

Digital New-Quality Productive Forces and High-Quality Agricultural Development of Beidahuang

Wu Xianfu^{1,2}, Zhou Zhijun¹, Wu Yanhua¹, Dai Liang¹

¹*School of Economics and Management, Guangxi Normal University, Guilin, Guangxi, China*

²*Key Laboratory of Digital Empowerment for Economic Development of Guangxi Universities, Guilin, Guangxi, China*

Abstract: *This paper explores the impact of digital new-quality productive forces on the high-quality agricultural development of Beidahuang, analyzes its mechanism of action and the challenges encountered, and puts forward optimization suggestions. Digital new-quality productive forces promote high-quality agricultural development by advancing innovative, coordinated, open, green, and shared development. The bottlenecks faced by Beidahuang include insufficient digital laborers, objects of labor, and means of labor. The paper suggests strengthening talent cultivation, industrial integration, infrastructure construction, and data resource integration to enhance the level of innovative, coordinated, green, open, and shared development of Beidahuang's agriculture.*

Keywords: *Digital New-Quality Productive Forces; Beidahuang; High-Quality Agricultural Development; Innovative Development; Coordinated Development; Green Development; Open Development; Shared Development*

1. Introduction

As a fundamental industry in China, agriculture serves as the foundation of the nation and the cornerstone of national strength. Accelerating high-quality agricultural development is an inherent requirement and a key focus for promoting high-quality development. The report of the 20th CPC National Congress further points out that the most arduous and onerous task in building a modern socialist country in an all-round way still lies in rural areas.^[1] Therefore, promoting high-quality agricultural development has become an indispensable strategy for realizing the comprehensive revitalization of rural areas. Thus, how to effectively advance high-quality agricultural development has become a major issue entrusted by the times.

As an important agricultural base in China, Beidahuang is the "ballast stone" for national food security and the "pacesetter" in agricultural modernization. It plays an irreplaceable role in ensuring national food supply, promoting agricultural scientific and technological progress, and inheriting the spirit of hard work, occupying an important strategic position. However, Beidahuang's agriculture is currently facing certain bottlenecks and challenges in the process of achieving high-quality development. For instance, in recent years, there have been problems such as an overall downward trend in soil organic matter content, insufficient processing and conversion rates, and issues related to wetland areas. In September 2023, during his inspection tour in Heilongjiang Province, General Secretary Xi Jinping put forward the concept of "new-quality productive forces" for the first time^[2]. Digital new-quality productive forces are an important component of new-quality productive forces. Guided by digital technology, with data elements as the core, digital industries as the carrier, and digital transformation as the driving force, they consist of three parts: digital laborers, digital means of labor, and digital objects of labor. They are the main manifestation of new-quality productive forces in the digital economy era^[3]. Under the current situation where agricultural labor is in short supply and there is an urgent need to replace labor with technology and capital elements, empowering agriculture with digital technology and accelerating the formation of digital agricultural new-quality productive forces have become an urgent task for the high-quality development of Beidahuang's agriculture.

Then, what is digital agricultural new-quality productive forces and how is it formed? What is the mechanism by which digital new-quality productive forces drive high-quality agricultural development? What are the current bottlenecks in the high-quality agricultural development of the Beidahuang Group? And what are the bottlenecks in the development of digital new-quality productive forces of the Beidahuang Group? Answers to these questions hold important theoretical and practical significance.

From the perspective of the five concepts of high-quality agricultural development, this paper studies the mechanism of action of digital new-quality productive forces in promoting high-quality agricultural development, analyzes the current bottlenecks in Beidahuang's high-quality agricultural development and the development of its digital new-quality productive forces, and puts forward targeted optimization suggestions.

2. Mechanism of Action of Digital New-Quality Productive Forces in Promoting High-Quality Agricultural Development

Digital new-quality productive forces consist of three parts: "high-quality" laborers capable of developing and applying digital technology, "new-medium" means of labor after digital transformation, and "new-material" objects of labor. In terms of the actual situation of China's agricultural development, the original agricultural operation systems and mechanisms that adapted to high-speed growth are difficult to match the requirements of high-quality development, resulting in a slowdown in the growth rate of high-quality development and insufficient momentum^[4]. The fundamental way to solve the above problems lies in adhering to the five development concepts of innovation, coordination, greenness, openness, and sharing, and reforming the original backward agricultural production methods. Therefore, starting from the empowerment of digital new-quality productive forces in these five aspects, we should construct the theoretical logic of new-quality productive forces empowering high-quality agricultural development, make up for the shortcomings in agricultural and rural development, and promote the upgrading of agriculture.

2.1 Digital New-Quality Productive Forces Promote Innovative Agricultural Development

In promoting innovative agricultural development, digital new-quality productive forces are mainly reflected in driving agricultural technological innovation and innovation in talent cultivation. Through digital technology and data elements, digital new-quality productive forces can empower agricultural production and digital management, making agricultural production technology more intelligent. Examples include digital technologies such as intelligent seedling raising, unmanned agricultural machinery, smart agricultural cloud platforms, 5G digital farms, and intelligent harvesting and soil preparation. Digital new-quality productive forces can cultivate compound digital talents who not only possess agricultural knowledge but also master digital technology, and apply digital technology to agricultural production, management, and services. The construction of digital teaching materials and teaching platforms enables farmers to acquire knowledge at a lower cost and improve production efficiency.

2.2 Digital New-Quality Productive Forces Promote Coordinated Agricultural Development

Coordination is an inherent requirement for high-quality agricultural development. By enhancing the coordinated development of urban and rural areas and industrial coordination, digital new-quality productive forces provide a strong driving force for the coordinated high-quality development of agriculture. The coordinated development of urban and rural areas aims to narrow the urban-rural gap and promote the comprehensive integration of cities and rural areas in economic, social, cultural, and other fields. In this process, digital new-quality productive forces provide support for information sharing and technology popularization, digital financial services, and urban-rural interconnected market platforms for agricultural and rural development, thereby promoting the narrowing of the urban-rural gap. For example, digital financial products such as mobile payments, online loans, and agricultural insurance play a key role in shortening the distance between farmers and financial institutions, and promoting the coordinated development of urban and rural areas. Using agricultural big data and information platforms, digital technology fully taps the cultural, ecological, and leisure values of agriculture in various regions, expands the radiation boundary of agricultural operations, and promotes the integrated development of agriculture with tourism, culture, education, and other industries.

2.3 Digital New-Quality Productive Forces Promote Open Agricultural Development

The promotion of open agricultural development by digital new-quality productive forces is reflected in enhancing the level of agricultural opening-up to the outside world. With the advancement of the global digital process, the internationalization of agriculture is also accelerating. Empowered by digital new-quality productive forces, the export of agricultural products has become more convenient and

transparent. In recent years, cross-border e-commerce platforms such as Alibaba and JD International are breaking traditional trade barriers, enabling Chinese agricultural products to enter the global market more smoothly. The application of digital technology in agricultural scientific research and production has enhanced the competitiveness of China's agriculture in the global market. According to the data in *China Agricultural Industry Development Report 2023*, the competitiveness of China's agriculture has steadily improved over the past five years. Especially in the fields of grain, vegetables, and fruits, China has gradually become a world-leading supplier.

2.4 Digital New-Quality Productive Forces Promote Green Agricultural Development

Digital new-quality productive forces promote green agricultural development, especially in promoting low energy consumption, low pollution, and low emissions in agriculture. For example, in agricultural irrigation, the digital twin system can simulate the water demand of different crops, formulate reasonable irrigation plans, and reduce water waste. Through continuous monitoring and automation, digital technology reduces process fluctuations, stabilizes operations, and helps wastewater treatment plants achieve optimal operating conditions. The intelligent power management system intelligently adjusts the power distribution ratio between the motor and the engine to achieve optimized system efficiency and fuel economy, reducing energy waste. The construction of a digital platform for ecological environment governance, relying on big data technology and a digital integrated platform, realizes real-time and dynamic monitoring of ecological environment indicators such as air, water, and soil, and promotes the restoration of ecosystems and the maintenance of biodiversity.

2.5 Digital New-Quality Productive Forces Promote Shared Agricultural Development

Digital new-quality productive forces promote shared agricultural development, especially in improving the level of public services and promoting efficiency sharing. Digital technology breaks the hierarchical and departmental barriers of traditional public services and promotes efficient collaborative management and services across levels, regions, and departments. By integrating public service resources, a digital public service system covering provinces, cities, counties, townships, and villages is built, attracting more diverse entities to participate and forming a collaborative governance model, thereby improving the level of public services. In the past, agricultural production was often individualized and fragmented, and farmers faced problems of low production efficiency and serious resource waste. With the introduction of digital technology, especially the combination of cloud computing, big data, and the Internet of Things, agricultural production resources have been optimally integrated. Digital technology has provided a brand-new sharing platform for agriculture.

3. Main Bottlenecks in Digital New-Quality Productive Forces and High-Quality Agricultural Development of Beidahuang

As a powerful builder and leader of China's agriculture, the Beidahuang Group has continuously promoted the development and construction of digital new-quality productive forces within the group, achieving a situation of high-quality agricultural development of Beidahuang. However, there are still some bottlenecks in the process of forming a high-quality agricultural development pattern through the construction of digital new-quality productive forces.

3.1 Main Bottlenecks in the Development of Digital New-Quality Productive Forces of Beidahuang

Combined with the needs of the argumentation and based on existing research^[5] this paper takes input and output as the entry point to analyze the current bottlenecks encountered by Beidahuang's digital new-quality productive forces.

3.1.1 Bottlenecks in the Development of Digital Laborers

Digital laborers can be further refined into two aspects: the quantity and quality of digital laborers. Both of these factors jointly restrict the promotion and application of digital technology in agricultural production. The large-scale agricultural production of Beidahuang requires a large number of laborers who master digital skills. However, according to the 2022 Statistical Yearbook of Beidahuang Heilongjiang Reclamation Area, there are 1,275 employees in the information transmission, software, and information technology service industries, accounting for only about 0.2% of the total number of employees in the Beidahuang Group. The number of compound talents who understand both agriculture

and digital technology is even scarcer. This mismatch between supply and demand has led to a human resource bottleneck in the promotion of digital agriculture in Beidahuang. There are deficiencies in the digital skills and comprehensive capabilities of laborers. Many traditional agricultural laborers in Beidahuang have a low acceptance of digital technology and lack proficiency in tools such as drones, Internet of Things equipment, and agricultural data platforms, especially in understanding technical principles and data analysis. The cultivation and introduction of high-quality technical personnel have lagged behind.

3.1.2 Bottlenecks in the Development of Digital Objects of Labor

With reference to the research classification of digital new-quality productive forces in the academic community, digital objects of labor can be divided into two types: digital new-quality industries and digital businesses.^[6] and the bottlenecks encountered at each level are discussed respectively. From the perspective of digital new-quality industries, when Beidahuang promotes the application of agricultural technology and intelligent agricultural equipment, it lacks sufficient technical strength, resulting in the failure to fully implement the research and development of intelligent equipment and the promotion of precision agriculture. The adaptation environment of digital technology is also a major problem, as many new technologies fail to play their due role effectively. There are also obvious shortcomings in the construction of digital infrastructure. According to the 2023 Statistical Yearbook of Beidahuang Heilongjiang Reclamation Area, although the length of optical cable lines in Beidahuang is 23,571 fiber kilometers, the total land area of Beidahuang is 5.363 million hectares, which means that there is only about 0.0003 fiber kilometers of optical cable lines per mu of land. The overall coverage breadth and depth are still insufficient. From the perspective of digital new-quality businesses, Beidahuang is facing friction between organizational culture and digital transformation.

3.1.3 Bottlenecks in the Development of Digital Means of Labor

Focusing on two aspects: tangible means of production and intangible means of production, this paper deeply explores the bottlenecks currently encountered by Beidahuang's new-quality productive forces. From the perspective of tangible means of production, the performance of wireless networks is insufficient. Sudden traffic during peak operation periods leads to a poor network access experience for employees, affecting office efficiency. The digital transformation of tangible assets such as agricultural machinery faces challenges, and the intelligence level of equipment needs to be further improved to achieve more efficient agricultural production. In terms of intangible means of production, problems such as inconsistent data formats and inconsistent data sources still exist, affecting the efficiency of data integration and application. The data sharing mechanism still needs to be improved, and the data update frequency and sharing timeliness between different departments need to be further enhanced. At the same time, data security and privacy protection are also key issues, and a more complete data security mechanism needs to be established to ensure the security and privacy of data in the sharing process.

3.2 Main Bottlenecks in the High-Quality Agricultural Development of Beidahuang

As a benchmark for China's modern agriculture, Beidahuang's agriculture is facing a series of bottlenecks in the process of achieving high-quality development, mainly from the five aspects of development, coordination, greenness, openness, and sharing.^[7]

The main bottlenecks faced by Beidahuang's agriculture in the process of innovative development are reflected in insufficient technological innovation, weak innovation in the coordinated allocation of scientific and technological resources, and insufficient innovation in the construction of endogenous driving forces ^[8]. The strategy of combining independent research and development with external cooperation to a certain extent reflects the group's insufficient independence in the research and development and innovation of core technologies. The coordinated allocation of scientific and technological innovation resources is weak. The introduction of scientific and technological talents by directly subordinate enterprises is carried out independently, and talent policies compete with each other, resulting in internal friction. R&D institutions are established separately, infrastructure is invested repeatedly, and external cooperation is carried out independently, leading to excessively high scientific and technological investment costs.

The main bottlenecks faced by Beidahuang's agriculture in the process of coordinated development, drawing on the classification of coordination in high-quality agricultural development by , are mainly concentrated in the development bottlenecks of industrial coordination and urban-rural coordination. Prominent problems such as incomplete industrial chains, loose interest connections, and weak core competitiveness have affected industrial coordination. The flow of factors between urban and rural areas

is not smooth, and the pattern of net inflow of factors such as talents and funds to cities still exists. The coordinated development of urban and rural areas is insufficient. The industrial foundation of some counties and townships is weak, lacking characteristics and competitiveness, and it is difficult to form effective industrial clusters. There is a large gap between urban and rural infrastructure and public services, and the level of infrastructure and public services such as transportation, communication, medical care, and education in rural areas is relatively low.

The main bottlenecks faced by Beidahuang's agriculture in the process of green development reflect the current challenges from multiple dimensions such as ecological environment protection, efficient resource utilization, green technological innovation, and green consumption. Continuous efforts are still needed in the protection of black soil. Erosion gullies are the most concentrated manifestation of soil erosion in the black soil region of Northeast China, resulting in the thinning of the black soil layer in sloping farmland, the loss of soil organic matter, and the fragmented surface, which leads to reduced productivity and reduced efficiency of mechanical farming. In addition, due to rainwater scouring, the erosion gullies continue to expand, and grain output decreases year by year. The scientific return of straw to the field and efficient removal of straw need to be further promoted and optimized to avoid pollution and the risk of burning. The amount of rice straw is large, and it is difficult to return it to the field and decompose. The promotion of green agricultural technology is not smooth. The Beidahuang Group uses bio-organic fertilizers to replace chemical fertilizers, but problems such as insufficient market awareness of bio-organic fertilizers, unstable raw material supply, high production costs, lack of unified technical standards and quality control for bio-organic fertilizers, and immature application technologies have hindered the promotion of bio-organic fertilizers. In terms of green consumption, the Beidahuang Group is facing bottlenecks in the construction of organic brands and the production and sales of green agricultural products. In terms of sales, the production cost of green agricultural products is significantly higher than that of traditional agricultural products, and consumers' awareness and acceptance of them are limited. For example, the average unit price of Qinmin organic sauerkraut is 1.5 times that of similar products on the market, which has once caused consumer doubts.

The main bottlenecks faced by Beidahuang's agriculture in the process of shared development are divided into three aspects: income level, culture and education, and public health. In 2018 (the latest data of Beidahuang is from 2018), the expenditure on wages and the "three insurances and one fund" (endowment insurance, medical insurance, unemployment insurance, and housing provident fund) in Beidahuang was 526 million yuan. By the end of the year, the number of on-the-job employees was 35,428, with an average monthly salary of only 1,485.54 yuan. There is a great room for improvement in employees' salaries. The Beidahuang Group has a total of 109 schools, including 105 kindergartens, 3 secondary vocational education schools, and 1 general college. The distribution of school grades is very uneven. In terms of school teaching, the professional teaching content of higher vocational colleges lags behind the latest trends in industry development, the experimental facilities are incomplete, and the design of professional practical tasks is relatively traditional and single, lacking challenges and innovation, which cannot meet the current demand for innovative talent cultivation. The total amount of health resources is relatively insufficient and unevenly distributed, with high medical costs, insufficient medical information construction, a shortage of medical talents, and an unreasonable medical system structure. For example, in 2023, the number of beds in medical and health institutions per 1,000 people was 8.2, and the number of practicing (assistant) doctors per 1,000 people was 3.2. The ratio of doctors to nurses was less than 1:1, which was in an inverted state.

3.3 Bottlenecks in the Empowerment of Digital New-Quality Productive Forces to the High-Quality Agricultural Development of Beidahuang

In terms of innovative agricultural development, the role of digital new-quality productive forces is mainly reflected in improving the efficiency of technology research and development and application. Firstly, there is a shortage of digital laborers, especially professional talents in digital agriculture who master the application of technologies such as artificial intelligence and big data analysis, and their quality is uneven, resulting in difficulties in the promotion of technology application. Secondly, in terms of digital objects of labor, the pace of innovation is restricted by the infrastructure and technology popularization in some regions, leading to regional differences in technological innovation. Thirdly, in terms of digital means of labor, the application and popularization of these technology platforms in remote areas are slow, resulting in the lag of production technology innovation in some farms and affecting the improvement of the overall agricultural innovation capacity.

In terms of coordinated agricultural development, digital new-quality productive forces have mainly affected the regional economic coordination and the exertion of industrial synergy effects. Firstly, digital

laborers help to promote the coordination of agricultural production, processing, circulation, and other links by improving the digital skills of agricultural science and technology workers. Secondly, the popularization of digital objects of labor varies in different regions, especially in the southern and remote areas where the digital level is relatively low, resulting in a large gap in agricultural production and income between these regions and the northern and core regions. The investment and application of digital means of labor are uneven, and some regions are still backward in the construction of infrastructure, equipment, and data platforms.

In terms of green agricultural development, digital new-quality productive forces have helped Beidahuang better balance agricultural production and environmental protection. However, due to the limitations of funds and technology in some regions, the popularization of green technology is still slow, resulting in an unbalanced overall green development effect. The imperfect information infrastructure in some regions has restricted the development of green agriculture due to the inability to feedback and process data in a timely manner, affecting the implementation of the overall green development strategy.

In terms of open agricultural development, digital new-quality productive forces have enhanced Beidahuang's global competitiveness and promoted the company's layout in the international market. However, in the expansion of the international market, Beidahuang still faces problems such as high market access barriers and weak brand influence, resulting in low market share and influence in the international market. Due to the differences in technology platforms and data systems, especially the existence of certain obstacles in connecting with the technologies and platforms of foreign enterprises, the depth and breadth of the company's internationalization process have been affected.

In terms of shared agricultural development, digital new-quality productive forces have promoted the sharing of internal resources of the company and the fair distribution of interests among regions. However, farmers in some regions have not received sufficient digital training and technical support, and the income gap among farmers is still large. The low Internet penetration rate and insufficient technical training in rural areas make it difficult for some farmers to enjoy the dividends brought by digitalization, resulting in limited effects of shared development.

4. Paths to Promote Digital New-Quality Productive Forces and High-Quality Agricultural Development of Beidahuang

4.1 Paths to Promote the Development of Digital New-Quality Productive Forces of Beidahuang

In response to the bottlenecks in the development of digital new-quality productive forces of Beidahuang, the promotion paths can start from the three dimensions of digital laborers, digital objects of labor, and digital means of labor, and gradually solve the deficiencies in quantity, quality, technology, equipment, platforms, etc., so as to improve the overall development level and achieve the goal of high-quality development.

To address the bottleneck of digital laborers, Beidahuang should strengthen the cultivation and introduction of digital agricultural talents. Firstly, it can cooperate with universities to set up agricultural digital majors and cultivate compound talents with digital technology and agricultural knowledge. Secondly, it should expand the coverage of internal enterprise training, improve the digital skills of existing employees, and enable them to adapt to the application of intelligent agricultural equipment and digital technology. Thirdly, it can attract external digital technology talents, especially professional talents in fields such as data science, artificial intelligence, and big data analysis, to support the company's digital transformation and the promotion of intelligent production. Fourthly, it is necessary to strengthen professional skills training and the cultivation of innovative awareness. Through a multi-level and multi-channel training system, the technical literacy of employees should be improved, including the learning of cutting-edge technologies such as artificial intelligence, the Internet of Things, and big data analysis. Fifthly, it is necessary to increase cooperation with international advanced agricultural technology companies, regularly send employees to conduct inspections and studies abroad, learn from the advanced experience of international agricultural technology, and enhance the global vision and innovative capabilities of employees.

To address the bottleneck of digital objects of labor, Beidahuang can promote industrial integration and innovation to form an "agriculture + information industry" model. Through the "agriculture + information industry" model, Beidahuang promotes the development of smart agriculture and forms a diversified industrial development format. At the same time, it promotes the extension of the industrial chain, and through the empowerment of digital technology, extends the agricultural industrial chain and

increases the added value of agricultural products.

To address the bottleneck of digital means of labor, a systematic layout and practical exploration can be carried out from two aspects: tangible means of production and intangible means of production. In terms of tangible means of production, through the large-scale construction of smart agriculture pilot projects, the digital transformation and upgrading of traditional agricultural machinery and tools are promoted, and intelligent agricultural machinery and equipment technology, automatic driving technology, and multi-machine collaboration technology are widely applied, and unmanned tractors and harvesters, intelligent seeders and fertilization machines, and intelligent irrigation equipment are promoted. In terms of intangible means of production, focus is placed on strengthening the construction of digital infrastructure and the integration and utilization of data resources.

4.2 Paths to Promote the High-Quality Agricultural Development of Beidahuang

In the process of promoting the high-quality agricultural development of Beidahuang, it is facing bottlenecks in multiple dimensions, involving the five aspects of innovation, coordination, greenness, openness, and sharing.

4.2.1 Paths to Improve the Innovative High-Quality Agricultural Development of Beidahuang

Through the organic combination of technological innovation, innovation in the coordinated allocation of scientific and technological resources, and innovation in the construction of endogenous driving forces, Beidahuang has taken solid steps on the road of agricultural modernization, providing a strong driving force for the realization of high-quality innovative development. Firstly, in terms of innovative development, technological innovation is the core driving force for the high-quality development of Beidahuang. To this end, Beidahuang needs to continue to make efforts in key technology fields, focus on key areas such as modern seed industry, black soil protection, smart agriculture, and food science, and reserve and implement a number of forward-looking and strategic scientific research projects through forms such as "unveiling the list and taking command". Secondly, promoting the innovation in the coordinated allocation of scientific and technological resources of Beidahuang is the key to achieving efficient development. Beidahuang needs to establish a scientific and technological innovation committee at the group level to comprehensively plan the investment in scientific and technological research and development, and avoid scattered investment and repeated construction among directly subordinate enterprises. Thirdly, promoting the innovation in the construction of endogenous driving forces is the internal guarantee for Beidahuang to achieve sustainable development. To this end, Beidahuang needs to innovate the operation system, establish and improve a two-tier operation system based on family farms and with large farms coordinating small farms, and promote the appropriate scale operation of agriculture.

4.2.2 Paths to Improve the Coordinated High-Quality Agricultural Development of Beidahuang

In the process of the coordinated high-quality development of Beidahuang's agriculture, promoting industrial coordination and urban-rural coordination are key links. Firstly, in terms of industrial coordination, Beidahuang needs to further optimize the industrial structure, promote the integrated development of industries, and strengthen the regional industrial synergy capacity. Specifically, Beidahuang can promote comprehensive cooperation in multiple fields such as agricultural production, processing, supply and marketing, finance, storage and transportation, and creativity through market-oriented methods and sharing mechanisms, break the bottleneck of agricultural factor input, and build a multi-level and multi-dimensional agricultural integrated development system. It is necessary to integrate resources such as modern agricultural demonstration parks and industrial parks, extend the industrial chain, build the supply chain, and enhance the value chain. Secondly, in terms of urban-rural coordination, Beidahuang needs to solve problems such as the gap in urban-rural infrastructure, unbalanced public services, and unsmooth factor flow. To this end, Beidahuang can break the dual structure of urban and rural areas through institutional innovation, encourage urban factors such as human capital and financial capital to flow to rural areas, attract social capital to participate in rural revitalization, and promote the rational allocation of urban and rural factors.

4.2.3 Paths to Improve the Green High-Quality Agricultural Development of Beidahuang

To promote the green and high-quality development of Beidahuang's agriculture, efforts should be made in a coordinated manner from four key dimensions: ecological environment protection, efficient resource utilization, green technological innovation, and green consumption. Firstly, to solve the problems of black soil degradation and fragile ecosystems, Beidahuang can further promote the "Sanjiang Model" and the "Beidahuang Model". Through technical means such as straw returning to the field, deep

loosening to reduce obstacles, and water and soil optimization, a long-term monitoring system for black soil protection is established to systematically diagnose the causes of black soil degradation and provide a scientific basis for precise protection. At the same time, it is necessary to strengthen ecological restoration projects, such as wetland restoration and returning farmland to forests and grasslands, to enhance the overall function of the ecosystem. Secondly, to improve the efficient utilization of resources, in terms of water resource utilization, Beidahuang should continue to promote the wide application of precise and intelligent water-saving irrigation technology, realize the precision of irrigation through the Internet of Things and big data analysis, and reduce water waste. At the same time, it is necessary to explore the comprehensive utilization mode of surface water, groundwater, and rainwater resources, such as the "joint dispatch of three types of water", to further reduce the dependence on groundwater. Beidahuang needs to further strengthen the research and development and application of green technologies, such as promoting biological pest control technology to reduce the use of chemical pesticides. It is necessary to further improve the construction of green smart kitchens, enable consumers to clearly understand the production process of products through the agricultural product quality traceability system, and enhance consumers' trust in green agricultural products. At the same time, it is necessary to strengthen brand building, highlight the green attributes of the "Beidahuang" brand, and organize green consumption education activities to improve consumers' awareness and willingness to purchase green agricultural products.

4.2.4 Paths to Improve the Open High-Quality Agricultural Development of Beidahuang

In response to the bottlenecks faced by Beidahuang's open high-quality agricultural development in terms of income level, culture and education, and public health, solutions are proposed one by one. Firstly, in terms of improving income levels, Beidahuang should optimize the agricultural industrial structure, vigorously develop the cultivation and breeding of green and characteristic agricultural products, promote the processing of agricultural products and the shaping of agricultural brands, and implement industrial integration development projects to improve the comprehensive benefits of agriculture. Secondly, in terms of improving culture and education, Beidahuang should carry forward the Beidahuang spirit, integrate the Beidahuang spirit into the education and teaching system through various forms such as exhibition hall construction, network platform promotion, and campus culture construction, and create a campus culture with Beidahuang characteristics. Thirdly, in terms of improving public health, Beidahuang should strengthen the construction of medical and health infrastructure, increase investment in medical facilities, optimize the layout of community health service stations, promote the integration of public health services, establish medical consortia, carry out family doctor contract services, strengthen the construction of the public health system, strengthen the prevention and control of major diseases, popularize health knowledge, and improve the health literacy of residents.

4.2.5 Paths to Improve the Shared High-Quality Agricultural Development of Beidahuang

In terms of shared development, in response to the bottlenecks of Beidahuang in the two aspects of the level of agricultural shared public services and the promotion of efficiency, the following promotion paths are proposed. Firstly, Beidahuang can improve the level of public services by building a more complete agricultural socialized service system. It is necessary to continue to promote the "double control and one service" model, that is, through the unified supply of agricultural inputs and the unified operation of agricultural products, provide farmers with full-process services from the purchase of production materials to the sale of agricultural products. In addition, digital tools such as the "Beidahuang Digital Agricultural Service APP" should be used to realize the onlineization of services such as land contracting, agricultural loan applications, and agricultural meteorology, and reduce the cost of farmers' handling affairs.

To deepen the application of digital technology, Beidahuang should continue to promote the process of agricultural mechanization and intelligence, further improve the comprehensive agricultural mechanization rate, and promote the application of advanced equipment such as drones and intelligent agricultural machinery. At the same time, through methods such as centralized procurement of agricultural production materials, integration of advanced agricultural technology, and promotion of standardized production, production costs are reduced, and output and quality are improved. In terms of land trusteeship, Beidahuang can improve land utilization efficiency and agricultural machinery utilization efficiency through large-scale operation and cross-regional operation of agricultural machinery.

5. Conclusion

This paper has examined the role of digital new-quality productive forces in promoting high-quality agricultural development in Beidahuang, analyzing its mechanisms across five dimensions—innovation, coordination, green development, openness, and sharing—while identifying key bottlenecks in both digital transformation and agricultural upgrading. The findings demonstrate that digital new-quality productive forces offer new pathways and momentum for agricultural modernization through technological empowerment, resource optimization, and institutional innovation. However, significant challenges remain, particularly in terms of digital talent shortages, inadequate infrastructure, fragmented data integration, and regional disparities.

Moving forward, it is essential to further deepen the integration of digital technologies and agriculture, accelerate the cultivation of a high-quality digital workforce, promote the digital transformation of the agricultural industrial chain, improve digital infrastructure and data governance mechanisms, and foster regional coordination and resource sharing. These efforts will comprehensively enhance the quality, efficiency, and sustainability of Beidahuang's agricultural sector, offering a replicable model for agricultural modernization and rural revitalization in China.

Acknowledgements

Fund Projects: National Natural Science Foundation of China Project "The Transmission Mechanism of New Kinetic Energy Accumulation of Industrial Internet on Value Chain Enhancement of Traditional Manufacturing Industry: From the Perspective of Industrial Network Agglomeration" (Project No.: 71963003); National Natural Science Foundation of China Project "Research on the Transmission Mechanism of Industrial Internet-Driven Value Creation and Multiplication of Manufacturing Data Elements" (Project No.: 72463005).

References

- [1] Ma, G., & Hou, P. (2024). *Path Analysis of New-Quality Productive Forces Empowering High-Quality Agricultural Development*. *Northern Horticulture*, (21), 144-148.
- [2] Guo, C. X., & Fang, A. (2023). *The Generative Logic and Priority Strategies of New Infrastructure Empowering the High-Quality Development of the Real Economy*. *Journal of Xinjiang Normal University (Philosophy and Social Sciences Edition)*, (06), 46-58.
- [3] Liu, A. F. (2024). *Analysis on the Balance of Regional Digital New-Quality Productive Forces Development in China*. *Journal of Statistics and Information Forum*, (11), 51-63.
- [4] Zhang, Z. (2024). *Digital New-Quality Productive Forces, Agricultural Industry Chain Extension and Common Prosperity*. *Statistics and Decision*, (09), 37-42.
- [5] Wang, Q. M., & Yang, J. G. (2023). *Research on Digital New-Quality Productive Forces and the High-Quality Development of China's Agriculture*. *Journal of Shaanxi Normal University (Philosophy and Social Sciences Edition)*, (06), 61-72.
- [6] Wang, J., & Wang, W. (2024). *Financial Agglomeration, Digital New-Quality Productive Forces and Common Prosperity*. *Enterprise Economy*, (10), 38-48.
- [7] Liu, Z. Y., & Reziyan, W. K. (2021). *Regional Differences and Dynamic Evolution of High-Quality Agricultural Development in China*. *Journal of Quantitative & Technical Economics*, (06), 28-44.
- [8] Kou, C. Y. (2021). *Some Thoughts on the Construction of a Scientific and Technological Innovation System by the Beidahuang Group*. *Farm Economic Management*, (11), 12-13.