

Research on the Path of Digital Rural Construction Supporting Rural Revitalization

Zhu Lan

Changchun Guanghua University, Changchun, Jilin, China

Abstract: Digital rural construction is a key carrier of rural revitalization strategy, which is reshaping the traditional rural development model through technological empowerment. This article will focus on the collaborative mechanism between digital technology applications, rural governance, and industrial upgrading, and conduct a systematic analysis of the structural contradictions and implementation obstacles in the current promotion of digital rural policies. Through research, it has been found that the imbalance in the allocation of digital resources between urban and rural areas, as well as the problem of talent supply gaps, have seriously constrained the release of digital dividends. The imperfect institutional guarantee system has also made it difficult for technology applications to be deeply embedded in rural social ecology. By constructing a four-dimensional path framework covering "infrastructure technology application subject cultivation institutional innovation", the internal logic of digital reform for the restructuring of rural production factors and value networks is revealed. The research results provide theoretical basis for optimizing the digital transformation strategy of rural areas, and play a supportive role in forming a sustainable urban-rural integration development pattern, which has practical guidance value for achieving agricultural and rural modernization.

Keywords: Digital Countryside; Rural Revitalization Construction Path

1. Introduction

The current construction of digital rural areas has evolved from the stage of basic network coverage to the stage of deep integration development. The organic integration of traditional agriculture and technological elements has given rise to emerging formats such as smart agriculture and e-commerce. This transformation is not limited to facility updates at the material level, but also includes the reconstruction of thinking patterns and organizational systems. In reality, there are problems with technology applications only remaining at a superficial level and regional development imbalances, as well as lagging institutional supply and insufficient participation of entities, which have led to the insufficient release of digital dividends. This article examines the transmission mechanism of digital technology empowering rural revitalization from a systems theory perspective, focusing on exploring how to break through the obstacles encountered in factor flow and technological application bottlenecks, construct a digital transformation path that is compatible with rural social characteristics, and provide theoretical support and practical reference for breaking the urban-rural binary structure and cultivating endogenous development momentum in rural areas.

2. The current situation and progress of digital rural construction

(1) National Digital Rural Policy and Planning

At the national level, a relatively complete policy framework and strategic layout have been formed around the construction of digital rural areas, showing a systematic promotion trend from top-level design to local practice. The Outline of the Digital Rural Development Strategy clearly regards digitization as the core driving force for rural revitalization, and various provinces and cities have successively introduced supporting implementation plans based on regional characteristics, achieving substantial breakthroughs in the construction of agricultural big data platforms and the creation of smart agriculture demonstration zones. The pilot work covers more than 100 counties and districts across the country, with a focus on promoting infrastructure construction such as fiber optic network extension and IoT base station deployment. Some pilot areas have achieved full coverage of 5G signal administrative villages, and new formats such as live streaming e-commerce and cloud based agricultural technology training have gradually become the norm. The Ministry of Agriculture and

Rural Affairs has jointly established a digital agriculture standard system with multiple departments, promoting the implementation and application of key technologies such as remote sensing monitoring and intelligent agricultural machinery. Some agricultural product traceability systems have achieved full chain digital management. The innovation model of "Internet plus+Village Affairs" platform emerged in the field of grass-roots governance. Villagers participate in collective affairs decision-making in real time through mobile terminals, and the online processing rate of grass-roots government services has significantly improved.

(2) Construction of Digital Rural Infrastructure

Digital countryside is an endogenous process of modernization and transformation in agriculture and rural areas, which is accompanied by the application of networking, informatization, and digitization in the economic and social development of agriculture and rural areas, as well as the improvement of farmers' modern information skills. It is not only a strategic direction for rural revitalization, but also an important part of building a digital China. Grassroots government service platforms and convenient service terminals are gradually sinking to the level of administrative villages, and rural data resource centers based on cloud computing architecture are beginning to integrate core information such as land, population, and industry, providing underlying support for accurate decision-making. The deployment of smart agriculture infrastructure presents differentiated characteristics. Internet of Things sensors and intelligent irrigation systems are commonly installed in major economic crop producing areas. Key agricultural machinery operation monitoring equipment and remote sensing monitoring stations are promoted in major grain producing counties. The application scope of unmanned aerial vehicle (UAV) crop protection and intelligent temperature controlled greenhouses in facility agriculture is steadily expanding. The digital transformation of the logistics system is advancing synchronously, and the coverage of automated sorting equipment in county-level express distribution centers is increasing. Cold chain storage nodes and fresh e-commerce pre warehouses are penetrating into the advantageous areas of characteristic agricultural products, and village level e-commerce service stations are overlaid with comprehensive functions such as collection and payment, information query, etc. The construction of digital governance platforms focuses on practicality, with some townships piloting intelligent command systems that integrate environmental monitoring, emergency management, and public security prevention and control. Mobile application development focuses on simplifying the workflow, allowing villagers to complete high-frequency tasks such as social security certification and subsidy applications without leaving their homes.

3. The challenges faced by digital rural construction in promoting rural revitalization

(1) Uneven construction of digital infrastructure

The current process of digital rural construction presents significant differences in basic conditions between regions. The eastern coastal counties, relying on the radiation effect of urban agglomerations, have taken the lead in building a dual coverage pattern of high-speed fiber optic and 5G networks. Sensor arrays and unmanned aerial vehicle inspection systems in the fields have been normalized for high standard farmland management. Due to the complex terrain and population density factors, some administrative villages in the hilly and mountainous areas of central and western China are still in the stage of 4G network blind spots, and the deployment of agricultural IoT devices is mostly concentrated in demonstration planting bases. The construction cost and maintenance difficulty of mobile communication base stations increase with the complexity of terrain, leading to a lag in real-time data collection in high-altitude pastoral areas and remote forest farms. Although the broadband access project has been completed in the urban-rural junction, the higher requirements for network quality from emerging services such as live streaming e-commerce and remote diagnosis and treatment still need to be met. There is a sharp contrast between traditional agricultural areas and new rural communities in terms of the per capita ownership of digital equipment. The application depth of intelligent irrigation terminals and digital breeding systems is positively correlated with the cultivation radius [1].

(2) Insufficient ability to apply digital technology

Currently, there is a lack of adaptability between technology applications and industrial demands in some regions. Smart agriculture solutions are mostly concentrated in large planting bases and leading enterprises. Small and medium-sized farmers are limited by equipment purchase costs and operational complexity, making it difficult to embed digital tools such as soil moisture monitoring and pest identification into their daily farming processes. In the context of grassroots governance, there is a

disconnect between the data collection system and the actual demands of villagers. Some functional modules of government service platforms are designed too standardized, making it difficult to accommodate dialect communication habits and traditional rules of procedure, resulting in misunderstandings in information filling and transaction processing processes. The operation of agricultural e-commerce generally faces the problem of low standardization of products, lack of traceability technology and visual recognition solutions that adapt to the characteristics of non-standard agricultural products, and the logistics monitoring data of fresh food categories has not yet formed a full chain linkage mechanism.

(3) Shortage of talent and need to improve digital literacy

The dual constraints of the digital talent gap and weak digital skills of rural residents have led to the hollowing out of technology application subjects due to the migration of young and middle-aged labor from remote areas to cities. Left behind personnel generally have an older age structure and lack of initiative in accepting new technologies, and the understanding of professional terminology and dialects in smart device operation manuals exacerbates learning difficulties. There is a scarcity of composite talents in the grassroots cadre team who possess both agricultural production experience and digital management capabilities. Although some townships are equipped with basic digital equipment, the equipment is idle due to the lagging knowledge update of operators. The information collected by agricultural big data platforms is difficult to transform into production decision-making basis due to the lack of interpretation ability. Farmers have cognitive blind spots in emerging formats such as e-commerce operations and live streaming promotion. There is no systematic connection between traditional production experience and digital tools, and there are often misunderstandings between crop growth monitoring data and actual field operations. In some areas, intelligent irrigation systems have misjudged soil moisture, resulting in water resource waste. The training direction of county-level vocational colleges is not well matched with the digital needs of rural areas, and the curriculum of IoT operation and digital marketing lags behind the speed of technological iteration. Graduates face the real contradiction of knowledge structure and application scenario mismatch when returning to their hometowns for employment.

(4) Insufficient policy support and funding investment

There are significant shortcomings in policy support and funding investment for the construction of digital rural areas. Some regions have not yet formed a supporting policy system that matches the rural revitalization strategy, and the policy framework lacks refined guidance on the layout and operation maintenance of digital infrastructure, resulting in a deviation between resource allocation and actual needs. Local governments face the dilemma of inadequate cross departmental coordination mechanisms when integrating agricultural funds. Agricultural special funds are often dispersed and invested in traditional infrastructure fields, making it difficult to effectively support the sustainable development of emerging industries such as smart agriculture and e-commerce logistics. Financial institutions have not yet perfected the risk assessment system for rural digital projects, and social capital is adopting a wait-and-see attitude due to factors such as long return cycles and uncertain returns, making it difficult to activate diversified investment mechanisms [2]. Some counties are forced to reduce the scope of data collection when promoting the construction of digital government platforms due to a lack of continuous operation and maintenance funds, which hinders the digital transformation process of grassroots governance.

4. The Path of Digital Rural Construction Supporting Rural Revitalization

(1) Strengthen the construction of digital infrastructure and narrow the digital divide between urban and rural areas

The construction of digital infrastructure needs to start with the accuracy of network coverage. Village level organizations can cooperate with telecom operators to conduct field surveys of signal blind areas, give priority to deploying optical fiber networks in densely populated administrative villages, gradually extend the construction of wireless base stations to natural villages, and synchronously optimize satellite Internet access schemes in remote mountain areas. The technical team should regularly organize villagers to participate in equipment operation training, and set up live classes based on agricultural cycles such as spring plowing and autumn harvest. The usage of tools such as unmanned aerial vehicle patrols and intelligent irrigation systems should be broken down into dialect version teaching videos, and learning materials should be pushed in stages in the village WeChat group. Township supply and marketing cooperatives can integrate existing places such as postal outlets

and Yinong Information Cooperatives, transform idle agricultural material warehouses into shared data centers, provide agricultural product traceability information storage services for surrounding farmers, and use the advantage of daily foot traffic to carry out data collection equipment experience activities, guiding villagers to become accustomed to querying market prices through electronic screens [3]. It is necessary for the power department to reserve digital device interfaces in the rural power grid renovation project, and customize modular distribution boxes for large electricity users such as breeding farms and family farms, in order to avoid repeated excavation of trenches during the installation of sensors in the later stage and reduce the operation and maintenance costs of intelligent monitoring equipment.

(2) Enhance the level of digital technology application and promote the digital transformation of rural industries

Grassroots technicians guide farmers to use smartphones to monitor soil moisture and receive meteorological warnings. Micro sensors installed in the field automatically record crop growth data and upload it to the village level management platform, solving the problem of decision-making lag caused by traditional agriculture relying on manual observation. Township cooperatives organize agricultural technology experts to develop cultivation models that are suitable for local crop varieties, and generate planting density recommendations based on annual yield data and climate characteristics. Farmers adjust the timing of fertilization according to charts pushed by their mobile phones to avoid blindly applying experience from other regions that may cause soil and water problems. Livestock farmers use ear tag recognition systems to track the growth cycle of their livestock, real-time feedback on temperature and humidity changes from environmental monitoring equipment, and a matching feed ratio algorithm to automatically generate feeding plans based on individual weight, reducing resource waste caused by empiricism. The regional logistics center integrates the order information of the e-commerce platform and the cold chain transportation route, the village level purchasing agent uses the inventory early warning function to deploy characteristic agricultural products in advance, and the Beidou positioning data of mountain trucks is synchronized to the township dispatching screen, reducing the turnover time of fresh goods in the county. Small and medium-sized processing plants introduce energy consumption monitoring modules to optimize the operating parameters of drying equipment. Traditional processes combine infrared detection technology to improve the uniformity of tea roasting. The quality inspection process uses image recognition systems to screen for defective products, gradually building a full chain quality control system from raw materials to finished products.

(3) Strengthening talent cultivation and introduction, improving the digital literacy of rural residents

Talent cultivation needs to be centered on localized cultivation. County governments can collaborate with local leading enterprises to establish training bases for returning talents, and offer night time digital skills training courses for family farmers and cooperative backbone. The course content focuses on practical technologies such as e-commerce live streaming equipment debugging and agricultural product quality traceability system operation. The training period is deeply linked to the off-season to avoid delaying production. Vocational colleges should adjust the curriculum structure of agricultural related majors, embed modules such as smart agriculture management system operation and unmanned aerial vehicle plant protection parameter setting into existing teaching syllabi, organize teacher teams to go deep into the fields to write dialect versions of operation manuals, and build 1:1 replicated digital agricultural machinery operation consoles in training workshops for students to repeatedly practice. Agricultural cooperatives can establish a skill level and income distribution linkage mechanism, regularly hold mobile agricultural application operation competitions, and include indicators such as WeChat mini program order response speed and intelligent irrigation program setting accuracy in the annual outstanding member selection criteria. Winners will be given priority to participate in digital agriculture inspections outside the county [4]. The group of left behind women can master short video shooting skills through the mutual aid learning group organized by the village women's federation. They can use their leisure time after dinner to collectively observe and edit teaching videos using software in the cultural hall. Volunteer college students stationed in the village can guide them step by step to add product links and data analysis tools. Agricultural enterprises should set up a digital tool basic operation test section when recruiting seasonal working hours, provide additional piece rate subsidies to skilled picking workers who use intelligent sorting equipment, and include the ability to use mechanical maintenance apps in the promotion assessment system for agricultural machinery operators.

(4) Intensify policy support and improve the mechanism for capital investment

When formulating agricultural policies, government departments should fully consider regional

differences, implement differentiated tax reduction policies for digital infrastructure projects, extend the subsidy period for smart agricultural equipment procurement in economically underdeveloped areas, set up green channels in the approval process to shorten the project approval cycle, and enable township cadres to focus on promoting project implementation. Financial institutions have developed low interest loan products for small family farms, allowing future agricultural product returns to serve as credit guarantees. Customer managers of rural credit cooperatives regularly visit villages to explain the operation process of mobile banking, and the real-time loan function in the fields can alleviate the capital turnover pressure during spring plowing and autumn harvest periods. County level finance will establish a special guidance fund for digital transformation, giving priority to supporting the linkage construction between village level logistics stations and township data centers [5]. Cooperatives that purchase localized customized management systems will receive equipment depreciation subsidies, and cross departmental funding approval will adopt an electronic joint signature system to save the trouble of running back and forth through windows. Village level organizations establish a transparent disclosure system for the use of funds, update digital project expenditure details in real-time on the electronic screen of the cultural square, invite village representatives to participate in equipment procurement comparison meetings, and township audit offices use blockchain technology to track the flow path of each fund. State owned banks have partnered with e-commerce platforms to launch agricultural financial products, converting online store operating records into reference credit limits. The supply chain finance model enables leading enterprises to provide digital transformation advance payment guarantees for contracted farmers, and postal savings outlets have added digital equipment rental insurance services to reduce usage risks. When formulating the five-year plan, the development and reform department separately lists the proportion of investment in smart agriculture, extracts a fixed amount of land transfer fees and injects them into the digital rural construction fund pool, adds an aging friendly intelligent terminal category to the government procurement catalog, and tilts the special funds for meteorological agricultural services towards the operation and maintenance costs of digital warning systems.

5. Conclusion

The core of digital rural construction lies in building a two-way interactive mechanism between technological empowerment and institutional innovation. On the one hand, it is necessary to consolidate the foundation of digitalization through the construction of new infrastructure, and on the other hand, it is necessary to achieve deep integration between technological applications and rural social capital. To solve the digital divide between urban and rural areas, we need to break through the mindset of simple hardware investment and shift our focus to cultivating rural human capital and organizational systems that can adapt to the digital age, and promote the effective transformation of technological tools into governance efficiency and industrial momentum. In terms of policy design, it is necessary to strengthen the mechanism of multi-party collaboration, and establish differentiated regional promotion strategies while ensuring that funds can be continuously invested. In terms of future research, it is necessary to focus on the empowering effect of digital technology on rural cultural inheritance and ecological protection, and explore the path of coexistence between digital civilization and local civilization, in order to provide a more explanatory theoretical framework for building a modernization model of agriculture and rural areas with Chinese characteristics.

Acknowledgements

Scientific Research Project of Jilin Provincial Department of Education, Project Number: JJKH20241649SK.

References

- [1] Fan Tianxin. *Exploring the Path of Rural E-commerce Supporting Rural Revitalization in the Digital Economy Era* [J]. *Journal of Jiamusi Vocational College*, 2024, 40 (10): 100-102.
- [2] Xiao Lixin. *Research on the Model of Digital Rural Construction Supporting Rural Revitalization* [J]. *Jingchu Journal*, 2024, 25 (05): 88-95.
- [3] Jia Meimei. *Research on Digital Rural Construction under the Background of Rural Revitalization Strategy* [J]. *Rural Economy and Technology*, 2024, 35 (18): 189-191+195.
- [4] Kong Lingzi, Ningxia, Mo Bin, et al. *The Effect and Mechanism of Empowering Rural Industrial*

Revitalization through Digital Rural Construction [J]. Southwest Agricultural Journal, 2024, 37 (09): 1925-1936.

[5] Duan Guangjun. The internal mechanism and path selection of digital rural construction empowering rural revitalization [J]. Rural Science and Technology, 2024, 15 (16): 28-31.