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Research on the High-Quality Development of Digital Villages in Henan Province Driven by New Quality Productivity

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Abstract: An advanced productivity state characterized by high technology, high efficiency and high quality. With the continuous advancement of digital rural construction, the new quality productivity has become a key factor in enhancing the high-quality development of digital rural areas. Currently, there are some predicaments in the process of promoting the high-quality development of digital rural areas in Henan Province with the new quality productivity, such as unbalanced digital development levels, weak infrastructure and the lack of digital supervision, shortage of professional talents and the difficulty in resource development. This article proposes corresponding solutions and paths: deepening scientific and technological innovation and the application of digital technology; optimizing the allocation of production factors and industrial upgrading; improving the infrastructure of digital rural areas; enhancing the quality of digital rural talents and farmers, etc.

1. Introduction

The report of the 20th National Congress of the Communist Party of China pointed out that "we should accelerate the development of digital economy, consolidate the foundation of common prosperity in promoting the construction of digital China and promoting the deep integration of digital economy and real economy", which provided policy guidance for the construction of digital countryside. From the "No. 1 Document" of the Central government in 2018, to the issuance of the "Outline of the Digital Rural Development Strategy", to the deployment of the national digital rural pilot work, the formulation of the "Digital Rural Construction Guide 2.0", the introduction and implementation of a series of policies and measures, marking the construction of digital countryside in China has entered a critical stage of in-depth exploration.

In September 2023, general secretary of the heilongjiang investigation during the research for the first time puts forward the concept of "new mass productivity", and emphasize to integrate science and technology innovation resources, will lead the development of strategic emerging industries and the industry in the future.

As an advanced form of productivity, new quality productivity has provided a strong driving force and enabling role for digital rural construction by promoting rural digital infrastructure construction, promoting rural agricultural industry upgrading, improving rural digital production efficiency and applying it in various aspects in specific practice. This connection not only contributes to the realization of high-quality agricultural development, but also injects new vitality and impetus into

rural revitalization. In view of this, this paper aims to explore the application of new quality productivity in digital rural construction, analyze the theoretical logic of enabling the high-quality development of digital rural construction, discover the key problems existing in the process of high-quality development of digital rural construction in Henan Province, and play its specific role in the practical path, so as to provide theoretical support and suggestions for the high-quality development of digital rural construction in Henan Province[1].

2. The theoretical logic of the high-quality development of digital rural construction empowered by the new quality productivity

2.1 New-quality productivity boosts rural digital production

New quality productivity has promoted the optimization and upgrading of traditional agricultural machinery, and intelligent agricultural machinery equipment, such as unmanned tractors and plant protection drones, have been developed and applied. These intelligent agricultural machinery equipment can significantly improve the efficiency of agricultural production, reduce the labor intensity of farmers, and realize the digital-intelligent management of field operations. By aggregating various business data in rural areas, a real digital rural map can be constructed to realize the refinement and intelligence of rural governance. At the same time, agricultural big data is used to carry out intelligent applications such as crop growth monitoring, yield prediction and land resource survey, providing all-round decision-making support for agricultural production. The Internet of Things (iot) technology plays an important role in rural digital production. By automatically collecting greenhouse data through sensors, the whole process of crop planting can be mechanized and automated, and the production situation can be monitored remotely in real time. This helps to find and solve problems in production in time, improve agricultural production efficiency and product quality[2].

The application of new quality productivity can significantly improve agricultural production efficiency. First of all, the application of intelligent agricultural machinery equipment and Internet of Things technology makes the agricultural production process more automatic and intelligent, thus improving the production efficiency; Secondly, the transformation of traditional industries through digital means to achieve data-driven decision-making can optimize the allocation of resources. Finally, in rural digital production, the production plan can be adjusted reasonably according to market demand and resource status to achieve optimal allocation of resources. The introduction and application of new quality productivity can help promote the upgrading and transformation of rural industries. By developing new forms of agriculture such as digital agriculture and smart agriculture, we can build a modern agricultural industrial system, production system and operation system, and provide new opportunities for building an agricultural power[3].

2.2 New-quality productive forces will boost the development of smart villages

Smart countryside is the trend of rural development in China in the next 30 years. The construction of smart countryside needs to realize the comprehensive digital management and optimal allocation of rural resources based on the new quality productivity and with the help of artificial intelligence, big data, Internet of Things and other advanced technologies. First of all, the Internet of Things technology, such as smart sensors and automation systems, can be used to monitor soil moisture, temperature, nutrients and other parameters in real time, and provide farmers with suggestions on precise irrigation, fertilization, and pest control, so as to improve crop yield and reduce resource waste. The application of intelligent agricultural machinery for farming, harvesting and other operations, improve agricultural production efficiency, reduce farmers' labor intensity. The environmental parameters in the greenhouse are monitored in real time through iot sensors, and the

environmental control system is automatically adjusted to create the most suitable conditions for vegetable growth. Secondly, using e-commerce platforms, farmers can directly put their agricultural products on the shelves for sale, broadening sales channels and increasing farmers' income. Through intelligent logistics and warehouse management systems, inventory control can be optimized to achieve rapid delivery of agricultural products and reduce logistics costs and time. Finally, the digitalization of rural governance should be promoted to improve the efficiency of rural governance and the level of public services. We should build intelligent community facilities and public service platforms, such as intelligent health management systems and educational resources, to improve residents' quality of life[4].

2.3 New-quality productivity will boost digital governance in rural areas

In rural digital governance, new-quality productivity plays a vital role due to its unique technological innovation, efficiency and convenience. First of all, new quality productivity provides strong information support for rural digital governance by introducing advanced technologies such as artificial intelligence, big data and Internet of Things. These technologies can achieve comprehensive digital management of rural areas and improve the efficiency and accuracy of governance. For example, through big data analysis and cloud computing technology, real-time monitoring and analysis of rural economic, social, environmental and other data can be carried out to provide scientific basis for government decision-making. Secondly, the new quality productivity promotes the intelligent development of rural governance. Through the application of artificial intelligence, machine learning and other technologies, rural digital governance can realize automatic data analysis and economic development prediction, and provide more accurate data support for regional decision-making. In addition, the new quality productivity also promotes the automatic development of rural digital governance, realizing the automatic management and control of various agricultural processes, and improving work efficiency and accuracy. For example, through intelligent monitoring and early warning systems, rural security and environmental conditions can be monitored in real time, and potential problems can be detected and dealt with in a timely manner. Finally, under the development trend of digitalization, networking and intelligence, the rural digital governance model needs to be constantly innovated and improved to adapt to the development needs of different regions. New quality productivity provides a broader innovation space and richer innovation means for rural digital governance. For example, the introduction of blockchain technology can realize the transparency and traceability of rural data, and improve the security and credibility of data. At the same time, the new quality productivity also supports diversified innovation of rural governance models, such as exploring new governance models such as government purchase of services and PPP, and encouraging social forces to participate in rural governance[5-6].

3. Development status of new-quality productive forces in Henan Province

3.1 Evaluation system of new quality productivity

According to the relevant discussion of many scholars, this paper builds the new quality productivity index system of Henan Province from four aspects: scientific and technological productivity, green productivity, digital productivity and industrial productivity. The specific indicators are shown in Table 1.

Table 1 Evaluation index system of new quality productivity

Level 1	Serial number	Explanation	Units	Attributes
Tech productivity	A1	Science and technology expenditure/GDP of Henan Province	%	+
	A2	Total R&D investment of listed enterprises/operating income	%	+
	A3	Number of technical personnel in listed enterprises	people	+
	A4	Number of regular colleges and universities	a	+
	A5	Number of patents of listed companies	a	+
Green productivity	B1	Harmless disposal rate of household garbage	%	+
	B2	Comprehensive utilization/production of general industrial solid waste	%	+
	B3	Industrial waste water discharge/regional GDP of Henan Province	%	−
	B4	Industrial SO2 discharge/regional GDP of Henan Province	%	−
Digital productivity	C1	Mobile phone penetration	%	+
	C2	Number of Internet users	house holds	+
	C3	Total telecom business/GDP of Henan Province	%	+
	C4	Digital Technology Index	%	+
Industrial productivity	D1	Industrial optimization	%	+
	D2	Industrial rationalization	%	+
	D3	Operating revenue of listed companies/GDP of Henan Province	%	+
	D4	Number of employees in information transmission, computer services and software industries/total employment	%	+

3.2 Measurement methods and results of NPM

This paper, by using entropy method to calculate the new quality, and the level of productivity development in henan province, the new measure of henan province in 2012-2022 productivity level data from the statistical yearbook of henan province and sample municipal statistics yearbook, data from iFind database of listed companies, individual missing data interpolation method and the moving average method is used to be added. The data of listed companies were from the IFIND database, and the missing data were supplemented by interpolation method and moving average method[7-9].

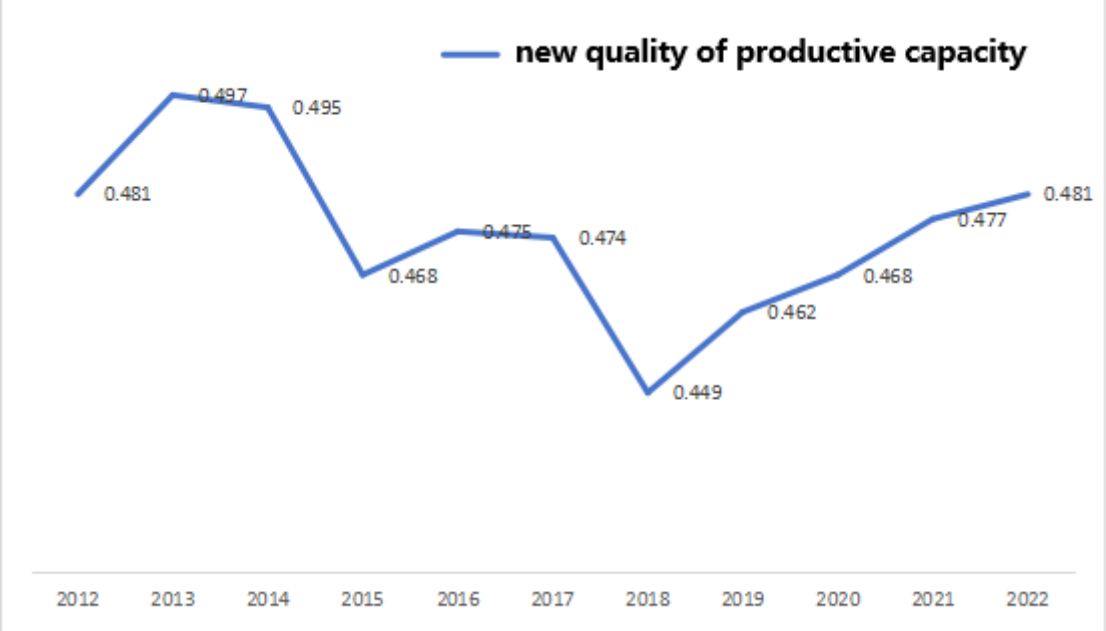

Figure. 1 New quality productivity level in Henan Province from 2012 to 2022

According to the change trend in Figure 1, the level of new quality productivity in Henan Province increased steadily from 2012 to 2022, and the overall level remained above 0.45. The level of new quality productivity in Henan Province is divided into two stages: the first stage is the fluctuation and decline stage from 2012 to 2018, which decreased from 0.481 in 2012 to 0.449 in 2018, with an average annual decline rate of 1.14%. First of all, the industrial structure adjustment policy of Henan Province lagged behind[10]. During this period, the traditional industries such as coal, chemical industry and steel still occupied a large proportion in the industrial structure of Henan Province. These industries usually have high energy consumption, high pollution, and relatively low technology content and added value. These traditional industries have not been timely and effective transformation and upgrading, resulting in the development of new quality productivity is restricted. In addition, Henan province has not made enough efforts to cultivate emerging industries, resulting in small scale of emerging industries and limited contribution to economic growth. Secondly, the policy support for scientific and technological innovation is not enough. Henan province has relatively little investment in scientific and technological innovation, which leads to weak scientific and technological innovation ability. The lack of R&D investment makes the progress of new technology R&D and transformation of scientific and technological achievements slow in Henan province, which makes it difficult to form competitive new quality productivity. In addition, the poor innovation environment, such as the imperfect innovation incentive mechanism, the insufficient protection of intellectual property rights, etc., all restrict the development of scientific and technological innovation. Finally, urbanization policy is slow to advance. The slow process of urbanization makes it difficult for rural population to effectively transfer to cities, which restricts the improvement of labor quality and the driving force of domestic consumption. At the same time, the widening gap between urban and rural areas makes it difficult to achieve effective allocation of resources between urban and rural areas, which further aggravates the unbalanced development of new quality productivity[11].

The second stage is the gradual increase stage from 2018 to 2022, from 0.449 in 2018 to 0.481 in 2022. The average annual growth rate is 0.8%. First, the push for technological innovation is one of the key factors. Since 2018, Henan Province has vigorously implemented the enterprise innovation capability cultivation project, and accelerated the cultivation of high-tech and innovative enterprises. This emphasis on and investment in scientific and technological innovation has significantly

improved the level of new-quality productivity in Henan Province. Secondly, the optimization of the economic structure and the development of high-end manufacturing have also played an important role in the improvement of the new quality productivity level[12]. The provincial government issued "made in China 2025 henan action outline, pushing up traditional manufacturing advanced manufacturing industry. Combined with the relevant state policies, henan throughout the province to carry out the intelligent manufacturing pilot demonstration, cultivate a group of intelligent manufacturing factories and workshops, promoted the high-end, intelligent, intensive, green development. The optimization of the economic structure and the development of high-end manufacturing industry have significantly improved the level of new-quality productivity in Henan province. In addition, policy support and regional competitiveness are important reasons. Henan Province has seized the opportunity of national strategy superposition, promoted supply-side structural reform, accelerated the transformation of power, and further promoted the development of new-quality productivity.

4. The problems faced by the new quality productivity in Henan Province in promoting the high-quality development of digital villages

4.1 The level of digital development is unbalanced

First of all, there are significant regional differences in the level of digital development in Henan Province. Urban areas benefit from a good economic foundation, education resources and technology accumulation, the rapid process of digitalization, smart agriculture, rural e-commerce and other emerging business forms are booming. However, rural areas, especially in remote mountainous area and economic less developed areas, as a result of the limitation of capital, technology, talent, digital development relative lag, the digital divide phenomenon is obvious. Secondly, the dual structure of urban and rural areas is solidified. The digital divide between urban and rural areas is not only reflected in the construction of hardware facilities, but also reflected in the differences in software application and digital literacy[13]. Urban residents generally have higher digital literacy, can make full use of digital technology to increase the quality of life and the work efficiency. But rural residents by education level, the limitation of information access, digital literacy is relatively low, difficult to fully enjoy the advantages of digital. Finally, the industrial application is uneven, and the degree of digital application is uneven in key fields such as agriculture, education and medical care. Some areas such as agriculture, wisdom has made some progress, but it is still in its infancy, penetration and application effect remains to be improved. And other areas such as education, medical treatment, digital application relative lag, influence the effect of the whole digital transformation.

4.2 Infrastructure is weak and digital supervision is lacking

First, the network infrastructure in rural areas of Henan province lags behind. Part of rural network coverage is not complete, access speed is slow, the signal is not stable, seriously affected the application and popularization of digital technology. This not only limits the ability of rural residents to obtain information and exchange information, but also restricts the development of emerging businesses such as smart agriculture and rural e-commerce. Second, the regulatory system is not sound. Rural areas in henan province digital supervision system has not been perfect, frequent problems such as data security and privacy protection. With the wide application of digital technology, rural residents of personal information protection consciousness gradually strengthened, but the lagging of the regulatory system makes is difficult to effectively solve these problems. At the same time, Internet fraud, Internet crime and other issues have also brought rural residents safe hidden trouble. Finally, technology updates lag behind. The infrastructure and technical standards in some areas have been difficult to meet the current digital needs. With the rapid development of the

Internet of Things, big data, artificial intelligence and other technologies, the infrastructure and technical standards in rural areas are in urgent need of upgrading to meet the development needs of the digital era[14].

4.3 There is a shortage of professionals and it is difficult to develop resources

First, there is a serious shortage of talents in rural areas of Henan Province. The construction of digital countryside needs a large number of interdisciplinary talents who are proficient in both agriculture and information technology. However, rural areas due to reasons such as economic underdevelopment, the lack of education resources, difficult to attract and retain top talent. At the same time, the number of rural residents quality is relatively low, also limits the talent cultivation and introduction. Second, there is a lack of educational resources in rural areas of Henan Province. Rural areas lack of high quality digital skills training and education opportunities, resulting in rural residents of digital literacy is difficult to ascend, is difficult to meet the demand of digital rural construction. At the same time, it also limits the competitiveness and development potential of rural residents in the digital era. Thirdly, there is a lack of resource integration mechanism in rural areas of Henan Province. Resources in rural areas are scattered and lack effective integration mechanisms. This leads to low efficiency of resource utilization, and it is difficult to form scale effect. At the same time, it also limits the application and promotion of digital technology in rural areas. Due to the lack of effective resource integration mechanism, it is difficult for rural areas to form synergy in digital rural construction, which affects the overall development effect.

5. Implementation path of high-quality development of digital villages in Henan Province empowered by new quality productivity

5.1 Deepening scientific and technological innovation and the application of digital technology

First, Henan province should focus on 5G, Internet of Things, artificial intelligence, blockchain, cloud computing and other cutting-edge technologies, establish a mechanism for industry-university-research-application collaborative innovation, and accelerate the transformation of scientific and technological achievements into real productivity. In particular, breakthroughs should be made in key technologies such as intelligent perception, precise decision-making and automatic control to provide a powerful technological engine for digital villages. Secondly, in addition to existing applications such as intelligent irrigation, intelligent greenhouse and UAV plant protection, digital solutions in fields such as intelligent agricultural machinery and equipment, agricultural product quality traceability and agricultural environment monitoring should also be explored to form a smart agricultural system covering the whole chain of agricultural production. Finally, a digital rural comprehensive information platform integrating data collection, analysis and application should be built to achieve data interconnection in rural governance, agricultural production, farmers' life and other aspects, and improve the efficiency and service level of rural governance[15].

5.2 Optimize the allocation of production factors and industrial upgrading

First, the allocation of precise agricultural resources. Big data, remote sensing and other technologies should be used to accurately manage land and water resources and improve the efficiency of resource utilization. At the same time, data analysis will be used to forecast market demand, guide the adjustment of agricultural production structure, and avoid overcapacity. Second, the extension of the agricultural industry chain. Relying on digital technology, we will promote the deep integration of agriculture with processing, logistics and sales to form a complete and efficient

agricultural industrial chain. We will encourage the development of deep processing of agricultural products and increase the added value of products. Third, we need to foster emerging industries. In combination with Henan's resource endowment and industrial base, we will vigorously develop emerging industries such as rural tourism, rural e-commerce and digital creativity to inject new vitality into the rural economy.

5.3 Improving digital rural infrastructure

First, Henan province should upgrade its network infrastructure. We should speed up fiber-to-village and 4G/5G network coverage to improve network access capacity and service quality in rural areas. At the same time, we will promote the development of Internet of Things infrastructure to provide network support for smart agriculture. Second, we will accelerate the development of information infrastructure. Rural data centers and cloud computing centers will be built to provide data storage, processing and analysis capabilities for digital villages. At the same time, the construction of information terminals in rural areas, such as electronic display screens and self-service terminals, will be strengthened to facilitate farmers' access to information and services.

5.4 Improve the quality of digital rural talents and farmers

Henan Province should attach importance to the establishment of long-term cooperative relations with universities and research institutions, and carry out digital rural talent training projects. At the same time, policy incentives should be used to attract external talents to start businesses and work in rural areas, so as to form a talent agglomeration effect.

We will establish a training system that combines online and offline training, and train farmers in digital skills, e-commerce and online marketing to improve their digital literacy and ability to start businesses and find jobs.

5.5 Digital rural governance and service innovation

Rural areas in Henan Province should use digital technology to promote the modernization of rural governance, such as the establishment of a big data platform for rural governance, to achieve real-time collection, analysis and sharing of governance information. At the same time, "Internet + government services" should be promoted to improve the efficiency and service level of rural governance. We will promote the digital allocation and sharing of education, medical care, culture and other public service resources, such as online education platforms, telemedicine systems, and digital libraries, so that farmers can enjoy more convenient and efficient public services.

5.6 Building a policy support and security system

The Henan provincial government should issue a series of policies and measures to support the construction of digital villages, such as tax incentives, financial support, land use incentives, etc. At the same time, the supervision and inspection mechanism of policy implementation should be established to ensure the effective implementation of the policy. We will strengthen the development of relevant regulations and standards for digital villages to ensure the legal compliance of the construction of digital villages. At the same time, we will establish a data security and personal information protection mechanism to ensure farmers' information security. The government (or relevant authorities/departments) of Henan Province should actively engage in international exchanges and cooperation for digital rural development, integrate foreign advanced technologies and experiences, and enhance the internationalization level of digital rural construction in Henan Province.

6. Conclusion

The high-quality development of digital villages in Henan Province, driven by new quality productivity, holds great promise for advancing rural revitalization and enhancing the overall well-being of rural residents. However, challenges such as uneven digital development, inadequate infrastructure, lack of digital supervision, talent shortages, and resource development difficulties must be addressed. To overcome these obstacles, it is crucial to deepen scientific and technological innovation, optimize the application of digital technology, and improve the allocation of production factors to facilitate industrial upgrading. Additionally, strengthening the infrastructure of digital rural areas and enhancing the quality of digital rural talents and farmers are essential measures. By implementing these strategies, Henan Province can effectively promote the high-quality development of digital villages, harnessing the power of new quality productivity to drive rural economic growth and social progress.

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