

Research on the Development Level of Rural Logistics in Yunnan Province Based on Factor Analysis

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Abstract: Taking the western province of Yunnan Province as an example, this paper selects eight indicators of per capita GDP, per capita disposable income of rural residents, total output value of primary industry, total output value of agriculture, forestry, animal husbandry and fishery, population urbanization rate, 5G user penetration rate, road transport route length and rural delivery route length to conduct factor analysis on the relevant data of rural logistics development level in 16 cities of Yunnan Province, and obtains the advantages and disadvantages of relevant urban development. Three suggestions are put forward to improve the overall rural logistics level of Yunnan Province, enhance the competitiveness of rural logistics in northeastern cities, and narrow the basic gap of rural logistics, so as to accelerate the development of rural logistics in Yunnan Province.

Keywords: Rural logistics; Development level; Factor analysis.

1. Introduction

In the era of rapid globalization and informatization, the logistics industry, as an important pillar of the modern economy, its development level directly affects the overall competitiveness of the regional economy. Compared with the rapid development of urban logistics, the development of rural logistics is lagging behind. Especially in a large agricultural province such as Yunnan Province, the development of rural logistics is not only an important indicator to measure the process of agricultural modernization, but also directly related to the growth of farmers' income and the overall prosperity of the rural economy.

In recent years, the rise of e-commerce in rural areas of China has been strong, showing a vigorous development trend, and has become an important engine to promote the development of rural industries. All regions continue to promote the construction of rural modern logistics system, and open up the peripheral circulation of agricultural products leaving the village and consumer goods going to the countryside. However, there are also some problems in the construction of logistics system in some remote areas, such as insufficient application of technology, high operating costs, imperfect service network and so on. There is still a certain gap between the demand for logistics services in rural areas and the demand for logistics services in rural areas [1]. From the existing research results, the research on the development level of rural logistics is mainly concentrated in the central region, and there is less research on the southwest region. Therefore, it is urgent to speed up the construction of cities in Southwest China, and it is particularly important to study the development level of rural logistics in Yunnan Province.

Yunnan is located in the southwest border of China. With its rich natural resources and unique geographical environment, it has become a pivotal agricultural production area in China. Due to the constraints of complex geographical environment, weak transportation infrastructure and low level of informatization, the development of rural logistics in Yunnan Province is facing many challenges. With the in-depth implementation of the rural revitalization strategy and the popularization of Internet technology, the development of rural logistics has ushered in new opportunities. This paper

starts with 16 prefecture-level administrative regions in Yunnan Province, constructs an evaluation index system for the development level of rural logistics in Yunnan Province, uses factor analysis method to quantitatively evaluate, and obtains the distribution of rural logistics development level in Yunnan Province. Based on this, corresponding improvement measures are proposed to provide an important basis for the development of rural logistics in Yunnan Province.

2. Literature Review and Theoretical Analysis

2.1. The Development Level of Rural Logistics

With the vigorous development of rural e-commerce and the enhancement of farmers' consumption ability, China's rural logistics system has been initially formed and has a certain scale. Li Hongmei (2021) pointed out that the construction of an efficient rural logistics system needs to strengthen infrastructure, train professional talents, and promote the integration of new industries and logistics to support and promote the overall process of rural revitalization [2]. Based on the relevant academic research, Ding Qiaoying et al. (2021) summarized the influencing factors of rural logistics development into internal and external aspects. The internal cause involves two levels of supply and demand: the supply side, covering the status of logistics infrastructure, investment intensity, education level, information degree and residents' consumption ability; in terms of demand, it is related to rural economic growth, agricultural product circulation activity and residents' income and consumption level. The external factors include government policy orientation, geographical location advantage and rural financial support level [3]. Through qualitative research, Wang Pu and Zhao Bin (2016) examined the current situation and core problems of rural logistics in China, deeply analyzed the root causes of the problems, and put forward targeted solutions accordingly [4]. Luo Yuting et al. (2022) used SWOT analysis to find the main problems and propose corresponding solutions [5]. On the other hand, quantitative analysis uses entropy weight method, comprehensive evaluation model, analytic hierarchy process and grey correlation analysis to deeply analyze the development of

rural logistics.

2.2. Index System of Rural Logistics Development Level

Cao Shuwen (2022) divides the index system of rural logistics development level into four aspects : rural economic level, agricultural product-related output value, logistics transportation volume and human resources and conditions [6]; wang Yiyuan (2023) believes that the relevant indicators of rural logistics development level are composed of rural development level, information level and infrastructure construction [7]; luo Hongen et al. (2019) believe that the indicators are divided into five indicators : regional economy, urban-rural integration, regional e-commerce foundation, rural e-commerce foundation, and rural economy [8].

These evaluation index systems have the same characteristics: First, they are comprehensive, covering not only hardware indicators such as logistics infrastructure and information level, but also software indicators such as logistics service intelligence and logistics talents, which can more comprehensively and objectively reflect the development of rural logistics. Secondly, it is targeted. In view of the gap between rural logistics and urban logistics in many aspects, especially in logistics infrastructure construction and logistics environment, the actual situation of rural logistics needs to be fully considered when constructing the index system. Third, operability. The data of each index can be collected, collated and analyzed by certain methods and means, and practical conclusions can be drawn, which is convenient for practical operation and application.

3. Research Scope and Method Description

3.1. Research Scope

This article mainly embarks from the rural logistics, using

statistical research methods, under the theoretical framework of statistics, to study the development level of rural logistics in Yunnan province. This paper mainly analyzes 16 prefecture-level administrative regions in Yunnan, including Kunming, Qujing, Yuxi, Baoshan, Zhaotong, Lijiang, Pu'er, Lincang, Chuxiong, Honghe, Wenshan, Xishuangbanna, Dali, Dehong, Nujiang and Diqing, establishes the corresponding index evaluation system, compares the development level of rural logistics in various administrative regions, and provides theoretical basis for the development of rural logistics in Yunnan Province.

3.2. Evaluation Indicators, Data and Method Description

Based on the existing research, this paper takes into account the reliability and availability of data, and selects 16 prefecture-level administrative regions in Yunnan Province as the research object. Combined with the above content and a series of previous studies on the development level of rural logistics, this paper evaluates the development level of rural logistics in each prefecture-level administrative region from the four aspects of rural economic development level, urban and rural integration, information level and infrastructure construction. The level of rural economic development includes the total value of per capita GDP, the per capita disposable income of rural residents, the total value of the primary industry, and the total output value of agriculture, forestry, animal husbandry and fishery. Urban-rural integration includes population urbanization rate; the level of informatization includes 5G user penetration rate; infrastructure construction includes the length of road transport routes and the length of rural delivery routes. The specific evaluation indicators are shown in Table 1.

Table 1. Evaluation index system of rural logistics development level

First-level indicators	Secondary indicators	Unit	symbol
The level of rural economic development	Gross GDP per capita	Yuan	X_1
	Per capita disposable income of rural residents	Yuan	X_2
	Gross primary industry production	hundred million Yuan	X_3
	Total output value of agriculture, forestry, animal husbandry and fishery	hundred million Yuan	X_4
Urban and rural co-ordination	Population urbanization rate	%	X_5
Informatization level	5G user penetration rate	%	X_6
Infrastructure construction	Road transport line length	kilometer	X_7
	Length of rural delivery route	ten thousand kilometers	X_8

This paper mainly uses the factor analysis method to quantitatively evaluate and sort the 16 prefecture-level administrative regions in Yunnan Province. The data in this paper are mainly from '2023 Yunnan Statistical Yearbook' and 'Yunnan Internet Development Report (2023)'.

4. Empirical Analysis of Rural Logistics Development Level in Yunnan Province

4.1. KMO Test and Bartlett's Test of Sphericity

According to the conditions of factor analysis, the relevant data of '2023 Yunnan Statistical Yearbook' and 'Yunnan

Internet Development Report (2023)' were selected for analysis. The eight indicators listed in Table 1 were used as analysis variables, and KMO and Bartlett spherical tests were performed using SPSS software. The results show that (as shown in Table 2), the KMO value is 0.723, which is in the range of 0.7 to 0.8, and the factor analysis method is suitable. At the same time, the p value of Bartlett 's sphericity test was 0.000, which was lower than 0.05, indicating that the data was suitable for factor analysis.

Table 2. KMO test and Bartlett's test of sphericity

KMO value		0.723
Bartlett's test of sphericity	Approximate chi-square	119.880
	df	28
	P value	0.000

4.2. Factor Extraction

Using SPSS software, the factor dimension reduction

analysis was carried out on 8 indicators of 16 prefecture-level administrative regions in Yunnan Province, and the factors with eigenvalues greater than 1 were extracted, and two common factors were extracted from the original variables by rotating the maximum variance method. As shown in Table 3, the cumulative contribution rate of these two common factors is as high as 81.663 %, which effectively covers most of the information of the original data, and the number of common factors is finally confirmed to be 2.

Table 3. Variance interpretation rate table

Factor number	latent root			Pre-rotation variance interpretation rate			The variance interpretation rate after rotation		
	Characteristic Roots	variance explained rate%	accumulation %	Characteristic Roots	variance explained rate%	accumulation %	Characteristic Roots	variance explained rate%	accumulation %
1	4.029	50.363	50.363	4.029	50.363	50.363	3.941	49.256	49.256
2	2.504	31.300	81.663	2.504	31.300	81.663	2.593	32.407	81.663
3	0.658	8.224	89.887	-	-	-	-	-	-
4	0.398	4.970	94.857	-	-	-	-	-	-
5	0.201	2.512	97.369	-	-	-	-	-	-
6	0.123	1.537	98.906	-	-	-	-	-	-
7	0.082	1.025	99.931	-	-	-	-	-	-
8	0.006	0.069	100.000	-	-	-	-	-	-

4.3. Actor Analysis and Calculation

According to the above information, the first common factor contains 49.256 % of the indicator information, including the gross output value of the primary industry (X_3), the total output value of agriculture, forestry, animal husbandry and fishery (X_4), the length of road transport routes (X_7), and the length of rural delivery routes (X_8), named

infrastructure development factor (F_1). The variance contribution rate of the second common factor is 32.407 %, which includes four indicators: total per capita GDP (X_1), per capita disposable income of rural residents (X_2), population urbanization rate (X_5), and 5G user penetration rate (X_6), named as rural logistics basic factor (F_2).

Table 4. Factor load coefficient table after rotation

Name	Factor load coefficient		Commonness (common factor variance)
	factor-1	factor-2	
Gross GDP per capita X_1	0.045	0.778	0.607
Per capita disposable income of rural residents X_2	0.486	0.783	0.849
Gross primary industry production X_3	0.968	0.125	0.952
total output of farming, forestry, stock raising and fishery X_4	0.960	0.152	0.945
population urbanization rate X_5	0.066	0.822	0.680
5G user penetration rate X_6	-0.300	0.805	0.738
Road transport line length X_7	0.945	-0.100	0.903
Length of rural delivery route X_8	0.926	-0.047	0.859

4.4. Factor Score Calculation

Using SPSS to carry out factor analysis to obtain the

component score coefficient matrix, as shown in Table 5, the common factor score function is as follows:

$$F_1 = -0.016X_1 + 0.097X_2 + 0.244X_3 + 0.241X_4 - 0.012X_5 - 0.106X_6 + 0.246X_7 + 0.239X_8$$

$$F_2 = 0.302X_1 + 0.289X_2 + 0.015X_3 + 0.025X_4 + 0.319X_5 + 0.325X_6 - 0.072X_7 - 0.051X_8$$

Table 5. Component score coefficient matrix

Name	component	
	Component-1	Component-2
Gross GDP per capita X_1	-0.016	0.302
Per capita disposable income of rural residents X_2	0.097	0.289
Gross primary industry production X_3	0.244	0.015
total output of farming, forestry, stock raising and fishery X_4	0.241	0.025
population urbanization rate X_5	-0.012	0.319
5G user penetration rate X_6	-0.106	0.325
Road transport line length X_7	0.246	-0.072
Length of rural delivery route X_8	0.239	-0.051

According to the eigenvalue and factor contribution rate shown in table 3, the variance contribution rate of the two factors is weighted, and the comprehensive score formula of rural logistics development level in Yunnan Province is obtained:

$$F = (49.256F_1 + 32.407F_2)/81.663$$

Finally, the score and ranking of rural logistics development level in Yunnan Province are obtained, as shown in Table 6.

Table 6. The factor scores and comprehensive factor scores of rural logistics development level in Yunnan Province

City	F ₁	Ranking	F ₂	Ranking	F	Ranking
Kunming	0.352	7	2.801	1	1.324	1
Qujing	1.735	1	0.157	4	1.109	2
Yuxi	-0.151	11	1.525	2	0.514	4
Baoshan	0.176	10	-0.428	11	-0.064	9
Zhaotong	0.494	6	-1.279	16	-0.209	11
Lijiang	-1.124	13	-0.059	7	-0.701	14
Pu'er	0.550	5	-0.583	13	0.100	7
Lincang	0.277	8	-0.571	12	-0.059	8
Chuxiong	0.634	4	-0.054	6	0.361	6
Red River	1.167	2	-0.137	8	0.649	3
Wenshan	0.209	9	-0.966	15	-0.258	12
Xishuangbanna	-0.730	12	0.826	3	-0.112	10
Dali	0.870	3	-0.360	10	0.382	5
Dehong	-1.165	14	0.017	5	-0.696	13
Nujiang	-1.587	15	-0.728	14	-1.246	16
Diqing	-1.706	16	-0.159	9	-1.092	15

4.5. Results Analysis

With the help of SPSS software, the factor scores and comprehensive factor scores of rural logistics development in Yunnan Province are obtained. The higher the score, the higher the level of rural logistics development in the city. From the perspective of factors, Qujing, Honghe and Dali rank the top three, indicating that Qujing, Honghe and Dali are stronger than other cities in infrastructure development, while Diqing, Nujiang and other places have lower indicators and weaker infrastructure development ; from the perspective of factors, Kunming, Yuxi and Xishuangbanna rank the top three, indicating that the rural logistics base of these three cities is strong and has great development potential. Shaotong and Wenshan scored lower, indicating that the rural logistics base is weak and the competitiveness is not strong. From the perspective of comprehensive score factors, Kunming, Qujing and Honghe rank the top three, and have great development potential in rural logistics. The comprehensive scores of Nujiang, Diqing and other places are low, and the development environment of rural logistics is weak.

5. Conclusion and Inspiration

In this paper, by constructing the evaluation index system of rural logistics development level, taking 16 prefecture-level administrative regions of Yunnan Province as samples, the empirical research on the development level of rural logistics in Yunnan Province is carried out, and the following characteristics are obtained. First, the overall rural logistics level in Yunnan Province is not high; second, on the whole, the development level of rural logistics in northeast cities is better than that in other regions. Third, the gap between rural logistics infrastructure is large.

In view of the three characteristics of rural logistics development in Yunnan Province, that is, the overall level is not high, the competitiveness of northeast cities is better than

that of other regions, and the rural logistics foundation gap is large, the corresponding suggestions are put forward.

First, improve the overall level of rural logistics in Yunnan Province. Speed up the construction of transportation infrastructure such as rural roads and railways, and improve the accessibility of transportation in rural areas ; construct and optimize county-level logistics centers, township service stations and village-level service points, and weave a rural logistics network covering the whole province ; at the same time, build a rural logistics information platform, integrate logistics resources, and improve the transparency and sharing of logistics information ; strengthen the information training of logistics practitioners and improve their information technology application ability.

The second is to enhance the competitiveness of rural logistics in northeast cities. Take advantage of the transportation and economic advantages of the northeastern cities, strengthen logistics cooperation with other regions, and form a regional logistics center ; promote the integration of logistics resources in the region, optimize the allocation, and improve logistics efficiency and service quality ; encourage northeast cities to absorb international advanced logistics technology and management wisdom, and improve the level of intelligence and automation of rural logistics.

Thirdly, narrowing the gap of rural logistics foundation. Increase investment in rural logistics infrastructure construction in poverty-stricken areas and remote areas to ensure that all regions can enjoy basic logistics services ; raise funds through diversified channels such as government investment and social donations to improve rural logistics conditions ; according to the actual situation and development needs of different regions, formulate differentiated rural logistics development strategies ; through the development of vocational training, skills competition and other activities to enhance the professional skills and professionalism of rural logistics personnel.

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