

Analysis on the Empowerment of New Quality Productivity in the Construction of Digital Villages and the Exploration of Enhancement Paths

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Abstract: With the deepening development of a new round of technological revolution and industrial transformation, new quality productive forces, characterized by high technology, digitalization, and intelligence, are becoming a key driver of high-quality socio-economic development. Digital rural construction is a strategic direction for rural revitalization and a crucial component of building a digital China. This paper aims to explore how new quality productive forces empower digital rural construction and analyze pathways for enhancement. First, it elucidates the theoretical foundations and intrinsic connections between new quality productive forces and digital rural construction. Second, it examines the current state and challenges of new quality productive forces enabling digital rural construction from technical, industrial, and governance dimensions, such as the digital divide, insufficient industrial integration, and an underdeveloped governance system. Finally, it systematically proposes pathways for enhancing the empowerment of digital rural construction by new quality productive forces across four levels: technological innovation, industrial upgrading, governance optimization, and sustainable development, with the goal of providing theoretical references and practical guidance for promoting comprehensive rural revitalization and achieving integrated urban-rural development.

Keywords: New Quality Productive Forces; Digital Countryside; Technology Empowerment; Rural Revitalization; Sustainable Development

1. Introduction

Relevant important national resolutions have emphasized the need to "improve the systems and mechanisms for developing new quality

productive forces based on local conditions." National leaders have profoundly pointed out that new quality productive forces are "characterized by innovation, with excellence as the key, and are essentially advanced productive forces." As a crucial strategy for promoting rural development, the concept of digital villages was first introduced in important related documents in 2018, and its connotations have since continued to evolve and expand. Subsequent strategic outlines have further clarified that digital villages represent an endogenously driven modernization transformation process in agriculture and rural areas, accompanied by the deepening application of networking, informatization, and digitalization across various sectors of agriculture and rural development, as well as the continuous improvement of farmers' digital literacy. Digital villages are a key initiative for implementing the rural revitalization strategy, while new quality productive forces provide the core driving force for achieving this goal [1].

2. Theoretical Foundations of New Quality Productivity and Digital Village Construction

2.1 Connotation and Characteristics of New Quality Productivity

2.1.1 Definition and Core Elements of New Quality Productivity

Focusing on the new requirements for the level of productivity development posed by the historic convergence of a new round of technological revolution and industrial transformation, intensifying competition among major nations, and the transformation of China's economic development model, national leaders have creatively proposed the entirely new concept of "new quality productive forces" [2]. Representing a fundamental transformation of productivity, its essential characteristics lie in an advanced productivity paradigm driven by major technological breakthroughs, centered on

innovative allocation of production factors, and aimed at deep industrial transformation and upgrading. This new form of productivity fundamentally differs from traditional models reliant on large-scale resource input, with its core driving force derived from the organic unity of high technology, high efficiency, and high quality. Academic research generally agrees that the defining trait of new quality productivity is its innovation-led nature, which breaks dependence on traditional economic growth paths to achieve a holistic leap and qualitative transformation of the productivity system. The composition of new quality productivity integrates advanced technologies, innovative talents, efficient management, and data elements into an interdependent and synergistic organic whole. Disruptive technology clusters—represented by AI, big data, IoT, and blockchain—form the most dynamic innovation elements within this system. Their deep integration and collaborative innovation continuously give rise to new production methods and business models. Innovative talents, as the core driving force, not only require solid professional knowledge and skills but also possess cross-domain integration capabilities and continuous innovation awareness, serving as a critical link between technological innovation and industrial application. Modern management systems, through digital governance and agile organizational models, establish flexible and efficient production structures to ensure optimal allocation and maximized efficacy of all production factors. Data, as a new type of production factor, derives its unique value from systematic development, in-depth analysis, and innovative application, permeating all stages of value creation to become the core engine propelling productivity growth. These core elements exhibit tight interactivity and synergistic effects. Major technological breakthroughs continuously generate demand for new capability systems, driving profound reforms in talent cultivation models and content. Enhanced talent quality, in turn, fosters innovation in management concepts and methods, while optimized management systems create more favorable conditions for technological innovation and talent development. This virtuous interaction and coordinated evolution form the internal dynamic mechanism for the sustainable advancement of new quality productivity. Notably, data elements, as a

connecting link, enhance the synergistic relationship among technology, talent, and management through their permeability and connectivity, collectively propelling the new quality productivity system toward higher levels. In practice, the development of new quality productivity demonstrates systematic and ecological characteristics. Technological innovation no longer occurs in isolation but forms mutually reinforcing technology clusters; talent development emphasizes not only specialized depth but also cross-domain integration; management innovation shifts from single-link optimization to holistic system efficacy; and data elements integrate other components through their unique connectivity, forming a collaborative innovation ecosystem. These systemic features grant new quality productivity stronger adaptability and sustainability, enabling it to better navigate complex and evolving development environments and provide sustained momentum for high-quality economic growth [3].

2.1.2 Main Characteristics and Manifestations of New Quality Productivity

New quality productivity exhibits distinct features that differentiate it from traditional productivity, collectively constituting its essential attributes and profoundly shaping its developmental form. Innovation, as the core trait, manifests not only in breakthroughs at the individual technology level but more importantly through the systemic transformation of production methods triggered by the collaborative advancement of technology clusters. This innovation is disruptive and revolutionary, capable of inducing paradigm shifts in industrial development—for example, major breakthroughs in bio-breeding technology have fundamentally restructured the technical foundation and developmental trajectory of agricultural production. In terms of efficacy, new quality productivity achieves a fundamental shift from localized efficiency improvements to comprehensive enhancements in total factor productivity through the deep application and system integration of intelligence and automation. This efficiency is reflected not only in production process optimization but also throughout resource allocation, organizational management, and value creation. Particularly noteworthy is the intrinsic integration of green development principles throughout the new quality productivity framework, manifesting as a

distinct green characteristic. This greenness demands not only low-carbon, circular, and sustainable production processes but also technological innovation to harmonize economic growth with environmental protection. The application of smart energy management systems in rural areas illustrates this—digital means enable precise regulation and optimized management of energy consumption, significantly reducing carbon emissions while ensuring development, thereby embodying the essential requirement of new quality productivity for sustainable development. These essential characteristics present diverse practical forms across fields. In industrial manufacturing, new quality productivity is embodied in the widespread adoption of smart manufacturing systems and flexible production models; in agricultural production, it is reflected in the in-depth development of precision agriculture technologies and smart farm systems; and in modern service industries, it emerges as innovative breakthroughs in platform economy ecosystems and personalized customization services. Although these manifestations vary in features, they collectively demonstrate the internal logic of new quality productivity in driving industrial transformation and upgrading, showcasing its powerful role in propelling high-quality economic development.

2.2 The Concept and Objectives of Digital Village Construction

2.2.1 Definition and Development Background of Digital Villages

A digital village refers to a new development model that systematically reshapes and upgrades rural infrastructure, economic industries, governance models, and lifestyles through the integration of modern digital technologies. It represents not merely an extension of informatization but a comprehensive and in-depth transformation encompassing production, ecology, and daily life. Digital village construction is both a fundamental requirement for rural revitalization and the foundation for high-quality rural economic development [4]. The development background of digital village construction is characterized by multidimensional drivers. At the policy level, national initiatives such as the Strategic Outline for Digital Village Development have established a comprehensive policy support framework, providing clear institutional

guarantees and directional guidance. Technologically, the rapid advancement and cost reduction of digital technologies—such as 5G and IoT—have made the large-scale application of advanced technologies in rural areas economically viable. More importantly, rural endogenous development needs serve as a key driver: faced with challenges such as population aging and weak industrial competitiveness, rural areas urgently require digital means to achieve transformational breakthroughs. These three dimensions—policy, technology, and endogenous demand—mutually reinforce and empower one another, collectively forming a robust impetus for digital village construction.

2.2.2 Primary Objectives and Significance of Digital Village Construction

Digital village construction aims to comprehensively advance rural development through digital transformation. Its core objectives are manifested in three dimensions: Economically, it enhances agricultural production efficiency and achieves cost reduction and performance improvement through digital technology equipment such as smart agricultural machinery and drones.

Socially, it improves rural living standards and promotes equitable access to urban and rural services by leveraging digital public services like telemedicine and online education. Governance-wise, it boosts transparency and decision-making efficiency in village affairs through digital tools such as "Internet + government services," advancing the modernization of rural governance.

This transformation holds profound significance: it not only activates rural economies and cultivates new growth points but also helps bridge the urban-rural digital divide and promote social equity. Additionally, digital environmental monitoring and governance tools contribute to the construction of ecologically livable and beautiful rural areas, ultimately providing comprehensive support for rural revitalization.

2.3 The Interconnection Between New Quality Productivity and Digital Village Construction

2.3.1 The Driving Role of New Quality Productivity in Digital Village Construction

Empowering rural revitalization through new quality productivity is a systematic project characterized by value alignment, goal orientation, and adherence to developmental

laws, carrying significant practical importance. In the digital intelligence era, new quality productivity can accelerate the advancement of industrial revitalization, ecological livability, cultural prosperity, effective governance, and prosperous living in ethnic rural areas, injecting new momentum into ethnic rural revitalization [5]. As the core driving force behind digital village construction, new quality productivity profoundly empowers the rural development process through multiple pathways. Technologically, the advanced technology system represented by AI, IoT, and big data provides comprehensive support for digital village construction. It shifts agricultural production from traditional experience-based decision-making to data-driven precision decisions. For example, satellite remote sensing monitoring systems enable intelligent management of crop growth. Industrially, new quality productivity fosters emerging sectors such as rural e-commerce, smart tourism, and digital wellness, driving the transformation of rural industries from single-agriculture models to diversified, high-value chains. This effectively extends the rural industrial value chain. Governance-wise, it facilitates fundamental changes in rural governance models. By establishing digital governance platforms and big data analytics systems, traditional "rule by man" transitions to modern "rule by data," enabling precise prediction and preemptive deployment of public services and significantly improving rural governance efficacy.

This comprehensive driving effect positions new quality productivity as the key engine leading digital village construction and promoting all-round rural revitalization.

2.3.2 Demand Analysis of Digital Village Construction for New Quality Productivity

As a critical practical domain for the development of new quality productivity, digital village construction imposes multidimensional and hierarchical demands on it. Technologically, the unique geographical environment, industrial structure, and social fabric of rural areas necessitate digital technologies with robust adaptability to complex application scenarios. These technologies must maintain advanced capabilities while remaining cost-effective, driving innovation from laboratories to fields and steering R&D toward more practical, ground-ready solutions. Talent -wise, digital village construction urgently requires a large

pool of interdisciplinary professionals who master both digital technologies and agricultural/rural domain knowledge. This demand guides the reform of education and training systems, fostering innovative models for cross-disciplinary talent cultivation. Meanwhile, the multi-source, massive data generated during rural digital transformation provides rich material for refining AI algorithms and optimizing governance models. These real-world data resources serve as vital "fuel" for the continuous evolution of new quality productivity. These demands not only highlight the traction of digital village construction on new quality productivity but also create favorable conditions for the synergistic development of technological innovation, talent cultivation, and data application in practice. Ultimately, they foster a virtuous cycle where demand-driven traction and technology-driven progress mutually reinforce each other.

3. The Current Status and Challenges of New Quality Productivity Empowering Digital Village Construction

3.1 Current Status of New Quality Productivity Empowering Digital Village Construction

3.1.1 Technological Empowerment: Application of Digital Technologies in Rural Areas

Currently, IoT technologies have been preliminarily applied in livestock, aquaculture, and facility agriculture, enabling automated environmental regulation. Big data platforms are used in major grain-producing regions for yield forecasting and market analysis. Rural e-commerce is widely adopted, with short-video live streaming becoming a key channel for agricultural product sales. However, applications are primarily concentrated in production and sales stages, with limited use in deeper domains such as ecological protection and cultural heritage.

3.1.2 Industrial Empowerment: New Quality Productivity Driving Rural Industrial Upgrading

New quality productivity is fostering the integration of primary, secondary, and tertiary industries. For instance, some regions utilize drones for crop protection services, creating new agricultural production service models. The processing sector has introduced intelligent sorting and non-destructive testing equipment to enhance product value. Yet, industrial upgrading

remains at a stage of isolated breakthroughs, without forming clustered effects.

3.1.3 Governance Empowerment: Practice of Digital Governance in Rural Areas

Nationwide, the "Sharp Eyes Project" employs video surveillance to safeguard rural safety. Many villages have established WeChat official accounts or government service platforms for announcements, financial transparency, and public opinion collection, effectively improving governance efficiency. However, data silos are prevalent, and cross-departmental collaboration capabilities require further enhancement.

3.2 Challenges and Issues in New Quality Productivity Empowering Digital Village Construction

3.2.1 Imbalanced Technology Application and the Digital Divide

In the process of new quality productivity empowering digital village construction, uneven technology application has emerged as the primary constraint. This imbalance manifests not only in macro-level regional disparities but also in micro-level gaps in usage capabilities. Geographically, rural areas in developed eastern coastal regions have achieved near-universal 5G coverage, with fiber-optic access rates exceeding 90%, whereas remote western mountainous regions still face extensive digital infrastructure gaps, with some villages lacking even basic mobile network coverage. This "hard gap" in infrastructure directly results in unequal access to digital resources, forming a pronounced "connectivity divide." More critical than infrastructure disparities is the "capability gap." Amid accelerating rural aging, many elderly farmers face severe deficiencies in digital skills. Surveys indicate that fewer than 30% of rural residents aged 60+ can proficiently use smartphones for basic operations such as mobile payments or information queries. These limitations not only restrict their access to digital services but also prevent them from benefiting from digital economic growth. Additionally, digital literacy shortcomings—such as weak information security awareness and poor discernment abilities—further marginalize certain farmer groups in the digital transition. The digital divide also exhibits notable intergenerational and gender disparities. While younger rural residents generally possess better digital skills, their mass migration to urban areas has led to severe shortages in rural digital talent

reserves. Left-behind middle-aged and elderly groups, particularly women, often become "marginalized populations" in the digital era. This structural contradiction exacerbates the insufficient endogenous drive for digital village construction, posing significant challenges to the promotion and application of new quality productivity in rural areas.

3.2.2 Insufficient Industrial Integration and Lack of Innovation Momentum

Currently, the integration of new quality productivity with rural industries remains in its nascent stages, characterized by "broad but shallow" progress. Most rural enterprises' digital transitions are superficial, limited to foundational applications like establishing corporate websites or launching e-commerce stores, without penetrating core production and operational processes. Such shallow digital modifications, while marginally expanding sales channels, fail to fundamentally alter traditional production models or business paradigms. In agricultural production, digital technology applications are largely confined to isolated automation upgrades in specific segments. For instance, while some agricultural enterprises have introduced smart irrigation systems, key stages such as planting decisions, pest control, and quality traceability still rely predominantly on traditional experience. This fragmented application of technology hinders the realization of systemic benefits from new quality productivity and prevents qualitative improvements in agricultural production efficiency. A pronounced lack of innovation momentum is evident among agriculture-related enterprises. Due to the sector's long investment cycles, high risks, and slow returns, most enterprises exhibit limited willingness or capacity for sustained R&D investment. Survey data reveals that the average R&D intensity of China's agricultural enterprises is less than 1% of revenue—far below the industrial average. This weak innovation input directly results in fragile technological capabilities, constraining enterprises' ability to overcome development bottlenecks. Moreover, rural industrial innovation faces severe homogenized competition. The absence of differentiated development strategies and innovative business models has led many regions into low-level redundant construction. For example, rural tourism initiatives across various areas blindly emulate trends by opening homestays and

agritainment venues, lacking distinctive positioning or personalized services. This ultimately results in market saturation and declining profitability. Such homogenization not only impedes industrial upgrading but also weakens the foundation for new quality productivity to take root in rural settings [6].

3.2.3 Imperfect Governance Systems and Inadequate Policy Support

The construction of rural digital governance systems grapples with a lack of standardized frameworks. Currently, the absence of unified technical specifications and operational standards during digital governance implementation has led to isolated information system development across departments. This non-standardized approach hampers system interoperability, creating numerous "information silos." Taking grassroots governance as an example, the varying data collection standards and disparate data formats across different public affairs significantly hinder the integration, sharing, and effective utilization of data. Digital governance in rural areas also exhibits notable shortcomings in data security and privacy protection. With the proliferation of government apps and village-level management platforms, vast amounts of villagers' personal information are collected and utilized. However, the absence of robust data security management mechanisms has heightened risks of personal data breaches. Concurrently, issues such as weak data security awareness among grassroots staff and irregular data handling practices have eroded villagers' trust in digital governance. Policy support demonstrates inadequate precision. Existing support policies often adopt a "one-size-fits-all" approach, failing to account for varying regional development foundations and actual needs. For example, some remote areas with underdeveloped digital infrastructure are mandated to implement high-level smart applications, resulting in resource wastage and inefficiency. Moreover, policy implementation disproportionately emphasizes hardware investment and equipment procurement while neglecting software development and talent cultivation. This imbalanced support approach limits the overall efficacy of digital governance. The funding mechanism also presents significant flaws. Current digital village construction relies heavily on fiscal inputs, with limited private-sector participation. The absence of effective incentive mechanisms and stable return-on-

investment models has rendered private capital hesitant to engage in digital village projects. This overdependence on public finances not only increases government burdens but also fails to meet the sector's substantial capital demands. Furthermore, inadequate post-construction operational and maintenance funding has led to the idling of some digital facilities, preventing them from delivering sustained benefits.

4. Pathways for Enhancing New Quality Productivity Empowerment in Digital Village Construction

4.1 Technological Innovation Path

4.1.1 Strengthening Digital Infrastructure

Implement an upgrade initiative for rural information infrastructure, prioritizing the extension of gigabit optical networks and 5G networks to qualified and demand-driven rural areas. Coordinated planning and construction of rural data centers and IoT facilities should be pursued to avoid redundant development. Low-cost solutions such as "micro base stations" and "satellite internet" are encouraged to cover remote and scattered households.

4.1.2 Deepening the Integration of Digital Technology and Agriculture

Develop and promote lightweight, low-cost, and user-friendly smart equipment tailored for smallholder farmers. Construct comprehensive agricultural big data platforms spanning the entire industrial chain to facilitate data sharing and application across breeding, planting, processing, and distribution stages. For example, the "climate-smart agriculture" model should be popularized, leveraging AI to address extreme weather challenges.

4.1.3 Cultivating Digitally Skilled Rural Talent

Launch the "Digital New Farmers" training program, collaborating with universities and enterprises to deliver customized programs. Establish incentive mechanisms to attract urban professionals (e.g., e-commerce operators, data analysts) to return or relocate to rural areas for entrepreneurship. Introduce interest-based courses such as programming and drone operation in rural primary and secondary schools to sow the seeds of digital literacy [7].

4.2 Industrial Upgrading Path

4.2.1 Developing Smart Agriculture and Specialty Industries

Concentrate resources to establish smart

agriculture demonstration zones that showcase integrated technological benefits. Deepen the exploration of local specialty resources and leverage blockchain technology to create traceable "one-village-one-product" brands, enhancing market trust and value-added. Promote the digital integration of agriculture with tourism, wellness, and cultural creativity, developing immersive experience projects.

4.2.2 Building a Rural Digital Economy Ecosystem

Support the establishment of county-level digital industry incubators to provide startups with technical, financial, and market support. Develop localized digital supply chain platforms that integrate production, processing, logistics, and marketing to reduce transaction costs. Encourage platform enterprises to open data and technological capabilities to empower small and micro rural businesses [8].

4.2.3 Facilitating Integrated Urban-Rural Industrial Development

Establish unified urban-rural factor markets to enable bidirectional flows of data, technology, and talent. Promote "enclave economy" models, encouraging urban enterprises to set up R&D or production bases in rural areas for complementary advantages. Utilize digital platforms to directly connect urban consumer demand with rural production, advancing order-based and customized agriculture.

4.3 Governance Optimization Path

4.3.1 Improving the Rural Digital Governance System

Construct a digitally-enabled governance platform with county-township-village three-tier linkage to integrate management functions across various public affairs. Establish "digital resident profiles" to enable precise service delivery. Implement the "panoramic digital village view" model to achieve integrated perception and management of all rural elements.

4.3.2 Strengthening Policy Support and Financial Safeguards

Establish a dedicated fund for digital village construction and introduce diversified support mechanisms such as reward-based subsidies and loan interest discounts. Encourage financial institutions to develop specialized financial products like "Digital Village Loans." Refine government procurement policies to prioritize the acquisition of digital technology-enabled rural products and services.

4.3.3 Enhancing Farmers' Digital Literacy and Participation

Offer "digital literacy classes" in village committee activity centers and cultural stations. Compile an easy-to-understand Farmers' Digital Application Handbook. Implement a "digital credit" system to reward villagers actively engaging in village affairs app discussions and utilizing digital services, fostering positive incentives.

4.4 Sustainable Development Path

4.4.1 Integrating Green Technologies with Digital Villages

Promote digital monitoring systems for the resourceful utilization of agricultural waste. Expand the adoption of Building-Integrated Photovoltaics (BIPV) in rural constructions and implement intelligent scheduling through energy management systems. Leverage digital technologies for integrated protection and systematic governance of rural landscapes, forests, farmlands, lakes, grasslands, and deserts.

4.4.2 Establishing Long-Term Development Mechanisms

Incorporate digital village construction into rural revitalization performance evaluations and create annual assessment and dynamic adjustment mechanisms. Explore models such as "operational rights" transfers to engage professional companies in long-term market-oriented operations, ensuring post-construction projects are "managed and sustained." [9]

4.4.3 Strengthening International Experience Learning and Cooperation

Conduct systematic studies on international best practices, such as the Netherlands' "smart agriculture" and Japan's "sixth industry." Encourage domestic digital technology enterprises to collaborate with "Belt and Road" countries on projects in smart agriculture and rural e-commerce, exporting Chinese solutions while absorbing global expertise.

5. Conclusion

Empowering digital village construction with new quality productivity is a profound and systematic endeavor, requiring the coordinated advancement of technology, industry, governance, and sustainable development. To address existing challenges such as the digital divide and superficial industrial integration, it is imperative to adhere to the principles of "people-centered development, technology utilization,

innovation as the core, and institutional safeguards." Systematic and sustained efforts are essential. Only through such comprehensive measures can dormant rural resources be truly activated, allowing the radiance of digital civilization to illuminate the rural hinterland of China, ultimately achieving comprehensive rural revitalization and high-quality development [10].

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