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Exploring the Efficacy Assessment and Influencing Factors of Digital Rural Governance

-- Anhui Province as an Example

Mengting Lu[1], Wenyu Teng[1,*], Xinbei Wu[1], Wenshuo Li[2], and Xinyue Zhang[1]

[1] School of Anhui University of Finance and Economics, Anhui, China

[2] School of Anhui University of Chinese Medicine, Anhui, China

[*]Corresponding Author: 3368096562@qq.com

Abstract

With the development of Internet technology, digital technology is continuously embedded in the countryside, providing new opportunities for the modernization of rural governance. The Strategic Plan for Rural Revitalization (2018-2022) mentions the need to consolidate the foundation of rural informatization and deepen the innovative application of agricultural and rural big data. A series of policy documents, such as the Opinions of the Central Committee of the Communist Party of China and the State Council on Doing a Good Job in Comprehensively Promoting the Key Work of Rural Revitalization in 2023, provide institutional safeguards for digital technology-enabled rural governance. The wide application of digital technology has brought new development opportunities for rural governance, which is of great significance for promoting the rural revitalization strategy and strengthening the modernization of the rural governance system and governance capacity. At present, digital rural governance has become the focus of attention in the academic world, and related research is becoming more and more abundant. By assessing the effectiveness of digital rural governance and analyzing its development connotation, this project will help to solve the problem of unclear influencing factors and degree of influence in the process of digital rural construction, and lay the foundation for further clarifying the direction of digital rural governance, coordinating the digital development of all kinds of resources, advancing the in-depth integration of digital and rural areas, and realizing the upgrade of digital rural governance system. This project takes the first 35 digital village pilot districts in Anhui Province as the research object, and measures and analyzes their governance effectiveness and influencing factors.

Keywords

Digital Countryside; Performance Evaluation; Principal Component; Evaluation System.

1. Literature Review

Digital economy concept was first proposed by Tapscott Don, and digital village is a form of digital economy. The research on digital countryside by foreign researchers mainly focuses on the concept of smart countryside, rural informatization, rural network construction and digital countryside model. Domestic research on digital countryside began in 2018 when the central government issued relevant documents to put forward the digital countryside strategy. Xia Xianli et al. pointed out that the digital countryside supported by digital technology provides new kinetic energy for rural revitalization, and at the same time, the digital countryside has also given rise to the digital culture industry [1]. Li Xiang et al. proposed the path of digital culture industry to revitalize the rural economy [2]. Regarding the current situation of digital

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countryside development, Wu Yayun lists the results achieved after the implementation of the overall layout of digital countryside in Yunnan Province [3]. In terms of the construction of the evaluation index system of digital countryside development, Su Lanlan et al. pointed out that the digital countryside index system should be considered from four perspectives: environment, economy, life and governance [4]. Meanwhile, Bai Xiaoming also put forward a series of digital platform construction suggestions [5]. Guo Tingting proposed that the "14th Five-Year Plan" period is a period of force to comprehensively promote rural revitalization and build a digital China. Digital technology and digital economy are developing vigorously, providing new opportunities and new momentum for solidly promoting the key work of rural development, rural construction and rural governance. The "digital countryside" has become a major proposition and trend of the times for high-quality rural revitalization and modernization of agriculture and rural areas. [6] Zhu Rongkang et al. also concluded that digital technology-enabled rural governance exists in the digital infrastructure construction is weak, the grassroots government of digital technology application cognitive bias, farmers digital literacy and skills are not strong and other problems. [7] However, most of the existing literature is qualitative research on the current situation of digital village development and countermeasures, and there are few assessments of the effects of digital village governance and influencing factors from a quantitative perspective. The main innovation of this project is to use the entropy method and TOPSIS to get the measured value of digital village governance, and explore the correlation between the assessment indicators based on the VAR model so as to find the factors affecting the development of digital villages.

2. Variable Selection and Model Design

2.1. Variable Selection

According to the policy documents, the first 35 digital village pilot areas in Anhui Province were selected for the study, and the specific pilot areas are shown in Table 1:

Table 1. The first batch of 35 digital rural pilot areas in Anhui Province

City	Pilot area
Hefei City	Feixi County Shangpai Town, Feixi County Huagang Town, Baohe District Dawei Town
Huaibei City	Tiefu Town, Suixi County, Gaoyue Street, Duji District
Bozhou city	engcheng County, Lixin County, Chengbei Town
Suzhou	Grey Ancient Town in Sixian County, Yongqiao District
Bengbu City	Guzhen County
Fuyang city	Funan County, Yingzhou District Xihu Town, Yingquan District Wenji Town, Yingdong District Flower Arrangement Town
Huainan City	Eight public mountain mountain king town
Chuzhou	Mingguang City, Tianchang City Yongfeng Town, the Chinese territory Zhangguang town
Liuan City	Huoshan County
Ma'anshan City	Hexian County
Wuhu City	Fanchang District, Hewan Town of Nanling County, Taoxin Town of Wan Zhi District, and Huaqiao Town of Wan Zhi District
Xuancheng City	Jing County, Langxi County cross town, Ningguo City port town
Tongling city	Zongyang County
Chizhou city	Dongzhi County
Anqing City	Huaining County, Qianshan City, Yuexi County
Huangshan city	Yixian County, Xiuning County Crane City Town, Huizhou District Xixi South Town

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2.2. Establishment of the Evaluation Index System

In the selection of indicators in this paper, drawing on policy documents such as the Development Report on the Construction of Digital China and the indicator system constructed by relevant scholars, four primary indicators and 14 secondary indicators are selected to construct an indicator system for evaluating the effectiveness of digital village governance.

Table 2. Evaluation index system

Level 1 index layer	Secondary index layer	Indicator code
Digital infrastructure construction	Rural broadband network access to the users	X_{11}
	Number of modern agricultural parks	X_{12}
	Internet penetration ; network coverage	X_{13}
Digital agricultural promotion	Number of digital agricultural facilities	X_{21}
	agricultural output	X_{22}
	Number of digital management and open policies	X_{23}
	farm machinery production	X_{24}
Digital community construction	Number of digital community platforms	X_{31}
	Villagers' digital community participation satisfaction	X_{32}
	The number of the community talents introduced	X_{33}
	Promulgating the number of policies for community construction	X_{34}
Development of the digital service industry	Total postal business	X_{41}
	Number of medical institutions	X_{42}
	The Internet network penetration rate in rural areas	X_{43}

2.3. Sources of Date

In order to be able to comprehensively and truly understand the current situation of the first 35 digital villages in Anhui Province, the data in this paper come from the government's public document "Anhui Provincial Statistical Yearbook" and through the network of field visits to the relevant personnel channels to obtain the current governance of digital villages in Anhui Province.

2.4. Model Design

1)The evaluation indicators were screened by principal component analysis

In the data collection, when calculating the effectiveness assessment value of digital rural governance, the data related to the four aspects of digital infrastructure construction, the degree of digitalization promotion, digital community construction, and the development of digital service industry are referred to as the evaluation criteria for the effectiveness of digital rural governance, and the collected data are subjected to principal component analysis, and the two indicator factors that are most suitable to be used as the indicators of the various aspects are selected as the most suitable factors for the evaluation of the effectiveness of digital rural governance. effectiveness assessment.

The following is the modeling process of principal component analysis:

①Standardized processing

Mean values were calculated by column $\bar{x}_j = \frac{1}{n}\sum_{i=1}^{n} x_{ij}$ and standard deviation $S_j = \sqrt{\frac{\sum_{i=1}^{n}(x_{ij}-\bar{x}_j)}{n-1}}$ calculted normalized data $X_{ij} = \frac{x_{ij}-\bar{x}_j}{S_j}$ the raw sample matrix is normalized to:

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$$X = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1p} \\ X_{21} & X_{22} & \cdots & X_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ X_{n1} & X_{n2} & \cdots & X_{np} \end{bmatrix}$$

②The covariance matrix was calculated for the normalized samples

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1p} \\ r_{21} & r_{22} & \cdots & r_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ r_{p1} & r_{p2} & \cdots & r_{pp} \end{bmatrix}$$

among: $r_{ij} = \frac{1}{n-1}\sum_{k=1}^{n}(X_{ki} - \bar{X}_i)(X_{kj} - \bar{X}_j) = \frac{1}{n-1}\sum_{k=1}^{n} X_{ki} X_{kj}$

$$R = \frac{\sum_{k=1}^{n}(x_{ki} - \bar{x}_i)(x_{kj} - \bar{x}_j)}{\sqrt{\sum_{k=1}^{n}(x_{ki} - \bar{x}_i)^2 \sum_{k=1}^{n}(x_{kj} - \bar{x}_j)^2}}$$

③Computing the eigenvalues and eigenvectors of R

The eigenvalues are: $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_p \geq 0$,

feature vector: $a_1 = \begin{bmatrix} a_{11} \\ a_{21} \\ \vdots \\ a_{p1} \end{bmatrix}, a_2 = \begin{bmatrix} a_{12} \\ a_{22} \\ \vdots \\ a_{p2} \end{bmatrix}, \cdots, a_p = \begin{bmatrix} a_{1p} \\ a_{2p} \\ \vdots \\ a_{pp} \end{bmatrix}$

④Calculate the principal component contribution rate and the cumulative contribution rate

Contribution rate= $\frac{\lambda_i}{\sum_{k=1}^{p}\lambda_k}(i = 1,2,\cdots,p)$

Cumulative contribution rate= $\frac{\sum_{k=1}^{i}\lambda_k}{\sum_{k=1}^{p}\lambda_k}(i = 1,2,\cdots,p)$

⑤Write the main component

$$F_i = a_{1i}X_1 + a_{2i}X_2 + \cdots + a_{pi}X_p(i = 1,2,\cdots,m)$$

Table 3. Evaluation index system

Level 1 index layer	Secondary index layer	Indicator code
Digital infrastructure	Rural broadband network access to the users	X_{11}
	Number of modern agricultural parks	X_{12}
Digital agricultural promotion	Number of digital agricultural facilities	X_{21}
	agricultural output	X_{22}
Digital community construction	Number of digital community platforms	X_{31}
	Villagers' digital community participation satisfaction	X_{32}
Development of the digital service industry	Total postal business	X_{41}
	Number of medical institutions	X_{42}

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2) Governance effectiveness was evaluated based on the entropy method-TOPSIS

The entropy method is an objective assignment method in the assessment indicators for the assignment, drawing on the idea of information entropy, through the degree of influence of the indicators on the overall change to determine the weight of the indicators.

First, the selected indicators are dimensionless, and they are divided into two categories of indicators, development and constraints, according to the characteristics of the indicators for assessing the effectiveness of governance in the digital countryside. The data are transformed into relative data between [0,1] as follows:

①Development indicators

$$y_{ij} = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}, (i = 1, 2 \cdots m; j = 1, 2 \cdots n)$$

②Restrictive index

$$y_{ij} = \frac{x_{\max} - x_i}{x_{\max} - x_{\min}}, (i = 1, 2 \cdots m; j = 1, 2 \cdots n)$$

Where: $x_{max}$is the maximum index value; x_{min} is the index minimum value. The larger the development index value, the greater the digital rural governance efficiency evaluation index value, and the smaller the restriction index value, the greater the word rural governance efficiency evaluation index value.

①In the j th index, the i th evaluation unit characteristic specific gravity formula:

$$P_{ij} = \frac{X_{ij}}{\sum_{i=1}^{m} X_{ij}}$$

②Therefore, the specific weight of the established data is:

$$\begin{pmatrix} p_{11} & \cdots & P_{1n} \\ \vdots & \ddots & \vdots \\ p_{m1} & \cdots & p_{mn} \end{pmatrix}$$

③Calculate the entropy value of the j th index:

$$e_j = -k \sum_{i=1}^{m} P_{ij} ln P_{ij}$$

④Calculate the coefficient of difference of the index

$$g_j = 1 - e_j$$

⑤Calculate the weight of each index

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$$W_{ij} = \frac{g_j}{\sum_{i=1}^{n} g_j}$$

Based on the collected data, the weights of each evaluation index in the assessment of digital rural governance in Anhui Province are calculated as the final index weights for the assessment of the effectiveness of digital rural governance in Anhui Province, and the final weights of each index are shown in the table:

Table 4. Weight of digital rural efficiency evaluation index in Anhui Province

Level 1 index layer	Level 1 index layer weight	Secondary index layer	Level 2 index layer weight
Digital infrastructure	0.326	Rural broadband network access to the users	0.671
		Number of modern agricultural parks	0.329
Digital agricultural promotion	0.254	Number of digital agricultural facilities	0.541
		agricultural output	0.459
Digital community construction	0.213	Number of digital community platforms	0.617
		Villagers' digital community participation satisfaction	0.383
Development of the digital service industry	0.207	Total postal business	0.512
		Number of medical institutions	0.488

⑥A composite score for each digital village governance was calculated by multiplying the weights of each of the above indicators with the characteristic weights of the indicators, and the composite score was calculated using the formula:

$$S = \sum_{i=1}^{n} W_{ij} \times P_{ij}$$

Taking Mengcheng County in Bozhou City as an example, the values are brought in to derive the results of the digital governance effectiveness assessment of digital villages in Mengcheng County from 2018 to 2022:

Table 5. Effectiveness evaluation results of digital rural governance in Mengcheng County from 2018 to 2022

Year	figure infrastructure	digitalize agricultural extension	digitalize Community construction	digitalize Service industry development	synthesize score
2018	0.1212	0.0836	0.1323	0.1815	0.5186
2019	0.1445	0.1228	0.1437	0.1293	0.5403
2020	0.1838	0.1823	0.1209	0.1315	0.6185
2021	0.2454	0.1843	0.1441	0.1945	0.7683
2022	0.2543	0.1814	0.1321	0.2312	0.799

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3. Model Result Inquiry

Based on the above results, the following will explore the influencing factors of digital rural governance from the perspectives of digital infrastructure construction, digital agriculture promotion, digital community construction and digital service industry development.

In terms of digital infrastructure construction: the development of digital rural governance cannot be supported by advanced infrastructure construction. For example, the improvement of network coverage and communication facilities can provide infrastructure support for digital agriculture, digital community and digital services, which in turn promotes the digital development of villages. Investment and policy support are important factors influencing infrastructure development.

In terms of digital agriculture promotion: the introduction of digital agriculture technology can improve agricultural production efficiency, optimize the allocation of agricultural resources and reduce production costs. These aspects, such as government policy support, professional and technical personnel training, and farmers' willingness to participate, have a more direct impact on the promotion of digital agriculture. The government can formulate policies to encourage farmers to adopt digital agriculture technology, provide training and technical support, and promote the popularization and application of digital agriculture in the countryside.

In the construction of digital communities: the construction of digital communities can improve the quality of life of rural residents and the level of public services. The government's willingness and ability to govern digitally, the cultivation of digital skills among community residents, and the construction of digital platforms have a strong correlation to the construction of digital communities. The government can strengthen the planning and investment in digital governance, promote the construction of digital community infrastructure, cultivate the digital skills of community residents, and increase the enthusiasm of residents to participate in digital community construction.

Development of digital service industry: the application of digital technology promotes the development of rural service industry, providing residents with more diversified and efficient services. Influencing factors include government policy support, digital technology innovation, and talent cultivation. The government can introduce corresponding policies to encourage the application of digital technology in the service industry, provide relevant training, and attract talents to devote themselves to the digital development of the rural service industry.

In summary, the influencing factors of digital rural governance cover multiple aspects such as infrastructure construction, digital agriculture promotion, digital community construction and digital service industry development. The combined effect of effective policy support, adapted technology application and talent cultivation will promote the development of digital rural governance and the sustainable development of villages.

4. Conclusion and Suggestions

4.1. Research Conclusion

The effectiveness of digital rural governance in Anhui Province is assessed to be high. Anhui Province has a more complete infrastructure construction in digital rural governance, the coverage of digital rural governance is expanding, the application of digital technology is gradually deepening, and the capacity and level of digital rural governance are constantly improving. Good conditions are provided for digital rural governance.

The Anhui provincial government attaches high importance to digital rural governance, including it as an important part of the construction of "Digital Anhui", and has issued a series of policy documents and plans, providing strong policy support for digital rural governance.

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Anhui Province has invested heavily in infrastructure such as rural network coverage and information platform construction, which has promoted the popularization and application of digital technology in rural governance. Second, the application of digital technology has gradually penetrated into all aspects of rural governance. For example, digital means have been widely used in rural land contracting, homestead management, agricultural insurance and other fields, improving the efficiency and precision of governance. Finally, the data integration and application of digital rural governance has been further strengthened. Digital technology not only facilitates data collection and entry, but also improves the ability to analyze and apply data, providing more scientific and precise decision-making support for rural governance.

4.2. Research Advice

1) Strengthen the integration and application of digital rural governance data

Although a number of digital platforms for rural governance have been established, the integration and sharing of data has yet to be improved, and there is also a need to further improve the standardization of data and enhance its quality. Deepen the application of digital technology to promote rural industrial development. Continuously strengthen the construction of digital rural governance infrastructure. Further expand network coverage, improve the speed and stability of rural networks, strengthen the construction of information platforms, promote the deep integration of digital technology with agriculture, rural areas and farmers, and increase the popularity and effectiveness of digital rural governance. It has increased support for the research, development and promotion of agricultural digital technology, guided farmers and enterprises to actively apply digital technology, promoted the modernization of agricultural production, intelligent sales and efficient distribution, and facilitated the high-quality development of rural industries.

2) Strengthen the training and introduction of digital rural governance talents

Digital rural governance requires a professional team with digital technology and management capabilities, and there is still a certain gap in this regard in Anhui Province. Anhui Province should clarify the direction and criteria for introducing talents according to the needs of digital rural governance and its own characteristics. It can focus on introducing professionals with backgrounds in digital technology, agricultural economics, rural planning, etc., and also pay attention to the practical experience and innovation ability of the talents to better adapt to and promote the development of digital rural governance. Strengthen the cultivation of digital technology and management ability, improve the digital literacy of rural cadres and farmers, and provide strong talent guarantee for digital rural governance.

3) Strengthen the publicity and education of digital rural governance

Digital rural governance requires broad social participation, including farmers, rural enterprises, social organizations and government agencies. Anhui Province's social participation in this area still needs to be improved. Through various channels and forms, including media reports, special lectures, brochures and promotional films, we have strengthened publicity and education on digital rural governance, and have stimulated the enthusiasm and creativity of all parties involved, including farmers, enterprises and social organizations. Actively guide social capital to participate in digital village governance. Utilize the synergy between the government and enterprises to jointly promote publicity. By means of government guidance and enterprise participation, we will take advantage of our respective strengths to jointly promote publicity and education on digital rural governance. Encourage and support social capital to enter the field of digital village governance, promote effective cooperation between the government and social capital, and jointly promote economic development and livelihood improvement in digital villages.

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