A Study on Multi-level Linkage and Synergy of China' s Digital Village Policies

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Abstract

Purpose/Significance The synergy between central and local digital rural policies is of great significance for policy implementation and achieving optimal policy effects, making digital rural policies a powerful driver in agricultural upgrading and transformation and rural economic development. Methods/Process This study utilizes sample data from central digital rural policies and digital rural policies in four major regions from 2018 to 2021, employs the entropy method and coupling coordination model to quantitatively measure the coupling coordination degree between central and local digital rural policies. On this basis, the geographical detector model is used for single-factor detection and multi-factor interaction detection to analyze the influence degree of various policy tool indicators on the synergy level of central-local policies and explore the multi-level linkage effects between policies. Results/Conclusions The overall synergy level of central-local policies among the four regions continues to optimize, the synergy levels of different policy tools develop unevenly, and regional differences in synergy levels tend to intensify. Among the influencing factors, scientific and technological innovation policy is the main driving force for the coordinated development of central and local digital rural policies, and the pairwise interaction effects among the influencing factors are stronger than those of single factors.

Full Text

Preamble

Research on Multi-level Linkage and Coordination of Digital Village Policies in China

(The second paper in the special issue on digital village development based on policy informatics)

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Abstract:
[Objective] Coordination between central and local digital village policies is crucial for effective policy implementation and optimal outcomes, enabling digital village policies to serve as a powerful catalyst for agricultural transformation and rural economic development. [Methods] This study employs sample data of central and local digital village policies from 2018-2021, utilizing the entropy method and coupling coordination model to quantitatively measure the coupling coordination degree between central and local digital village policies. Building upon this foundation, the geographic detector model is applied for single-factor detection and multi-factor interaction detection to analyze the influence of various policy instrument indicators on the level of central-local policy synergy and explore the multi-level linkage effects among policies. [Results] The overall level of central-local policy synergy across the four regions continues to optimize, though development remains unbalanced across different policy instruments, with regional disparities in synergy levels tending to intensify. Among the influencing factors, science and technology innovation policy emerges as the primary driver for coordinated development between central and local digital village policies, with pairwise interactions between factors demonstrating stronger effects than individual factors. [Limitations] Policy sample collection may have omitted some policies, and the quantitative criteria for policy instruments could be further improved. [Conclusions] Efforts should continue to strengthen central-local policy synergy, optimize the three types of policy instruments, and enhance mutual coordination among policy measures to promote balanced development of regional synergy levels.

Keywords: Digital Village Policy; Central-Local Policy Synergy; Coupling Coordination Model
Classification Number: G203

1 Introduction

Digital village construction constitutes an essential component of China' s rural revitalization strategy and serves as the primary driving force for agricultural transformation and high-quality rural economic development. In this regard, the central government has successively issued multiple major policies: the 2018 "No. 1 Central Document" first introduced the concept of digital village development; the 2019 Government Work Report proposed new requirements for rural development, including accelerating agricultural technology innovation and developing modern crop cultivation, with emphasis on advancing "Internet Plus Rural Areas," improving rural distribution networks, and supporting the growth

of rural e-commerce and express delivery services. In February 2019, the "Several Opinions on Upholding Priority Development of Agriculture and Rural Areas and Doing Well in 'Three Rural' Work" proposed the "digital village" development strategy, calling for continued advancement of "Internet Plus Agriculture" to guide agriculture toward digital and intelligent development. In May 2019, the "Digital Village Development Strategy Outline" emphasized accelerating rural information development to drive the modernization of agriculture and rural areas. Concurrently, local governments have actively implemented central government digital village policies and formulated specific measures tailored to local conditions, with 22 provinces including Zhejiang, Jiangsu, Shandong, Hunan, and Guangdong issuing various concrete policies. This has led to a more comprehensive digital village policy system and the initial formation of a coordinated, holistic work framework.

Digital village policies are important tools for creating a favorable atmosphere and guiding digital village construction, involving multiple stakeholders such as enterprises, universities, and research institutes, as well as various elements including technology, capital, talent, and data, across multiple domains like agriculture, human resources, finance, and healthcare. Digital village policies are promulgated and implemented by different policy actors with hierarchical characteristics, thus the policies themselves exhibit hierarchical features, manifesting as horizontal coordination at the same level and vertical central-local coordination. Vertical central-local digital village policy coordination emphasizes that during policy implementation, local policy actors should respond to and learn from central policies based on their actual development conditions, ensuring that central policy ideas and intentions are reflected in regional digital village construction. This approach avoids policy implementation obstacles such as central-local policy conflicts, forms synergistic central-local policy forces, improves policy implementation effectiveness, and promotes local rural revitalization and agricultural modernization. Evidently, vertical central-local digital village policy coordination holds significant importance for achieving digital village strategic objectives.

Accordingly, this study examines the multi-level linkage and synergy effects of digital village policies from a vertical central-local coordination perspective, based on the policy instrument dimension. Furthermore, it employs geographic detectors to analyze the influence of various policy instrument indicators on multi-level linkage and synergy in digital village policies. The policy multi-level linkage synergy in this research primarily refers to policy linkage and coordination between central and local governments, encompassing two aspects: first, the overall level of central-local policy measure synergy across different periods, and second, the level of central-local policy measure synergy for different types of policy instruments across different regions.

Academic research on policy synergy has been extensively explored, primarily falling into three categories: First, theoretical foundation research, including collaborative governance theory, whole-of-government theory, and policy pro-

cess theory [?]. Collaborative governance theory advocates that multiple actors adopt collaborative approaches to address public problems that single actors cannot solve [?]. Given the Chinese government' s key role in public affairs management, cross-boundary public issues require "synergy" between governments, departments, and policies to achieve effects where the whole exceeds the sum of its parts [?]. Whole-of-government theory features cross-boundary cooperation as its core characteristic, emphasizing institutionalized, regular, and effective cross-boundary collaboration to achieve public value [?]. In public policy science, policy process theory plays an important role in explaining policy phenomena, viewing policy synergy as dynamic coordination between decision-making and implementation layers [?]. Second, measurement research on policy synergy, which mainly employs three analytical frameworks: the first involves multi-dimensional classification of general policy types from macro and micro perspectives to analyze synergy levels among different policy elements [?][?]; the second directly constructs relevant models such as regression models to measure policy synergy [?]; the third establishes policy quantification standard manuals, assigns values to policies based on these manuals [?], and constructs synergy measurement models to conduct quantitative analysis of internal structural policy elements using text analysis methods [?]. Third, research on implementation pathways for policy synergy, with scholars proposing pathways from perspectives such as organizational structure, multi-department management systems [?], different policy actors [?], and processes.

In summary, existing research primarily focuses on synergistic relationships between policies but lacks investigation into the degree of policy coordination, with relatively few studies employing coupling coordination models for policy coordination research. Domestic research using coupling coordination models to measure policy synergy requires deepening. Therefore, based on policy decomposition and utilizing the coupling coordination model, this study constructs an evaluation index system for digital village policy instruments. From a policy instrument perspective, it measures central-local policy synergy conditions using central and representative regional policies from 2018-2021 as examples. Building upon this, the study employs geographic detectors for single-factor and multi-factor interaction detection to analyze the influence of various policy instrument indicators on central-local policy synergy, providing direction and recommendations for improving synergy levels.

The coupling coordination degree model is constructed as follows. For two subsystems, the coupling degree function is expressed as:

$$C = \frac{U_1 \times U_2}{[\frac{U_1+U_2}{2}]^2}$$

where U_1 and U_2 represent the order degrees of different subsystems. C is the coupling correlation degree, with values in the interval (0,1). Larger values indicate greater correlation between the two subsystems. $C \in (0, 0.3]$ indicates

low-level interaction; $C \in (0, 0.5]$ indicates antagonistic stage; $C \in (0.5, 0.8]$ indicates mutual adaptation stage; and $C \in (0.8, 1]$ indicates high-level interaction stage.

Coupling coordination conditions require measurement not only of coupling correlation degree but also coordination degree to comprehensively explore the interaction mechanism between subsystems. The coupling coordination degree function is constructed using C and U as shown in formulas (2) and (3):

$$D = \sqrt{C \times T}$$

$$T = \alpha U_1 + \beta U_2$$

where C is the coupling correlation coefficient, T is the comprehensive coordination index, D is the coupling coordination degree with values in (0,1). Larger D values indicate better synergistic development between the two systems. T represents the overall development level of the binary system, with α and β as undetermined coefficients summing to 1. This study considers the importance and contribution of both systems to be equivalent, assigning both α and β values of 0.5. The classification of coupling coordination degree levels between central and local digital village policies is shown in Table 4 .

Table 4 Classification of Coupling Coordination Degree Levels >0.1-0.2 >0.2-0.3 >0.3-0.4 >0.4-0.5 >0.5-0.6 >0.6-0.7 >0.7-0.8 >0.8-0.9 >0.9-1

(4) Geographic Detector

The geographic detector is a factor analysis model proposed by Wang Jinfeng and Xu Chengdong [**?**], widely used for detecting spatial heterogeneity and measuring the extent to which a factor can explain the spatial differentiation of a dependent variable [**?**]. This study compares the determinant power values q of spatial differentiation in the coupling coordination degree of the central-local digital village policy binary system to reveal the driving forces affecting spatial differentiation in central-local digital village policy synergy. The calculation formula is shown in equation (4):

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N\sigma^2}$$

where L is the stratification of variables, N_h and N are the unit numbers in stratum h and the entire region respectively, σ_h^2 and σ^2 are the variances of stratum h and the entire region. The value range of q is [0,1]; larger q values indicate stronger driving effects of the factor on the coordination between central and local digital village policy systems [**?**], and vice versa.

4 Empirical Analysis of Multi-level Linkage Synergy

Central digital village policy and local digital village policy are two complex dynamic systems, and their coordination is influenced by numerous factors. This study uses coupling coordination degree as the dependent variable and environmental, supply, and demand policy instruments as independent variables, employing geographic detectors to examine the influence of policy instrument factors on central-local policy coupling synergy. Specifically, environmental policy is measured by regulation control (X_1), policy publicity (X_2), and rural digital inclusive finance (X_3); supply policy by public services (X_4), talent cultivation (X_5), capital investment (X_6), information infrastructure construction (X_7), and science and technology innovation (X_8); and demand policy by demonstration projects (X_9), new rural business forms (X_{10}), and economic regulation (X_{11}). Based on SPSS' s rapid clustering analysis method, the continuous variables of 11 indicators across the three dimensions of environmental, supply, and demand policies are discretized into categorical variables and graded. The geographic detector analysis program is then used to calculate the single-factor influence degree and multi-factor interaction effects of each factor on central-local digital village policy coupling synergy, with results shown in Table 10 and Table 11 respectively.

(1) Single-factor Detection Analysis

In Table 10, the q value indicates the extent to which influencing factors explain and affect the coupling coordination degree between central and local digital village policies. Larger q values indicate greater influence, while smaller values indicate lesser influence. Overall, among the 11 influencing factors examined, the factors affecting the coupling coordination degree between central and local digital village policies, in descending order of influence, are: science and technology innovation, information infrastructure construction, policy publicity, public services, demonstration projects, economic regulation, new rural business forms, rural digital inclusive finance, capital investment, talent cultivation, and regulation control.

The influence of environmental policy instruments on policy synergy is primarily reflected in policy publicity. Effective publicity of digital village policies by governments at all levels can enhance farmers' understanding of policy content and strengthen the role of digital village construction in promoting rural revitalization. Without increased support, it becomes difficult to promote the extension of digital village-related construction projects.

Regarding supply policy instruments, science and technology innovation and information infrastructure construction exert relatively strong influence on policy synergy. China' s digital village construction remains in its initial stage, and technological support constitutes the core "power engine" driving high-quality development of digital agriculture. However, in the current digital economy system, rural information infrastructure construction in China still lags behind, and farmers' ability to utilize information technology remains relatively weak,

leading to the emergence of a digital divide that adversely affects digital village construction [**?**].

Concerning demand policy instruments, demonstration projects and economic regulation demonstrate relatively strong influence on policy synergy. China' s digital village construction has just begun, with limited accumulation of relevant theoretical and practical experience. Through digital village demonstration projects, new models of digital village development can be explored to promote comprehensive agricultural upgrading, rural progress, and farmer development. Meanwhile, under market economy conditions, economic regulation measures such as tax incentives can maximize the innovative capacity of actors in the rural digital economy.

Table 10 Single-factor Detection Results

(2) Interaction Factor Detection Analysis

The multi-factor interaction detection results using geographic detectors show that the interactive driving force of multiple factors exceeds that of single factors. Among them, the interaction $X_8 \cap X_{11}$ demonstrates the strongest interactive driving force, indicating that the interaction between science and technology innovation and economic regulation has substantial driving power, with the most significant impact on the coupling coordination of central and local digital village policies. By providing market demand for agriculture-related enterprises through tax incentives, procurement, and outsourcing, the government strongly supports the development of these enterprises, which in turn can provide agricultural information technology support to farmers, enhance agricultural informatization levels, and ultimately promote high-quality development of digital village agriculture [**?**]. Next are the interactions among supply policy instruments: $X_6 \cap X_7$ (capital investment and information infrastructure construction) and $X_5 \cap X_7$ (talent cultivation and information infrastructure construction). Digital village construction involves broad areas, heavy tasks, and long cycles. Coupled with China' s large rural population and vast yet sparsely populated territories that have long remained underdeveloped with prominent shortcomings, digital village construction requires continuous long-term investment with substantial funding demands. Although China' s digital village construction has entered a comprehensive promotion stage, local governments have not invested sufficiently in digital village construction, which significantly impacts digital village information infrastructure construction. Talent cultivation programs can improve rural residents' digital literacy, promote shifts in thinking patterns and cognitive levels among rural populations, enhance rural residents' willingness and creative capacity to use digital infrastructure, thereby narrowing the urban-rural "digital divide."

Table 11 Interaction Factor Detection Results

5 Conclusions and Discussion

(1) Continue strengthening central-local policy synergy to promote balanced development of regional synergy levels. Digital village construction is a systematic project involving policy issues that cannot be resolved by single government entities, single government levels, or single government departments. Specifically: First, optimize the central-local decentralization system and strengthen the "top-level design" of digital village policies. While providing strategic guidance for the overall development of digital villages and macro-planning for important development areas, the central government need not involve itself in excessive details. Local governments should formulate rich digital village construction themes tailored to local conditions based on central guidelines. Additionally, local policies must effectively connect with national data platforms to avoid redundant planning and construction, forming a "top-bottom interaction" development mechanism. Second, innovate mechanisms to advance coordination and cooperation among localities during policy implementation, consolidating the foundation for central-local synergy. Third, issue regulations and rules concerning central-local policy synergy, add review procedures for key central-local collaborative development policies by collaborative development leading groups, and establish targeted policy synergy performance evaluation mechanisms to compel strengthened communication and cooperation during policy formulation and jointly develop central-local collaborative development policies.

(2) Optimize the three types of policy instruments and grasp key driving forces. Single-factor detection results reveal that policy measures have varying degrees of influence on the coupling coordination of central and local digital village policies. Specifically: First, within environmental policy instruments, further optimize policy publicity measures, such as developing digital village publicity policies based on local characteristics and improving publicity content. Second, within supply policy instruments, further optimize science and technology innovation support and information infrastructure construction measures. For instance, for cultivating major scientific and technological achievements, research directions and application fields should be clearly specified. For information infrastructure construction, governments should simplify approval procedures for relevant projects while promoting co-construction and sharing to avoid redundant construction. Third, within demand policy instruments, further optimize demonstration projects and economic regulation measures, such as actively developing digital village demonstration projects, promoting new industrial organizational forms, and using government procurement to achieve stable market demand, thereby enhancing farmers' understanding and awareness of market demands related to digital villages and achieving high-quality, sustainable digital village development.

(3) Strengthen mutual coordination among policy measures and grasp multi-factor interaction effects. To promote comprehensive digital village construction, central and local governments have issued a series of relevant poli-

cies. The various policy instruments included in these policies are not independent but should form coordinated policy combinations. Empirical results demonstrate that multi-factor interactive driving effects on central-local policy coupling synergy are highly significant. Specifically: First, leverage the leading role of government departments at all levels in supplying agriculture-related elements. By increasing support for economic regulation measures such as fiscal taxation and subsidies, guide various market actors, particularly agriculture-related and digital enterprises, to increase the supply of innovation elements, forming an industry-university-research collaborative innovation mechanism centered on these enterprises. Second, increase fiscal investment in information infrastructure construction, establish special funds for digital villages, and appropriately allocate fiscal transfer funds to underdeveloped regions to accelerate the construction of rural information infrastructure for co-construction and sharing, enabling coordinated development of urban-rural information infrastructure. Third, further improve the digital village talent cultivation system, accelerate the implementation of new-type professional farmer training programs, enhance rural residents' digital literacy, provide intellectual support for agricultural digital transformation, effectively improve farmers' willingness and creative capacity to use digital infrastructure, and continuously strengthen the spillover effects of information technology and network knowledge. Only by strengthening mutual coordination among policy measures and comprehensively applying multiple approaches can we maximize the driving, pulling, and penetrating impacts on digital village development, jointly advance goal achievement, and fill gaps and deficiencies in China' s digital village policy system.

References

[1] Xiao Fengrong. Characteristic Analysis and Future Prospects of Policy Synergy Research—A Bibliometric Analysis Based on CSSCI Literature[J]. Journal of Lanzhou University (Social Sciences Edition), 2021, 49(05): 153-160.
[2] Xiao Ke, Xie Qi. The Governance Narrative of Cross-departmental Synergy, Its Applicability in China, and Theoretical Improvement[J]. Administrative Tribune, 2021, 28(06): 51-57.
[3] Li Hanqing. Analysis of Collaborative Governance Theory[J]. Theory Monthly, 2014(01): 138-142.
[4] Zhou Zhiren, Jiang Minjuan. Policy Synergy Under Whole-of-Government: Theory and Contemporary Practice in Developed Countries[J]. Journal of Chinese Academy of Governance, 2010(06): 28-33.
[5] Zhu Demi. Where Lies the Difficulty in Implementation—An Explanation Based on Policy Process Theory[J]. Exploration and Free Views, 2015(09): 61-63.
[6] Jiang Xin, Wang Dezhuang. Policy Synergy Between Open Scientific Data and Personal Data Protection—From the Perspective of Policy Text Content Analysis[J]. Information Studies: Theory & Application, 2019, 42(12): 49-54+93.
[7] Li Qiao. Research on the Structural System and Optimization Strategy of

Policy Instrument Selection for Promoting Big Data Development in China[J]. Library and Information Service, 2018, 62(11): 5-15.
[8] Chen Chen, Li Ping, Wang Hongwei. Research on the Synergistic Effects of National Innovation Policies[J/OL]. Journal of Finance and Economics: 1-17[2022-04-20].
[9] Peng Jisheng, Zhong Weiguo, Sun Wenxiang. Policy Measurement, Evolution of Policy Synergy and Economic Performance: An Empirical Study Based on Innovation Policies[J]. Management World, 2008(09): 25-36.
[10] Zhang Na, Ma Xubu, Zhang Yuzhen, Liu Huailiang, Qin Chunxiu, Liu Wei. Policy Synergy Analysis of China' s Public Information Resource Opening Based on Text Content Analysis Method[J]. Information Studies: Theory & Application, 2020, 43(04): 115-122.
[11] Ralf Nordbeck and Reinhard Steurer. Multi-sectoral strategies as dead ends of policy integration: Lessons to be learned from sustainable development[J]. Environment and Planning C: Government and Policy, 2016, 34(4): 737-755.
[12] Cheng Enfu, Wang Xinjian. Coordinated Development of Beijing-Tianjin-Hebei: Evolution, Current Situation and Countermeasures[J]. Journal of Management, 2015, 28(01): 1-9.
[13] Rothwell R, Zegveld W. Reindustrialization and Technology[M]. Logman Group Limited, 1985: 83-104.
[14] Zhang Wenguang, Yan Rong. Quantitative Analysis of China' s Innovation Policy Based on a Three-dimensional Perspective[J]. The Journal of Shanghai Administration Institute, 2019, 20(05): 58-69.
[15] Grassano Nicola, Rotolo Daniele, Hutton Joshua, et al. Funding Data from Publication Acknowledgments: Coverage, Uses, and Limitations[J]. Journal of the Association for Information Science and Technology. 2017, 68(4): 999-1017.
[16] Wang Jinfeng, Xu Chengdong. Geographic Detector: Principle and Prospects[J]. Acta Geographica Sinica, 2017, 72(01): 116-134.
[17] Xu Qian, Dong Yuxiang, Wang Yuying, Yang Ren, Xu Chengdong. Delimiting the Northern Border of Tropical Zone of China' s Mainland Using Geographical Detector[J]. Journal of Geographical Sciences, 2018, 28(01): 31-45.
[18] Yin Jie, Yang Yitong. Spatiotemporal Evolution Characteristics and Driving Factors of the Coordinated Development Between China' s Exhibition Industry and Tourism Industry[J]. Economic Geography, 2020, 40(08): 194-202.
[19] Wang Tingyong, Yang Li, Guo Jiangyun. Related Issues and Countermeasures for Digital Village Construction[J]. Southwest Finance, 2021(12): 43-55.
[20] Mei Yan, Lu Yuhui, Mao Danling. Summary and Comparative Analysis of Digital Village Development Models in Typical Developed Countries[J]. Comparative Economic & Social Systems, 2021(03): 58-68.

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