoring across the entire agricultural[6]. But in fact, the use of modern technologies still has some problems. First, there is a "agricultural digital and intelligentization gap". This is a big gap from weak foundations for agricultural digital transformation. Smallholder farmers resist these changes, and there are operational difficulties between urban and rural areas and among different agricultural sectors[7]; second, there is the agricultural inefficiency trap. It comes from problems like too much resource consumption, depending too much on labor, old infrastructure and equipment, and low organization levels in small-scale farming. All these come from traditional production models and institutional frameworks[8]. The second viewpoint is about Institutional and Organizational Transformation. It looks at institutional arrangements needed for land system innovation, developing new types of agricultural business entities, and also modern agriculture. It says that institutional and organizational transformation can be key to agricultural modernization. Improving land systems and developing new types of agricultural business entities can stabilize farmers' contractual land rights and liberalize land management rights. This helps change small plots into larger plots and fragmented land into consolidated plots across different regions, and creates conditions for mechanized and smart farming activities [9]. Such entities as family farms, farmers

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cooperatives, leading agricultural enterprises, and agricultural industrialization consortia can realize a state-owned state-run agricultural enterprise–local farmers "continuous symbiosis" or "integrated symbiosis" through share-based cooperation, profit-sharing funds, and also long-term purchase and salescontracts[10]. The third viewpoint is about Industrial System Restructuring. It looks for sustainable development ways for industrial integration in the context of industrial chain extension, value chain enhancement, and also the multifunctional development of agriculture. The goal of industrial restructuring should be to break from the traditional agricultural pattern with low added value, weak resilience and single operations, and instead build a modern industrial ecosystem with integration of the primary, secondary and tertiary sectors, diversified functions, and also green sustainability[11]. This view also suggests using "integration" to push vertical industrial expansion, achieve revenue sharing and structural upgrading, and expand the horizontal boundaries of the industrial sector through the multifunctional development of agriculture[12].

Existing research shows that agricultural modernization includes three aspects: technological pathways, institutional frameworks, and industrial systems which are relatively mature. These three are mature. But most studies only look at one level. It is worth noting that we lack full examination on how digital and intelligent technologies can integrate technological applications, organizational transformation, and industrial governance to help the transition from traditional agriculture to modern agriculture. So in this context, we examine how digital and intelligent technologies-as a new key factor-can use their internal logic and external mechanisms to build a development paradigm that integrates with agriculture and can drive the modernization transition in critical phase. In fact, it is important in theory and can be used as a reference. It can support advancing modernization of agriculture and rural areas and building a strong agricultural nation.

2. The Concrete Manifestations of Digital and Intelligent Technologies Driving Agricultural Modernization

The idea of putting digital and intelligent technologies into agriculture started from 1997. In that year, the U.S. National Academy of Sciences and the National Academy of Engineering proposed the concept of "Digital and Intelligent Agriculture".In fact, this approach is based on the digital transformation of traditional agricultural production. It uses agricultural big data as central element. Also, the system uses "3S" technologies including Remote Sensing (RS), Geographic Information Systems (GIS), as well as Global Positioning Systems (GPS) as supporting frameworks. By putting digital and intelligent technologies into every segment of agricultural value chain, we can achieve simulation, monitoring, analysis, and forecasting for the entire production process. It is worth noting that this is a typical representation of modern agriculture. The development of modern agriculture has four stages. The first stage used "human" and "animal power" for production and decision-making was based on experience. Farmers used simple tools and the "household-based" model. Then, the second stage saw machinery adopted. Decision-making relied on experience and advanced agricultural machinery was used for large-scale production. The third stage was driven by standalone information technologies. Here, decision-making integrated experience and data, and information technologies were put into all aspects of agriculture. Digital and Intelligent Agriculture is the fourth stage. It uses "big data" for decision-making. Also, it can help utilize resources with good efficiency and can support sustainable development of agricultural ecosystems. This fourth stage is expected to be an inevitable trend. It can involve the integration of various new technologies to push agriculture toward modernization, with characteristics of intelligence, precision, and good synergy.

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2.1. System Intelligent Empowerment

China's agricultural development has a long history of thousands of years, and it evolved from the traditional iron plow and ox-drawn farming model to a modern system with diversification. Today, modern machinery, chemical fertilizers, water conservancy facilities, pesticides, and other inputs have been integrated into agricultural production. They replace the traditional methods that relied only on human and animal labor. Also, the conventional "autumn harvest and winter storage" model has transformed into a modern industrial development framework that includes agricultural product processing, storage, transportation, marketing, and import-export trade. Mechanical engineering, bioengineering, satellite remote sensing, information technology, and computer science are the key technical support for this transformation. The integration of digital and intelligent technologies into agriculture has long been a reality. Many characteristics of digital and intelligent agriculture are already evident in modern farming practices. For example, sensor technology is used to collect data on crop conditions, soil status, and atmospheric environment. This helps achieve intelligent farming operations with precision. The construction of digital and intelligent grain storage facilities, agricultural disaster forecasting, and the monitoring and prediction of agricultural yield and quality are practical applications of these technologies in agricultural sector. It is worth noting that conventional computerized agricultural machinery already can meet the demands of the modern agricultural development. However, digital and intelligent agriculture can place greater emphasis on the efficient integration and synergistic coordination of all sectors and components within agricultural sector. It can release the system's overall potential and achieve an intelligent upgrade of all factors within the sector. Unlike the era of industrial mechanization, which focused on extending and replacing human physical labor with machinery, digital and intelligent agriculture can focus on extending and replacing human cognitive labor with data. Based on the foundation of mechanization, it integrates isolated equipment and processes with core operational entities for systematic upgrading with intelligence, so it creates an organic whole that can sense and analyze, and can be intelligently controlled, and helps improve agricultural productivity continuously. Currently, numerous agricultural machinery enterprises are working on the integration of high-tech innovations with agricultural machinery-especially by using intelligent sensing and IoT technologies-helping achieve breakthroughs in areas such as high automation, unmanned operation, and also autonomous mobility. The intelligent transformation across all stages of agriculture is accelerating. We can see that a range of new solutions have appeared, including field management robots, plant protection drones, intelligent irrigation systems, combine harvesters with intelligent grain recognition capabilities, robotic arms that can harvest fruit and vegetable on-demand, and post-harvest processing equipment designed for automated sorting and packaging. Based on the foundation of mechanization, digital and intelligent technologies are helping the autonomous and intelligent upgrade of the entire agricultural sector by endowing machinery with sensing, decision-making, and also execution capabilities.

2.2. Precision Production Management

Precision agriculture is a main part of agricultural modernization. It is driven by digital and intelligent technologies. Efficiency is very important in agricultural production. In fact, it is regarded as the key factor to optimize resource allocation and maximize output. It determines the output per unit input and can drive the expansion of production possibility frontier. Modern agriculture is expected to solve inefficiency in resource allocation and the outdated methods in traditional smallholder farming. In Digital and Intelligent Agriculture,Precision Agriculture is a key way to enhance efficiency. Precision agriculture can help coordinate economic and environmental sustainability. It uses information technology, mechanical automation, and also modeling of agricultural processes as main technical tools. This approach enables input

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delivery based on specific nutritional and environmental requirements of crops or fields [13]. In agricultural practice, this is done by using digital technologies such as GIS, remote sensing and IoT sensors based on the mechanization to detect spatial variations in farmland conditions, crop growth and production inputs, and then we use smart machinery for variable input application and automated operation. For example, before crop planting, GIS can be used to generate prescription maps showing soil nutrient levels, soil moisture conditions, field topography and other factors. During cultivation, real-time sensor monitoring and crop model analysis can guide agricultural machinery to perform variable-rate fertilization, precision irrigation as well as targeted pesticide application. The adoption of precision agriculture in China is an inevitable response to resource constraints-aimed at reducing costs and increasing efficiency, and it should promote environmental sustainability-and it is a necessary adaptation to the country's specific socioeconomic realities. This is particularly true in southern regions with extensive mountainous and hilly terrain, fragmented terraced fields, and conditions where integrated farm machinery combining irrigation, plowing as well as fertilization cannot operate effectively. Also, after the Household Contract Responsibility System was implemented in rural China, farmland has become fragmented. There are significant disparities in landholdings among different households[14]. Traditional management approaches are homogeneous and they struggle to accommodate these inter-household variations in production practices. In contrast, precision agriculture uses technological means to identify and respond to spatial heterogeneity. It uses the farmer's designated plot as the fundamental unit to implement differentiated input and management practices. This approach can enhance resource utilization efficiency and reduce production costs. Also, it drives small-scale agriculture toward sustainable development.

2.3. Collaborative Entity-Based Operation

China is a typical agrarian country. The family is the basic unit, which means farmers are usually small-scale and relatively independent They are agricultural producers with limited individual capacity. Also, as agricultural production and farmers' lifestyles change, the limitations of decentralized traditional agriculture, and we can easily observe this. In fact, there is an inherent conflict between traditional methods and the requirements of socialized large-scale production, including scale and intensification. Therefore, current agricultural production models should change from decentralized operations to large-scale operations. China uses new types of agricultural entities-such as family farms, corporate farms, and leading enterprises-as a key means to advance modern agriculture. However, the small-scale farming model still has a large share in sector and it shows a trend of increasing consolidation. In contrast, Digital and Intelligent Agriculture is guided by appropriately scaled operations. The Internet of Things is the core of digital and intelligent technologies and it can break through the limitations of traditional models that used computers and mobile phones as main connectivity terminals, transcending temporal and spatial constraints to achieve the interconnection of all things. Also, network technologies represented by the IoT and the Internet, have large transformative power and create new agricultural business models. For example, agricultural e-commerce platforms help multiple stakeholders participate together, including infrastructure investors, agricultural operators, technology experts, e-commerce enterprises, government agencies, and consumers. As a result, the platform economy and the sharing economy become important topics in the Digital and Intelligent Agriculture management. Producers, cooperatives, e-commerce platforms, logistics enterprises, and other stakeholders use the digital platforms to help information sharing and resource integration, and they can coordinate processes. So we establish an integrated service system that covers procurement, warehousing, logistics, sales, and after-sales support. The collaborative operations among these entities can overcome the distribution bottlenecks of the "first mile" for agricultural products entering urban markets. Also, they can solve the "last mile" problem for industrial goods reaching rural areas. They

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break away from the traditional model with isolation and limited scale. This drives agriculture toward intensification and standardization.

3. The Logic Behind Driving Agricultural Modernization Through Digital and Intelligent Technologies

Based on Marx's basic theory, productive forces determine production relations, and production relations can influence productive forces back; the connection between laborers, production tools, and the objects of labor are basic material elements of productive forces. It is worth noting that the liberation and development of productive forces is a basic requirement of socialism, and it can be a key force for social progress and economic growth[15]. Digital and intelligent technologies are deeply integrated into agriculture, which helps improve productivity. When data-driven approaches support the continuous development of productive forces, production relations also can experience dynamic adjustment and improvement, and this advances the digital and intelligent transformation and the informatization of agricultural activities in all stages, sectors, and different processes.

3.1. Digital and Intelligent Technologies Drive an Intelligent Revolution in Agricultural Production Tools

Marx argued that labor tools in means of labor can be seen as one measure of social productive forces development level. Also, the distinction between different economic eras depends on the mode of production and the means of labor employed. Based on different development levels of labor tools, we can divide agricultural development into three stages: primitive agriculture, traditional agriculture, and also modern agriculture. The primitive agriculture stage was from Stone Age to iron tools appeared. Humans relied on natural conditions. The traditional agriculture stage began with iron tools widely used and continued until the eve of the Industrial Revolution.[16]. When iron agricultural tools were used, labor efficiency could be improved. This became a key factor for agricultural production advancement. Engels once pointed out: "Without tools such as iron axes or shovels, large-scale land reclamation and cultivation would be difficult to achieve". As agricultural production scale expanded, humanity's ability to intervene in and transform nature strengthened. During this period, animal power was used to replace human labor in agricultural activities. It helped increase land productivity. Also, it produced a small-scale peasant economy model where the family was the basic production unit and the economy was self-sufficient. It is worth noting that only in the 19th century, the invention and application of steam engine and internal combustion engine brought agriculture into an era of power substitution. Large-scale machinery-such as tractors and harvesters-replaced both human and animal labor. The promotion of mechanical equipment and irrigation technologies, along with modern scientific methods-including crop variety improvement, chemical fertilizers, pesticides and other inputs-can improve production efficiency and avoid the inefficiency in traditional agricultural production models. In today's information-driven society, the application of digital and intelligent technologies-such as the Internet and artificial intelligence-has brought transformation to agricultural production tools. These tools are not limited to the singular functions of traditional machinery. Instead, they are integrating perception, decision-making, and execution capabilities, evolving to digital and intelligent transformation. For example, by integrating sensors, the Internet of Things (IoT), and AI algorithms, agricultural machinery can perform real-time sensing and autonomous decision-making. Also it can execute. Field equipment can collect data on crop growth, soil moisture conditions and other parameters in real time and upload this data to cloud platforms. Based on this data analysis, the system can generate variable-rate application prescriptions. This enables agricultural machinery to apply fertilizers and pesticides according to specific needs. Cutting-edge technologies-such as robotics, IoT, and AI-are driving breakthroughs in labor tools. They

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push agricultural production from a "human-operated machinery" experience-based model to a "data-driven" intelligent revolution.

3.2. Digital and Intelligent Technologies Drive the Digital Transformation of Agricultural Production Factors.

Agriculture is basic sector in material production. Historically, we analyzed production factors including land, labor, capital and other basic inputs. In traditional model, we can achieve productivity increases through adding more factors like land and labor and this helps primitive capital accumulation. In this context, production factors are seen as results of natural endowments and labor accumulation. Also, improvement of agricultural productivity depends on the control and allocation of land and labor. However, as the law of diminishing marginal returns is evident, this growth model shows characteristics of quantitative accumulation and it is hard to get qualitative leap in productivity by increasing input of these factors. In fact, with industrial age, driving force of economic growth can shift from expanding factor inputs to improving factor quality. Mechanized production can extend functions of traditional factors. At same time, we should pay attention to technology, institutions, management methods and other elements in production process. In information age, data can become new type of production factor. It is one of key features that can differentiate digital economy from industrial economy[17].

Digital and intelligent technologies bring new production factors to agriculture and new products keep appearing and production structures change over time. This shows agriculture is experiencing big shift. In fact, these technologies can upgrade traditional agricultural production factors and turn them into data resources that can be quantified and analyzed and connected to networks, which changes methods of agricultural resource allocation and value creation process. For example, we use IoT sensors with remote sensing and these technologies can analyze land and environmental conditions in real time while invisible parameters like soil quality, nutrient levels, meteorological data and other information become continuous data streams that farmers can use. Also, using gene sequencing, phenomics, image recognition and other technologies, biological information is turned into interpretable data models. At the same time, mobile devices and platform applications record farmers' experiences and decision-making processes and these become structured data. Finally, artificial intelligence algorithms analyze this data to drive terminal devices and agricultural commands can be executed automatically and actionable data is generated. On this foundation, agricultural production means of labor are no longer merely simple machinery but become intelligent equipment and objects of labor are no longer just land and crops because they become digital twins with intelligent features.DataIt is worth noting that "Data" itself has become new and core means of production. It can drive transformation of internal architecture of agricultural production factors and their leapfrog integration. This improves efficiency of their allocation. Also, it expands potential boundaries of agricultural production.

3.3. Digital and Intelligent Technologies Drive the Digital Transformation of Business Entities

China's traditional agricultural production organization model faces two persistent challenges for a long time. It is worth noting that these problems exist during the whole evolution process. First, we can observe that the agricultural production in China has used small-scale household farming as fundamental unit, which means that most farms are very small and this situation has existed for many years because of the historical development path of China's rural areas. This operational model has a high degree of fragmentation. Numerous smallholder farmers operate by themselves and this can result in a low level of organizational integration when they engage with the market, so it is hard to establish a large-scale, intensive operational system that can compete with modern agricultural enterprises in other countries. Second, the various segments

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of agricultural industry chain remain isolated. These segments range from the supply of agricultural inputs and crop farming to processing, sales, and related services. The linkages between them are weak and coordination is insufficient. Also, the participating entities operate in isolation, which leads to limited overall integration. Marxist theory of productive forces posits that laborers are the subjects of purposeful activity, and in production activities, laborers use their subjective initiative to develop and utilize both the means of labor and the objects of labor according to their own decisions and needs. Laborers represent the most dynamic element within productive forces. At the same time, the application of digital and intelligent technologies can give rise to a new class of digital and intelligent agricultural laborers. We can see that these laborers possess two key characteristics. First, they have horizontal coordination capabilities. They use digital and intelligent platforms and tools to aggregate dispersed smallholder farmers online. This helps organize farmers and promotes standardized and large-scale management at production level. By helping data sharing and integrating resources, this approach can align with a unified market. It can overcome the limitations inherent in the fragmented farming practices of smallholder farmers. Second, it serves as a bridge across the vertical agricultural value chain. These workers are well-versed in the various stages of agricultural production. Also, they understand the operational logic governing both the upstream and downstream segments of the chain. Using data analytics, the Internet of Things (IoT), and information systems, they can enhance data interoperability and operational synergy across the supply of agricultural inputs, production management, processing and distribution, and service delivery phases. This breaks down the barriers between different actors within the value chain. It can strengthen the interconnection between various segments. Also, it can improve overall operational efficiency across the entire chain. Compared to traditional agricultural laborers, digital and intelligent agricultural workers can create greater value. They can engage in more complex agricultural tasks. Digital and intelligent technologies are reshaping the socioeconomic roles of farmers. They are dismantling traditional perceptions and boundaries surrounding the agricultural labor force over time. Also, these technologies drive the transformation of agriculture from a labor-intensive to a technology-intensive sector. They can inject fresh, endogenous momentum into the advancement of agricultural modernization.

4. Conclusion

Agriculture now stands at a historical turning point, which is the convergence of agricultural civilization evolution and digital transformation. It can advance transformation of human civilization. Also it should continue China's agrarian traditions and improve people's well-being. The global economy is evolving and digital technologies upgrade fast. China's digital technologies are entering agriculture. They can reshape productivity structures. They help break resource bottlenecks. Also they can lead global agricultural transformation if we build new ecosystems. Digital and intelligent transformation of agriculture represents adirection we should follow. To do this, we need to return to theoretical foundations. We should clarify enabling logic. Also we can explore feasible pathways among new technologies in this era. Research shows that using digital technologies in agriculture can achieve systematic intelligent empowerment. It helps precise production management. Also it supports collaborative operations among stakeholders. The core logic is simple. In fact, digital technologies can exert fundamental driving force to enhance agricultural productivity. First, technologies such as Internet of Things, big data as well as artificial intelligence are driving shift in production tools. They evolve from extensions of physical labor to enrichments of cognitive capabilities. Second, data is new production factor. It integrates with land, labor, capital and other traditional factors and it becomes quantifiable data resources. This data-driven approach enables agricultural production to achieve "qualitative leap forward"." Finally, digital platforms connect producers, service providers, markets and consumers. They build networked ecosystem with online and

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offline channels. Diverse stakeholders can collaborate there. Without altering existing land contract relationships, these platforms integrate fragmented resources. It is worth noting that this enhances organizational capacity and market responsiveness of smallholder farmers. The three elements-production factors, production tools and production entities-support each other. They evolve in synergy. This drives modernization of agricultural sector. To help deep integration of digital technologies into agriculture in the future, we should work on following areas. First, we can strengthen institutional design and we should develop agricultural data standards, property rights, transaction and security regulations. This creates institutional environment that can incentivize innovation and ensure fairness. Second, we should implement infrastructure and capacity-building plan. It should focus on underdeveloped regions and smallholder farmers. We can enhance these entities' capabilities to access and use digital technologies through training and demonstration projects with support. Third, we should encourage exploration of diverse new models rooted in local practices. We respect diversity of agriculture. Also we can promote integration of technological solutions with local resources and social networks. Fourth, we should adhere to people-centered value. We prioritize protection of farmers rights and interests, preserving traditional farming wisdom while sustaining rural communities. This ensures that digital technologies can serve improvement of farmers well-being. It lays foundation for full advancement of agricultural modernization.This approach can accelerate adoption of smart agriculture. Also it preserves cultural heritage. By integrating AI-driven insights with indigenous knowledge, farmers can make better decisions and optimize resource use. Yields are boosted. Consequently, rural areas become more resilient to climate challenges while maintaining social fabric. Such balanced strategy ensures that technological progress does not marginalize traditional practices. It enhances them. This supports inclusive growth. Ultimately, this synergy paves way for robust agricultural sector with equity and benefits all stakeholders.

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