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Comparative Research on the Rural Development Levels of 31 Provinces and Regions in China

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Abstract According to the 2010 *China Statistical Yearbook*, a total of 12 indicators in the aspects of residents' production, consumption expenditure, and living conditions are selected in order to construct the indicator system of rural development level. Both factor analysis and cluster analysis methods are adopted to compare the current situations of rural development levels in 31 provinces and regions of China. Result of factor analysis shows that the 12 indicators can be classified into 4 factors, such as the income and expenditure factor, the agricultural scale and science and technology factor, the life quality factor, and the agricultural output factor. Moreover, factors affecting the rural development level of China are analyzed. Then, the 31 provinces and regions are divided into 4 categories according to the development levels in rural areas: the first category is Shanghai, Beijing and Zhejiang, which have the highest development level in rural areas; the second category includes Jiangsu, Shandong and Tianjin, which take the 4th to 6th places; the third category is Guangdong, Jilin, Liaoning, Hebei, Fujian, Heilongjiang, Henan, Inner Mongolia, Anhui, Hubei, Hunan and Jiangxi, which rank the 7th–18th; and the fourth category includes Sichuan, Hainan, Ningxia, Shanxi, Guangxi, Shanxi, Xinjiang, Chongqing, Tibet, Yunnan, Gansu, Qinghai and Guizhou, taking the 19th–31st places.

Key words Rural development level, Factor analysis, Cluster analysis, China

During the 31 years of reform and opening up, China has undergone enormous changes in rural areas. Per capita net income of rural residents has increased from 133.6 yuan in the year 1978 to 5153.2 yuan in the year 2009, up by 37.6 times within 31 years. However, compared with the developed countries, development level of rural China is relatively low and there is unbalanced development between urban and rural areas. Taking the rural areas in 31 provinces and regions of China as examples, this research uses factor analysis and cluster analysis methods to compare and research the status of rural development levels in different provinces and regions.

1 Index selection, data source and research method

1.1 Index selection According to the 2010 *China Statistical Yearbook*^[1], a total of 12 indicators in the aspects of residents' production, consumption expenditure, and living conditions are selected to construct the indicator system of rural development level (Table 1).

1.2 Data source Data are from the 2010 *China Statistical Yearbook* and the online data of the National Bureau of Statistics of China^[1].

1.3 Research method Factor analysis method is used to classify the indicators selected and to calculate their scores. Based on this, rural development levels of different provinces and regions are compared according to the comprehensive scores. Then, cluster analysis method is applied to classify the rural development status of the provinces and regions in China^[2–3].

Table 1 Evaluation indicators of rural development level

Code	Indicator name
X_1	Per capita consumption expenditure of rural residents//Yuan
X_2	Household equipment and services//Yuan
X_3	Transport and communication//Yuan
X_4	Educational, entertainment products and services//Yuan
X_5	Medical care//Yuan
X_6	Grain output //kg
X_7	Vegetable output //kg
X_8	Total sowing area of crops// $\times 10^3$ hm ²
X_9	Per capita net income of rural residents//Yuan
X_{10}	Agricultural machinery power// $\times 10^4$ kW
X_{11}	Number of cars
X_{12}	Livestocks

2 Result and analysis

2.1 Factor analysis Factor analysis is carried out by statistical software SPSS11.5. Then, KMO test and Bartlett's Test of Sphericity are applied, which are automatically generated by SPSS. The test results show that KMO = 0.701 > 0.7. In the Bartlett's Test, we have Sig. = 0.000, which accords with the standard of factor analysis.

Table 2 Total explained variance

Factor number	Eigenvalue	Explained variance//%	Cumulative explained variance//%
1	5.603	46.689	46.689
2	2.272	18.933	65.622
3	1.281	10.676	76.298
4	1.016	8.466	84.763

Table 2 reports the variance contribution rate. And the cumulative variance contribution rate of the four factors is 84.763% > 80%, which meets the requirements.

According to the result of factor analysis, the following 4 factors are obtained. And a total of 12 indicators are classified in order to establish the indicator system (Fig. 1).

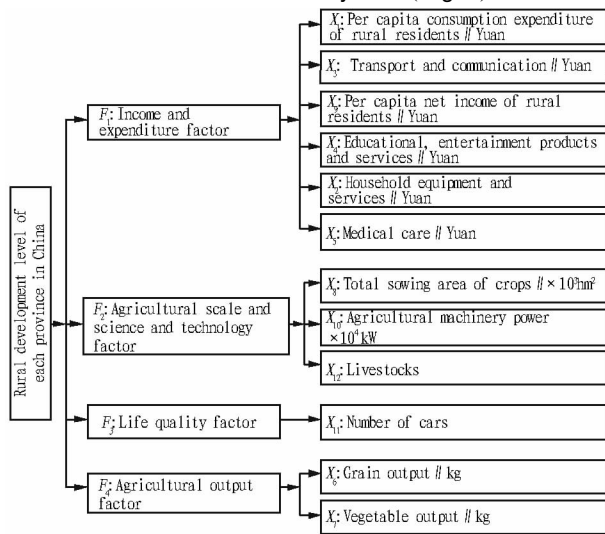


Fig. 1 Factor name and indicator system of rural development level

Table 3 reports the information of scores of the indicators.

Table 3 Score coefficient matrix of factor

Variable	Factor 1	Factor 2	Factor 3	Factor 4
X_1	0.174	-0.041	-0.024	-0.016
X_2	0.163	-0.065	0.016	-0.108
X_3	0.177	0.027	0.033	-0.045
X_4	0.176	-0.017	0.018	0.071
X_5	0.169	0.048	-0.085	0.278
X_6	0.031	0.096	-0.103	0.790
X_7	0.037	0.224	0.596	-0.142
X_8	-0.022	-0.240	0.192	0.243
X_9	0.177	0.055	0.097	-0.061
X_{10}	0.012	-0.076	0.500	-0.035
X_{11}	0.036	0.555	0.256	-0.012
X_{12}	-0.036	0.418	-0.064	0.187

According to Table 3, the expressions for 4 principal component factors are as followings:

$$F_1 = 0.174X_1 + 0.163X_2 + 0.177X_3 + 0.176X_4 + 0.169X_5 + 0.031X_6 + 0.037X_7 - 0.022X_8 + 0.177X_9 + 0.012X_{10} + 0.036X_{11} - 0.036X_{12} \quad (1)$$

$$F_2 = -0.041X_1 - 0.065X_2 + 0.027X_3 - 0.017X_4 + 0.048X_5 + 0.096X_6 + 0.224X_7 - 0.022X_8 + 0.055X_9 - 0.076X_{10} + 0.055X_{11} + 0.418X_{12} \quad (2)$$

$$F_3 = -0.024X_1 + 0.016X_2 + 0.033X_3 + 0.018X_4 - 0.085X_5 - 0.103X_6 + 0.596X_7 + 0.192X_8 + 0.097X_9 + 0.500X_{10} + 0.256X_{11} - 0.064X_{12} \quad (3)$$

$$F_4 = -0.016X_1 - 0.108X_2 - 0.045X_3 + 0.071X_4 + 0.278X_5 + 0.790X_6 - 0.142X_7 + 0.243X_8 - 0.061X_9 - 0.035X_{10} - 0.012X_{11} + 0.187X_{12} \quad (4)$$

Proportion of the variance contribution rate of each factor to the cumulative variance contribution rate is used as the weight number, in order to obtain the comprehensive score F of the rural development level of each province, municipality and autonomous region:

$$F = 0.5508F_1 + 0.2234F_2 + 0.1260F_3 + 0.0999F_4 \quad (5)$$

According to equations (1) – (5), the factor scores of provinces, municipalities and autonomous regions ($F_1 - F_4$) are obtained, as well as the comprehensive scores F and their ranks. Table 4 reports the calculation results.

According to Table 4, the diagram of the score of each factor is obtained, as well as the diagram of the comprehensive scores of the provinces, municipalities and autonomous regions in China (Fig. 2 and 3).

2.1.1 Income and expenditure factor. This factor includes several indicators, such as the medical care, the per capita consumption expenditure of rural residents, the transport and communication, the household equipment and services, the per capita net income of rural residents, and the educational, entertainment products and services. According to equation (5), it can be concluded that the contribution rate of income and expenditure factor to F is 55.08%, which indicates that the income and expenditure of rural residents has great impact on the rural development level and this factor belongs to the fundamental factor. Fig. 3 illustrates that except Shanghai, Beijing and Zhejiang, the rest provinces and regions have similar scores of income and expenditure factor, showing that there are relatively small differences in the income and expenditure factor for the overall rural development level. And most of the provinces and regions have balanced development in the internal income and expenditure in rural China.

2.1.2 Agricultural scale and science and technology factor. This factor includes three indicators of the livestock, the total sowing area of crops, and the agricultural machinery power. Equation (5) shows that the contribution rate of agricultural scale and science and technology factor to F is 22.34%, indicating that the large scale and the application of science and technology of agriculture can promote the rural development.

2.1.3 Life quality factor. This factor has only one indicator, which is the number of cars. According to equation (5), it can be calculated that the contribution rate of life quality factor to F is 12.6%. Fig. 3 illustrates that Shandong, Henan and Hebei take the top three places. The number of cars in this research refers to the number of tractors, tricycles, motorcycles and other motor vehicles. In the rural areas of China, cars can be used for both daily life and agricultural production. With the further implementation of a series of preferential agricultural policies, it is believed that the rural development will move to a new level in China.

2.1.4 Agricultural output factor. This factor includes the indicators of grain output and vegetable output. According to equation (5), it can be calculated that the contribution rate of agricultural output factor to F is 9.99%. Due to the sharp increase of rural migrant workers, proportion of farmers' nonagricultural income decreases. Thus, the contribution rate of agricultural output factor is relatively small. Fig. 3 shows that Heilongjiang, Henan, Jilin, Shandong, Inner Mongolia, Anhui and other major grain producing areas have relatively high scores of agricultural output factor.

2.2 Cluster analysis According to the comprehensive score of rural development level of each province or region, cluster analysis of the 31 provinces and regions is conducted (Fig. 4).

Table 4 Factor scores, comprehensive scores and comprehensive rankings of the rural development levels of 31 provinces and regions in China

Province or region	F_1	F_2	F_3	F_4	F	Comprehensive ranking
Beijing	4 218.662	258.194	1 144.847	-472.342	2 478.383	2
Tianjin	2 528.633	267.857	1 247.157	-226.691	1 587.106	6
Hebei	1 625.174	-2 522.599	6 966.393	1 829.104	1 392.090	10
Shanxi	1 491.041	-860.159	2 431.152	825.254	1 017.874	19
Inner Mongolia	1 723.355	-1 494.231	3 009.542	2 248.336	1 219.224	14
Liaoning	2 035.290	-655.655	2 328.974	1 337.073	1 401.589	9
Jilin	1 856.855	-846.162	2 043.297	3 150.046	1 405.868	8
Heilongjiang	1 784.035	-2 652.752	4 063.912	4 745.974	1 376.198	12
Shanghai	4 494.650	220.195	1 116.648	-625.188	2 603.086	1
Jiangsu	2 692.670	-1 784.562	3 935.003	1 591.920	1 739.295	4
Zhejiang	3 580.698	-418.992	2 552.550	-15.020	2 198.766	3
Anhui	1 497.887	-2 344.189	4 437.854	2 214.882	1 081.781	17
Fujian	2 281.401	-370.826	1 606.993	130.979	1 389.319	11
Jiangxi	1 616.452	-1 292.776	2 888.570	1 297.129	1 095.079	16
Shandong	2 029.874	-3 051.775	7 900.128	2 270.616	1 658.539	5
Henan	1 433.923	-3 879.325	7 845.765	3 226.295	1 234.037	13
Hubei	1 611.014	-1 760.570	3 232.488	1 673.953	1 068.556	18
Hunan	1 649.158	-1 963.042	3 840.268	1 606.370	1 114.163	15
Guangdong	2 257.830	-968.384	2 566.371	573.168	1 407.898	7
Guangxi	1 322.467	-1 393.430	2 655.072	1 165.338	868.079	25
Hainan	1 534.185	25.274	929.709	-101.554	957.673	21
Chongqing	1 450.123	-664.421	1 498.768	545.479	893.634	24
Sichuan	1 514.008	-2 332.297	3 537.254	1 993.614	957.737	20
Guizhou	973.195	-1 122.187	1 920.928	930.074	620.291	31
Yunnan	1 147.689	-1 462.074	2 511.497	1 254.314	747.275	29
Tibet	1 099.305	401.796	451.195	22.194	754.326	28
Shaanxi	1 339.550	-1 009.008	1 935.000	983.806	854.504	26
Gansu	1 090.152	-919.796	1 894.947	850.094	718.661	30
Qinghai	1 305.216	-9.278	520.662	19.365	784.378	27
Ningxia	1 489.821	-139.324	926.471	370.668	943.234	22
Xinjiang	1 283.049	-745.402	1 908.777	1 343.004	914.853	23

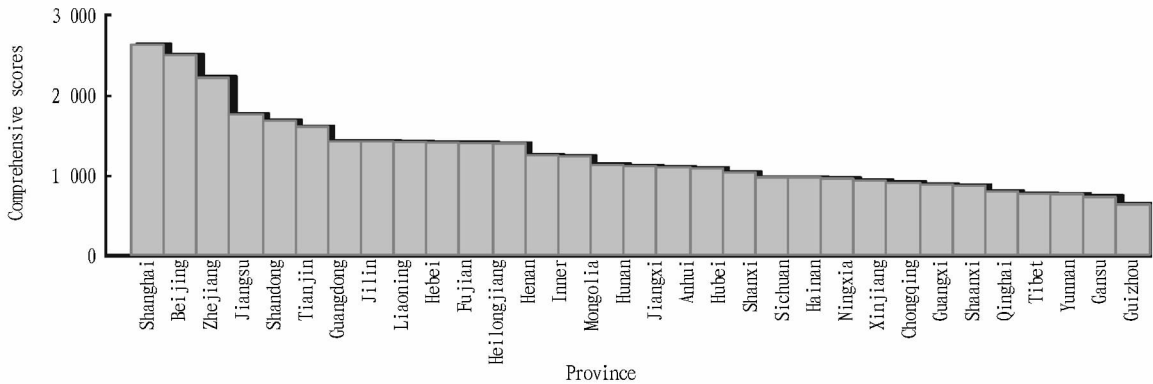


Fig.2 Comprehensive scores (F) of the provinces, municipalities and autonomous regions in China

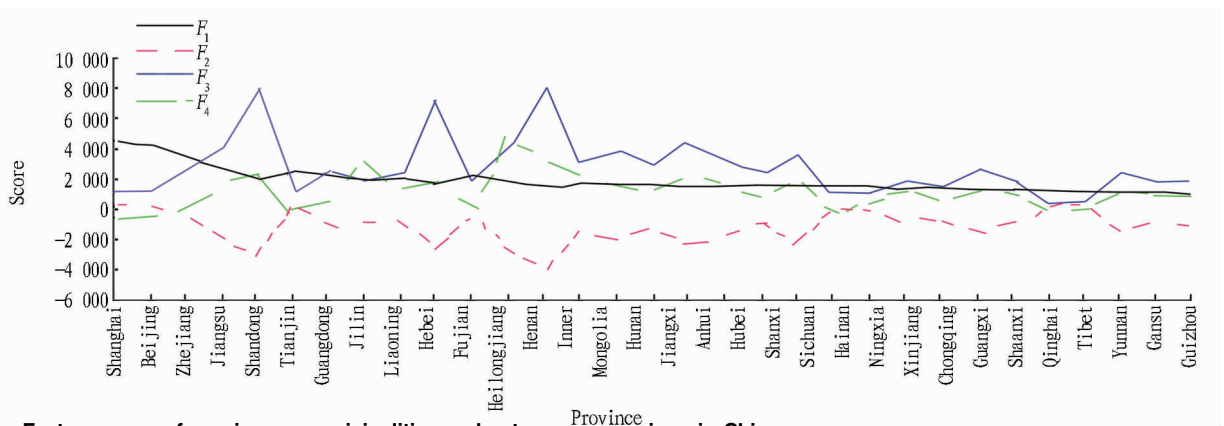


Fig.3 Factor scores of provinces, municipalities and autonomous regions in China

people and technologists out of every ten thousand people stay at the low level. the index of economic development, resource reduction, cultural and developmental level and ecological environment of Suqian lays at the disadvantaged stage. The eight indices all rank last and the other indices are not so high, which lead to the great difference with the overall indices of other areas.

3 Conclusions

Jiangsu is strong province of China in economy and population, but a small province in resources. The statistics show that Jiangsu has the densest population but smallest mineral resources and environmental capacity. At present, Jiangsu has entered the middle age of heavy and chemical industries, but the resource and environment become the "choke point" for its economic development, which are the largest challenge confronted by Jiangsu Province. However, insisting on scientific development view and laying tress on developing recycling economy are the crucial way for solving the difficulties of resources and environment. In view of the problems mentioned above, the following developing strategies and suggestions are put forward.

Firstly, the government should construct and perfect the management, operation and supervision of recycling economy. Secondly, industrial transformation should be accelerated and the industrial structure adjustment should be positively pushed forward to form the industrial system that can meet the demands of recycling economy. Thirdly, energy saving and comprehensive use of resources should be intensified to improve the efficiency of energy use and promote the energy saving, land saving and material saving; positively improve the deep processing of mineral resources and enhance the added value

of products and then realize the optimization and upgrade of mineral industry. Fourthly, the research and development of recycling economy should be intensified. Fifthly, the government should construct ecological cities and countryside; give priority to the development of urban public transportation; guarantee the priority of public transportation; promote the construction of urban transportation equipments; positively push forward the construction of metro or light train; advocate the use of energy-saving and environment-friendly vehicles. Besides, the design and the building materials of civil architecture should fully consider the needs of energy saving and heat preservation.

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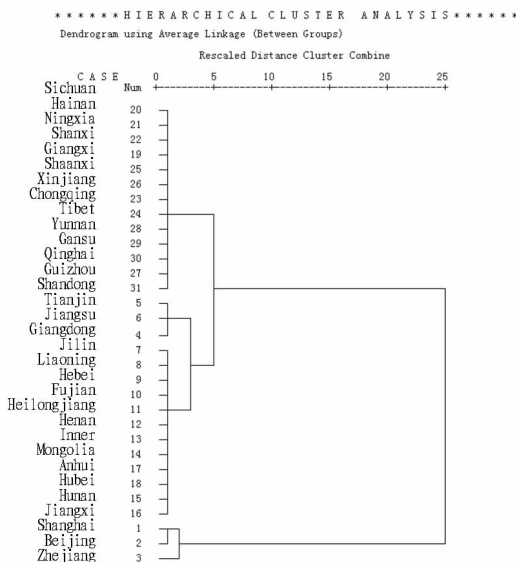


Fig. 4 The cluster dendrogram of rural development level in 31 provinces and regions in China

According to Fig. 4, rural development levels of different provinces and regions in China can be divided into four categories. The first category is Shanghai, Beijing and Zhejiang,

which have the highest comprehensive scores F of rural development level, and are far greater than the comprehensive scores F of other provinces and regions. Due to the developed economy and superior geographical position, the rural development level of the first category is relatively high. The second category includes Jiangsu, Shandong and Tianjin, which take the 4th to 6th places. The third category is Guangdong, Jilin, Liaoning, Hebei, Fujian, Heilongjiang, Henan, Inner Mongolia, Anhui, Hubei, Hunan and Jiangxi, which rank the 7th – 18th. And the fourth category includes Sichuan, Hainan, Ningxia, Shanxi, Guangxi, Shaanxi, Xinjiang, Chongqing, Tibet, Yunnan, Gansu, Qinghai and Guizhou, taking the 19th – 31st places. These provinces and regions are mostly located in western China where people of an ethnic minority with a smaller population live in concentrated communities. Due to the backward economy. And rural development level of this category is relatively low.

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