Study on spatial agglomeration degree of land use in Shanghai

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Abstract. Spatial agglomeration of land use is the basic factor leading to the formation and continuous expansion of cities, which provides effective support for regional coordinated and sustainable development. In this paper, the status of land use in Baoshan District of Shanghai during the second and third national land survey is used to analyze the location entropy and spatial hotspot, and the change of spatial agglomeration is explored through comparison. The results show that during the period from the second to the third national land survey, the farmland in Baoshan District is scattered, the residential land is concentrated in a small scope, and the industrial land stock is large. According to the characteristics of different land use, relevant policy suggestions are put forward.

1. Research background
With China's rapid development, human-earth relations are facing severe challenges. With the rapid progress of Industrialization and urbanization in China, the spatial agglomeration effect of land use cannot be underestimated, which has a long-term and subtle influence on regional economy and ecological environment.

In the context that tight constraints of resources and environment have become the new normal in Shanghai[1], spatial agglomeration degree analysis of land survey results is conducive to improving the intensive use of land, ensuring urban and rural development and farmland protection.

2. The theoretical basis of spatial agglomeration degree analysis of land use

2.1. Spatial agglomeration of land use
The spatial agglomeration of land use is mainly manifested as the cluster phenomenon in which the population, industry and capital attached to the land are close to each other in space and have concentrated distribution. Foreign scholars believe that the spatial agglomeration of economic activities promotes the formation of external economic effects[2-3]. Domestic scholars believe that the trend of spatial agglomeration in China's urbanization process is of historical inevitability[4], and the rational use of urban space should follow the path of green and intensive sustainable development[5-6].

In the long run, rational planning of the spatial agglomeration of different land types, such as setting ecological red lines and controlling the amount of construction land, not only protects green mountains and clear water, but also promotes the healthy development of economy, which is of far-reaching significance.
2.2. Location entropy theory
Location entropy is the specialization rate first put forward by P. Haggett and applied in industrial location analysis. In recent years, location entropy has been used in spatial analysis of land use to reflect the degree of agglomeration of certain land use types in the whole region. The location entropy calculation formula is:

\[ Q = \frac{m_i}{M} \]

Where: \( Q \) is location entropy; \( m_i \) is the area of a certain type of land use in a certain region; \( M_i \) is the total area of the land use type within the region; \( M \) is the total area of a region. Generally, when \( Q > 1 \) indicates that the land type has a high degree of agglomeration in the region; And vice versa[7].

2.3. Regional spatial characteristics
Spatial agglomeration of land use is one of the most significant features of urban spatial pattern. In ArcGIS10.4, spatial clustering analysis methods include optimization hotspot analysis, similarity search, multivariate clustering, etc.

In this paper, hot spot analysis (Getis-ORD Gi*) is used to calculate hot spot (high value) and cold spot (low value) to reflect the degree of land agglomeration. In the visual expression of ArcGIS10.4, the red image spot is the hot spot, indicating the high-value aggregation. The yellow spots are randomly distributed; Blue spots are cold spots and represent low value clusters[8].

3. Measurement and analysis of spatial agglomeration degree of land use in Shanghai – a case study of Baoshan District
This paper compares the land use in the second national land survey (referred to as SNLS) and the third national land survey (referred to as TNLS) in Baoshan District of Shanghai, and focuses on the spatial agglomeration of farmland (referred to as F), residential land (referred to as R) and industrial land (referred to as I). Finally, summarize and put forward relevant policy recommendations.

3.1. Overview of the research area
Baoshan District, located in the north of Shanghai, has excellent natural conditions and superior geographical location. In 1995, The People's Government of Shanghai established Baoshan Urban Industrial Park, which has been developing for more than 20 years, driving the development of economy and high-tech industries and injecting vitality into the urban construction of Shanghai.

3.2. Location entropy analysis
Baoshan District has three streets and nine towns. The \( m_i, M_i, m \) and \( M \) values of some towns in the second national land survey and the third national land survey were statistically calculated, and the value of location entropy \( Q \) was shown in Table 1.

| Town      | F_Q SNLS | F_Q TNLS | R_Q SNLS | R_Q TNLS | I_Q SNLS | I_Q TNLS |
|-----------|----------|----------|----------|----------|----------|----------|
| Zhangmiao | 0.00     | 0.00     | 3.73     | 3.62     | 0.23     | 0.07     |
| Luodian  | 2.74     | 2.31     | 0.97     | 1.22     | 0.69     | 0.55     |
| Dachang  | 0.30     | 0.33     | 1.97     | 1.72     | 1.06     | 0.53     |
| Yangxing | 0.64     | 0.78     | 1.10     | 1.03     | 1.56     | 0.99     |
| Yuepu    | 1.04     | 0.94     | 0.56     | 0.53     | 1.95     | 3.25     |
| Luojing  | 2.07     | 2.28     | 0.48     | 0.50     | 1.11     | 1.22     |
It can be seen from Table 1 that in the second and third national land survey, the Q value of farmland in Luodian Town and Luojing Town both exceeded 2, which was much higher than that of other towns, indicating that the agglomeration degree of agricultural land in these two towns was higher than that of other towns. The Q value of residential land in Zhangmiao Street was the largest in the whole region in the second and third national land survey, indicating that the residential land agglomeration level of Zhangmiao Street was higher than that of other towns. During the third national land survey, the Q value of industrial land in Yuepu Town reached 3.25, ranking first in the whole region, and the agglomeration level of industrial land was much higher than other towns.

3.3. Spatial characteristics of land use
This paper uses the hot spot analysis tool and the farmland, residential land and industrial land distribution map in Baoshan District during the second and third national land survey to get the hot spot distribution map of all kinds of land in Baoshan District, and shows it visually.

3.3.1. Hotspot distribution of farmland.
It can be seen from Figure 1 that there are fewer yellow spots in the second national land survey, that is, less agricultural land randomly distributed. A large number of red spots appeared in Gucun Town and Luodian Town, that is, there are large and clustered farmland in these two towns, indicating that farmland is relatively complete, concentrated and of a large scale. It can be seen from Figure 2 that, at the third national land survey, the blue spot decreases and the farmland becomes more intensive.

3.3.2. Hotspot distribution of residential land.
As can be seen from Figure 3, at the second national land survey, many red spots are distributed in Zhangmiao Street, Gaojing Town, southern Yuepu Town and other places, indicating that the residents in these places are concentrated. A large number of blue spots are distributed in Luojing Town, western Yuepu Town and other places, indicating that these places do not have a large population. It can be seen from Figure 4 that the distribution of residential land is roughly the same as that of the second national land survey.
3.3.3. Hotspot distribution of residential land.
As shown in Figure 5, the red spots are concentrated in Yuepu Town, Songnan Town, eastern Luojing Town and other places during the second national land survey, indicating that these places have dense industrial land. Each town has a blue spot distribution, that is, Baoshan District has a large number of small area distribution of industrial land. As shown in Figure 6, blue spots in Dachang Town, Gaojing Town, Gucun Town, Yanghang Town and Luodian Town were greatly reduced in the third national land survey, that is, the agglomeration degree of cold points decreased.

4. Conclusions
By analyzing the hot spots of farmland, residential land and industrial land, the following conclusions are drawn:

(1) Farmland is concentrated in the northern and western of Baoshan District, but the overall distribution is scattered, which is not conducive to the large-scale and intensive development of agriculture and weakens the ecological functions of basic farmland and cultivated land. We should strengthen the regulation and control of ecological land use and attach equal importance to the quantity and quality of cultivated land and ecology.

(2) Residential land is concentrated in a small area, showing the trend of "south gathering, north sparsing". The government can strengthen the road network construction, at the same time support the
development of commercial land, improve the infrastructure construction, improve the quality of life of residents.

(3) The industrial land is dense in the northeast and scattered throughout the region. The government should rationally plan the layout of industrial land and reduce the stock.

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