Title： Spatial-temporal charactristic and dynamic mechanism of Land Use Index in Hebei Province in 2000

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Abstract:

In this paper, with the help of relevant data such as statistical yearbooks, geographic data clouds, and thematic maps, and analyzed by means of coefficient of variation and geographic probes study and explore the level of influence of different driving factors on land use degree index.

The results show that: (1) land use is influenced by various factors such as geomorphology, climate, economy and population, and the mechanism of interaction between different factors is very complex; (2) population density and economic factors have a significant influence on land use index in single factor, while climate and economic factors together have a greater influence on land use index under the condition of interaction between two factors.

Keywords:land use; drivers; coefficients of variation; geographic probes;

1. Introduction

The comprehensive land use index quantifies the impact of human activities on the land system by grading the degree of land use, and quantitatively describes the comprehensive level and change trend of land use in the region, which is an important indicator to measure the land use in the designated area.

In the study of the relationship between land use and driver analysis, some scholars mainly focus on the dynamic changes of land use types, landscape changes and index changes. Based on land use data, simulations are conducted using principal component analysis and fitted curves, such as comparative land use change analysis, dynamic land use change and structural analysis. Other scholars also focus on the degree of influence of drivers on land use, such as dynamic land use change and driver variance analysis.

The existing studies have dissected the relationship between land use change and drivers from several aspects, but there are still some shortcomings: first, the changes in land use index are mainly calculated from land use type data, of which there is no unified classification standard for land use type, which is rather subjective; second, most of the driver analysis is derived from the principal component analysis of the increase or decrease in land use type changes Second, most of the driver analysis is derived from the principal component analysis of the increase or decrease of land use types, which is less intuitive. Therefore, this paper directly uses the urbanization rate and the degree of urban intensification to refer to the land use index (for reference only), and considers the direct influence of each driver on the land use index.

2. Methods and Data

2.1 Methods

1. Geographical detectors

Geographic detectors are mainly used to study the spatially divergent characteristics of the dependent variable, including four detectors. In this paper, we mainly study the influence of each driving factor on the land use degree index through factor detectors and interaction detectors.

Factor detectors: detecting the spatial variation characteristics of the dependent variable and detecting the explanation of the dependent variable by the individual independent variable factors. The factor probes in this paper are mainly used to detect the intensity of the effect of different types of economic factors on the size of out-of-province and in-province in-migration population, calculated as:

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma^2_h}{n\sigma^2}$$

where is the explanatory power of the influence factor on the dependent variable; is the sample size; is the variance; and is the sample size and variance of the () stratum. The values are taken in the range of [0,1], and when the value is closer to 1, it indicates the higher degree of influence of this type of driving factor on the land use index. Conversely, when the value is closer to 0, it indicates a weaker degree of influence on the land use index.

2. Coefficient of variation

The coefficient of variation in this paper is used to reflect the regional differences of the mobile population at different time periods, which is calculated by the formula:

$$C_v = \frac{\delta}{\bar{x}} \times 100\% = \frac{1}{\bar{x}} \sqrt{\frac{\sum_{i-1}^{n} (x_i - \bar{x})^2}{n-1}} \times 100\%$$

where is the standard deviation; is the mean value of different driver sampling points; is the number number of townships; and is the specific value of the driver for the township. A larger standard deviation indicates a more important factor.

2.2 Data

The driver data used in this paper were obtained from the Hebei Statistical Yearbook data in 2000, including the first output value, second output value, GDP, temperature, precipitation, population density and total population at the end of the year. The elevation data are obtained by intercepting and processing from the geographic data cloud. Due to the absence of some data, the data of Hebei land use index in 2010 has a large uncertainty, so it will not be discussed any further.

3. Results and Discussion

3.1 Results

The land use index is influenced by a variety of factors. Among them, economic and demographic factors are still important factors leading to the changes of land use index. In this paper, we analyze the differences of different driving factors on the land use index of Hebei in 2000, and select the elevation (X1) and slope (X2) reflecting landform characteristics, temperature (X3) and precipitation (X4) reflecting climate characteristics, population density (X5) and total population at the end of the year (X6) reflecting population characteristics, GDP (X7), output value of primary industry (X8) and output value of secondary industry (X9) reflecting economic characteristics. X8), output value of secondary industry (X9), and other 9 related indicators reflecting economic characteristics.

The results of single-factor detection with the factor detector show that the p-values of all detection factors are less than 0.01, indicating that each type of driving factor significantly influences the land use degree index of Hebei. In terms of each influence indicator, there are differences in the degree of influence of different driving factors on the land use index. Among them, the indicators expressing demographic characteristics are population density (0.764) and total population at the end of the year (0.490) and the output value of primary industry (0.733) and secondary industry (0.717) expressing economic characteristics, temperature (0.552) and precipitation (0.410) expressing climatic characteristics and elevation (0.696) and slope (0.306) expressing geomorphological characteristics.

The results of the interaction detector showed that the interaction of any two driving factors had a greater effect on the land use index than the single factor alone, and the interactions all showed a two-factor enhancement. The two-factor interactions with greater explanatory power were mainly precipitation ∩ population density (0.8873), precipitation ∩ GDP (0.8870), population density ∩ elevation (0.876), total year-end population ∩ elevation (0.870), and population density ∩ slope (0.848). In addition, the interactions of population density with precipitation, total year-end population and elevation show nonlinearly enhanced results.

	q statistic	p value
坡度	0.306	0.000
降水	0.410	0.000
年末总人口	0.490	0.000
气温	0.552	0.000
GDP	0.653	0.000
高程	0.696	0.000
第二产业产值	0.717	0.000
第一产业产值	0.733	0.000
人口密度	0.764	0.000

交互探测									
	X1	X2	X3	X4	X5	X6	X7	X8	X9
X1	0.696275								
X2	0.719907	0.305819							
X3	0.757763	0.67156	0.551728						
X4	0.824069	0.646815	0.842212	0.409535					
X5	0.876532	0.848871	0.83892	0.887357	0.764447				
X6	0.870144	0.629479	0.8051	0.749799	0.764747	0.489568			
X7	0.844506	0.743883	0.83157	0.887025	0.764747	0.664785	0.653491		
X8	0.845565	0.806423	0.803489	0.879042	0.764747	0.763595	0.762929	0.732564	
X9	0.839155	0.793338	0.784292	0.870687	0.764747	0.764747	0.761098	0.76282	0.716767

3.2 Discussion

The relationship between land use change and drivers has been analyzed from several aspects, but there are still some shortcomings: firstly, the change of land use index is mainly calculated from the data of land use types, among which there is no unified classification standard for land use types, which is rather subjective; secondly, most of the driver analysis is derived from the principal component analysis of the increase or decrease of land use types Secondly, most of the driver analysis is derived from the principal component analysis of the increase or decrease of land use types, which is not very intuitive. Therefore, this paper directly uses the urbanization rate and the degree of urban intensification to refer to the land use index (for reference only), and considers the direct influence of each driver on the land use index.

4. Conclusion

This paper focuses on the interrelationship between the land use degree index and the driving factors in Hebei in 2000, and reveals that population density and economic factors have the most significant influence on the land use index through methods such as coefficient of variation and geographic probes. The main spatial analysis in this study is mainly reflected in the fact that each driver has different distribution characteristics in different townships during the study. Although the role of demographic and economic characteristics in a single factor is large, it also has a non-negligible role in the interaction of multiple factors. The next step is to investigate how the differences in land use indices are reflected by different drivers, whether the superposition of multiple drivers can continue to enhance the influence on land use indices, and whether the same drivers still have the same influence in different time periods.