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The role of statistical service capacity in supporting the implementation of the rural revitalization strategy from the perspective of grass-roots governance

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SUMMARY: *From the perspective of grassroots governance, this paper selects 50 villages in 11 townships (management service centers) of Zhangzi County, Changzhi City, Shanxi Province as the research objects.By applying the Analytic Hierarchy Process - Entropy Method - TOPSIS analysis method to construct a TOPSIS comprehensive evaluation model for the statistical service capability evaluation system, it systematically explores the mechanism of "statistical services" in supporting the rural revitalization strategy from four aspects: "data support - resource allocation - policy optimization - governance innovation".The experimental results show that among the weights of the indicators obtained under the TOPSIS comprehensive evaluation model of this paper, among which the digital quality is 0.342, the informatization level is 0.267, the synergistic ability is 0.228 and the service efficiency is 0.163, after the comprehensive assessment of TOPSIS, the relative proximity of each township of the sample villages is in the range of 0.712-0.983, and there are 12 townships reaching the excellent level accounting for 24.0%. Through quantitative analysis, the study clarifies the main pathways for improving statistical service capability in Zhangzi County, Changzhi City, Shanxi Province, and explores a practical and operable path for realizing the coordinated development of rural revitalization and grassroots statistical work.*

KEYWORDS: *statistical service; hierarchical analysis method; entropy value method; TOPSIS; rural revitalization strategy*

1 Introduction

The strategy of rural revitalization should be based on the overall goal of “prosperous industry, ecological livability, civilized rural culture, effective governance and affluent life”, and “effective governance” is the key to promote rural revitalization. The improvement of grassroots governance efficiency is highly dependent on the support of accurate, efficient and comprehensive statistical services [1, 2]. Agricultural and rural statistical services provide a basis for decision-making and optimize resource allocation for grassroots management through the collection, collation, analysis and application of data. With China's formal accession to the WTO, the amount of data about agriculture has increased dramatically [3, 4], therefore, it is necessary to compare and analyze them at the international level, and the status and role of the statistical service work has increased accordingly, which is of great significance for the development of China's agriculture and rural economy. At present, there are still many problems in data transparency, management and efficiency of statistical services, and it is necessary to

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actively take measures to improve the efficiency of the services, to provide sufficient data support for rural revitalization, to provide a strong basis for the formulation of policies, and to explore a new road for rural development, so as to achieve the development goal of agricultural modernization [5, 6].

This study takes 50 administrative villages in 11 townships (management service centers) of Zhangzi County, Changzhi City, Shanxi Province as the research objects. By integrating the Analytic Hierarchy Process, the entropy method, and the TOPSIS method, it constructs a multidimensional evaluation system for statistical service capacity and examines the quantitative relationship between statistical service capacity and the effectiveness of rural revitalization based on large-sample data. The study aims to provide a theoretical basis and practical reference for optimizing grassroots statistical work in Changzhi City, Shanxi Province, while enriching cross-disciplinary research on rural revitalization and grassroots governance. Through the construction of multidimensional assessment indicators, detailed field investigation, data analysis, and questionnaire surveys on the statistical service conditions in the sample area, the study finds that grassroots statistical service capacity still needs to be improved. The main problems include the inability of data collection speed to meet practical demand, the insufficient rationality of statistical indicator design, and the relatively low efficiency of interdepartmental coordination. To address these issues, this study explores the mechanism through which statistical service capacity supports the implementation of the rural revitalization strategy from the perspective of grassroots governance. By constructing a scientific evaluation index system, it quantitatively analyzes the effects of different dimensions of statistical service capacity on various areas of rural revitalization and then proposes targeted improvement strategies.

2 Mechanism of statistical service capacity for the implementation of the rural revitalization strategy

2.1 “Three-tier statistical network” enhances the energy efficiency of grass-roots governance

With the advent of the digital era, Li, J et al. consider the complexity of grassroots community governance in China and promote the transformation of grassroots digital governance in terms of strengthening the integration of grassroots digital systems, enhancing the ability to solve digital governance problems, and applying the logic of incremental governance [7]. Liu, D and Qi, X, in the context of the new era, suggest that smart governance is a modernization of the social governance system and the social governance capacity as an important way, so as to shape a new type of grassroots government that is more service-oriented, modernized, and technologized [8].

Combined with the current stage of the above research, the use of big data technology, relying on grid management, the establishment of a grassroots governance information platform that vertically connects the district, township and village levels, and horizontally connects the relevant departments, to realize the intelligent grass-roots governance model of “grass-roots whistle blowing, department reporting”.

2.2 Enhancing the subjectivity of grassroots governance

Q Adogbeji, O. E and Ugochukwu, M. O used a qualitative research approach with local governments in Nigeria to point out the increasing importance of local self-governance in promoting grassroots participation and enhancing governance at the societal level [9]. Islam, N

and Rahaman, M in their study for identifying the multiple ways in which individuals from different underrepresented groups may be involved in the local government of Bangladesh, in the local governance kind, the primary consideration is the public participation which enhances the quality of decision making [10].

In the process of grass-roots governance, it focuses on key links such as information transmission, resource allocation and responsibility implementation, and creates an interlocking and dynamically coupled institutional chain from top-level decision-making and deployment to grass-roots implementation and feedback on implementation.

2.3 Requirements for the realization of the main lines of the rural development strategy

Rural revitalization is a key strategy to promote sustainable rural development, Xue, E et al. pointed out that sustainability, openness and endogeneity are the basic requirements for developing sustainable rural areas, and proposed that policies should be oriented towards the rural areas to enhance the enhancement of integration and symbiosis effects [11]. Zhao, W. et al. studied how to transform the countryside into a digital countryside and realize sustainable development, and established a digital countryside technical architecture that includes an infrastructure system, a countryside brain, an application support system, and an application service system, which attracts multiple participants to form a symbiotic relationship and realize sustainable rural development [12].

Agriculture and rural areas are the “ballast” and “stabilizer” of the healthy development of the national economy, and only by implementing the strategy of revitalizing the countryside can we strengthen the foundation of agriculture, and provide solid support for the realization of high-quality development and the promotion of Chinese modernization.

2.4 Contribute to the revitalization of rural industries

Tian, Y et al. constructed a double fixed-effects model to analyze the integrated level of rural digital economy and industrial revitalization and development using the entropy value method based on the agricultural and rural development data of 30 provinces in China from 2014 to 2019 [13]. Peng, H et al. measured the promotion effect of rural industry revitalization on farmers' income based on panel data from 30 provinces in China between 2011 and 2020 using a double fixed-effects model. The results show that rural revitalization helps promote the growth of farmers' income [14].

Accelerating the digital transformation of agriculture and rural areas has become an important measure to promote the revitalization of rural industries and realize the modernization of agriculture and rural areas.

2.5 Research methodology for monitoring effectiveness in preventing return to poverty

Based on the theory of complex governance and the perspective of grass-roots governance, this paper establishes a logical transfer model of “statistical service capacity - effectiveness of grass-roots governance - effectiveness of rural revitalization”, and the logical framework of rural revitalization is shown in Figure 1. The statistical service capacity can be reflected in four aspects: data quality, service efficiency, informatization and synergy. Through scientific decision-making, optimization of resource allocation and innovative governance, the five goals of rural revitalization are supported [15, 16].

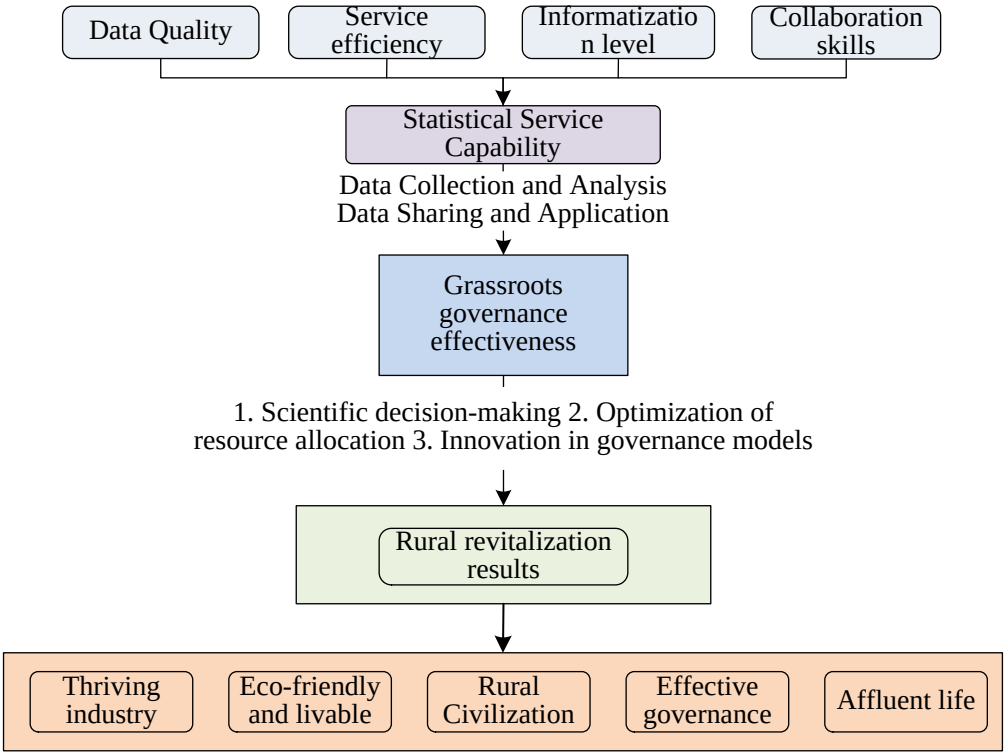

Figure 1: Logical framework for rural revitalization

The AHP method decomposes the complex problem hierarchically and constructs a judgment matrix, so as to determine the subjective weights of each index [17]. First of all, taking statistical service capacity as the research object and data quality, service efficiency, informatization level and collaborative capacity as the research object, we establish a multiple indicator system of data quality, business efficiency, informatization level and collaborative capacity with data quality as the core, and put forward an evaluation method based on the efficiency of statistical service, which is based on the 1-9 scaling method to score the weights of the indicators of each level, and construct the Judgment matrix $P=\left(p_{ij}\right)_{n\times n}$.

Regularize each column of the judgment matrix to obtain the matrix P :

$$\bar{p}_{ij}=\frac{p_{ij}}{\sum_{k=1}^{n}p_{kj}}\left(i,j=1,2,...n\right) \tag{1}$$

where $\bar{p}_{ij}$ is the regularized value of the element in the i th row, j th column, p_{ij} is the element in the i th row, j th column, $\sum_{k=1}^{n}p_{kj}$ is the sum of the elements of the j th column.

The regularized judgment matrix P for each column is summed by row:

$$\bar{W}_i=\sum_{j=1}^{n}p_{ij}\quad\left(i,j=1,2,...,n\right) \tag{2}$$

where $\bar{W}_i$ is the sum of the i th row in the regularized judgment matrix. For the vector $W=\left[W_1,W_2,...,W_n\right]^T$ regularize:

$$W = \frac{\bar{W}_i}{\sum_{i=1}^{n} \bar{W}_i} \quad (i = 1, 2, ..., n) \tag{3}$$

Get the feature vector $W = [W_1, W_2, ..., W_n]^T$, and the consistency test formula is:

$$CR = \frac{CI}{RI}, \quad CI = \frac{\lambda_{\max} - n}{n - 1} \tag{4}$$

where $\lambda_{\max}$ is the maximum eigenvalue and RI is the average random consistency index. When $CR < 0.1$, the judgment matrix has consistency.

The entropy value method determines the objective weights according to the degree of dispersion of the indicator data, and carries out the standardization of the indicators, and the larger the positive indicators, the better, and the standardization formula is:

$$r_{ij}^{'} = \frac{r_{ij} - \min(r_{ij})}{\max(r_{ij}) - \min(r_{ij})} \tag{5}$$

The smaller the negative indicator, the better it is, normalized by the formula:

$$r_{ij}^{'} = \frac{\max(r_{ij}) - r_{ij}}{\max(r_{ij}) - \min(r_{ij})} \tag{6}$$

The entropy value of the indicator is calculated by the formula:

$$H_j = -k \times \sum_{i=1}^{m} f_{ij} \ln f_{ij} \tag{7}$$

where $f_{ij} = \frac{r_{ij}^{'}}{\sum_{i=1}^{m} r_{ij}^{'}}$, $k = \frac{1}{\ln m}$, and if $f_{ij} = 0$, then $f_{ij} \ln f_{ij} = 0$.

The entropy weight is calculated as:

$$w_j = \frac{1 - H_j}{\sum_{j=1}^{n} (1 - H_j)} \left(0 \le w_j \le 1, \sum_{j=1}^{n} w_j = 1 \right) \tag{8}$$

The entropy weight W_j can reflect the magnitude of information contained in different indicators at the time of evaluation, and quantitatively reflect the role of indicators in evaluation [18]. Combining the AHP subjective weight $W_1(j)$ and the entropy value method objective weight $W_2(j)$, the multiplicative synthesis method is used to calculate the combination of the weights, and the formula is:

$$W(j)=\frac{\left[W_1(j)\times W_2(j)\right]^{\frac{1}{2}}}{\sum_{j=1}^{n}\left[W_1(j)\times W_2(j)\right]^{\frac{1}{2}}} \tag{9}$$

The TOPSIS method is a comprehensive ranking based on the relative proximity between the assessment objectives and the positive and negative ideal scenarios [19]. A weighted normalization matrix is constructed and a weighted normalization is applied to it to obtain a weighted normalized matrix. In order to eliminate the effect of magnitude, the original data is normalized by the polar deviation, distinguishing between positive-type and negative-type indicators, and normalized to obtain a normalized matrix P. Positive type indicators:

$$p_{ij}=\frac{x_{ij}-\min x_{ij}}{\max x_{ij}-\min x_{ij}} \tag{10}$$

Negative Type Indicator:

$$p_{ij}=\frac{\max x_{ij}-x_{ij}}{\max x_{ij}-\min x_{ij}} \tag{11}$$

Determine the weights of each evaluation index through the combination assignment method to form the weight vector w, and combine the standardized decision matrix with the combination weight vector to obtain the weighted normalized judgment matrix Z. Determine the positive ideal solution and the negative ideal solution, and use the Euclidean distance to calculate the distance between each year and the ideal solution. By calculating the relative closeness D_i, each year is ranked, and the larger the value of D_i, the higher the score. Positive ideal solution:

$$M^{+}=\left\{z_1^{+},z_2^{+},...,z_n^{+}\right\}..... \tag{12}$$

Negative Ideal Solution:

$$M^{-}=\left\{z_1^{-},z_2^{-},...,z_n^{-}\right\}..... \tag{13}$$

where $z_j^{+}=\max\left(z_{ij}\right)$, $z_j^{-}=min\left(z_{ij}\right)$, $i=1,2,...,m$; $j=1,2,...n$.

Relative closeness:

$$D_j=\frac{S_i^{-}}{S_i^{-}+S_i^{+}} \tag{14}$$

where $S_i^{+}=\sqrt{\sum_{j=1}^{n}\left(z_{ij}-z_j^{+}\right)^2}$ is the Euclidean distance of the evaluated object to the positive ideal solution, $S_i^{-}=\sqrt{\sum_{j=1}^{n}\left(z_{ij}-z_j^{-}\right)^2}$ is the Euclidean distance to the negative ideal solution. Based on the above, the return-to-poor factors are identified and the anti-return-to-poor

monitoring is completed.

3 Research design

3.1 Selection of research subjects

Fifty administrative villages in 11 townships (management service centers) of Zhangzi County, Changzhi City, Shanxi Province were selected as the study sample, including townships such as Dabu Town and Cilin Town. The sample covered different types of villages, including major grain-producing villages, specialty-industry villages, and key villages for cultural industry protection. Information was collected through questionnaires, field research, statistical yearbooks and public government data. 600 questionnaires were distributed and 548 valid questionnaires were collected, with an effective recovery rate of 91.3%. Field verification was conducted in 50 villages, and more than 1,800 pieces of original information, such as statistical work ledgers and data reports, were collected.

3.2 Measurement indicators

Based on the perspective of grass-roots governance, the evaluation index system of grass-roots statistical service capacity is shown in Table 1. Following the principles of scientificity, systematicity and operability, the statistical service capacity evaluation index system is constructed, including 4 guideline layers and 22 indicator layers.

Table 1: Indicator system for evaluating the capacity of grass-roots statistical services

Standardized layer	Weights (AHP)	Weights	Portfolio weighting	Indicator layer	Indicator properties
Data quality (B_1)	0.428	0.286	0.342	Authenticity of data(C_1)	Forward
				Data integrity(C_2)	Forward
				Data timeliness(C_3)	Forward
				Data accuracy(C_4)	Forward
				Data transparency(C_5)	Forward
				Data traceability(C_6)	Forward
Service efficiency (B_2)	0.157	0.171	0.163	Data collection efficiency(C_7)	Forward
				Efficiency of data analysis(C_8)	Forward
				Efficiency of report generation(C_9)	Forward
				Efficiency of policy response(C_{10})	Forward
				Consultation response efficiency(C_{11})	Forward
Informatization level (B_3)	0.246	0.293	0.267	Digital capture coverage(C_{12})	Forward
				Level of data platform construction(C_{13})	Forward
				Big data technology adoption rate(C_{14})	Forward
				Degree of information sharing(C_{15})	Forward
				Data security assurance rate(C_{16})	Forward
				Mobile terminal utilization rate(C_{17})	Forward
Synergistic capability (B_4)	0.169	0.250	0.228	Efficiency of sectoral collaboration(C_{18})	Forward
				Level of collaboration between government and enterprises(C_{19})	Forward
				Level of village participation(C_{20})	Forward
				Rate of cross-regional data sharing(C_{21})	Forward
				Professionalism of statistical team(C_{22})	Forward

3.3 Data collection methods

Multiple interpolation is used to deal with the missing data, assuming that the missing data follows a normal distribution, and the interpolation values are generated by the following formula:

$$\hat{X}_{mis} = \hat{\mu} + \hat{\Sigma}_{mis,obs} \hat{\Sigma}_{obs,obs}^{-1} \left(X_{obs} - \hat{\mu}_{obs} \right) + \epsilon \tag{15}$$

where $\hat{\mu}$ is the overall mean vector, $\hat{\Sigma}$ is the covariance matrix, and ϵ is the random error term.

Applying the Grubbs criterion to eliminate outliers, the test statistic is:

$$G = \frac{\left| X_i - \bar{X} \right|}{S} \tag{16}$$

where $\bar{X}$ is the sample mean and S is the sample standard deviation. When $G > G_{\alpha,n}$ critical value, it is judged as an outlier, and a total of 8 abnormal samples are eliminated.

Polar deviation standardization method is used to eliminate the influence of the quantitative outline, and the formula is the same as that described in the section of entropy value method weighting model to ensure the validity and reliability of the data.

By constructing the determination matrix and conducting a consistency test on it (CR=0.068<0.1), the subjective weights of the criterion level were derived: data quality (0.428)>informatization level (0.246)>collaboration capacity (0.169)>service efficiency (0.157), which indicates that data quality determination is an important factor in the capacity of the statistical service.

According to the results of entropy weighting method, it can be seen that at the standard level, the level of informatization (0.293) > synergistic ability (0.250) > data quality (0.286) > service efficiency (0.171), which indicates that the level of informatization and the synergistic ability have a more important role for the statistical service ability through the discrete nature of the data.

The result of comprehensive weighting shows that data quality 0.342 > informatization level 0.267 > synergistic ability 0.228 > service efficiency 0.163, and the objective attributes of comprehensive data make the conclusion more scientific. At the indicator level, data authenticity (C_1=0.092), digital collection coverage (C_2=0.078), departmental collaboration efficiency (C_2=0.073), and data transparency (C_5=0.069) are the main impact indicators.

4 Analysis of empirical results

4.1 Testing the effectiveness of grass-roots governance

4.1.1 Network coverage and organizational effectiveness

Table 2 presents the descriptive statistics of the dimensions of statistical service capacity. The overall score of statistical service capacity in the sample villages of Zhangzi County, Changzhi City, Shanxi Province is 74.35, indicating a moderate overall level, while the development across different dimensions remains uneven. The mean score of data quality is 78.43, suggesting that grassroots statistical work in Zhangzi County has established a basic foundation, but there is still room for further improvement. The level of informatization shows the largest variation,

with a coefficient of variation of 0.146, indicating relatively significant differences in informatization development among villages.

Table 2: Descriptive Statistics of the Dimensions of Statistical Service Capacity

Criterion stratum	Mean	Standard deviation	Maximum	Minimum	Coefficient of variation
Data Quality (B_1)	78.43	7.12	91.68	63.54	0.091
Service Efficiency (B_2)	73.18	8.64	88.35	57.26	0.118
Level of Informatization (B_3)	71.26	10.41	87.94	54.38	0.146
Collaboration Capability (B_4)	74.52	8.03	89.47	58.63	0.108
Overall Score	74.35	8.09	88.22	59.41	0.109

4.1.2 Institutional and safeguard mechanisms

The TOPSIS method was used to calculate the relative closeness of the statistical service capacity of the 50 sample villages D_j, and the statistical service capacity was categorized into four grades based on the values of D_j, excellent $D_j \geq 0.9$, good $0.8 \leq D_j 0.9$, medium $0.7 \leq D_j < 0.8$, average $D_j < 0.7$, Table 3 shows the results of the TOPSIS evaluation of the capacity of grassroots statistical services. Table 3 shows the results of the TOPSIS evaluation of the statistical service capacity at the grassroots level.

Table 3: Results of the TOPSIS evaluation of the capacity of grass-roots statistical services

Hierarchy	Sample size	Percentage (%)	Average closeness	Regional Distribution Characteristics
Excellent	12	24.0	0.942	Mainly concentrated in villages under townships such as Danzhu Town, Setou Town, and Cilin Town, with a relatively high level of informatization and close interdepartmental coordination
Good	23	46.0	0.856	Distributed in villages under townships such as Dabaotou Town, Nanzhang Town, and other areas, with relatively high data quality and stable service efficiency
Moderate	11	22.0	0.763	Mainly found in villages under townships such as Songcun Township and Changzhang Township, where informatization development is relatively lagging
Average	4	8.0	0.712	Mostly located in relatively remote villages, with a low degree of specialization among statistical personnel and insufficient coordination capacity

The results of the TOPSIS evaluation are presented in Figure 2. According to the heat map, the statistical service capacity of the sample villages in Zhangzi County, Changzhi City, Shanxi Province shows a differentiated distribution pattern across different townships and management service centers, rather than a typical urban-centered pattern. In some better-performing villages

under townships such as Danzhu Town and Cilin Town, the coverage rate of digital data collection reaches 98%, and the rate of cross-departmental data sharing reaches 85%, indicating that statistical service capacity has gradually become an important institutional support for grassroots governance.

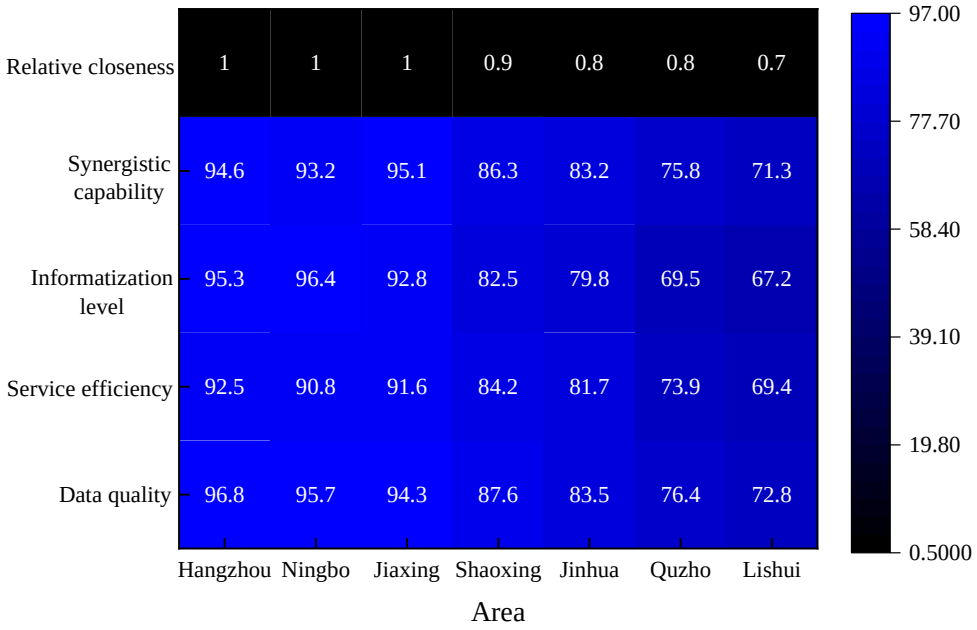

Figure 2: TOPSIS evaluation heat results

4.2 Validation of subjectivity in grassroots governance

The questionnaire survey covered 548 villagers in 50 sample villages, covering the aspects of awareness, willingness to participate and satisfaction with statistical services. The villagers' knowledge of statistical services is shown in Table 4. 34.1% of the villagers know about statistical services, 89.2% feel that statistical data are very important for village development, 43.9% pay attention to the disclosure of statistical data occasionally, and 37.0% pay attention to the disclosure of statistical data, reflecting that the villagers' knowledge of statistical services as well as their attention to statistical services needs to be improved.

Table 4: Villagers' perception of statistical services (n=548)

Cognitive dimension	Options	Number of people	Percentage (%)
Knowledge of statistical services	Understanding	187	34.1
	General	253	46.2
	Not Understanding	108	19.7
Implications of statistical data for rural development	Important	489	89.2
	General	52	9.5
	Not Important	7	1.3
Concerns about disclosure of statistics	Concerned	203	37.0
	Occasional	241	43.9
	Not Concerned	104	19.1

Table 5 shows the participation of villagers in statistical services. 56.7% of villagers participated in statistics, but only 12.4% participated regularly. The average score of intention

to participate is 3.42, which is in the middle to upper level, indicating that the villagers have a certain intention to participate, but the depth of their willingness to participate and their understanding of statistical services is not sufficient.

Table 5: Participation of villagers in statistical services (n=548)

Cognitive dimension	Options	Number of people	Percentage (%)
Whether or not they have been involved in data provision	Yes	311	56.7
	No	237	43.3
Frequency of participation in data provision	Often	68	12.4
	Occasionally	243	44.3
	Never	237	43.3
Willingness to participate (on a scale of 1-5, with 5 being the highest)	1 point	32	5.8
	2 points	57	10.4
	3 points	189	34.5
	4 points	176	32.1
	5 points	94	17.2
	Average score	3.42	-

Table 6 shows the villagers' satisfaction with statistical services, and it can be seen that the villagers are 52.2% satisfied with the authenticity of data, 44.3% satisfied with the efficiency of services, 39.2% satisfied with the level of informatization, and 41.6% dissatisfied with the collaborative services, accounting for 13.7%. The overall satisfaction of villagers with statistical services was obtained as 45.8% satisfied, 43.1% average and 11.1% dissatisfied. This result echoes the previous conclusion of a high coefficient of variation of informationization level in the evaluation of statistical service capacity, revealing the structural differences of current statistical services in meeting the actual needs of villagers.

Table 6: Satisfaction of villagers with statistical services (n=548)

Cognitive dimension	Options	Number of people	Percentage (%)
Satisfaction with Data Authenticity	Satisfactory	286	52.2
	Fair	201	36.7
	Unsatisfactory	61	11.1
Satisfaction with Service Efficiency	Satisfactory	243	44.3
	Fair	227	41.4
	Unsatisfactory	78	14.3
Satisfaction with Informatization Level	Satisfactory	215	39.2
	Fair	234	42.7
	Unsatisfactory	99	18.1
Satisfaction with Collaboration Service	Satisfactory	228	41.6
	Fair	245	44.7
	Unsatisfactory	75	13.7
Overall Satisfaction	Satisfactory	251	45.8
	Fair	236	43.1
	Unsatisfactory	61	11.1

The correlation analysis between data quality and policy implementation effects is shown

in Table 7, with ** indicating p<0.01 and significant correlation. All data quality indices have a high positive relationship with all dimensions of policy implementation, and all of them reach a high level, which confirms that data quality has a good supportive effect on policy implementation. Among these data, the relationship between data transparency on policy satisfaction 0.91** and data timeliness on policy implementation 0.83** is the most prominent. Data authenticity is the basic and core support for all policies, while the overall correlation of traceability is relatively small. This implies that increasing the transparency of statistical data can enhance villagers' motivation towards grassroots governance and facilitate policy implementation.

Table 7: Correlation analysis between data quality and policy implementation effects

Data quality indicators	Policy Relevance	Policy Implementation	Policy Satisfaction	Overall Effectiveness
Data authenticity	0.85**	0.82**	0.87**	0.86**
Data integrity	0.81**	0.79**	0.83**	0.82**
Data timeliness	0.78**	0.83**	0.80**	0.81**
Data transparency	0.76**	0.74**	0.91**	0.83**
Data traceability	0.73**	0.77**	0.75**	0.76**

4.3 Supporting role for rural revitalization strategy

The level of informatization is a key lever for improving statistical service capacity, and the relationship between informatization level and resource allocation efficiency is shown in Table 8. Different levels of informatization exhibit a clear positive association with improvements in resource allocation efficiency and per-mu income growth. In villages at the excellent level, the digital collection coverage rate reaches 98.0%, the data sharing rate reaches 85.0%, the resource allocation efficiency enhancement rate reaches 52.8%, and the average per-mu income increases by more than 2,100 yuan. In contrast, in villages at the average level, the digital collection coverage rate is only 52.4%, the data sharing rate is 48.3%, the resource allocation efficiency enhancement rate is only 11.2%, and the per-mu income increase is less than 320 yuan. These results indicate that, once rural statistical services reach a certain level of informatization, digital technologies can play a stronger role in the accurate monitoring and dynamic allocation of agricultural production factors and public service resources.

Table 8: Level of informatization and resource allocation efficiency

Informatization level	Digital collection coverage rate (%)	Big data application rate (%)	Data sharing rate (%)	Resource allocation efficiency enhancement rate (%)	Per-mu income increase (yuan)
Excellent	98.0	85.7	85.0	52.8	2100+
Good	82.5	68.4	81.2	37.6	1000–2100
Moderate	67.8	45.3	65.7	23.4	320–1000
Average	52.4	28.6	48.3	11.2	<320

Collaborative capacity is an important support for the realization of grass-roots statistical services for village governance, and the multi-level collaborative statistical service model of “government + enterprises + social organizations + villagers” has been widely established,

greatly improving the scientific and effective statistical work. Figure 3 shows the correlation between collaborative capacity and governance effectiveness. In villages with full-time statisticians, the timeliness of data collection reaches 97.6%, while that of part-time statisticians is only 75.8%. Strengthening the training of statisticians and enhancing their professionalism can significantly improve the precision and efficiency of statistical services.

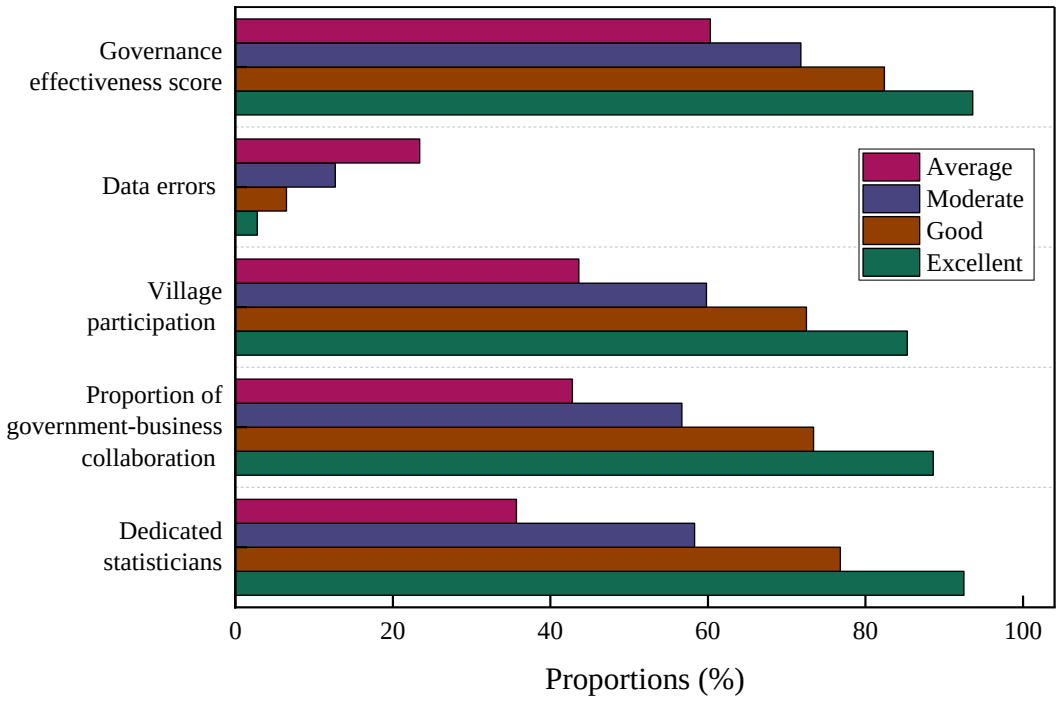

Figure 3: Correlation between collaborative capacity and governance effectiveness

Correlation analysis was conducted between the comprehensive score of statistical service capacity and the evaluation scores of the five objectives of rural revitalization, namely, industrial prosperity, ecological livability, civilized rural culture, effective governance and affluent life, and Table 9 shows the statistical service capacity and the effectiveness of rural revitalization. Statistical service capacity is significantly positively correlated with the comprehensive effectiveness of rural revitalization ($r=0.91, p<0.01$), with the most significant supporting effect on effective governance ($r=0.94$) and industrial prosperity ($r=0.89$), and a relatively weak supporting effect on rural civilization ($r=0.77$), which is consistent with the functional positioning of statistical services in data support and resource allocation.

Table 9: Capacity of statistical services and effectiveness of rural revitalization

Rural Revitalization Goals	Correlation coefficient (r)	Significance (p)	Regression coefficient	Goodness of fit (R^2)
Prosperous industries	0.89	<0.01	0.876	0.792
Eco-livability	0.83	<0.01	0.821	0.689
Civilized rural customs	0.77	<0.01	0.758	0.585
Effective governance	0.94	<0.01	0.923	0.884
Wealthy living	0.86	<0.01	0.847	0.739
Comprehensive results	0.91	<0.01	0.898	0.828

4.4 Contribution to rural industries

Service efficiency directly affects the speed of village industry development, and Table 10 shows the correlation analysis between service efficiency and industry upgrading. The policy response efficiency of the superior villages is 2.8 days on average, and the 6.3 days of the better villages is 55.6% less than that of the superior villages. Improving the efficiency of data analysis can provide forward-looking guidance for the development of the industry. Through machine learning analysis of agricultural production data, prediction of the probability of crop pests and diseases can be realized, and farmers can be reasonably medicated, with a 32.4% reduction in usage and an increase in the quality and safety pass rate of agricultural products to 99.2%.

Table 10: Analysis of the correlation between service efficiency and industrial upgrading

Service Efficiency Rating	Length of policy response (days)	Efficiency of data analysis (days)	Product value-added enhancement rate (%)	Pesticide reduction rate (%)	Agricultural product qualification rate (%)
Excellent	2.8	3.5	280+	32.4	99.2
Good	6.3	7.8	150-280	21.7	97.5
Medium	9.6	12.4	80-150	13.5	95.3
Fair	14.2	18.7	<80	7.8	92.1

The sample villages were classified into three types, namely characteristic industrial villages, major grain-producing villages, and key villages for traditional cultural protection, in order to compare differences in their statistical service capacity. Table 11 presents the comparative results for these three types of villages. Owing to relatively greater investment in data quality and informatization standardization, characteristic industrial villages achieve the highest overall score of 86.73, with an excellence rate of 36.4%. By contrast, villages oriented toward traditional cultural protection show relatively weaker overall performance in statistical service capacity, mainly due to insufficient informatization support, relatively limited data integration, and comparatively weaker service coordination mechanisms, with an excellence rate of only 10.0%. This indicates that greater support should be provided to such villages in improving service efficiency and informatization capacity, so as to better support the coordinated development of cultural protection and rural revitalization.

Table 11: Comparison of the capacity of different types of village statistical services

Village Type	Sample size	Composite score	Data quality	Service efficiency	Level of informatization	Collaboration capacity	Excellence rate (%)
Special Industry Village	22	86.73	88.45	82.67	87.32	86.54	36.4
Main Grain Producing Village	18	81.25	84.32	78.95	79.86	82.17	22.2
Ecological Reserve Village	10	75.38	80.17	73.42	72.58	76.83	10.0

5 Deepening and promoting the “three-tier statistical network” to assist in the implementation of the rural revitalization strategy

(1) Relying on the statistical platform audit formula, accurately set up four types of audit rules, the rural revitalization of enterprises to fill in the data for automatic screening and verification, from the source to improve the quality of data. Furthermore, it is an expert gatekeeper and multi-layer screening. Set up a team of statistical experts to carry out multi-layer manual review, accurate verification and screening of doubtful data screened by the system to ensure that the reported data is true and reliable, accurately reflecting the actual situation in the countryside, and build a standardized “three-tier statistical network” covering the entire process of data collection.

(2) With the help of the “three-tier statistical network”, we will optimize the mechanism for supplying cultural services and products, promote cultural volunteer services in villages, and carry out mass cultural and sports activities with agricultural interest and flavor. We will promote the excellent traditional Chinese culture, strengthen the protection and inheritance of traditional villages, enhance the protection and utilization of cultural relics and intangible cultural heritage, implement the revitalization project of traditional handicrafts, and carry out the restoration and strengthening of old and valuable trees as well as the protection of ancient tree clusters. It will promote the revitalization of traditional Chinese festivals and organize the Chinese Farmers' Harvest Festival. Cultivate and strengthen the rural cultural industry, implement the cultural industry-enabled rural revitalization plan, the deep integration of rural culture and tourism project, improve the quality and efficiency of rural tourism, and accelerate the digital empowerment of rural cultural industry [20].

6 Conclusion

This paper focuses on the statistical service capacity in the perspective of grass-roots governance is an important supporting role in the implementation of rural revitalization strategy, in which data quality, information technology level, synergy, service efficiency, all four together in the implementation of rural revitalization strategy into empowerment. Therefore, a comprehensive assessment method of TOPSIS is proposed The results show that the average score of the grassroots statistical service level of the 50 sample villages of Zhangzi County, Changzhi City, Shanxi Province is 74.35, indicating a moderate overall level with clear inter-village differences. Characteristic industrial villages perform better than major grain-producing villages and key villages for traditional cultural protection in terms of overall statistical service capacity. Through the questionnaire survey, it was found that rural residents' awareness of statistical work know accounted for 34.1%, the level of participation accounted for 12.4%, and the level of information is the biggest drawback satisfaction accounted for 39.2%. The results of correlation analysis show that the correlation coefficient between the statistical service capacity and the comprehensive effectiveness of rural revitalization is 0.91 ($P<0.01$), especially “effective governance” and “industrial prosperity” ($r=0.89$) have the greatest degree of support for the comprehensive effectiveness of rural revitalization The comparison of different types of villages reveals that Comparison of different types of villages revealed that due to high data quality and high degree of informatization, characteristic industrial villages had the highest composite score of 86.73 for statistical service capacity, while ecological reserve villages had obvious deficiencies in informatization and synergy, with an excellence of only 10.0%. This study can be targeted to improve the level of statistical services at the grassroots level,

differentiation and thus promote rural revitalization for the implementation of the implementation of rural revitalization strategy to provide supportive role and decision-making reference.

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