

# Comprehensive Evaluation of the Development Level of Rural Logistics in China from the Perspective of Rural Revitalization

Yuhong Shi<sup>1</sup>, Mengju Yang<sup>2</sup>

<sup>1</sup> School of Economics and Management, Chongqing University of Posts and Telecommunications, China

<sup>2</sup> Modern Postal School, Chongqing University of Posts and Telecommunications, China

## Abstract

Taking the perspective of rural revitalization, this study constructs an index system for the development level of rural logistics. Based on data from the year 2021, the entropy method is employed to calculate scores for each index, thus providing a comprehensive evaluation of the current status of rural logistics development in China. The results indicate that the overall level of rural logistics development in China is on an upward trend with robust developmental momentum. However, challenges such as supply and demand imbalances, unfavorable conditions, slowing speed, and inappropriate structure exist. The spatial layout of rural logistics development exhibits a decreasing trend from the southeast coastal areas to the central, northern, and western regions. It is suggested that enhancing rural economic levels, improving rural infrastructure, addressing imbalances in rural logistics supply and demand, and promoting rural informatization are the main strategies for developing rural logistics in China.

## Keywords

Rural Revitalization; Rural Logistics; Entropy Method; Spatial Layout.

## 1. Introduction

With the widespread application of modern digital “new technologies” and the gradual popularization of digital “new infrastructure,” modern logistics has become more sensitive in state perception, timelier in data analysis, more precise in execution and delivery, and more autonomous in iterative evolution, with “intelligence” being its most prominent feature. However, for a long time, due to weak economic foundations and remote geographical locations, the development of modern logistics in vast rural areas of China has remained relatively backward and disconnected compared to urban areas. According to survey data from the China Consumers Association, the logistics costs for parcel delivery in rural areas of China are three times higher within a 30-kilometer radius compared to urban areas, and this figure increases to five times within a 60-kilometer radius[1]. Among the nearly 500 million rural residents in China, over 30% feel that purchasing daily necessities is inconvenient, while nearly 40% find purchasing agricultural production materials insufficiently convenient[2]. The “Opinions of the Central Committee of the Communist Party of China and the State Council on the Key Tasks of Comprehensively Promoting Rural Revitalization in 2022” explicitly states the need to continuously improve rural logistics infrastructure, vigorously promote the integration of digital technology and services into the rural logistics system, eliminate logistical “bottlenecks” obstructing the unified national market, comprehensively reduce logistics costs in rural areas, and support rural revitalization efforts. Thus, whether from the practical needs of the vast rural population or the inherent requirements of China’s rural revitalization strategy, the construction of a logistics system in rural areas has become extremely urgent. Logistics represents the inevitable direction of transformation and upgrading in the modern logistics

industry, with contemporary digital information technology marking its entry into a rapid development stage. Currently, domestic and foreign scholars have extensively explored logistics from different perspectives, utilizing various scenarios and methodologies.

Research on the interrelationship between logistics development and economic development levels has been conducted. Ji Xiaofeng and Yang found, through their study of the relationship between urban economic development and urban logistics in China, that urban economic development serves as the foundation for urban logistics development, with urban logistics development playing a promotive role in economic development, indicating a significant correlation between the two[3]. Building upon this, Gao Kang and others further investigated and discovered that the dynamic coupling of logistics supply and demand with the economic environment constitutes a stimulating factor for the growth of logistics demand within a region, thereby meeting the needs of economic development[4]. This phenomenon is not limited to China; even abroad, such a relationship is commonly observed, as scholars like Sultan Kuzu found a long-term significant bidirectional Granger causality relationship between economic growth and modern logistics development in Turkey[5]. Research has also focused on the factors influencing logistics development. Lan and others found that key factors affecting urban logistics development include investment in logistics infrastructure, development of the logistics industry, basic research and development, and intra-chain technological development[6]. Fu Weizhong and others identified factors such as highway operating mileage, freight volume, cargo turnover, economic structure, fixed asset investment in the logistics industry, total postal business volume, and regional gross domestic product as influencing logistics development[7]. Allen, based on extensive data on urban logistics development, analyzed the effects of factors such as locational space, geographical location, and regional land area on urban logistics development[8]. Building on research on EU logistics competitiveness, D'Aleo and Sergi discussed the impact of information technology and human resources on logistics performance[9]. Utilizing global entropy and GMM estimation methods, Sun Lei and others determined that cost pressures, environmental regulations, government interventions, traffic network density, and technological levels play a crucial role in enhancing China's logistics development level[10]. Research on logistics development measurement indicators has been undertaken. Cao Zhiqiang and others constructed measurement indicators from five dimensions: regional economic development, logistics supply and demand relationships, logistics infrastructure construction, information networkization, and foreign trade exchanges[11]. They conducted quantitative research on the logistics status of nine provinces and cities in the Yellow River Basin using global principal component analysis, entropy weight TOPSIS combination model, gray correlation model, and ICC combined correlation coefficient method. Liu Yan and others, from the perspective of industrial linkage, constructed a city logistics industry competitiveness evaluation index system, including economic development capabilities, logistics demand capabilities, urban supply capabilities, talent environment construction capabilities, and informatization capabilities, using entropy weight and TOPSIS combination models, analyzing the strengths and weaknesses of city logistics industry competitiveness in inland node cities of the "Belt and Road"[12]. Zong Huiming and others utilized the Analytic Hierarchy Process to evaluate the logistics competitiveness of western region node cities from five aspects: economic level of regional logistics development, social consumption capacity, development foundation of the logistics industry, logistics talent level, and information technology level[13].

Through this review, it is widely recognized by domestic and foreign scholars that logistics plays a significant role in promoting high-quality economic development in regions, while high-quality economic development constitutes the material basis for regional logistics construction, thereby establishing a mutual promotion relationship. Among these, economic conditions, information technology levels, policy support intensity, industrial structure scale, and

infrastructure construction are core variables for high-quality logistics development. Evidently, these existing research findings have provided us with a relatively clear and intuitive understanding of the current status of logistics development and its key influencing factors. However, it is also evident that there are significant differences between urban and rural areas in terms of population size, age structure, industrial forms, and operational modes. Evaluating rural logistics development using the “yardstick” of urban logistics development makes it difficult to draw convincing conclusions and lacks specificity for improving rural logistics construction. Furthermore, there is relatively limited research on rural logistics in China. Therefore, based on the era of rural revitalization, this paper, inspired by the theory of coevolution and logistics theory, aims to construct a quantitative evaluation index system for Chinese rural logistics, guided by the essence of logistics and its relevant influencing factors. It seeks to quantitatively analyze the problems and main characteristics in the development process of rural logistics in China, thereby providing theoretical suggestions for the construction of rural logistics in China during the “14th Five-Year Plan” period.

## **2. Main Framework and Practical Role from the Perspective of Rural Revitalization**

### **2.1. Theoretical Foundation**

#### **2.1.1. Main Framework of Rural Logistics**

Rural logistics constitutes a crucial component of the national modern logistics system, designed to adapt to the unique economic and resource characteristics of rural areas. It provides logistical functions and meets the developmental needs of rural regions. The system primarily comprises four subsystems: dominant platforms, key populations, functional populations, and supportive populations. Dominant platforms consist of logistics central platforms, including data and algorithm central platforms. These platforms efficiently connect and aggregate all logistical elements, centrally integrating and depositing resources and data related to the supply and demand sides of rural logistics services and commodities.

Demand entities exhibit a dual nature of “consumption-production,” generating demand for logistical services while contributing various resource elements to rural logistics. They serve as the starting point and mapping for modular organizational value innovation. Supply entities transport resources, services, and facilities through networks to different value modules, forming the foundation for organizational innovation. Functional populations are critical factors in enhancing the high-quality, sustainable, and coordinated development of rural logistics. Comprising the direct execution populations of rural logistics activities, such as transportation, warehousing, packaging, and distribution populations, they provide functional support for the operation of the logistics central platform. Supportive populations mainly provide necessary software and hardware support for rural logistics activities, including logistics equipment manufacturers, logistics financial service providers, and logistics service software providers.

#### **2.1.2. Role of Rural Logistics in Rural Revitalization**

Facilitating the Flow of Rural Elements and Enhancing the Competitiveness of Agricultural Products. The development of rural logistics can overcome the barriers caused by geographical constraints and information blockages between urban and rural areas. By integrating rural development elements and linking with urban logistics public information platforms, a widely covered and efficient integrated logistics network is formed[14]. This network caters to rural production and lifestyle needs, facilitating the efficient flow and rational allocation of capital, talent, and other factors between urban and rural areas. It invigorates rural production and consumption markets, effectively connecting “small farmers” with “large markets,” thereby enhancing the level of specialization and competitiveness of rural products.

Lowering Rural Logistics Costs and Promoting Rural Industrial Development. The key to rural revitalization lies in industrial rejuvenation, with logistics advancement being paramount. Rural logistics establish real-time connections between the supply and demand ends of rural industries. By optimizing and integrating various logistics processes such as processing, sorting, warehousing, transportation, and distribution, rural logistics reduce circulation links, enhance commodity turnover efficiency, lower factor circulation costs, and thereby improve the overall economic benefits of rural areas[15].

Increasing Rural Residents' Incomes and Consolidating Poverty Alleviation Achievements. Leveraging digital technologies such as the internet, cloud computing, big data, and artificial intelligence, rural logistics enhance the efficiency of production, supply, and sales processes. This attracts more businesses to settle in rural areas, creating and increasing employment opportunities in infrastructure and distribution systems[16]. Consequently, it attracts surplus rural labor, increases rural residents' incomes, and improves their living standards. The rural logistics system provides efficient warehousing, transportation, and distribution services for commodities in poverty-stricken areas, establishing high-quality sales and distribution channels for agricultural products. This ensures timely market access, creating value in terms of time, place, and processing, thereby increasing farmers' profit margins and laying a solid foundation for sustained income growth. Additionally, rural logistics provide rural residents with more choices of consumer goods, expand their options and bargaining space, reduce rural living costs and agricultural transaction costs, facilitate the purchase of affordable and high-quality goods, indirectly raise rural income levels, upgrade consumption structures, and effectively consolidate poverty alleviation achievements.

Improving Rural Infrastructure and Narrowing the Urban-Rural Living Gap. Rural logistics development upgrades the urban-rural commodity circulation system, resolving the "first and last mile" issues of agricultural product upstream and consumer goods downstream, and achieving integrated development from agricultural production to market sales. In this process, it drives rural infrastructure construction and promotes rural economic development. The development of rural economy supports the upgrading and optimization of rural roads and the introduction and application of modern intelligent equipment, thereby improving the quality of rural life and narrowing the urban-rural living gap.

### **3. Empirical Analysis of Rural Logistics Development Levels under the Rural Revitalization Strategy**

#### **3.1. Construction of Indicator System**

In order to assess the current level of rural logistics development in China, this study draws upon the index selection criteria proposed by Dai Debao [17] and Li Guojun [18] in evaluating logistics development levels. Based on principles of data availability, completeness, comprehensiveness, and representativeness, this study constructs an evaluation index system comprising three primary indicators: development trend, driving forces, and development conditions. Furthermore, six secondary indicators-scale, speed, supply side, demand side, economic conditions, and facility conditions-and 26 tertiary indicators are established within the evaluation index system. Notably, the data for these indicators are sourced from the Statistical Yearbooks of various provincial-level administrative regions in China for the year 2021, see Table 1.

**Table 1.** Comprehensive Evaluation Indicator System for the Development Level of Rural Logistics in China

Primary Indicator	Secondary Indicator	Tertiary Indicator	Data Source	Calculation Method	
Development Trend A1	Development Scale B1	The added value of logistics per ten thousand people in rural areas (in 100 million yuan) C1	The Statistical Yearbook of Various Provinces	$((\text{Per capita disposable income in rural areas} / \text{Total resident income level}) * \text{Value added of transportation, warehousing, and postal services}) / \text{Rural population}$	
		The delivery route kilometers per ten thousand people in rural areas (in kilometers) C2	The Statistical Yearbook of Various Provinces	$\text{Rural delivery route mileage} / \text{Rural population}$	
		The revenue of express delivery services per ten thousand people in rural areas (in ten thousand yuan)C3	The Statistical Yearbook of Various Provinces	$((\text{Number of rural broadband access users} / \text{Total broadband access users}) * \text{Express delivery business revenue}) / \text{Rural population}$	
		The total volume of postal services C4	The Statistical Yearbook of Various Provinces	raw data	
	Development rate B2	The growth rate of delivery route in rural areas(%)C5	The Statistical Yearbook of Various Provinces	$((\text{Rural delivery route mileage in the current period} / \text{Rural delivery route mileage in the previous period}) - 1)$	
		The growth rate of broadband access users in rural areas(%)C6	The Statistical Yearbook of Various Provinces	$((\text{Number of rural broadband access users in the current period} / \text{Number of rural broadband access users in the previous period}) - 1)$	
		The growth rate of the average number of household-owned automobiles per hundred households in rural areas(%)C7	The Statistical Yearbook of Various Provinces	$((\text{Per capita number of household cars in rural areas in the current period} / \text{Per capita number of household cars in rural areas in the previous period}) - 1)$	
		The growth rate of employed individuals in rural transportation, storage, and postal services sector(%)C8	The Statistical Yearbook of Various Provinces	$((\text{Number of rural transportation, warehousing, and postal industry employees in the current period} / \text{Number of rural transportation, warehousing, and postal industry employees in the previous period}) - 1)$	
	Development dynamics A2	Demand side B3	The per capita consumption expenditure of rural residents (in yuan) C9	The Statistical Yearbook of Various Provinces	raw data
			The turnover of rural e-commerce (in hundred million yuan) C10	The Statistical Yearbook of Various Provinces	$(\text{The number of rural broadband access users} / \text{Total number of broadband access users}) * \text{Total enterprise e-commerce procurement amount}$
The market turnover of agricultural products per ten thousand people (in hundred million yuan) C11			The Statistical Yearbook of Various Provinces	$(\text{The transaction value of agricultural products market} / \text{Rural population})$	
The per capita consumption of cereals by rural residents (in			The Statistical Yearbook of Various	raw data	

		kilograms) C12	Provinces	
		The per capita turnover of goods per ten thousand rural residents (in hundred million ton-kilometers) C13	The Statistical Yearbook of Various Provinces	((Ratio of rural residents' disposable income to total residents' disposable income) * Turnover of goods) / Rural population
	Supply Side B4	The number of rural logistics personnel per ten thousand rural employees in rural areas C14	The Statistical Yearbook of Various Provinces	((Ratio of rural employment to total employment) * Number of employees in transportation, warehousing, and postal services) / Rural population
		The fixed asset investment in logistics industry per ten thousand people (in ten thousand yuan) C15	The Statistical Yearbook of Various Provinces	Fixed asset investment in the logistics industry / Regional resident population
		The number of postal service outlets per ten thousand rural population C16	The Statistical Yearbook of Various Provinces	((Ratio of rural broadband access users to total broadband access users) * Number of postal service outlets) / Rural population
The average number of computers per one hundred households in rural areas C17		The Statistical Yearbook of Various Provinces	raw data	
Infrastructure conditions A3	Economic Conditions B5	Per capita disposable income of farmers (in yuan)C18	The Statistical Yearbook of Various Provinces	raw data
		The added value of the primary industry (in billion yuan) C19	The Statistical Yearbook of Various Provinces	raw data
		Per capita disposable income of rural residents (in yuan) C20	The Statistical Yearbook of Various Provinces	raw data
		The budgeted expenditure on transportation and logistics (in ten thousand yuan) C21	The Statistical Yearbook of Various Provinces	raw data
	Infrastructure conditions B6	The per 10,000 people count of rural broadband access users (in ten thousand households) C22	The Statistical Yearbook of Various Provinces	Number of rural broadband access users per rural population
		The average number of household cars per one hundred rural residents (in vehicles) C23	The Statistical Yearbook of Various Provinces	raw data
		The per 10,000 people count of rural freight vehicle tonnage (in ten thousand tons) C24	The Statistical Yearbook of Various Provinces	((Ratio of rural per capita disposable income to total per capita disposable income) * Regional freight truck tonnage) / Rural resident population
		The per 10,000 people count of rural railway operational mileage (in ten thousand kilometers) C25	The Statistical Yearbook of Various Provinces	Railway operating mileage per regional population
		The per 10,000 people count of rural road operational mileage (in ten thousand kilometers) C26	The Statistical Yearbook of Various Provinces	Highway operating mileage per regional population

### 3.2. Entropy Method

First of all, China's rural logistics development index system is a comprehensive index that is measured from the three aspects of development trend, development momentum and development conditions, and each dimension is a sub-index that constitutes the total index, and each sub-index is synthesized by a number of specific indicators[19]. First of all, in order to eliminate the influence of index outline and order of magnitude, this paper needs to normalize the raw data, specifically:

$$B_{ij} = \frac{X_{ij} - X_{\min}^{ij}}{X_{\max}^{ij} - X_{\min}^{ij}} \quad (1)$$

where the actual value of the  $i$ th indicator is recorded as  $X_{ij}$ , and the upper limit value is  $X_{\max}^{ij}$  and the lower value is  $X_{\min}^{ij}$ . The normalized value is  $B_{ij}$ .

Step 1: Based on the normalized data, calculate the contribution of the  $i$ th indicator under the  $j$ th indicator:

$$p_{ij} = \frac{B_{ij}}{\sum_{i=1}^n X_{ij}} \quad (i, j = 1, 2, \dots, n) \quad (2)$$

Step 2: Calculate the  $j$ th indicator  $x_j$ . The entropy value is:

$$e_j = -\frac{1}{LNn} \sum_{i=1}^n p_{ij} LN(p_{ij}), \text{ among } 0 \leq e_j \leq 1 \quad (3)$$

Step 3: Find the indicator  $x_j$ . Coefficient of variation of.

$$g_j = 1 - e_j \quad (j = 1, 2, \dots, n) \quad (4)$$

Step 4: Determine evaluation indicator weights:

$$W_E = \frac{g_j}{\sum_{i=1}^n g_j} \quad (5)$$

Step 5: Calculate the composite score for each indicator:

$$S = \sum_j^n W_E * B_{ij} \quad (6)$$

## 4. Evaluation Results and Analysis of the Current Situation of Rural Logistics Development in China

### 4.1. Comprehensive Evaluation of the Current Level of Rural Logistics Development in China

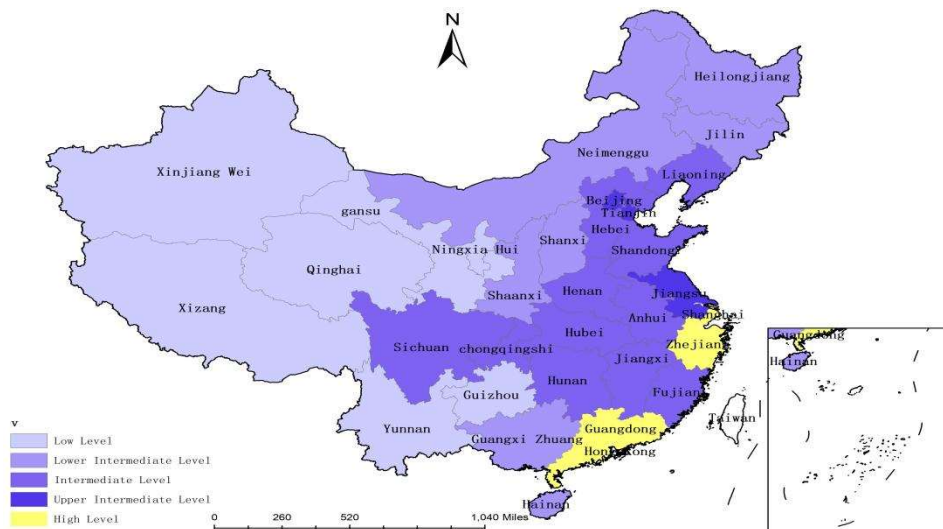
In this section, the entropy method model from Chapter 3 (1)-(6) is employed to analyze the current state of rural logistics development in China. Firstly, the original data of 26 indicators for the year 2021 from 31 provincial-level administrative regions in China are standardized. Subsequently, the information entropy and weight values for each indicator are calculated, and finally, the comprehensive scores for each indicator are computed, as presented in Table 2:

**Table 2.** Scores and Rankings of the Overall Rural Development Level in China in 2021

Region	Province	Total Development Level Score	Ranking
Northern China	Beijing	0.363626711	4
	Tianjin	0.317289317	6
	anhui	0.22462465	15
	Shanxi	0.169159334	24
	Inner Mongolia	0.161137444	25
north-eastern	Liaoning	0.221052294	17
	Jilin	0.182134	21
	Heilongjiang	0.184613911	20
Eastern China	Shanghai	0.530918919	1
	Jiangsu	0.356831723	5
	Zhejiang	0.47532867	2
	Anhui	0.226458673	14
	Fujian	0.236818215	12
	Jiangxi	0.239187939	11
	Shandong	0.272592842	7
central China	Henan	0.247515148	8
	Hubei	0.242227539	10
	Hunan	0.243625443	9
Southern China	Guangdong	0.436289799	3
	Guangxi	0.17663598	22
	Hainan	0.171084601	23
southwestern	Chongqing	0.216234252	18
	Sichuan	0.222915974	16
	Guizhou	0.145592065	27
	Yunnan	0.156347007	26
	Tibet	0.125064598	32
northwestern	Shaanxi	0.1938352	19
	Gansu	0.138397614	30
	Qinghai	0.127955854	31
	Ningxia	0.139711437	29
	Xinjiang	0.140892366	28
mean value	national average	0.235035468	13

The development level of rural logistics in China varies greatly, with an overall low level. The rural logistics development level is highest in the southeast coastal areas and lowest in the northwest. There is extreme imbalance in national development levels. According to the scores and rankings of rural logistics development levels in 31 provincial-level administrative regions of China in 2021, the national average score is 0.235, with 12 provinces exceeding this average. These provinces include Shanghai, Zhejiang, Guangdong, Beijing, Jiangsu, Tianjin, Shandong, Henan, Hubei, Jiangxi, Hunan, and Fujian, indicating relatively favorable rural logistics development environments and higher levels. Shanghai has the highest score of 0.5309, which is 2.26 times the national average and 4.15 times that of the lowest-scoring province, Qinghai, demonstrating significant disparities in rural logistics development. Nineteen provinces including Anhui, Hebei, Sichuan, Hubei, Liaoning, Shanxi, and Fujian have scores below the national average.

Using ArcGIS 10.8 software and employing the natural break point method, China’s 31 provincial-level administrative regions are classified into four levels: low, medium, medium-high, and high. This categorization forms the spatial layout map of rural logistics development levels in China for 2021. The map illustrates the spatial distribution characteristics of rural logistics development levels across mainland China, as shown in Figure 1:



**Figure 1.** Spatial Layout Map of the Development Level of Rural Logistics in China in 2021

The overall development of rural logistics exhibits a spatial layout characterized by a gradual decrease from the southeast coastal areas to the central, northern, and western regions. Regions with high and medium-high levels of rural logistics development are mainly concentrated along the coastal areas, Yangtze River, and Yellow River, while areas with medium levels are primarily distributed in the central plains. Lower and low-level areas are found in the central-western and northwest regions, presenting an overall “)|”-shaped layout. Along the “)|”-shaped axis, China boasts several super-large urban clusters, including the Yangtze River Delta urban cluster, Beijing-Tianjin-Hebei urban cluster, Pearl River Delta urban cluster, Yangtze River Midstream urban cluster, Chengdu-Chongqing urban cluster, as well as other important regional urban clusters like the Liaoning-South urban cluster, Shandong Peninsula urban cluster, Taiwan Strait Line urban cluster, and Huaihai urban cluster. These urban clusters not only serve as crucial engines for China’s economic growth but also act as hubs for the logistics industry.

**4.2. Assessment of the Current Status of Rural Logistics Development in China**

In order to further analyze the current level of rural logistics development in each province, an in-depth analysis of the development status of rural logistics is conducted based on the scores of six secondary indicators: scale degree, speed magnitude, demand side, supply side, economic conditions, and infrastructure conditions, as detailed in Table 3.

From the perspective of scale, the rural logistics scale in East China and Central China is large, but more than half of the provincial rural logistics scales do not reach the average value of 0.0473, indicating a relatively low overall level of the rural logistics industry in China. Specifically, Shanghai, Guangdong, Zhejiang, Jiangsu, Beijing, and Tianjin are at the forefront nationally in terms of scores, exhibiting high to moderately high levels and belong to regions of high and moderately high levels. These provinces and regions have a vast logistics scale, significantly driving the development of the rural logistics industry.

**Table 3.** Sub-item Scores of China's Rural Logistics Development Index System in 2021

Region	Province	Scale Degree	Speed Magnitude	Demand Side	Supply Side	Economic Conditions	Infrastructure Conditions
Northern China	Beijing	0.0872	0.0230	0.0767	0.0642	0.0559	0.0567
	Tianjin	0.1069	0.0193	0.0841	0.0367	0.0302	0.0402
	anhui	0.0368	0.0206	0.0616	0.0286	0.0319	0.0450
	Shanxi	0.0413	0.0182	0.0370	0.0177	0.0147	0.0402
	Inner Mongolia	0.0199	0.0084	0.0504	0.0178	0.0236	0.0410
north-eastern	Liaoning	0.0236	0.0567	0.0529	0.0170	0.0255	0.0455
	Jilin	0.0274	0.0160	0.0357	0.0433	0.0166	0.0431
	Heilongjiang	0.0228	0.0150	0.0493	0.0416	0.0153	0.0408
Eastern China	Shanghai	0.0915	0.0187	0.1554	0.0948	0.0638	0.1067
	Jiangsu	0.0853	0.0192	0.0917	0.0580	0.0556	0.0469
	Zhejiang	0.1731	0.0239	0.1214	0.0554	0.0573	0.0442
	Anhui	0.0614	0.0205	0.0566	0.0209	0.0292	0.0379
	Fujian	0.0669	0.0112	0.0611	0.0276	0.0358	0.0342
	Jiangxi	0.0605	0.0185	0.0475	0.0262	0.0236	0.0628
	Shandong	0.0337	0.0101	0.0884	0.0320	0.0464	0.0620
central China	Henan	0.0628	0.0224	0.0478	0.0285	0.0360	0.0500
	Hubei	0.0488	0.0164	0.0609	0.0281	0.0363	0.0517
	Hunan	0.0580	0.0196	0.0603	0.0248	0.0336	0.0472
Southern China	Guangdong	0.1295	0.0206	0.1104	0.0538	0.0732	0.0488
	Guangxi	0.0094	0.0166	0.0417	0.0230	0.0269	0.0591
	Hainan	0.0296	0.0176	0.0676	0.0106	0.0181	0.0275
southwestern	Chongqing	0.0420	0.0277	0.0566	0.0320	0.0233	0.0346
	Sichuan	0.0434	0.0095	0.0627	0.0358	0.0421	0.0294
	Guizhou	0.0265	0.0346	0.0336	0.0064	0.0170	0.0275
	Yunnan	0.0140	0.0181	0.0428	0.0206	0.0286	0.0323
	Tibet	0.0026	0.0270	0.0331	0.0085	0.0058	0.0480
northwestern	Shaanxi	0.0179	0.0094	0.0543	0.0409	0.0229	0.0485
	Gansu	0.0184	0.0214	0.0368	0.0125	0.0094	0.0400
	Qinghai	0.0076	0.0215	0.0297	0.0209	0.0075	0.0407
	Ningxia	0.0091	0.0354	0.0378	0.0132	0.0081	0.0361
	Xinjiang	0.0070	0.0213	0.0347	0.0120	0.0196	0.0463
mean value	national average	0.0473	0.0210	0.0607	0.0307	0.0301	0.0456

Looking at the magnitude of speed, the overall development speed of rural logistics in China is slow, yet highly uneven. Firstly, Liaoning province exhibits the fastest development speed, followed by Tibet, Ningxia, Chongqing, and Guizhou, indicating increased growth rates in rural delivery routes, rural broadband access users, average number of household cars per hundred rural residents, and the number of employees in rural transportation, warehousing, and postal services. These four indicators in these provinces all rank among the top nationally. From the demand perspective, the southern and central regions of China exhibit a significant demand for rural logistics, while the western, northeastern, and northwestern regions show comparatively lower demand. Zhejiang, Guangdong, Jiangsu, Shandong, Beijing, and Tianjin rank high nationally, with scores exceeding the average of 0.0607, categorizing them as regions of high and moderately high levels.

From the supply side perspective, rural areas in Shanghai, Zhejiang, Jiangsu, Beijing, and Guangdong exhibit ample supply in the logistics industry, while the northwest, parts of the southwest, and northeast regions have relatively limited and less diverse offerings compared to the central and eastern provinces. Only Shanghai, Zhejiang, Jiangsu, Beijing, and Guangdong

significantly surpass other provinces on the supply side, placing them in the category of high-level development. Tianjin, Sichuan, Shaanxi, Heilongjiang, and Jilin score well above the average (0.0307) on the rural logistics supply side, categorizing them as moderately high-level regions.

In terms of economic conditions, there are distinct disparities in rural economic levels nationwide, with Guangdong, Shanghai, Zhejiang, and Beijing boasting the highest levels of development. Their economic condition scores stand at 0.0732, 0.0638, 0.0573, 0.0559, and 0.0556 respectively, positioning them at the forefront nationally. These regions exhibit notably high scores in per capita disposable income among farmers, added value of the primary industry, and transportation budget expenditures, thereby elevating farmer income and consumption levels.

In terms of infrastructure conditions, 25 provinces across the nation present a moderate level of rural infrastructure, alongside provinces at lower and moderate-low levels, indicating that the overall status of rural logistics infrastructure in China is generally average. Shanghai stands alone in the high-level category of infrastructure with a score of 0.1066. The relatively small geographical expanse of Shanghai, with short distances between urban and rural areas, augments the coverage and depth of its logistics network. Being an international metropolis, Shanghai holds a prominent position as a transportation hub, boasting a highly developed network encompassing expressways, railways, ports, and aviation.

## 5. Research Findings and Development Strategies

### 5.1. Research Conclusions

From the perspective of rural revitalization, a comprehensive evaluation index system for rural logistics in China was constructed. Using the entropy method, a comprehensive evaluation and analysis of the current level of rural logistics development were conducted based on the relevant indicator data of rural areas in 31 provinces and municipalities (autonomous regions) of China in 2021. The following conclusions were drawn:

(1) Overall, the development of rural logistics presents a spatial layout feature of decreasing from the southeastern coastal areas to the central, northern, and western regions. Regions with high and medium-high levels of rural logistics development are mainly distributed along the coastlines of the southeast, the Yangtze River, and the Yellow River, while areas with medium levels are mainly distributed in the central plains. Regions with lower and low levels are respectively distributed in the central-western and northwestern regions, showing an overall "Sichuan"-shaped layout feature.

(2) The key axis of rural logistics development in China has formed in the southeastern coastal areas, extending along the coastline from Beijing and Tianjin to Zhejiang, Shanghai, and Guangdong, forming an important activity belt for national economic development and foreign trade.

(3) Shandong and Henan have seen remarkable development in rural logistics, forming an axis of rural logistics development connected with Hebei and Anhui.

(4) The overall level of rural logistics development in China is on the rise with strong development momentum, but there are problems such as supply-demand imbalance, poor conditions, slowing speed, and improper structure.

### 5.2. Development Strategies

Within the framework of the rural revitalization strategy, it is imperative to elevate the level of rural logistics in China. The key to driving rural economic growth lies in the development of deep processing and distinctive rural industries. By increasing the depth of processing for agricultural products, we can not only enhance their added value but also cultivate brand

awareness for local agricultural products, making them stand out in the market. Simultaneously, the rise of rural e-commerce presents new opportunities for agricultural product sales. Establishing a robust rural e-commerce platform and collaborating closely with logistics enterprises will effectively expand the sales channels for agricultural products, facilitating direct interaction between producers and consumers. Such efforts will bring new vitality and momentum to the rural economy, promoting diversified development of rural industries and comprehensive economic prosperity in local areas.

The optimization of rural infrastructure is crucial not only for the smooth flow of agricultural product logistics but also for the overall development of rural economic and social aspects. Investments in the construction of rural roads and bridges can not only shorten transportation time and reduce costs but also promote the development of rural tourism, diversifying the rural economy. In the current era of information, constructing intelligent and information-based systems is indispensable. Establishing a rural logistics big data center and employing artificial intelligence for data analysis and optimization decisions can enhance the efficiency of route planning and vehicle scheduling, thereby improving the safety and punctuality of agricultural product transportation. Implementing these measures will inject new vitality into rural infrastructure construction, providing a more stable and efficient guarantee for the circulation of agricultural products.

To address the imbalance in rural logistics supply and demand, efforts should be focused on building an efficient logistics system to better coordinate supply and demand relationships. Establishing a unified agricultural product information platform to integrate supply chain information and achieve transparent information sharing can help farmers adjust production structures based on market demand, enhancing the specificity and market adaptability of production. Additionally, strengthening the construction of cold chain logistics to ensure the freshness and quality of agricultural products can effectively alleviate issues arising from seasonal fluctuations in supply and demand. Through the construction of agricultural product reserves and dispatch centers, flexible control over the timing of agricultural product listings can be achieved, balancing supply and demand relationships and ensuring market supply stability. These measures will not only help address imbalances in rural logistics supply and demand but also promote the efficient and stable development of agricultural product circulation.

Advancing rural informatization and intelligent distribution is a crucial means to enhance the level of rural logistics. Establishing a rural logistics information platform to integrate logistics resources and achieve comprehensive informatized management can enhance the transparency and efficiency of agricultural product circulation. The application of intelligent distribution systems, such as using IoT technology for intelligent vehicle scheduling and improving the precision of route selection, can not only reduce logistics costs but also enhance distribution efficiency, ensuring the safety and promptness of agricultural product transportation. Simultaneously, the digitized agricultural product traceability system will further enhance the traceability and quality of agricultural products, increasing consumer trust. These initiatives will propel rural logistics towards informatization and intelligence, injecting new vitality and momentum into the rural economy.

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