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An Analysis on Driving Forces of Arable Land Resource Change in Jieshou City

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Abstract By the qualitative and quantitative analysis method, we analyze the driving forces of arable land resource change in Jieshou City and find that the arable land resource change in Jieshou City arises mainly from social and economic driving forces. Based on the social and economic indicator data about arable land resource in Jieshou City, we use principal component analysis to establish evaluation index system, and analyze the driving forces of dynamic arable land resource change in Jieshou City during 2006 – 2015. It is concluded that Jieshou's arable land change is mainly affected by economic and social factors.

Key words Arable land resource change, Driving forces, Jieshou City

1 Introduction

Jieshou City (115°15′ – 115°32′E, 30°0′ – 33°0′N), as the northwest gate of Anhui, is located in the northwest of Huaibei Plain, and at the junction of Beijing-Kowloon Economic Zone and the Eurasian Continental Bridge Economic Zone. It borders the East China Economic Circle to the east with Shanghai as the center, and backs onto the Central Plains hinterland. Jieshou has jurisdiction over 18 townships, towns and streets, and it is an important commercial port and gateway of northwest Anhui. At the end of 2015, the city had a total population of 802000, and a total area of 667.3 km^2. In recent years, Jieshou City has maintained sustained and rapid economic and social development. According to statistics, the city achieved GDP of 14.53 billion yuan, and the ratio of primary industry to secondary industry to tertiary industry was 16.3: 58.2: 25.5 in 2015. The fixed industrial investment reached 8.18 billion yuan, and per capita GDP reached 24580 yuan. Rural per capita disposable income was 9840 yuan, an increase of 9.5% over the previous year, while urban per capita disposable income was 24436 yuan, an increase of 8.3%.

2 Research methods and data sources

The quantitative analysis is combined with qualitative analysis to analyze the driving forces of arable land resource change in Jieshou City from 2006 to 2015. (i) Qualitatively analyzing the driving forces of dynamic arable land resource change in Jieshou City; (ii) selecting the 10 indicators that can reflect population growth, economic development and policy changes, and establishing the index system for the driving forces affecting dynamic arable land change; (iii) using SPSS13.0 software and principal component analysis to obtain the main driving factors affecting dynamic arable land change. The data about arable land area and other socio-economic statistics in Jieshou City are from *Statistical Yearbook of Anhui Province and Jieshou National Economic* and *Social Development Statistics Bulletin* (2006 – 2015).

3 Analysis on the driving forces of dynamic arable land resource change

3.1 Qualitative analysis It is generally believed that there are two kinds of factors affecting arable land area change: natural factors and human factors. Arable land is an important land use type, whose quality and quantity is affected by the natural elements of topography, climate, soil, hydrology and vegetation. Jieshou City is in the Huanghuai Plain, with flat terrain, and it had a warm temperate semi-humid monsoon climate. In the given period, the natural resource endowment is stable, and has a slow impact on arable land area change, so it is not discussed in detail. In the short term, human behavior has a decisive impact on arable land area change, and population growth and socio-economic development have placed a certain demand on the quality and quantity of arable land. Mechanized large-scale cultivation becomes a modern model of agricultural development, so science and technology are of great significance to maintaining arable land quantity, improving arable land quality and ensuring food security. In summary, human factors include social driving forces, economic driving forces and technological driving forces. (i) Social driving forces. This paper selects regional population and rural per capita income to analyze social driving forces. In a given period, due to the relative stability of productivity, arable land change is positively correlated with population change. Rural per capita income can partly reflect the degree of investment of agricultural laborers in arable land. (ii) Economic driving forces. Economic driving forces are the main factors affecting arable land resource change. Regional GDP, output value of primary, secondary and tertiary industries, fixed asset investment and total retail sales of social consumer goods can reflect the level of regional economic development. Eco-

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nomic development can not be separated from the protection from arable land, and it also stimulates the transformation of agricultural production methods, indirectly affecting arable land change. (iii) Technological driving forces. With the deepening of agricultural modernization, the application of science and technology in the land range becomes increasingly wide, total grain output reflects the level of agricultural intensification, and agricultural machinery is an important application of modern agriculture[5]. In the process of human development and utilization of land, scientific and technological factors can help people to realize the intensive use of arable land resources.

3.2 Selection of driving force indicators Natural factors may be stable over a long period of time, so this paper selects the human factors having a great impact on arable land change as driving factors[6]. Based on relevant information and actual situation of Jieshou, we select some indicators to study the driving forces of arable land change in Jieshou City: C_1 (regional GDP); C_2 (output value of primary industry); C_3 (output value of secondary industry); C_4 (output value of tertiary industry); C_5 (total grain output); C_6 (fixed asset investment); C_7 (total retail sales of social consumer goods); C_8 (total power of agricultural machinery); C_9 (population); C_{10} (rural per capita income).

3.3 Quantitative analysis In this paper, we use principal component analysis and SPSS statistic 20 software package to normalize the original value of the indicators chosen, and perform the principal component analysis. Then we get the main factors affecting arable land resource change and make recommendations.

3.3.1 Data normalization. SPSS software uses z-score normalization, and this method is based on the normalization of mean and standard deviation of the raw data. The specific formula is as follows:

$$S = \frac{X_i - \overline{X}}{\sqrt{\frac{\sum_{i=1}^{n}(X_i - \overline{X})^2}{N}}}$$

where S is the standardized value; X_i is the original value of indicator i; $\overline{X}$ is the mean of this indicator; N is the number of indicators.

The normalized data are obtained by operation (Table 1).

Table 1 Principal component analysis data after normalization

Year	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
2006	-1.286	-1.477	-1.249	-1.260	-2.131	-1.004	-1.275	-1.424	-2.555	-1.283
2007	-1.047	-1.161	-1.040	-0.976	-0.814	-0.916	-1.107	-1.318	-0.628	-1.094
2008	-0.888	-0.743	-0.967	-0.710	-0.667	-0.786	-0.820	-0.801	-0.203	-0.848
2009	-0.646	-0.657	-0.631	-0.671	-0.252	-0.661	-0.541	-0.406	0.122	-0.699
2010	-0.289	-0.261	-0.259	-0.393	0.320	-0.330	-0.329	-0.269	0.336	-0.324
2011	0.083	0.281	0.074	-0.009	0.546	-0.252	0.023	0.293	0.514	0.102
2012	0.487	0.581	0.506	0.359	0.370	0.118	0.390	0.445	0.371	0.515
2013	0.810	0.944	0.812	0.707	0.432	0.556	0.771	1.008	0.764	0.934
2014	1.068	1.263	1.028	1.050	0.821	1.284	1.163	1.236	0.407	1.176
2015	1.709	1.231	1.726	1.903	1.375	1.990	1.725	1.236	0.871	1.521

Table 2 Correlation coefficient matrix on driving factors of arable land change in Jieshou City

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
C_1	1									
C_2	0.978	1								
C_3	0.999	0.973	1							
C_4	0.993	0.956	0.991	1						
C_5	0.895	0.908	0.892	0.879	1					
C_6	0.970	0.916	0.968	0.984	0.823	1				
C_7	0.998	0.975	0.996	0.994	0.890	0.977	1			
C_8	0.972	0.993	0.969	0.95	0.904	0.912	0.974	1		
C_9	0.746	0.795	0.738	0.724	0.939	0.634	0.741	0.795	1	
C_{10}	0.996	0.990	0.994	0.984	0.885	0.957	0.994	0.984	0.745	1

3.3.2 Calculation results of principal component analysis. The normalized data are calculated with SPSS software, and the principal component analysis is used to get the correlation coefficient matrix (Table 2), cumulative contribution rate (Table 3), and factor loading matrix (Table 4). The correlation coefficient matrix reflects the degree of correlation between indicators, the higher the value, the higher the correlation. Table 2 shows that there is a strong correlation between the selected indicators. The correlation coefficient between C_1 and C_3 is highest, reaching 0.999, while the correlation coefficient between C_6 and C_9 is lowest, reaching 0.634. Table 3 shows that according to the cumulative contribution rate of greater than 85%, we extract the principal component with eigenvalues of greater than 1 and cumulative contribution rate of greater than 85% under SPSS extraction conditions, and find that the first principal component has eigenvalue of greater than 1 and cumulative contribution rate of 92.818%, so the value changes of the first principal component can represent the change in the 10 indicators to meet the requirements of this analysis. We only need to get the factor loading matrix of the first principal component. As can be seen from Table 4, the load of the first principal component on 10 indicators is similar, but the load is high on C_1, C_3, C_7 and C_{10}. It can be found that the main driving forces affecting the arable land change in Jieshou City are social and economic driving forces.

Table 3 Eigenvalues and variance contribution rate of the principal component

Principal component	Eigenvalues	Variance contribution rate//%	Cumulative variance contribution rate//%
1	9.282	92.818	92.818
2	0.567	5.674	98.492
3	0.101	1.012	99.504
4	0.022	0.223	99.727
5	0.017	0.165	99.893
6	0.008	0.076	99.969
7	0.003	0.028	99.997
8	0.000	0.003	100.000
9	1.92E-07	1.92E-06	100.000
10	-3.07E-18	-3.07E-17	100.000

Table 4 Load value matrix of principal component

Original variable	First principal component	Original variable	First principal component
C_1	0.994	C_6	0.953
C_2	0.986	C_7	0.993
C_3	0.991	C_8	0.983
C_4	0.984	C_9	0.810
C_5	0.933	C_{10}	0.992

4 Conclusions

(i) The principal component analysis results show that one of the main factors that constitute the principal component is rural per capita income (C_{10}). Low income level reduces the enthusiasm of farmers for growing grain, and the means of production can not be improved, resulting in decreased quality of arable land. (ii) The change in the level of economic development has a very significant impact on arable land quantity change. Due to low income and long income cycle in agriculture, more people are willing to invest in the tertiary industry-related industries, thus getting more social investments. The development of the tertiary industry has attracted a large number of rural laborers to work in city, reducing the agricultural labor and compressing the space for cultivated land use. (iii) The process of urbanization increases the demand for urban construction land, including urban infrastructure construction land demand, industrial land demand and housing land demand. Although the urban environment has been improved, the arable land resources are reduced, that is, unreasonable and excessive land occupation in the industrialization and urbanization process causes considerable land resources to be used for non-agricultural construction.

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consolidation potential, about two-thirds of the total land. The future agricultural land consolidation projects are mainly distributed in Level I potential areas: Xiatang Town, Shuangdun Town, Duji Township and the surrounding areas. By carrying out agricultural land consolidation and taking the measures of high-standard farmland construction, farm road adjustment, shelterbelt construction and ditch transformation, the theoretical quantity potential that can be achieved is 1112.89 ha, while the actual quantity potential that can be achieved is 928.41 ha, and the food production is expected to increase by 45600 t.

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