Evaluation of China's rural basic public service guarantee capability under the new "dual circulation" pattern

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Abstract: *Based on China's new development paradigm of "dual circulation",this paper aims to meet the three new requirements faced by basic public services in rural China,namely consumption upgrading,human capital cultivation,and coordinated regional development. Addressing the issue of regional differentiation in the supply of rural public services in China,and following the principles of accessibility,representativeness,comprehensiveness,and dynamism,this paper constructs an evaluation system for support capacity,encompassing three primary indicators and 31 secondary indicators related to fiscal investment,service output,and support effectiveness. The entropy weight TOPSIS method is employed to evaluate the support capacity of basic public services in rural areas across 31 provinces (including autonomous regions and municipalities) in China in 2024.The evaluation results reveal a four-tiered differentiation pattern in the support capacity of basic public services in rural China.Eight regions,including Shanghai and Beijing, demonstrate strong support capacity;nine regions,such as Hainan,exhibit relatively strong support capacity;ten regions,including Heilongjiang,have average support capacity;and four regions, including Ningxia,have weak support capacity.Overall,there is a regional disparity characterized by stronger support capacity in the east and weaker support capacity in the west.*

Keywords: *Rural China; basic public services; guarantee capacity; evaluate*

1. Introduction

Currently,significant differences exist in economic foundation, population structure,and fiscal capacity among rural areas in China's four major regions:eastern,central,western,and northeastern.These differences lead to regional disparities in the supply level and demand for basic public services such as pension,healthcare, and education.Under the new "dual circulation" development pattern,evaluating the guarantee capacity of basic public services in rural China helps accurately identify shortcomings in each region,providing a basis for optimizing resource allocation and narrowing the gap in basic public services across regions.It can also effectively enhance rural livelihood well-being,ensure coordinated urban-rural development,and accelerate the establishment of the new "dual circulation" development pattern.

2. Construction of evaluation index system for basic public service guarantee capacity in rural China

2.1 Principles for constructing an indicator system

The construction of an evaluation index system for China's rural basic public service guarantee capacity must adhere to certain principles, and the specific principles are as follows.

2.1.1 Principle of accessibility

When constructing a relevant evaluation index system,it is essential to ensure that the selected indicators are accessible.In the actual evaluation process,although some indicators meet the evaluation requirements of public service guarantee capability,it is difficult to obtain relevant data, or the cost of

obtaining data is very high.

2.1.2 Principle of Representativeness

The selected indicators should possess a certain degree of representativeness. It is not the case that the more indicators,the better.Instead,efforts should be made to select the most representative indicators that accurately reflect the basic public service guarantee capacity in rural areas,ensuring that all evaluation indicators are highly representative.

2.1.3 Principle of Comprehensiveness

The principle of comprehensiveness does not merely entail a simple enumeration of all basic indicators.Instead,it requires adhering to the logical relationships among indicators,aiming to reflect the overall situation of the research subject as comprehensively as possible.This section primarily evaluates the support capability of rural basic public services from both subjective and objective perspectives.

2.2 Indicator system for evaluating the basic public service guarantee capacity in rural China

This section establishes an indicator system for evaluating the capacity of rural basic public service guarantees (see Table 1).

Table 1：Evaluation Indicator System for Rural Public Service Guarantee Capacity in China

Primary Indicator	Secondary Indicator	Tertiary Indicator	Indicator Meaning	Indicator Nature
Financial Input Capacity	Financial Resources	Per Capita Financial Input in Rural Public Services (Yuan/capita)	Reflects public finance investment intensity in rural public services	Positive
		Per Capita Financial Transfer Payment for Rural Public Services (Yuan/capita)	Reflects rural public services' dependence on financial transfer payments	Positive
	Economic Resources	Per Capita Disposable Income of Rural Residents (Yuan/capita)	Reflects private capital investment potential in rural public services	Positive
Service Output Capacity	Medical and Health Care	Number of Medical and Health Institutions per 1,000 Rural Population (Institutions/1,000 people)	Reflects rural medical and health service output level	Positive
		Number of Medical and Health Personnel per 1,000 Rural Population (Personnel/1,000 people)		Positive
		Number of Beds in Medical Institutions per 1,000 Rural Population (Beds/1,000 people)		Positive
	Public Education	Number of Schools per 1,000 Rural Primary and Secondary Students (Schools/1,000 students)	Reflects rural public education service output level	Positive
		Number of Teachers per 1,000 Rural Primary and Secondary Students (Teachers/1,000 students)		Positive
		Number of Schools per 1,000 Rural Secondary Vocational Students (Schools/1,000 students)		Positive
		Number of Teachers per 1,000 Rural Secondary Vocational Students (Teachers/1,000 students)		Positive
	Elderly Care Services	Number of Elderly Care Institutions per 1,000 Rural Population (Institutions/1,000 people)	Reflects rural elderly care service output	Positive

Primary Indicator	Secondary Indicator	Tertiary Indicator	Indicator Meaning	Indicator Nature
		Number of Elderly Care Workers per 1,000 Rural Population (Workers/1,000 people)	level	Positive
		Number of Beds in Elderly Care Institutions per 1,000 Rural Population (Beds/1,000 people)		Positive
	Social Security	Per Capita Expenditure on Rural Residents' Basic Pension Insurance (Yuan/capita)	Reflects rural social security service output level	Positive
		Per Capita Expenditure on Rural Residents' Basic Medical Insurance (Yuan/capita)		Positive
	Employment and Entrepreneurship	Number of Farmer Training Person-times (Person-times)	Reflects rural employment and entrepreneurship service output level	Positive
		Number of Rural Employed Persons at the End of the Year (Persons)		Positive
	Culture and Sports	Number of Cultural Institutions per 10,000 Rural Population (Institutions/10,000 people)	Reflects rural public cultural and sports service output level	Positive
		Per Capita Sports Venue Area in Rural Areas (Square meters/capita)		Positive
	Medical and Health Care	Rural Maternal Mortality Rate (Per 100,000)	Reflects rural medical and health service guarantee effect	Negative
		Rural Neonatal Mortality Rate (‰)		Negative
		Rural Under-5 Child Mortality Rate (‰)		Negative
Guarantee Effect Capacity	Public Education	Average Years of Education of Rural Residents (Years)	Reflects rural public education service guarantee effect	Positive
		Rural Compulsory Education Consolidation Rate (%)		Positive
	Elderly Care Services	Guarantee Rate of Rural Special Elderly Groups (%)	Reflects rural elderly care service guarantee effect	Positive
		Bed Occupancy Rate of Rural Elderly Care Institutions (%)		Positive
	Social Security	Rural Residents' Pension Insurance Participation Rate (%)	Reflects rural social security service guarantee effect	Positive
		Rural Residents' Medical Insurance Participation Rate (%)		Positive
	Employment and Entrepreneurship	Wage Income in Per Capita Disposable Income of Rural Residents (Yuan/capita)	Reflects rural employment and entrepreneurship service guarantee effect	Positive
		Net Operating Income in Per Capita Disposable Income of Rural Residents (Yuan/capita)		Positive
	Public Culture	Coverage Rate of Rural Cultural Institutions (%)	Reflects rural public cultural service guarantee effect	Positive

3. Calculation method and data source of evaluation indicators

3.1 Fiscal investment capacity indicator

The per capita fiscal investment index for rural public services is calculated by dividing the total fiscal investment in rural public services by the number of permanent rural residents. The per capita fiscal transfer payment index for rural public services is calculated by dividing the sum of general transfer payments and special transfer payments from the central government to local governments,

which are used for rural public services, by the number of permanent rural residents. The values of the above two secondary indicators are calculated based on data collated from the China Finance Yearbook and the National Financial Statistics of Prefectures, Cities, and Counties over the years. The data for the secondary indicator of per capita disposable income of rural residents is sourced from the China Rural Statistical Yearbook and the Statistical Communiqué on National Economic and Social Development of various provinces (autonomous regions, municipalities directly under the central government) over the years.

3.2 Service output capacity indicator

The data for the three secondary indicators, namely the number of medical and health institutions per 1,000 people in rural areas, the number of medical and health personnel per 1,000 people in rural areas, and the number of hospital beds per 1,000 people in rural medical institutions, are sourced from the China Rural Statistical Yearbook over the years.

The data for the secondary indicators, including the number of schools and teachers per 1,000 primary and secondary school students in rural areas, as well as the number of schools and teachers per 1,000 vocational school students in rural areas, are sourced from the China Statistical Yearbook, China Education Statistical Yearbook, and statistical yearbooks of various provinces (autonomous regions, municipalities directly under the central government) over the years.

3.3 Support effectiveness and capability indicators

The data for the three secondary indicators, namely, the number of medical and health institutions per 1,000 people in rural areas, the maternal mortality rate in rural areas, the neonatal mortality rate in rural areas, and the mortality rate of children under 5 years old in rural areas, are sourced from the China Statistical Yearbook and the China Social Statistical Yearbook over the years.

The calculation method for the secondary indicator of the average years of education for rural residents refers to the calculation method for average years of education per capita proposed by the Department of Population, Society, and Science and Technology Statistics of the National Bureau of Statistics. According to China's current school system, the average years of education for rural residents = (population of rural residents with primary school education level × 6 + population of rural residents with junior high school education level × 9 + population of rural residents with high school and technical secondary school education level × 12 + population of rural residents with college degree or above × 16) / population of rural residents aged 6 and above. The value of this secondary indicator is calculated based on data collated from the China Statistical Yearbook and the China Rural Statistical Yearbook over the years.

4. Evaluation of basic public service guarantee capacity in rural China

4.1 Evaluation method:entropy weight TOPSIS method

When using TOPSIS for decision-making or evaluation, the determination of weights is crucial to the results. To reduce subjectivity in the weight determination process, combining the entropy weight method can make the TOPSIS weight determination method more scientific and objective. This section adopts the entropy weight TOPSIS method for research.

4.1.1 Data standardization processing

Given that the objects to be evaluated are m (m=31) provinces (including autonomous regions and municipalities), and each object has n (n=31) evaluation indicators (see Table 1), the following judgment matrix is constructed: $X = (x_{ij})_{mn}$， where x_{ij} represents the value of the j-th evaluation indicator in the i-th region, with i = 1,2...m，j = 1,2...n.

This study intends to adopt the extreme value normalization method to eliminate the differences in dimensions among various indicators. The normalization method for positive indicators (+) is as follows:

$$x'_{ij} = [x_{ij} - \min(x_{ij})] / [\max(x_{ij}) - \min(x_{ij})] \quad (1)$$

The standardization method for the inverse indicator (-) is as follows:

$$x'_{ij} = 1 - [x_{ij} - \min(x_{ij})]/[\max(x_{ij}) - \min(x_{ij})]$$
$$= [\max(x_{ij}) - x_{ij}]/[\max(x_{ij}) - \min(x_{ij})] \quad (2)$$

4.1.2 Calculate the entropy value of each index

According to the information entropy theory,the entropy value e_j of the j-th index can be expressed as:

$$e_j = -k\sum_{i=1}^{m} y_{ij} \ln y_{ij} \quad (3)$$

In formula (3):

$$k = 1/\ln(m),\ y_{ij} = x'_{ij}/\sum_{i=1}^{m} x'_{ij}$$

4.1.3 Calculate the coefficient of variation for each indicator

After determining the information entropy of the indicators, the coefficient of variation for each indicator can be calculated:

$$h_j = 1 - e_j \quad (4)$$

If the coefficient of variation of the j-th index value among various rating samples is greater, the entropy value of the index is smaller, and the greater role the index plays in comparing schemes.

4.1.4 Determine the weight of each indicator

Define the weight of the j-th indicator:

$$w_j = h_j/\sum_{j=1}^{n} h_j \quad (5)$$

In formula (5):

$$w_j \in [0,1],\ \sum_{j=1}^{n} w_j = 1$$

4.1.5 Construct a standardized evaluation matrix

Right multiply the normalized judgment matrix $X' = (x'_{ij})_{mn}$ by the weight vector w_j of each index to obtain the weighted normalized evaluation matrix:

$$R = (r_{ij})_{mn} = (x'_{ij} w_j)_{mn} \quad (6)$$

4.1.6 Determine the positive and negative ideal solutions

Let S_j^+ be the maximum value of evaluation index j in region i, and S_j^- be the minimum value of evaluation index j in region i. Then the positive and negative ideal solutions are respectively:

$$S_j^+ = \max(r_{1j}, r_{2j}, ...r_{mj}) \quad j = 1,2, ..., n \quad (7)$$

$$S_j^- = \min(r_{1j}, r_{2j}, ...r_{mj}) \quad j = 1,2, ..., n \quad (8)$$

4.1.7 Calculate the distance from the ideal solution

Let D_i^+ denote the Euclidean distance between the j-th evaluation index of region i and the positive ideal solution S_j^+, and D_i^- denote the Euclidean distance between the j-th evaluation index of region i and the negative ideal solution S_j^-. Then, the distance between each evaluation object and the positive and negative ideal solutions can be expressed as follows:

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (r_{ij} - s_j^+)^2} \quad i = 1,2, ..., m \quad (9)$$

$$D_i^- = \sqrt{\sum_{j=1}^{n} (r_{ij} - s_j^-)^2} \quad i = 1,2, ..., m \quad (10)$$

4.1.8 Calculate the closeness degree of each evaluation object

Let C_i represent the closeness degree, which indicates the extent to which the basic public service guarantee capability of rural areas in the i-th region approaches the ideal solution. The calculation

method is as follows:

$$C_i = D_i^- / (D_i^- + D_i^+) \qquad i = 1,2,...,m \qquad (11)$$

In formula (11): $C_i \in [0,1]$, The greater the value of C_i, the stronger the basic public service guarantee capability of rural areas in region i.Based on existing research(Lei Xunping et al., 2016; Yang Qiuxia, 2022), this study divides the closeness degree of evaluation of rural basic public service guarantee capacity in China into four levels, thereby distinguishing the strength and weakness of rural basic public service guarantee capacity (see Table 2).

Table 2：Evaluation Criteria for Basic Public Service Guarantee Capacity in Rural China

The value of closeness C	0<C≤0.30	0.30<C≤0.60	0.60<C≤0.80	0.80<C≤1.00
Support capability	relatively weak	average	relatively strong	very strong

4.2 Evaluation process and results

Firstly, a judgment matrix is established based on the evaluation index system of rural basic public service guarantee capacity in Table 1.Combined with the aforementioned analysis of rural basic public service demand and satisfaction, university professors and experts from the agricultural and rural bureau assign weights to the relevant primary and secondary indicators. Then, the entropy value and entropy weight of each tertiary indicator in 2024 can be calculated according to formulas (1) to (5) (see Table 3).

Table 3: Entropy values and entropy weights of evaluation indicators for China's rural basic public service guarantee capacity

Primary Indicator	Weight	Secondary Indicator	Weight	Tertiary Indicator	Entropy Value	Entropy Weight
Fiscal Input Capacity	25%	Fiscal Resources	60%	Per Capita Fiscal Input in Rural Public Services (yuan/person)	0.7696	0.6483
				Per Capita Fiscal Transfer Payment for Rural Public Services (yuan/person)	0.8750	0.3517
		Economic Resources	40%	Per Capita Disposable Income of Rural Residents (yuan/person)	0.8264	1.0000
Service Output Capacity	40%	Medical and Health Care	25%	Number of Medical and Health Institutions per Thousand Rural Population (institutions/thousand persons)	0.8331	0.2357
				Number of Medical and Health Personnel per Thousand Rural Population (persons/thousand persons)	0.6966	0.4261
				Number of Beds in Medical and Health Institutions per Thousand Rural Population (beds/thousand persons)	0.7599	0.3382
		Public Education	20%	Number of Schools per Thousand Rural Primary and Secondary School Students (schools/thousand students)	0.8472	0.2011
				Number of Teachers per Thousand Rural Primary and Secondary School Students (teachers/thousand students)	0.7163	0.3732
				Number of Schools per Thousand Rural Secondary	0.8914	0.1429

Primary Indicator	Weight	Secondary Indicator	Weight	Tertiary Indicator	Entropy Value	Entropy Weight
Guarantee Effectiveness Capacity	35%	Elderly Care Services	18%	Vocational School Students (schools/thousand students)	0.7852	0.2828
				Number of Teachers per Thousand Rural Secondary Vocational School Students (teachers/thousand students)	0.8549	0.2118
				Number of Elderly Care Institutions per Thousand Rural Population (institutions/thousand persons)	0.6657	0.4879
				Number of Elderly Care Givers per Thousand Rural Population (persons/thousand persons)	0.7944	0.3003
				Number of Beds in Elderly Care Institutions per Thousand Rural Population (beds/thousand persons)	0.8223	0.4036
		Social Security	15%	Per Capita Expenditure on Basic Endowment Insurance for Rural Residents (yuan/person)	0.7374	0.5964
				Per Capita Expenditure on Basic Medical Insurance for Rural Residents (yuan/person)	0.8826	0.3252
		Employment and Entrepreneurship	12%	Number of Migrant Worker Training Sessions (person-times)	0.7564	0.6748
				Number of Rural Employed Persons at the End of the Year (persons)	0.9104	0.1635
		Culture and Sports	10%	Number of Cultural Institutions per Ten Thousand Rural Population (institutions/ten thousand persons)	0.5417	0.8365
				Per Capita Sports Venue Area in Rural Areas (square meters/person)	0.8677	0.1657
		Medical and Health Care	25%	Rural Maternal Mortality Rate (1/100,000)	0.6731	0.4082
				Rural Neonatal Mortality Rate (‰)	0.6592	0.4261
				Rural Under-5 Child Mortality Rate (‰)	0.8392	0.9236
		Public Education	20%	Average Years of Education of Rural Residents (years)	0.9867	0.0764
				Rural Compulsory Education Consolidation Rate (%)	0.8850	0.6678
		Elderly Care Services	15%	Guarantee Rate of Special Rural Elderly Groups (%)	0.9428	0.3322
				Bed Occupancy Rate of Rural Elderly Care Institutions (%)	0.8450	0.6143
		Social Security	18%	Participation Rate of Rural Residents in Endowment Insurance (%)	0.9027	0.3857
				Participation Rate of Rural		

Primary Indicator	Weight	Secondary Indicator	Weight	Tertiary Indicator	Entropy Value	Entropy Weight
				Residents in Medical Insurance (%)		
		Employment and Entrepreneurship	12%	Wage Income in Per Capita Disposable Income of Rural Residents (yuan/person)	0.7802	0.6312
				Net Business Income in Per Capita Disposable Income of Rural Residents (yuan/person)	0.8716	0.3688
		Public Culture	10%	Coverage Rate of Rural Cultural Institutions (%)	0.6204	1.0000

Based on formulas (6) to (11),the Euclidean distances D_i^+,D_i^- between the evaluation index values of each province (autonomous region,municipality) in 2024 and the positive and negative ideal solutions S_j^+ , S_j^- can be calculated respectively,as well as the closeness degree C_i to the optimal solution (see Table 4).

Table 4: The closeness degree C_i of rural basic public service guarantee capacity in 31 provinces (autonomous regions,municipalities directly under the central government) in China in 2024

Region	Distance to Positive Ideal Solution D_i^+	Distance to Negative Ideal Solution D_i^-	Closeness Coefficient C_i	Ranking of Closeness Coefficient
Beijing	0.0809	2.3702	0.9712	2
Tianjin	0.3025	2.1518	0.8809	8
Hebei	0.7302	1.7203	0.7015	11
Shanxi	0.9806	1.4713	0.6016	17
Inner Mongolia	1.2212	1.2306	0.5013	20
Liaoning	0.6811	1.7714	0.7208	10
Jilin	1.1807	1.2711	0.5202	19
Heilongjiang	1.1016	1.3506	0.5517	18
Shanghai	0.0516	2.4013	0.9803	1
Jiangsu	0.1022	2.3516	0.9625	3
Zhejiang	0.1247	2.3307	0.9504	4
Anhui	0.9518	1.5016	0.6107	16
Fujian	0.2503	2.2036	0.9011	6
Jiangxi	0.9203	1.5308	0.6219	15
Shandong	0.2816	2.1702	0.8816	7
Henan	0.8812	1.5713	0.6405	14
Hubei	0.8506	1.6025	0.6506	13
Hunan	0.8613	1.5908	0.6514	12
Guangdong	0.2015	2.2514	0.9227	5
Guangxi	1.2803	1.1712	0.4818	22
Hainan	0.6103	1.8409	0.7513	9
Chongqing	1.3503	1.1024	0.4581	24
Sichuan	1.3014	1.1505	0.4722	23
Guizhou	1.7219	0.7308	0.3026	27
Yunnan	1.6011	0.8516	0.3521	26
Tibet	2.1603	0.2909	0.1238	31
Shaanxi	1.2506	1.2017	0.4924	21
Gansu	1.9602	0.4914	0.2029	29
Qinghai	2.0212	0.4306	0.1732	30
Ningxia	1.9016	0.5512	0.2223	28
Xinjiang	1.5009	0.9504	0.4036	25

As can be seen from Table 4, based on the evaluation criteria for rural basic public service guarantee capacity in Table 2, the rural basic public service guarantee capacity of China's 31 provinces (including autonomous regions and municipalities directly under the central government) in 2024 is divided into four levels (see Table 5).

Table 5: Levels of Basic Public Service Guarantee Capacity in Rural Areas of China in 2024

Closeness Degree C_i	Guarantee Capacity	Province (Autonomous Region, Municipality Directly under the Central Government)	Number of Regions
$0.80<C_i\leq1.00$	very strong	Shanghai, Beijing, Jiangsu, Zhejiang, Guangdong, Fujian, Shandong, Tianjin	8
$0.60<C_i\leq0.80$	relatively strong	Hainan, Liaoning, Hebei, Hunan, Hubei, Henan, Jiangxi, Anhui, Shanxi	9
$0.30<C_i\leq0.60$	average	Heilongjiang, Jilin, Inner Mongolia, Shaanxi, Guangxi, Sichuan, Chongqing, Xinjiang, Yunnan, Guizhou	10
$0<C_i\leq0.30$	relatively weak	Ningxia, Gansu, Qinghai, Tibet	4

4.3 Brief conclusion

For the first-tier regions with strong support capabilities, we should promote service quality improvement and efficiency enhancement, encourage them to export advanced experience and management models, and give full play to their exemplary and leading role. For the second and third-tier regions, it is necessary to increase provincial financial investment, focus on core areas such as education and healthcare to address shortcomings, and strengthen infrastructure construction. For the fourth-tier western provinces and autonomous regions, it is important to strengthen central financial transfer payments, establish a mechanism for cooperation and assistance between the eastern and western regions, and provide targeted delivery of resources such as talents and technology. In addition, a dynamic monitoring and evaluation mechanism needs to be established to adjust support strategies in a timely manner according to local development changes. Only by adapting measures to local conditions and promoting collaborative progress can we gradually bridge the regional gap and achieve balanced and high-quality development of basic public services in rural areas nationwide.

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