

Research on the Spatial Pattern of National Landscape Garden Counties

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Abstract—Through the systematic description of the spatial pattern characteristics of the National Garden Counties, this paper enriches the research on the city spatial distribution and provides a scientific basis for the improvement of the policy of "Building Garden Cities". Comprehensively using the methods of nearest neighbor indexes, nuclear density estimation, imbalance indexes and ESDA, it systematically characterizes the spatial pattern of National Landscape Garden Counties. The results show that: (1) the spatial agglomeration of National Landscape Garden Counties are significant, and 3 high density areas are formed in the central Shandong, Southern Hebei and Western Guanzhong. (2) There is the scale effect in the distribution of National Landscape Garden Counties, which indicates the transformation from the regional scale to the provincial scale. (3) There are obvious autocorrelation features in the distribution of National Landscape Garden Counties. The core-periphery structure of the spatial association pattern is significant, and the law of the change from heat to cold and the gradient are presented.

Keywords—National Landscape Garden Counties; Spatial pattern; Spatial agglomeration; Spatial differentiation; Spatial correlation

I. INTRODUCTION

The national scale of urban spatial distribution is an important topic in China's urban geography since 1980s [1]. It can be seen from the literature that the academic circles have made remarkable progress in this study, which includes the deepening of the research content, including the revelation of the characteristics of the macro pattern of urban distribution in China, the analysis of evolution process and the interpretation

of the mechanism of influence. The research methods have been improved continuously, including descriptive statistics, thematic maps, nearest neighbor analysis, center of gravity model [2] and grid analysis [3]. The application of spatial autocorrelation analysis [4], GIS spatial analysis method [5] and geostatistical methods [6] have increased significantly in the last 10 years. The time span of research extends from 100 years [7] to the whole feudal society of China [6]. Data sources are expanded from statistical yearbooks to historical documents [6] and night lighting data [8]. However, it is also necessary to know that the results are mainly focused on the cities of different levels [4], and the analysis of the towns, especially the county towns [9-10], is relatively inadequate, and lack of the discussion of the specific types of cities, such as National Landscape Garden County [11]. In view of this, the National Landscape Garden County town in the national garden city series is taken as an example. By using the nearest neighbor index, nuclear density estimation, unbalance index and ESDA, the spatial agglomeration pattern, distribution pattern and association pattern are systematically depicted in order to expand the content of urban spatial distribution research and provide scientific basis for the perfection of "creation garden" policy.

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II. DATA AND METHODOLOGIES

A. Data

The research samples are 291 National Landscape Garden County named by the end of 2017. The analysis units are 31 provinces in the mainland of China with national garden counties. The sample data came from the website of the Ministry of Housing and Urban-Rural Development (<http://www.mohurd.gov.cn>), and the spatial cdata ame from the National Basic Geographic Information Center (<http://ngcc.sbsm.gov.cn>). With the help of the Baidu map API, the spatial location information of National Landscape Garden County is obtained and approved by xGeocoding software. ArcGIS10.2 software was used to visualize the distribution of National Landscape Garden County (Fig. 1).



Fig. 1 The Spatial Distribution of National Landscape Garden Counties

B. Methodologies

(1) Nearest neighbor index. It is a geographical index that represents the proximity and relationship between dots and can be used to measure the spatial distribution pattern of National Landscape Garden County. The calculation formula is detailed in reference [12]. When $NNI < 1$, the elements present a spatial aggregation pattern; when $NNI = 1$, the elements are randomly distributed; when $NNI > 1$, the elements are uniform distributed.

(2) Kernel density estimation. It has been widely used in the study of geographical elements distribution, which can directly reflect the spatial agglomeration area of National Landscape Garden County and can be obtained by using the Kernel Density tool in the ArcGIS. The calculation formula is detailed in reference literature [11]. In this study, bandwidth has been identified as 200km after many tests.

(3) Imbalance index. It can characterize the equilibrium degree of National Landscape Garden County in different spatial scales distribution. The calculation formula is detailed in reference literature [12]. The index value is $[0, 1]$, if $=0$, it indicates that the average distribution of National Landscape Garden County in different areas. If $=1$, it indicates that National Landscape Garden County are concentrated in one area.

(4) ESDA. It takes the spatial correlation measure as the core, and the representative tools have Global Moran's I, Moran scatter plot and Getis-Ord G_i^* indices. The calculation results of the former and the latter two can reflect the spatial correlation characteristics of National Landscape Garden County in the global and local areas respectively. The specific formulas refer to the literature [4] and [11].

III. RESULTS AND ANALYSIS

A. Spatial agglomeration pattern of National Landscape Garden Counties

The nearest neighbor index of National Landscape Garden County was calculated to be 0.59, and the result passed the significance test (Fig. 2).Based on this, we can see that it has a significant spatial agglomeration pattern. Then, performed a kernel density mapping for National Landscape Garden County (Fig. 3), to explore the specific regions and pattern of spatial agglomeration. From the figure, we can see that the pattern of National Landscape Garden County is generally in the form of "Eastern is dense and Western is sparse" and a multi-centered structure; A total of three agglomeration centers are located in the eastern, central and western regions. They are located in the Luzhong, Jinan and Guanzhong western areas.

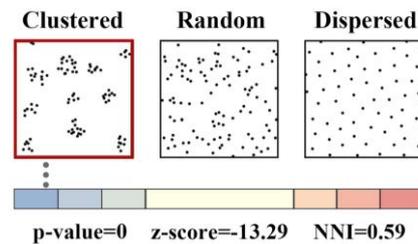


Fig. 2 Nearest Neighbor Indexes of National Landscape Garden Counties

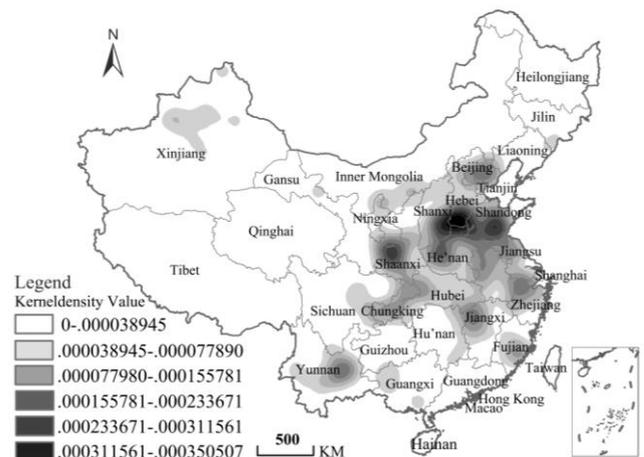


Fig. 3 The Kernel Density Map of National Landscape Garden Counties

B. Spatial heterogeneity pattern of National Landscape Garden Counties

Statistics of the number of National Landscape Garden County counted in seven geographical regions and provincial administrative regions and calculated its proportion to the total number of the country (table1, table2). The imbalance indices at the regional and provincial scales are 0.37 and 0.52, respectively. It shows that with the declining of research scale, the distribution of National Landscape Garden County tends to be uneven from the average. In terms of sub-regions, the number of National Landscape Garden County in the East China region is the largest, followed by the northwest and north China regions. The above three geographical regions

have gathered nearly two-thirds of National Landscape Garden County .In terms of provinces, the top 10 provinces and cities are distributed in all five geographical regions except South China and Northeast China. However, the total number of National Landscape Garden County within the country has accounted for nearly 70% of the country's total .The number of National Landscape Garden County in 4 provinces of Hebei, Shandong, Henan and Shaanxi is over 20, ranking the top 4; the number of National Landscape Garden County in Beijing, Liaoning, Heilongjiang, Tianjin, Hainan and other 10 provinces are all below 3, including Shanghai, Guangdong, Guizhou, Tibet and Qinghai are even the blank areas of National Landscape Garden County.

TABLE I. STATISTICS OF NATIONAL LANDSCAPE GARDEN COUNTIES IN GEOGRAPHIC REGIONS

<i>Geographic area</i>	<i>Number of National Landscape Garden County</i>	<i>Ratio (%)</i>	<i>Cumulative ratio (%)</i>	<i>Rank</i>
<i>East China</i>	83	28.53	28.53	1
<i>North China</i>	53	18.21	64.95	2
<i>North-west region</i>	53	18.21	46.74	2
<i>Central China</i>	43	14.78	79.73	4
<i>Southwest Region</i>	41	14.09	93.82	5
<i>Southern China</i>	9	3.09	96.91	6
<i>North-east area</i>	9	3.09	100	6

TABLE II. STATISTICS OF NATIONAL LANDSCAPE GARDEN COUNTIES ON THE PROVINCIAL BASIS

Province	Quantity(number)	Ratio (%)	Cumulative ratio (%)	Rank
Hubei	27	9.28	9.28	1
Shandong	26	8.94	18.22	2
He'nan	25	8.59	26.81	3
Shaanxi	23	7.90	34.71	4
Yunnan	19	6.53	41.24	5
Xinjiang	19	6.53	47.77	5
Shanxi	17	5.84	53.61	7
Chungking	16	5.50	59.11	8
Zhejiang	14	4.81	63.92	9
Anhui	13	4.47	68.39	10
Hubei	12	4.12	72.51	11
Jiangxi	11	3.78	76.29	12
Jiangsu	10	3.44	79.73	13
Fujian	9	3.09	82.82	14
Inner Mongolia	8	2.75	85.57	15
Guangxi	8	2.75	88.32	15
Hunan	6	2.06	90.38	17
Sichuan	6	2.06	92.44	17
Ningxia	6	2.06	94.5	17
Gansu	5	1.72	96.22	20
Jilin	3	1.03	97.25	21
Beijing	2	0.69	97.94	22
Liaoning	2	0.69	98.63	22
Heilongjiang	2	0.69	99.32	22
Tianjin	1	0.34	99.66	25
Hainan	1	0.34	100	25
Shanghai	0	0	100	27
Guangdong	0	0	100	27
Guizhou	0	0	100	27
Tibet	0	0	100	27
Qinghai	0	0	100	27

C. Spatial association pattern of National Landscape Garden Counties

The estimated index value of Global Moran's I of the spatial distribution of National Landscape Garden County is 0.1867 and the normal statistic is 2.02. The index values are all positive. These indices are greater than the critical value of 1.96 at a confidence level of 0.05 and passed the significance test. It shows that the distribution of National Landscape Garden County has obvious spatial autocorrelation characteristics, and the provinces with the same number of named county cities tend to agglomerate in space.

From the Moran scatter plot (Fig. 4), the number of provinces in the first and third quadrants is 10 and 7, which together account for 54.84% of the analysis units, of which the province in the first quadrant accounts for 32.06%. It is reflected that the spatial distribution of National Landscape Garden County is more positively related, and the spatial

association of neighboring provinces is more indicative of a High-High clustering model.

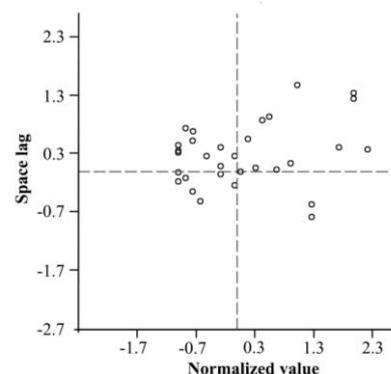


Fig. 4 Scatter Plot of Moran

