Available Online: 5 December 2025 DOI: 10.54254/2753-7102/2025.30287

How does digital empowerment reshape rural governance?—a comparative analysis based on four typical cases in Nanjing

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Abstract. This study examines four typical cases in Nanjing—Dongge Community in Pukou District, Longshang Village in Jiangning District, Hemujian Village in Gaochun District, and Shitouzhai Village in Lishui District—to explore how digital empowerment promotes rural governance through comparative analysis. The findings reveal that digital technologies reshape the rural governance landscape by constructing an integrated "infrastructure–industry–services–governance" system. The study concludes that the essence of digital empowerment in rural governance lies in achieving simultaneous improvements in efficiency, industrial transformation, and service optimization through technological integration and data-driven processes, thereby providing a practical model for rural revitalization in the new era.

Keywords: digital empowerment, rural governance, multi-case study, smart countryside

1. Introduction

The world is currently undergoing profound social transformation driven by digital technologies. The digital wave represented by big data, artificial intelligence, and the Internet of Things is not only reshaping economic structures and everyday life, but also injecting new momentum into the modernization of national governance systems and governance capacity. Against this backdrop, the digital transformation of rural governance—long regarded as the foundation of national governance—has become both an inevitable choice and a key pathway for advancing the rural revitalization strategy and building a modern rural governance system.

For a long time, China's traditional modes of rural governance have often struggled to cope with emerging challenges. With the rapid progress of urbanization, rural population structures have undergone significant changes, grassroots governance has grown increasingly complex, and conventional top-down, manpower-driven governance approaches are faced with multiple constraints, including low efficiency in information transmission, imprecise public service provision, and limited channels for villagers' participation. Addressing these bottlenecks and stimulating the endogenous momentum of rural governance have therefore become urgent practical tasks. The rise of digital technologies provides new ideas and tools to tackle these pain points, with its core lying in the reconstruction of the rural governance ecosystem through "digital empowerment."

Digital empowerment is far more than simply transferring offline activities online; fundamentally, it constitutes a profound transformation of governance. It entails reconstructing patterns of information flow through digital technologies, breaking spatial and temporal constraints, enabling diverse actors to participate in governance, and fostering greater transparency in governance processes, scientific decision-making, and precision in public service delivery. Such a transformation has the potential to shift villagers from passive recipients of governance to active participants and supervisors, thereby redefining the relationships among government, village collectives, and villagers within the governance structure, and fostering a new model of rural governance characterized by co-construction, co-governance, and shared benefits.

Nanjing, a highly developed city in China's Yangtze River Delta region, possesses advanced digital infrastructure and has undertaken forward-looking explorations and practices in smart city and digital countryside development. Rural areas under its jurisdiction, drawing on their distinct resource endowments and development needs, have adopted diverse approaches to implementing digital empowerment in rural governance. Over time, they have developed a series of representative models such as "integrated digital governance platforms," "smart Party-building," "digital points systems," and "cloud-based public services." These cases serve as vivid experimental fields: they not only demonstrate the broad prospects of digital technologies in rural settings, but also reveal the variations and challenges encountered during implementation. On one hand, digital empowerment contributes to sustainable rural industrial and economic development and promotes the construction of rural culture and civility. On the other hand, it injects strong momentum into grassroots governance. However, existing research tends to focus either on the role of digital technologies in empowering e-government or on urban–rural differences in digital development, with limited attention to summarizing typical models and challenges observed in rural digitalization. Against this backdrop, this study selects four typical rural cases in Nanjing as field sites and analyzes the representative practices that emerged during the process of digital empowerment in rural governance, with the aim of uncovering their underlying generative logic.

2. Theory and literature review

2.1. Rural governance

Since the trial implementation of the Organic Law of the Villagers' Committees of the People's Republic of China in 1987, domestic studies on villagers' self-governance have gradually merged with Western governance theories, giving rise to the concept of "rural governance." Chinese scholars have since explored its connotations from different perspectives. Xuefeng He argues that rural governance refers to how rural areas are managed or how they can manage themselves autonomously to achieve orderly rural development, emphasizing local autonomy and the capacity to address issues arising from rural social development [1]. Guoying Dang, focusing on governance subjects and content, defines rural governance as the activities through which state institutions—represented by township governments—and other authoritative bodies in rural society provide public goods to rural communities [2]. De Wen Lü, reviewing seventy years of rural governance practice, proposes from a macro perspective that rural governance encompasses all relationships formed in the interactions between the state and rural society [3].

With respect to the elements involved in rural governance, numerous actors contribute to the process, including grassroots governments and rural residents. First, township governments are viewed by many scholars as central actors in rural governance, forming the foundation of grassroots governance modernization while undergoing transformations in governmental functions and roles [4,5]. Wencheng Cai contends that grassroots Party organizations in rural areas constitute the fundamental force and central pillar of the rural governance system—they lead rural development, represent farmers' interests, promote agricultural progress, and guide rural governance [6]. In certain regions, village Party branches function as the de facto governing authority, shouldering nearly all village affairs. Villagers' committees, by contrast, are self-governing bodies responsible for democratic elections, decision-making, management, and supervision. As the grassroots organizations closest to farmers, they are expected to possess stronger governance agency [7]. In recent years, an increasing number of civil society organizations have participated in rural governance, becoming integral components of the system. Min'e Yin categorizes these organizations into four types: economic, non-profit, self-governing, and traditional [8]. Meanwhile, with the advance of modernization, lineage groups have shifted from their traditional role as "formal governors" to "informal influencers." Despite this shift, lineage forces continue to exert significant influence on villagers' daily life, the selection of rural leaders, and governance behavior [9]. In terms of public actors, scholars have highlighted the important role of local gentry in the creative transformation and innovative development of traditional culture within rural governance, [10] as well as the active contributions of women—particularly in impoverished areas—who remain as the core of left-behind populations [11].

Research on rural governance models is rich and diverse. Representative models include the People's Commune model, the "county governance–township administration–village self-governance" model, and the "integration of self-governance, rule of law, and rule of virtue." After the establishment of the People's Commune system in 1958, state power intervened comprehensively in rural daily life, reshaping the relationship between the state and rural society. Xueshu Li argues that the People's Commune model constituted an omnipotent governance structure that combined economic organization and grassroots political authority while overseeing all aspects of rural affairs [12]. Yong Xu, noting the social transformation of China's rural society from "dispersed–unified–divided" to integration, proposes that the governance structure should shift from "township governance and village self-governance" to a model in which counties exercise greater governance autonomy, townships function as administrative extensions of county governments, and villagers' committees focus on self-governance [13]. The "integration of the three modes of governance"—self-governance, rule of law, and rule of virtue—originated in Tongxiang, Zhejiang, and was later emphasized in the report of the 19th National Congress of the Communist Party of China. Scholars have engaged extensively with the relationships among the three, as well as strategies for their integration [14-16].

Since the founding of the People's Republic of China, rural governance has undergone several historical stages: the land reform period, agricultural collectivization period, People's Commune period, reform and experimentation period, new rural construction period, and now the period of rural revitalization [17]. Meanwhile, rapid digitalization—epitomized by the internet—has merged with rural governance in this new stage, giving rise to the development of digital rural governance.

2.2. Digital empowerment

Empowerment refers to granting specific groups certain capacities—such as survival capability, life skills, and developmental abilities—through particular means. With the rapid advancement of digital technologies, digital education, smart transportation, e-government, new retail, hotel ecosystems, and intelligent healthcare have all reshaped everyday life. Digital empowerment, therefore, denotes the process of enhancing people's abilities by utilizing cloud computing, big data, the Internet of Things (IoT), mobile connectivity, and artificial intelligence [18].

Regarding the conceptual definition of digital empowerment, scholars across different disciplines have offered diverse interpretations. From a sociological perspective, digital empowerment involves identifying, fostering, and enhancing individuals' abilities to address their needs and solve their own problems, while mobilizing necessary digital resources to enable individuals to consciously direct their lives [19]. From a management perspective, empowerment of those being managed can significantly stimulate subjective initiative and creativity, allowing individuals to maximize their talents and potential [20]. Some scholars further define digital empowerment through its cognitive components, proposing a cognitive model consisting of four elements: influence, capability, meaning, and selectivity [21].

In terms of the tools of digital empowerment, new technologies play a central role. Artificial intelligence (AI)—currently the most prominent emerging technology—empowers sectors such as education, business, healthcare, and transportation. Big data, by harnessing massive datasets, plays a crucial role in transportation, healthcare, education, and public decision-making. Meanwhile, IoT technologies connect everyday objects, enabling intelligent identification and unified management [22]. In addition, the emergence of new media also provides channels for digital empowerment. Through new media, individuals can communicate information, participate actively in decision-making, and take action to improve their circumstances or enhance their agency and power, thereby altering the overall power structure of society [23].

Digital empowerment exerts varying influences across different domains of life. In governance, e-government platforms improve interactions between government and citizens and promote local development [24]. In healthcare, digital empowerment enhances the service capacity, accessibility, and user-friendliness of medical institutions, doctors, government departments, primary healthcare facilities, and diverse social groups [25]. In the commercial sector, online technological services influence consumers' perceptions of empowerment and stimulate consumption [26]. In public services, digital empowerment promotes innovation, coordination, and environmental sustainability, thus supporting high-quality development [27].

In summary, scholars in China and abroad have conducted fruitful research on the structure, characteristics, challenges, and potential pathways related to digital rural governance and governance modernization. Theoretical and practical explorations concerning the application of digital technologies in social and rural governance have also grown substantially in recent years. However, as digital technologies become widely integrated into all aspects of social governance and as the nation strives to modernize its governance system, research on how digital technology facilitates the modernization of rural governance remains insufficient. Moreover, sustainable and operational strategies for effectively integrating digital technology into rural governance are still lacking. Studies on the challenges and construction pathways of digital rural governance also require solid support from concrete local case evidence. While domestic scholars have conducted extensive macro-level research on the internet, regional disparities remain significant, and localized studies are still limited. By selecting Nanjing as a case for investigation, the present study aims to enrich the body of region-specific case research.

3. Research methods

This study selected Pukou District, Jiangning District, Gaochun District, and Lishui District in Nanjing, Jiangsu Province, as its research sites, focusing specifically on Dongge Community in Pukou District, Longshang Village in Jiangning District, Hemujian Village in Gaochun District, and Shitouzhai Village in Lishui District. These villages and communities represent exemplary cases of digital governance in Nanjing. Based on the "Three-Micro Project" research initiative, the research team conducted multiple field visits to collect data. These four locations were identified as highly representative cases of digital rural governance in Nanjing; therefore, selecting them as objects of study aligns well with the objectives of this research.

3.1. Case study method

The case study method refers to an in-depth description and analysis of a single case or a group of cases to reveal and explain the issues, phenomena, developments, and underlying causes within the cases, and to establish conceptual or theoretical models. It is

a systematic, in-depth quasi-experimental research approach aimed at describing, interpreting, and elucidating case-related phenomena and comparing them with the broader sample. Since the selected cases for this study are situated in Pukou, Jiangning, Gaochun, and Lishui Districts in Nanjing, typical cases were identified from these areas to further explore optimized pathways for digital rural governance systems.

3.2. Comparative analysis method

The comparative analysis method, commonly employed in traditional social sciences, involves comparing objective phenomena to understand their essential characteristics and governing patterns, thereby enabling sound evaluation. In this study, Pukou, Jiangning, Gaochun, and Lishui Districts serve as the primary research sites, and comparative analysis is conducted based on their respective models of digital rural governance. The analysis focuses on classifying and comparing the current conditions of digital rural governance and summarizing the operational processes that can be referenced for broader application, ultimately identifying models that are suitable for wider promotion.

3.3. Digital ethnography

Digital ethnography involves researchers entering the digital spaces inhabited by research participants to conduct participant observation and interviews using digital technologies, thereby understanding the specific contexts and meanings of their actions. To gain insight into how digital empowerment functions in rural governance and how it stimulates farmers' endogenous motivation, this study adopted two approaches. First, drawing from the earlier "Jiangning District Three-Micro Research and Evaluation" project, researchers conducted field observations during the implementation of rural revitalization initiatives, focusing on phenomena related to the role of digital technologies in rural governance and documenting observations in real time. Second, unstructured interviews were conducted to understand the intentions behind the actions of key actors, thereby facilitating grounded inquiry.

4. Research findings

4.1. From "fragmented management" to "closed-loop intelligent governance"

Taking Dongge Community in Pukou District, Nanjing, as the main case, the community launched its digital construction initiative four years ago, building upon a "1+3+N" grid-based smart cloud platform. The "1+3+N" model greatly enhances the efficiency of remote problem discovery. "1" refers to a set of digital infrastructure; "2" refers to the dual support system of institutional and technological safeguards; "3" refers to digital industry, digital governance, and digital services; and "N" refers to multiple information-based application systems. Through an effective closed-loop processing mechanism, the model helps alleviate pressing livelihood issues faced by residents. By optimizing the operational procedures of the digital rural integrated governance platform, various types of data—such as people, events, and locations within each grid—can be dynamically visualized, forming an integrated "early warning–locating–disposal" management system. Through the decision-making and smart center digital platform for rural digital applications, population distribution, industrial chains, and public service information within the jurisdiction can be clearly accessed. The digital platform has played a significant role in supporting household farming activities. For instance, aquatic farming industries such as fish and shrimp cultivation now utilize drones and mobile automated monitoring, greatly reducing labor costs. Large-scale crop cultivation has also adopted an "unmanned" production mode.

4.2. From "hot land of hot springs" to "fertile soil for digitalization"

Longshang Village in Jiangning District enjoys natural geographical advantages, with the prosperity of the Tangshan hot spring industry providing capital support for its digital governance. This year, Longshang Village became the only village in Nanjing selected as a national model case for rural revitalization. With the establishment of the "Smart Longshang Management Platform," a big data system enables the sharing of basic information such as personnel data, vehicle data, business data, and affairs data. Government service tasks—such as the online registration and assessment of welfare benefits for "marginalized" groups, persons with disabilities, and individuals facing hardship—are clearly presented. The service content is comprehensive, covering basic services such as housing construction and social security. Among them, the introduction of point-based incentives, satisfaction evaluations, and the intelligent interactive terminal "Village-to-Village Loudspeaker" enables villagers to use interactive devices, infusing digital rural governance with a sense of warmth. This "Longshang Model" offers an experience that is both replicable and scalable for broader rural revitalization efforts.

4.3. From “organic rice fields” to “digital rice pathways”

In contrast, Hemujiàn Village in Gaochun District is known for its production of high-quality organic rice. Traditional cultivation methods require high costs, but in recent years the village has constructed intelligent greenhouse facilities and introduced devices such as soil probes and temperature–humidity monitors, enabling digital management across all stages of production. Through the Internet of Things system, farmers can remotely check cultivation data and adjust irrigation, fertilization, and lighting in a timely manner, significantly reducing labor intensity and production costs. On the sales side, the village integrates traditional sales channels with e-commerce platforms, promoting its organic rice products overseas via digital networks and expanding market reach. By combining agricultural experience activities with research-based learning, the village integrates the twenty-four solar terms with agricultural production. Increasing numbers of visitors are attracted to participate in “DIY” rural rice wine making, experiencing the charm of farmland cultivation in a digitalized context.

4.4. From “smart blueberries” to “warm-hearted care”

Shitouzhai Village in Baimajhen, Lishui District, has leveraged its digital governance advantages through stable electricity supply and the application of “5G blueberry cultivation technology.” Using a “smart brain” system for precise control of temperature and humidity in blueberry fields, the village integrates agriculture and tourism while highlighting the red historical heritage of Lixiang Natural Village. This has strengthened local prosperity, improved environmental governance, and made Shitouzhai a model of “beautiful countryside” development. Furthermore, Party-led grassroots services play a central role. For example, under the “Peaceful Watch” project, surveillance devices were installed in the homes of elderly residents living alone. This not only addresses potential safety risks but also allows children living elsewhere to maintain closer interaction with their parents. To help elderly residents overcome the “digital divide,” the local Party organization collaborated with enterprise Party committees to provide immersive, hands-on training in smartphone use. Through repeated instruction and technological literacy activities, elderly residents with clear cognitive and physical abilities learned to use basic communication applications (such as WeChat and phone services). Emergency contact cards were also prepared for those living alone. These detailed and concrete services demonstrate the effectiveness of Party leadership in promoting grassroots governance.

5. Conclusion and discussion

The four villages selected in this study have each developed distinctive models of digital governance by adapting digitalization to local conditions. At the same time, several common patterns emerge. First, digital technologies have driven rural governance toward greater intelligence and precision. Counties, in cooperation with telecom operators, have used artificial intelligence, big data, cloud computing, and the Internet of Things to build unified digital governance platforms that enable big-data-based early warning, point-to-point monitoring, and long-term service management. This has led to real-time, full-area, and full-time refined management of people, events, land, and objects in rural areas. Second, the deep integration of digital technologies with the financial sector has enhanced the virtuous cycle between rural ecological environments and rural economic development. By applying geographic information systems and big data, ecological products can be digitally managed, traded, supervised, and evaluated. Fragmented ecological resources are transformed into concentrated asset packages, enabling the conversion of resources into assets and eventually capital. Third, digital technologies optimize the rural governance process by addressing the needs of vulnerable groups, stimulating the participation of multiple actors, and fostering a two-way interactive governance model. Through automated data collection and data analysis on rural governance platforms, the system assigns issues to staff members, who process tasks offline and upload results. The entire process—from discovery to resolution, evaluation, and integration—forms a closed loop. Most steps can be automated, enabling timely problem identification and resolution while significantly reducing governance costs and workload.

5.1. From “fragmentation” to “platformization” in governance foundations

Digital empowerment has reshaped agricultural management systems in two key ways. First, digital platforms that link production and consumption improve farmers’ motivation and income. In traditional agricultural operations, information asymmetry often leads to supply–demand mismatches, while excessive intermediaries weaken farmers’ bargaining power. These issues can result in low crop prices that harm farmers, ultimately dampening their motivation to produce. By adopting digital technologies, traditional agricultural operators can transition into e-commerce, connecting producers directly with consumers and reducing multi-layer distribution. This enhances farmers’ access to information, risk resistance, and ability to self-market, ultimately increasing their bargaining power and income distribution capacity within the agricultural value chain. Second, digital technologies support the development of agricultural training platforms that improve farmers’ professional competencies. Through deep collaboration among governments, enterprises, and agricultural universities, remote training systems for

agricultural management talent have been established on digital agricultural training platforms. Combining online and offline instruction, these platforms provide training in agricultural production and management, enabling practitioners to improve their management capabilities.

5.2. From "experience-driven" to "data-driven" industrial development

Digital technologies are profoundly reshaping rural industrial structures. Evidence from this study indicates that digital empowerment extends far beyond e-commerce sales, penetrating deeply into agricultural production itself. In cases such as Dongge Community's "unmanned" aquaculture, Hemujiàn Village's precision-controlled intelligent greenhouses, and Shitouzhai Village's 5G-enabled blueberry smart farms, IoT sensors, drones, and intelligent irrigation systems have become the new agricultural tools, while data has become a new form of agricultural input. By collecting and analyzing real-time data on environmental temperature and humidity, soil moisture, and crop growth, production processes can be precisely regulated and costs significantly reduced, diminishing the traditional reliance on the experience of seasoned farmers. Coupled with e-commerce platforms, 特色 agricultural products can enter international markets, naturally supporting a transformation from extensive, weather-dependent production toward data-driven, intelligent, and high–value-added rural industries.

5.3. From "universal access" to "human-centered care" in livelihood services

Digital technologies improve rural services in two major ways. First, they accelerate the digital transformation of convenience services. Given unclear institutional responsibilities and limited digital literacy among villagers, many residents struggle to complete administrative procedures in a single attempt. By breaking information and organizational barriers through integrated information systems and data sharing, digital technologies foster innovative service content, new service formats, and collaborative organizational structures. This effectively addresses the problems of information asymmetry and fragmentation in rural public services, improving their accuracy, timeliness, and accessibility. Second, digital technologies help extend public services from urban to rural areas. Traditional public service systems tend to be exclusive and competitive, whereas digital technologies allow certain services to be delivered to rural areas at low marginal cost. This not only improves the efficiency of public resource allocation but also substantially narrows the gap between urban and rural public service provision.

5.4. From "single-track promotion" to "multi-actor integration" in governance models

Digital technologies encourage diverse actors to participate in rural governance. One purpose of rural governance is to better serve rural residents, yet villagers often lack channels to express their needs or participate in governance due to information asymmetry. Digital governance platforms allow villagers to access policy information and village committee announcements in a timely manner while also providing channels to express their concerns. Relevant departments can accurately identify villagers' needs through the platform and respond accordingly, accelerating the formation of a demand-driven governance system and improving alignment between governance supply and demand. By leveraging information sharing to open communication channels and reduce the information gap between governments and villagers, digital technologies introduce transparency and monitoring mechanisms that stimulate individual participation. Ultimately, they promote a shift from a single, top-down management model to a pluralistic and collaborative governance model.

Urbanization and industrialization have resulted in population outflow, aging, and environmental pollution in rural areas, posing serious challenges to sustainable rural development. At the same time, excessive digital control may risk "alienating" individuals. Experiences from digital city construction show that digital technologies can reshape regional development models and accelerate sustainable development, offering insights for rural sustainability. Although academic consensus has emerged regarding the role of digital empowerment in rural development, research on digital villages remains at an early stage. Villages are complex systems requiring coordinated development across multiple domains to achieve sustainable development. This study argues that digital rural construction involves transforming real-world rural elements into binary data, processing this data through digital technologies, and ultimately generating decision-support insights that promote rural sustainability. Therefore, digital village construction should rely on data, digital technologies, and digital platforms, and establish interaction rules that strengthen symbiotic relationships among governments, villagers, enterprises, financial institutions, and other stakeholders, thereby advancing the goal of sustainable rural development.

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