

Research on the Characteristics of Spatial Pattern of Logistics

Enterprises——Taking Suzhou as an Example

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Abstract: The acceleration of economic globalization and integration has led to a sharp increase in global cargo flows and a change in the spatial location of logistics facilities. The location of logistics facilities affects not only the cost and efficiency of cargo transportation, but also the rational allocation of logistics resources. Recently, two main perspectives of logistics space research—cluster (concentration of geographic facilities and geographic functions) and expansion (the movement of facilities from the core of the city to the surrounding areas) have received widespread attention from academics and policy makers. Based on the attribute data of 10,789 logistics enterprises in Suzhou, this paper explores the location and evolution characteristics of logistics enterprises in Suzhou by using location quotient, nuclear density and standard deviation ellipse. The research finds that: (1) The differences in logistics development between the five research areas in Suzhou are gradually increasing, and the spatial and temporal development levels of regional logistics enterprises are significantly different; (2) Suzhou logistics enterprises show a characteristic of the shift from “single center” to “multi-center” agglomeration mode. The number and intensity of agglomeration points are constantly increasing.

Keywords: logistics space; distribution characteristics; time and space pattern; Suzhou City.

1. INTRODUCTION

In the context of economic globalization and regional economic integration, more and more products are circulating, producing, selling and consuming around the world. As a new engine of economic growth, logistics plays a central role in overcoming the time and space constraints between producers and the markets they serve. Logistics space refers to the prediction of urban logistics activities (professional market, logistics company, logistics node, logistics infrastructure) in geospatial space. As the economic organization of logistics activities, logistics enterprises undertake basic functions such as transportation, warehousing, loading and unloading, packaging, distribution processing and distribution. The logistics node is the space subject that undertakes the urban logistics functions, including logistics parks, logistics centers and distribution centers.

For the study of logistics spatial distribution characteristics, Qian Qinglan (2011), Hu Yanyan (2016), and Shen Yufang (2011) used GIS spatial analysis methods to study the spatial distribution

characteristics of logistics in Guangzhou, Hefei and Yangtze River Delta regions ^[1]. Zeng Xiaoyong (2010) found that the warehouse-type logistics nodes appear generally as “large concentration and small dispersion”, and the density of those in the old city is relatively high. It is concentrated in the main traffic trunks of the city, around the airport and ports, and near the logistics park ^[4]. Sakai (2015) analyzed the location dynamics of logistics facilities in Tokyo's metropolitan area and found that logistics facilities moved outward by only 26% in 10 years [5]. For the evolution of logistics space, it mainly comes from two perspectives of cluster and expansion. Logistics expansion refers to the trend of logistics facilities moving from the inner city to the suburbs and suburbs to the outward [6]. A large number of foreign studies have confirmed this phenomenon by calculating the change in the average distance between logistics facilities and urban centers (for example, Gothenburg, Atlanta, Zurich, Los Angeles, and Tokyo) [7-13]. Dablanc and Ross (2012) compared the changes in the average distance between logistics facilities and commercial organizations, which they called “relative (logistics) spread” [7]. Sakai (2017) finds that the average distance of the logistics facilities from the urban center has increased considerably more than that of the population (2.4km versus 0.4km) [11]. Rivera and Sheffi (2013) define logistics clusters as third-party logistics (3PL-s) for logistics services, freight forwarders, geographic concentration of transportation carriers, and storage providers[14]. The most obvious benefit of a logistics cluster is that it combines transportation traffic, which usually saves on transportation costs. Moreover, lower transportation costs will further attract the logistics cluster of the enterprise, thus forming a virtuous circle. In addition to transportation advantages, the fundamentals of logistics clusters are the ability to share assets more easily, to serve customers better, and to allow for better adjustments to business volume, and provide other advantages, including shared labor, infrastructure and information [15]. He and Shen reviewed the research status of logistics space, and analyzed the factors affecting the evolution of logistics space from land prices, traffic accessibility, market demand, agglomeration advantages and government policies, and discussed the impact of logistics space evolution from a sustainable perspective [16]. Adding location quotient, nuclear density and other methods, relying on ArcGIS spatial analysis, combined with Suzhou logistics enterprise database, this study focuses on the location distribution characteristics and evolution law of logistics enterprises in Suzhou, to provide reference for optimizing logistics space layout and organizing logistics activity.

2. RESEARCH AREAS AND DATA SOURCES

2.1 Research area

Suzhou, known as Wu, is a national historical and cultural city, a scenic tourist city, a national high-tech industrial base, and one of the important central cities in the Yangtze River Delta. It is located in the southeast of Jiangsu Province, in the middle of the Yangtze River Delta, east to Shanghai, south to Zhejiang, west to Taihu, and north to the Yangtze River. It is an important part of the Jiangsu Yangtze River Economic Belt. The total area of Suzhou is 8848.42 square kilometers. In 2017, the resident population was 10.863 million, and the GDP was 173.951 billion yuan, of which the third industry accounted for 51.2%. In 2017, the total revenue of Suzhou logistics industry accounted for 15% of Suzhou's total GDP, and 28% of Jiangsu, ranking first. The freight turnover was 149.37 million tons, the port cargo throughput reached 605.56 million tons, and the container throughput was 5.8752 million TEU. There are more than 20,000 logistics enterprises in Suzhou, and

the development momentum of them is rapid, with an annual growth rate of 12%. The overall development of the logistics industry is good. There are 5 municipal districts in Suzhou: Gusu District, Huqiu District, Wuzhong District, Xiangcheng District, Wujiang District (collectively referred to as the urban area); 4 county-level cities: Changshu City, Zhangjiagang City, Kunshan City, Taicang City (Fig. 1).

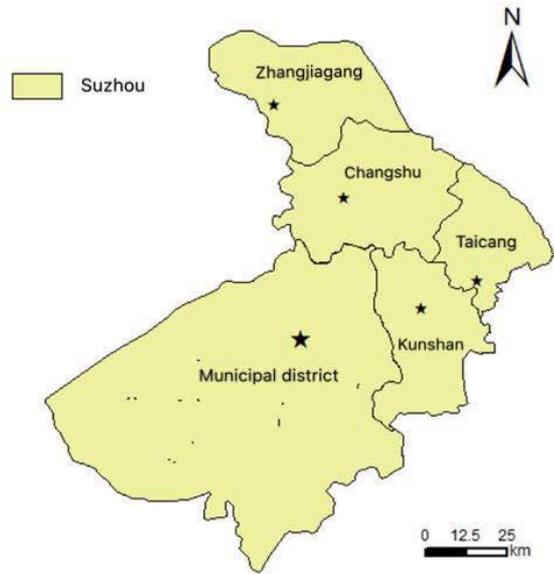


Fig. 1 Research area and its administrative divisions

2.2 Data Sources

Based on the industrial and commercial management system of Suzhou City, this paper collects more than 20,000 logistics enterprises in Suzhou within the categories of “logistics”, “transportation”, “warehousing” and “express”. Then, after screening and classifying data, there are 10,789 logistics companies with a registered capital of more than 1 million; finally, according to the Gaode map API, the company's latitude and longitude coordinates were obtained, thus establishing a database of logistics enterprise with Grade A and above and of all logistics enterprise. Database information includes company name, business address, latitude and longitude coordinates, establishment period, business scope, and business type.

3. RESEARCH METHODS

3.1 Location quotients

Location quotients can measure the level of industry development in a particular region and are generally used to measure the degree of specialization and concentration of different industries within the region. When researching the space distribution of industry, the location quotients can compare the comparative advantages of different industries in different regions. The formula is:

$$LQ_{iw} = \frac{E_{iw} / E_i}{E_{hw} / E_h} \quad (1)$$

LQ_{iw} represents the location quotient of i companies in the study area w ; E_{iw} represents the employees of transportation, warehousing and postal services in the city of I , E_i represents all employees in the city, and E_{hw} represents employees in all areas of transportation, warehousing and postal services. Personnel, E_h represents employees in all regions. If $LQ_{iw} > 1$, it means that the distribution of such

enterprises in the region is concentrated, and the degree of specialization is higher than the average; if $LQ_{iw} < 1$, it means that the distribution of such enterprises in the region is more scattered; if $LQ_{iw} = 1$, indicating that the degree of specialization and distribution of such enterprises in the region are close to the overall.

3.2 Nuclear density

The kernel density estimation method is suitable for visual representation of point distribution patterns. The circular area search is performed on the network center p of the grid to be calculated, and then the density value of each grid is calculated. The weight given is gradually decreased as the distance from the center point increases.

$$\hat{\lambda}_h(p) = \sum_{i=1}^n \frac{1}{h^2} k\left(\frac{p-p_i}{h}\right) \quad (2)$$

$\hat{\lambda}_h(p)$ is the density value of p point; K is the weight function; $p-p_i$ represents the distance between p and p_i which need density estimating; h is the bandwidth, also called the search radius, and the choice of its value will affect the smoothness of the density estimate.

4. SPATIAL PATTERN AND EVOLUTION CHARACTERISTICS OF LOGISTICS ENTERPRISES

4.1 Spatial distribution characteristics of logistics enterprises

The spatial distribution of logistics enterprises is mainly affected by land prices, transportation, market demand, agglomeration advantages and government policies. Demand for logistics-related land is growing and land is becoming less and less. From 2010 to 2018, the logistics and storage land in Suzhou has nearly doubled, and the contradiction between supply and demand of land has increasingly affected the spatial distribution of logistics enterprises. Suzhou's road network is sound, with a total mileage of 12,658km. By 2020, Suzhou will achieve a goal reaching high speed within 15-minute in the city. In terms of waterways, Zhangjiagang Port, Taicang Port and Changshu Port have complete facilities, and the construction and information systems of multimodal transport infrastructure have developed rapidly. In addition, the Beijing-Shanghai Railway and the Shanghai-Nanjing Railway run through Suzhou. As a service industry, logistics can get a lot of logistics needs close to the market. The change in logistics space follow that in the market, and the expansion of logistics always follows that in population and other commercial institutions. In addition, the huge demand for logistics in ports, airports and industrial parks is an important factor in attracting logistics accumulation. For logistics enterprises, the agglomeration area provides sufficient professional labor, transportation advantages, resource sharing, value-added services and sound infrastructure for logistics enterprises. The government can stimulate and guide the orderly development of logistics enterprises through urban planning and public policies. On the fiscal front, it is possible to increase investment in logistics infrastructure, especially the key and pivotal logistics facilities that support the "One Belt and One Road" and the strategic implementation of the Yangtze River Economic Belt. In terms of land use security, the land use policy will be further implemented and improved to support the development of the logistics industry. The layout of land for logistics facilities will be made overall consideration of. The rational land use needs of the logistics industry will be ensured. In terms of taxation, taxation preferential policies for the development of the logistics

industry can be implemented to further reduce the tax burden of logistics enterprises. The spatial layout of logistics enterprises in Suzhou shows that the main distribution areas of logistics enterprises in the city area are (Fig. 2):

- (1) Urban central area. The urban central area has gathered a lot of flows of people, logistics, business and information, and has become an important distribution area of various logistics enterprises. Suzhou logistics enterprises are mainly concentrated in urban central areas and sub-central areas.
- (2) Important logistics parks. Suzhou has 14 provincial-level logistics parks. These logistics parks gather a large number of logistics enterprises, with a sound logistics system and high service quality. For example, Kunshan Logistics Park focuses on the development of production logistics, life logistics and trade transactions. Among them, there are 9 provincial key logistics enterprises, 69 A-level logistics enterprises and 2 listed logistics enterprises.
- (3) Developed transportation. The capacity and structure of transportation infrastructure can stimulate the flow of goods, shorten transportation time, improve market access and promote economic growth. For logistics companies, cargo transportation is the core of their business, so traffic accessibility plays an important role in location decision-making. Such as a large number of logistics companies near the expressway and railway in Suzhou. The function of the Jianghai Intermodal Hub in Suzhou Port is also promoting the development of container logistics.
- (4) Adjacent to Shanghai. Suzhou can develop itself by serving Shanghai with the help of Shanghai's developed economic advantages. For example, Suzhou has a large number of auto parts manufacturing companies, which provide support for Shanghai's vehicle manufacturing. Therefore, the border between Suzhou and Shanghai has become an important gathering point for logistics companies.

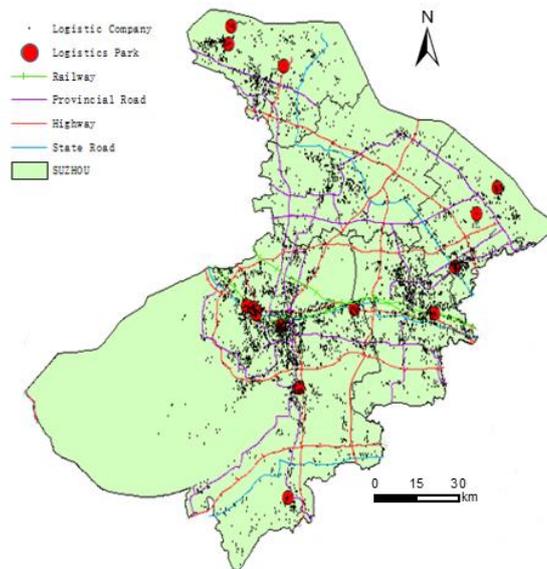


Fig. 2 Spatial distribution map of Suzhou logistics enterprises

4.2 Spatial Evolution Characteristics of Logistics Enterprises

By calculating the location quotients of logistics enterprises in five regions of Suzhou from 2001 to 2017, the spatial distribution differences of logistics enterprises in different regions of Suzhou in different periods are accurately characterized (Fig. 3). It can be seen from Figure 4: In 2001, there is

little difference between the location quotients, whose mean values are all around 1. With the passage of time, the location quotients in Zhangjiagang has been continuously improved, and the overall concentration and specialization level have been continuously improved, which mainly due to the rapid development of port logistics. In addition, because of the economic radiation of Shanghai, that in Taicang gradually increased from 0.78 to 1.46. That in Kunshan declined, from 0.90 to 0.59. That in the urban area and Changshu did not change much overall remaining around 1.

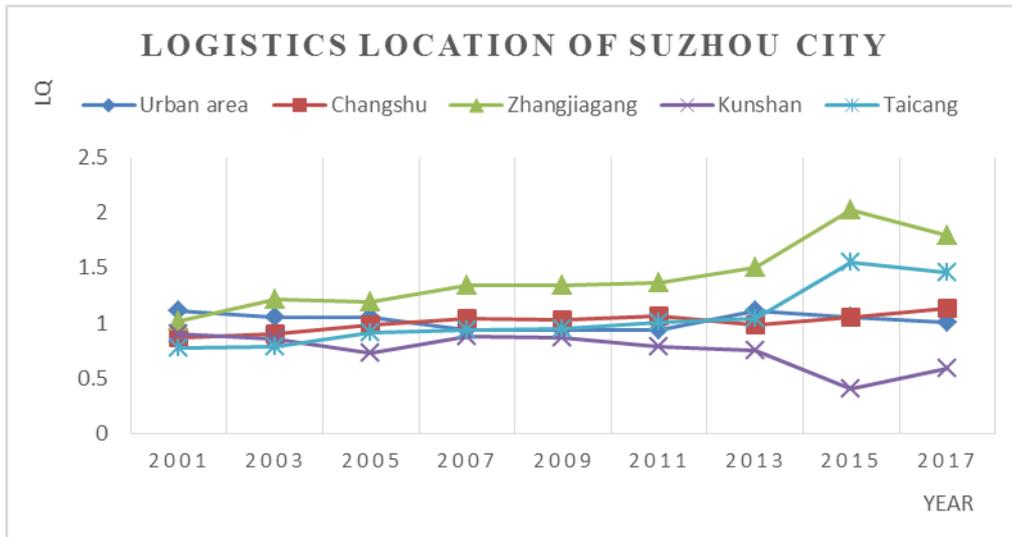


Fig. 3 2001-2017 Suzhou City Logistics Location

This paper intends to analyze the spatial cluster and expansion of logistics enterprises in Suzhou by using the nuclear density estimation method in the ArcGIS software spatial analysis module. By The nuclear density to calculating the number of logistics enterprises in a single grid, the corresponding nuclear density values can be obtained. Then, after dividing that into the 10 levels according to the natural cracking method, the density distribution of the logistics enterprises at different time points is vertically compared. Overall, Suzhou logistics companies have shown a shift from a “single center” to a “multi-center” cluster model, and the number and intensity of agglomeration points are increasing (Fig. 4). In 2000, there are clusters of logistics companies in Suzhou City, Kunshan City, and Zhangjiagang City gathered. In 2006, there are the accumulation of clusters in the county-level cities and towns began to form a secondary logistics center. By 2012, the intensity of cluster gradually increased. In 2018, the concentration of logistics enterprises is further enhanced, and several gathering centers began to appear in the urban area. The intersection with Shanghai, the port and the national logistics park have also begun to form a gathering center.

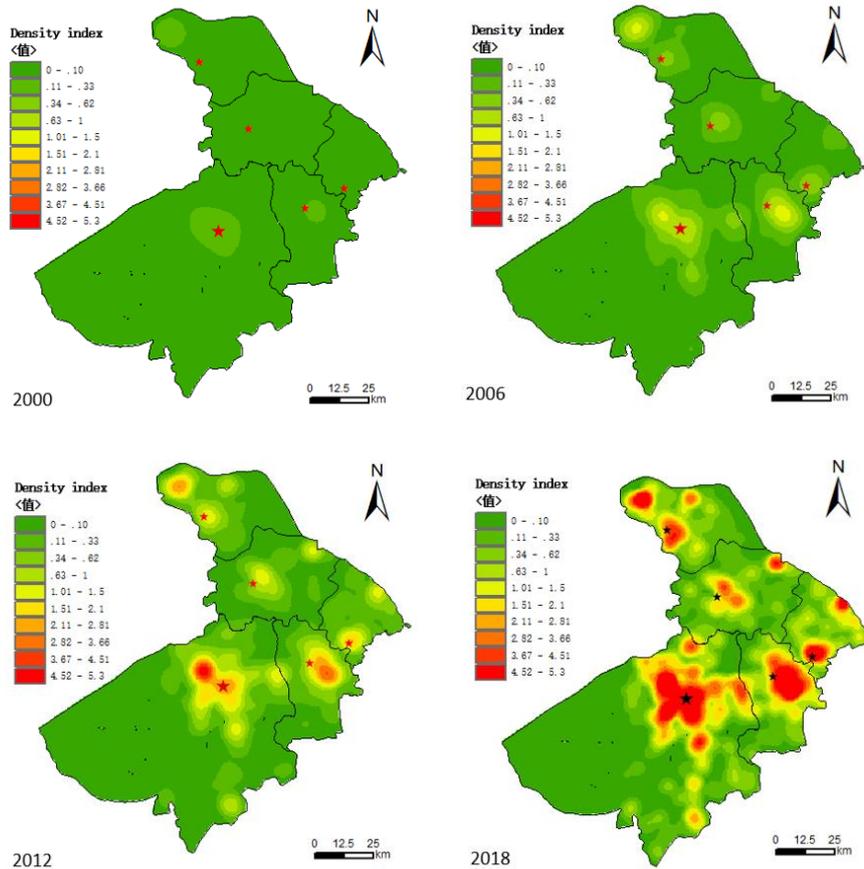


Fig. 4 Nuclear density distribution of logistics enterprises in Suzhou

5. CONCLUSIONS AND RECOMMENDATIONS

Modern logistics has a strong correlation with the development of urban industries. Its growth and development is also a very important driving factor for the growth of urban economy. The location choice of logistics enterprises is the spatial form and structure of urban logistics activities, and its formation and evolution have its own characteristics and laws. The main conclusions of this paper are:

- (1) The spatial distribution of logistics enterprises in Suzhou City is obviously different, and the distribution is north-south as a whole. The distribution within each region is also different, which is more obvious in the port area. The city center, important logistics parks, traffic trunks, and the area adjacent Shanghai have become the main distribution areas.
- (2) The logistics enterprises in Suzhou have shown the characteristics of “single center” to “multi-center” clusters mode. The number and intensity of clustering points are increasing, and the logistics expansion in the five regions of Suzhou as a whole has occurred. The spatial logistics space evolution of logistics enterprises in Suzhou is the result of the repeated operation of the logistics expansion and clusters. The driving forces behind the evolution of logistics space are land price, market demand, traffic accessibility, cluster advantages and centripetal force and centrifugal force provided by government policies.

The scale of Suzhou logistics has been steadily improved. The transportation infrastructure is perfect. The pace of regional cooperation is accelerating. The development environment is continuously optimized. The city has built a logistics park and logistics base with reasonable layout, perfect

functions and strong radiation action. There are many logistics enterprises, including 233 logistics enterprises above Grade A and 10,789 logistics enterprises with registered capital of over 1 million. However, the development of Suzhou logistics enterprises still has its drawbacks: high logistics costs, prominent structural contradictions, single function of logistics enterprises, and lack of overall coordination of spatial layout. In the future, the development of logistics enterprises in Suzhou should pay attention to the following points:

(1) To give play to the location advantage that Suzhou is adjacent to Shanghai. By leveraging Shanghai's developed economic advantages, Suzhou can develop itself by serving Shanghai. What's more, by vigorously developing service-oriented manufacturing and promoting the industrial integration of manufacturing and logistics, Suzhou strengthen the industrial complementarity and industrial linkage with Shanghai.

(2) To bring into play the role of the logistics park. By focusing on cultivating a comprehensive logistics park with high intensive degree and strong clustering and radiation ability, and supporting the "One Belt and One Road" and the Yangtze River Economic Belt Strategy, a professional logistics park with obvious industrial characteristics, strong professional logistics capabilities and complete supporting functions is created.

(3) To improve transportation infrastructure. It is important to further improve the Suzhou transportation network and transportation efficiency, and to reduce logistics costs. It is a good way to accelerate the construction of the coastal port logistics system, enhance the penetration and radiation of port logistics services, and vigorously develop multimodal transport and port container logistics.

(4) To strengthen planning guidance. Government can strengthen supervision and inspection of planning implementation, policy implementation and project promotion. For key development areas such as smart logistics, multimodal transport, and e-commerce logistics, we must promptly formulate special plans and logistics industry development plans.

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