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Study on the Spatial Effects of Digital Rural Construction on High Quality Rural Development

-- An Empirical Analysis Based on 11 Provinces and Cities in the Yangtze River Economic Belt

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Abstract: The report from the 20th National Congress of the Communist Party emphasized the crucial role of digital rural development in promoting rural revitalization and achieving high-quality rural development. Guided by this policy direction, this study explores how digital rural development impacts rural quality growth from a digital perspective. This paper assesses the digital rural development and rural quality development levels across 11 provinces and cities in the Yangtze River Economic Belt, utilizing spatial econometric models to analyze the interaction mechanisms between them. Finally, this paper offers strategic recommendations for enhancing rural quality development in these regions.

Keywords: Digital economy; Digital rural construction; High-quality rural development.

1. Introduction

Since the Central No.1 Document in 2018 first explicitly proposed the implementation of the digital countryside strategy, the state and relevant departments have paid great attention to the construction of digital countryside and implemented a few measures [1]. In May 2023, the Central Network Information Office and other relevant departments jointly issued a working document on digital countryside construction, which comprehensively deployed the construction of digital countryside from the aspects of infrastructure, food, agriculture, economy, culture, and governance. In May 2023, the Central Network Information Office and other relevant departments jointly issued a working document on digital village construction, which comprehensively deployed digital village construction in terms of infrastructure, food, agriculture, economy, culture, governance, etc., and solidified the policy foundation of digital village construction to empower high-quality development of the countryside [2]. The "Opinions on Learning and Applying the Experience of the "Thousand Villages Demonstration and Ten Thousand Villages Improvement" Project to Powerfully and Effectively Promote Comprehensive Revitalization of Rural Areas" particularly emphasizes the main direction of the digital countryside action, and puts forward a series of specific policy measures and action plans in terms of scientific and technological innovation, e-commerce logistics and digitalization, in order to promote the construction of the digital countryside and the high-quality development of the countryside [3].

These policy documents have paved the policy framework for China's digital village construction and marked the accelerated development of China's digital village construction. At present, the digital economy empowers the in-depth development of various industries, and China also has a favorable environment to support the development of digital rural construction, which has brought new vitality and vigor to rural areas. From the background of the digital economy era, this study empirically analyzes the impact mechanism of digital rural construction in promoting the high-quality development of China's rural areas, with the aim of promoting the common and coordinated development of rural areas in provinces and cities of the Yangtze River Economic Belt.

High-quality rural development emphasizes scientific and technological innovation, sustainable development and the extension of the agricultural industry chain, and is equally important for improving the living standards of farmers. As a multidimensional concept, it encompasses a wide range of areas such as agricultural production, rural environment and farmers' life. Studies have shown that digital rural construction has a significant effect on enhancing agricultural production efficiency, securing farmers' basic income, improving rural livability, and optimizing social governance, effectively promoting high-quality rural development. This study explores the spatial correlation between digital village construction and rural high-quality development based on the actual situation of 11 provinces and municipalities in the Yangtze River Economic Belt, with the aim of providing useful strategic suggestions for promoting rural high-quality development. The theoretical contribution of this paper lies in the establishment of a comprehensive evaluation system for analyzing the relationship between digital village construction and rural high-quality development, and the empirical study of this linkage from a spatial perspective, aiming to extend the theoretical foundation of this research area. In terms of application, the results of the study help to provide support for the government to formulate policies to promote high-quality rural development, which is of practical importance for promoting the digitalization of the countryside.

2. Literature Review

2.1. Digital Rural Development

In terms of measuring the measurement of digital villages, given the complexity and multidimensional characteristics of digital villages, many scholars have constructed relevant indicator systems from multiple dimensions to comprehensively capture the broad connotation of digital

villages. Qi Wenhao et al. (2021) measured the development level of digital villages by considering the Internet coverage rate, the maturity of e-commerce platforms, and the digital financial inclusion index [4]. Cui Kai et al. (2020) constructed an assessment index system for digital villages from four dimensions: digital environment, digital resources, digital results and digital services [5]. Zhang Hong et al. (2020) assessed the development status of digital villages from the macro and application environment levels, involving 29 indicators, and found through empirical research that the development of digital villages is unbalanced among regions, showing a decreasing trend from the eastern region to the central-western and northeastern regions [6].

2.2. Quality Rural Development

In the construction of the indicator system of rural high-quality development, Xin Ling and An Xiaoning constructed a system of high-quality development based on green development, industrial diversification, and agricultural efficiency [7]. Huang Xiujie, Cai Xun, and Chu Xia Ling selected more than 20 indicators from farmers, agriculture, rural areas and other multi-dimensions, and finally constructed the indicator system about high-quality development of agriculture [8]. In terms of research and analysis at the spatial level, Ji Zhiheng used AHP-entropy method and Dagum Gini coefficient, etc. to establish a system about rural high-quality development according to five dimensions of innovation, coordination, greenness, openness and sharing, and the results of the study showed that there are obvious spatial differences in China's rural high-quality development [9]. Qin Xiaojuan constructed an evaluation index system from the perspective of agricultural and rural development, and at the same time used the Moran index to test the spatial characteristics of rural high-quality development, and concluded that the closer the geographic distance, the stronger the influence of rural high-quality development in the provinces and cities [10].

2.3. Brife Comments

To summarize, scholars in China have considerable research accumulation on issues related to the development of digital economy, the construction of digital countryside and rural high-quality development. Their research mainly focuses on the status quo of digital village development, existing problems, solution mechanisms and other theoretical aspects, while quantitative research mainly involves the measurement of the evaluation index system of the digital economy and rural high-quality development, but seldom combines the two. In the current literature, there is a lack of research on the spatial effects of how the digital economy promotes rural high-quality development, and more of a single analysis of the spatial effects of rural high-quality development, and less analysis of the mechanism of the role of the digital economy. Therefore, the purpose of this paper is to synthesize the two evaluation index systems of digital village construction and rural high-quality development constructed separately in previous studies, and empirically analyze their impact mechanisms through spatial econometrics, and ultimately put forward targeted recommendations for how China's digital economy can promote the development of agriculture, rural areas and farmers.

3. Measuring The Level of Digital Village Construction

Based on the research on digital economy and digital village construction by relevant scholars, this paper draws on the existing research on digital economy development and digital village construction assessment, and selects three level 1 indicators of infrastructure, information environment, and degree of application from the principles of data authenticity, availability, and scientificity, including a few levels 2 indicators, and the specific indicator evaluation system is as follows:

Table 1. Evaluation system of digital village construction level

target level	Dimension layer	Index layer
Digital Rural Development	digital infrastructure	Fiber optic line length
		Gross power of agricultural machinery
		Rural delivery routes
	information environment	Rural electricity consumption
		Per capita transportation and communication consumption expenditure of rural residents
		Proportion of administrative villages with postal service
	application level	E-commerce sales
		Per capita consumption expenditure on education, culture and recreation of rural residents
		Revenue from express delivery operations

First, the data were standardized using Stata 17.0 software, and then the processed data were imported into SPSS software for KMO and Bartlett sphericity test. The results show that the KMO value is 0.713, which is greater than 0.7, while the p-value of Bartlett's test of sphericity is 0, indicating that the data are suitable for factor analysis. The data were factor analyzed in SPSS software, and the results are detailed in Table 2. a score of negatives does not indicate that the effect of the empirical results is negative, and the score only indicates the positional relationship of the level of the region relative to the average level.

Table 2. Factor scores

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Shanghai	-0.85	-0.68	-0.54	-0.29	-0.17	-0.09	0.06	0.03	-0.21	-0.28
Jiangsu	0.49	0.68	0.79	0.91	1.04	1.16	1.27	1.26	1.25	1.3
Zhejiang	0.23	0.51	0.68	0.83	0.91	1.01	1.2	1.14	1.23	1.33
Anhui	-1.03	-0.59	-0.35	-0.11	0.06	0.27	0.39	0.42	0.64	0.71
Jiangxi	-1.45	-1.04	-0.83	-0.72	-0.37	-0.22	-0.06	0.04	0.23	0.31
Hubei	-0.95	-0.43	-0.18	-0.03	0.15	0.32	0.48	0.42	0.68	0.79
Hunan	-0.88	-0.67	-0.37	-0.13	0.2	0.29	0.38	0.44	0.7	0.83
Chongqing	-1.65	-1.12	-0.96	-1.09	-0.55	-0.39	-0.28	-0.26	-0.09	0.06
Sichuan	-0.91	-0.49	-0.26	-0.1	0.15	0.36	0.55	0.6	0.74	0.85
Guizhou	-2.3	-1.31	-1.05	-0.8	-0.66	-0.38	-0.24	-0.21	-0.02	0.22
Yunnan	-1.37	-0.81	-0.58	-0.53	-0.34	-0.17	0.05	0.15	0.25	0.36

4. Measuring The Level of High-Quality Rural Development

Drawing on the core requirements of the rural revitalization strategy and referring to the research results of Xin Ling and Huang Xiujie, this paper constructs an evaluation index system. By considering the four aspects of production efficiency, ecological environmental protection, openness and quality of life of residents, this study aims to comprehensively assess the high-quality development of the countryside and further develops the relevant evaluation system, and the selection of the evaluation index system is shown in Table 3.

Table 3. Evaluation system for the level of high-quality rural development

target level	Dimension layer	Index layer	Attribute
production efficiency	The level of agricultural mechanization	Direct data	+
	The proportion of agricultural fiscal input.	Agriculture, Forestry, and Water Fiscal Expenditure / Total Fiscal Expenditure	+
	Labor productivity	Total output value of agriculture, forestry, animal husbandry, and fishery / Number of people employed in the primary sector	+
	Land productivity	Gross value of agricultural production/area sown to crops	+
	Effectively irrigated area	Direct data	+
Green development	The amount of agricultural film used per unit area	Agricultural film use/sown area	_
	Electricity consumption per capita	Rural electricity consumption/primary industry workers	_
	The amount of chemical fertilizer applied per unit area	Fertilizer application rate/sown area	_
	Pesticide application rate per unit area	Pesticide application rate/sown area	_
	Forest cover	Direct data	+
Degree of openness	Rural land transfer rate	The proportion of farmland transferred by households is in agricultural land	+
	Proportion of investment in fixed assets in agriculture	Investment in fixed assets of agriculture, forestry, animal husbandry and fishery/investment in total fixed assets	+
	Proportion of agricultural market turnover	Turnover of agricultural products market/value added of primary industry	+
	Dependence on import and export of agricultural products	Total imports and exports of agricultural products/gross domestic product	+
	Leading enterprises drive efficiency	Leading Companies/Rural Population	+
standard of living	The income level of rural residents	Per capita net income of rural residents	+
	The overall level of affluence of rural residents	Rural Engel coefficient	_
	The richness of life for rural residents	Per capita expenditure on education, culture and entertainment/per capita consumption expenditure	+
	The degree of medical care attached to rural residents	Health care expenditure per capita/consumption expenditure per capita	+
	Ratio of income of urban and rural residents	Disposable income of urban residents/disposable income of rural residents	–

To measure the level of high-quality rural development in 11 provinces and cities in the Yangtze River Economic Belt through the entropy method, firstly, the collected panel data are standardized to eliminate the influence of positive and negative indicators on the scale. Secondly, the weight of each indicator in each year of the ith region in the indicator is calculated and the information entropy of each indicator and its redundancy are calculated. Finally, calculate the weight of each indicator and the comprehensive score of each province and city region. The scores of each province and city are shown in Table 4:

Table 4. Level of high-quality rural development in 11 provinces and cities of the Yangtze River Economic Belt

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Shanghai	0.76	0.75	0.76	0.72	0.66	0.67	0.64	0.63	0.68
Jiangsu	0.46	0.43	0.41	0.39	0.37	0.36	0.35	0.35	0.33
Zhejiang	0.54	0.56	0.53	0.52	0.51	0.51	0.52	0.51	0.50
Anhui	0.29	0.30	0.27	0.26	0.27	0.26	0.27	0.29	0.31
Jiangxi	0.27	0.28	0.27	0.26	0.27	0.27	0.29	0.31	0.32
Hubei	0.32	0.32	0.31	0.31	0.32	0.30	0.31	0.28	0.29
Hunan	0.31	0.29	0.29	0.30	0.32	0.31	0.34	0.33	0.34
Chongqing	0.34	0.29	0.30	0.29	0.26	0.26	0.26	0.30	0.31
Sichuan	0.25	0.24	0.24	0.24	0.24	0.26	0.28	0.27	0.28
Guizhou	0.20	0.21	0.24	0.28	0.26	0.27	0.32	0.32	0.30
Yunnan	0.25	0.27	0.26	0.27	0.27	0.27	0.29	0.27	0.27

5. Empirical Analysis of The Impact of Digital Village Construction on High-Quality Rural Development

Through the score analysis of digital village construction and rural high-quality development, this chapter takes the level of digital village construction as an explanatory variable and rural high-quality development as an explanatory variable, and applies spatial econometric model for further empirical research to explore the spatial impact of digital village construction on rural high-quality development.

5.1. Selection of Variables

This study is about the impact of digital village construction on rural high-quality development, so the level of digital village construction is taken as the core explanatory variable X, and the latter rural high-quality development is taken as the explanatory variable Y. At the same time, this paper refers to the research on rural high-quality development by other scholars, such as Zhang Jun [11], and starts from the principles of data availability, scientificity, and accuracy, and selects five control variables in terms of economic development, government support for agricultural development, agricultural labor productivity, industrial coordination (agricultural industry structure adjustment index), and binary comparison coefficient of urban-rural coordination, in constructing the spatial measurement model. level, government support for agricultural development, agricultural labor productivity, industrial coordination (agricultural industry structural adjustment index) and urban-rural coordination binary comparison coefficients of five selected control variables.

The above data comes from China Statistical Yearbook, statistical yearbooks of provinces and cities and macroeconomic database of EPS data platform.

5.2. Spatial Autocorrelation

The global Moran's index test for the rural high-quality development and digital village construction variables using STATA17.0 software shows that the p-value of the global Moran's index is less than 0.01 for all years from 2013-2021, passing the confidence test at the 99% level, and the I values for all the years are positive, i.e., it shows that under the level of digital village construction, the provinces with higher levels of rural high-quality development are neighboring each other, and the provinces with lower development levels are neighboring each other, and both digital village construction show a positive spatial autocorrelation. provinces are neighboring each other and provinces with lower development levels are neighboring each other, and that both high-quality rural development and digital village construction show positive spatial autocorrelation. In terms of the global Mo Lan index value, the value ranges from 0.14 to 0.20, which is higher, indicating that the spatial agglomeration of rural high-quality development in the 11 provinces and cities of the Yangtze River Economic Belt is higher. In summary, the analysis shows that the data and related indicators in this paper are spatially dependent and can be analyzed in the next step of spatial measurement.

5.3. Analysis of Spatial Measurement Regression Results

The degree of socio-economic development of the 11 provinces and cities in the Yangtze River Economic Belt is not balanced, and the division of regions such as Jiangsu, Zhejiang, Shanghai, Yunnan, Guizhou and Sichuan better reflects the transmission of spatial effects, and the geographic distance matrix is more in line with the actual situation than the neighboring matrix, so the research in this paper is based on the geographic distance matrix.

STATA17.0 software was applied to input the running code for optimal model selection respectively, after the random effects model, time fixed effects, individual fixed effects and double fixed effects for the three models of Spatial Durbin Model (SDM), Spatial Error Model (SEM) and Spatial Lag Model (SAR) respectively. The double fixed effects log-likelihood value was selected to be the largest (293.9185) under the Spatial Durbin Model (SDM), so it can be shown that the fit is better and more credible under this model. Through the above model selection and testing, the appropriate Spatial Durbin Model (SDM) was finally determined to be used for the spatial econometric analysis, and the STATA 17.0 software was used to derive the results as shown in Table 5.

Table 5. Spatial Durbin Model (SDM)

	(1)	(2)	(3)
	ind	time	both
Main			
Digital village construction	0.0310*** (1.86)	0.0237*** (1.40)	0.0176*** (1.11)
level of economic development	-0.00000231*** (-4.20)	0.00000182*** (3.72)	-0.00000262*** (-5.65)
The government supports agriculture	0.00562** (2.93)	0.00943** (2.67)	0.00652*** (4.15)
Agricultural productivity	0.00936*** (4.32)	0.0430*** (7.68)	0.0102*** (4.22)
The degree of industrial coordination	-0.124* (-2.31)	-0.308** (-2.73)	-0.133** (-2.89)
The level of urban-rural coordination	2.66e-05 (0.26)	0.000133 (0.53)	-4.33e-05 (-0.51)
Wx			
Digital village construction	-0.0337** (-1.92)	0.115** (3.08)	-0.0221*** (-0.85)
level of economic development	-3.72e-07 (-0.42)	-2.41e-06 (-1.69)	-0.00000387*** (-3.90)
The government supports agriculture	0.00180 (0.56)	0.0329*** (4.04)	0.00781* (2.49)
Agricultural productivity	0.0145*** (3.42)	0.0563*** (3.80)	0.0198** (3.16)
The degree of industrial coordination	-0.0381 (-0.39)	-0.947*** (-3.48)	-0.120 (-1.23)
The level of urban-rural coordination	-0.000707*** (-3.67)	-0.00189*** (-3.59)	-0.000398* (-2.44)

In the double fixed effects model, the β-value of the Main term statistic shows that Digital village construction, level of economic development, The government supports agriculture have reached the 1% level of significance, the Digital village construction coefficient is -0.000003, the level of economic development coefficient is 0.007, and the government supports agriculture coefficient is 0.01, which indicates that Digital village construction has a negative effect on, and that level of economic development, The government supports agriculture have a positive effect on rural high-quality development. The Digital village construction coefficient is -0.000003, the level of economic development coefficient is 0.007, and the government supports agriculture coefficient is 0.01.

6. Conclusions And Recommendations of The Study

6.1. Conclusion

From the current state of research, the comprehensive evaluation of digital village construction in the Yangtze River Economic Belt shows obvious geographical distribution characteristics. Lower Yangtze River provinces such as Jiangsu and Zhejiang have the highest evaluation of digital village construction, which can be attributed to the more mature economic development, well-developed infrastructures, strong governmental investment, as well as higher market openness and technology application level in these regions. Together, these factors have contributed to the widespread application and efficient integration of digital technologies, which in turn have promoted high-quality rural development. In contrast, provinces in the middle reaches of the Yangtze River, such as Hubei and Chongqing, have seen some development in digital rural development, but the overall level and impact is still lower than that of the downstream regions. Although policy support is increasing in these regions, there are still a few shortcomings in digital infrastructure construction, informatization services, and the execution of local governments. In addition, agriculture and industry are not as well integrated as in the coastal regions, affecting the depth and breadth of digital applications. Finally, the upper reaches of the Yangtze River, such as Sichuan and Yunnan, have the lowest level of digital village construction due to their complex terrain and late economic start. The main challenges faced by these regions include financial, technological, and infrastructural problems. These factors constrain the popularization and application of information technology, which in turn affects high-quality rural development. In a study of 11 provinces and cities in the Yangtze River Economic Belt, the application of the spatial Durbin model reveals the positive spatial spillover effect of digital village construction on high-quality rural development, a finding that has important implications for regional development strategies.

6.2. Recommendations

On the one hand, the construction of digital infrastructure in the countryside should be further improved. The primary support for the construction of digital villages is digital infrastructure, and from the development experience of various countries, the construction of digital villages relies on perfect infrastructure. It mainly includes: stable and fast broadband Internet; 5G mobile communication network with wider coverage; setting up data centers in or near rural areas to provide local data storage, processing and analysis services; promoting digital payment tools and financial services to ensure that rural residents can conveniently conduct transactions and receive financial services; and setting up information service stations in rural areas to provide information inquiry and use of information such as

governmental information, agricultural technology, weather forecast and educational resources. , educational resources and other information inquiry and use. On the other hand, specific development initiatives need to be fine-tuned for the 11 provinces and municipalities in the Yangtze River Economic Belt. For the eastern provinces and municipalities along the Yangtze River Economic Belt, such as Shanghai, Jiangsu and Zhejiang, these regions should capitalize on their technological and capital advantages, seize the opportunity of digital village construction, and actively introduce cutting-edge technologies, such as big data, blockchain and cloud computing, to promote the transformation of traditional agriculture into smart agriculture. For the inland provinces of Hubei and Hunan, as well as Chongqing and Sichuan in the west, a digital village development plan that meets actual needs should be designed according to local resource endowments and development levels, and information services should be improved to ensure a balanced development of the digitalization process. Jiangxi in the northeast should also accelerate the pace of agricultural digitization and networking based on its local agricultural development advantages. Meanwhile, provinces and cities in the Yangtze River Economic Belt should strengthen cooperation among themselves. The eastern region can serve as an export center for technology and experience, and support digital village projects in the central, western, and northeastern regions by setting up cross-provincial cooperation mechanisms to share resources and technology. In addition, these provinces and municipalities should promote talent mobility and knowledge sharing through policy guidance and incentives, to achieve overall synergy and high-quality promotion of rural development in the Yangtze River Economic Belt.

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