

Research on Spatial Agglomeration and Development Strategy of Feed Enterprises Based on GIS Geographic Data Mining

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Abstract: Enterprise agglomeration is an important indicator of industrial scale development. Studying the spatial agglomeration level and regional differences of feed enterprises can provide reference for the development and spatial layout of feed industry. Based on the spatial distribution data of feed enterprises, ArcGIS spatial analysis technology was used to study the spatial agglomeration and distribution of feed enterprises in China. The results showed that: (1) The spatial agglomeration of feed enterprises in China was obvious and had a certain spatial agglomeration effect. (2) The spatial distribution of China's feed enterprises has the typical characteristics of 'Hu Huanyong Line', showing a dense southeast and sparse northwest; (3) China has formed a number of feed enterprises gathering center, and the trend of industrial cluster development is becoming increasingly evident; (4) The regional differences of China's feed enterprises are large, and the level of industrial agglomeration needs to be improved. Therefore, it is of great significance to achieve optimal allocation of resources and optimize the structure of feed industry by strengthening the regional division of labor and cooperation and playing the leading role of feed enterprise cluster.

1 INTRODUCTION

Industrial agglomeration is an important phenomenon in the process of economic development and industrialization, which refers to the mechanism of a certain number of enterprises in the same industry to gather in a designated geographical area to seek agglomeration benefits, which is a geographical phenomenon in the process of the evolution of an industry into an advantageous industry, which plays an important role in promoting the development of spatial agglomeration of regional economic entities and achieving economies of scale, and has become the model choice for promoting economic development in many regions (Wang 2019). Based on the analysis of the level and process of industrial agglomeration, the relevant research results take market size, transportation conditions, policy support, economic level, resource endowment and urbanization level as the main factors affecting industrial agglomeration (GAO 2022, MA 2021). In terms of the benefit evaluation of industrial agglomeration, some scholars have studied the role

and impact of the agglomeration effect of different industries on socio-economic development and industrial layout optimization (LI 2021, LIU 2021); In terms of measuring the level of industrial agglomeration, some scholars used methods such as industry concentration, location entropy index, spatial Gini coefficient, and Moran index to measure the agglomeration level of relevant industries (YE 2022). There are also relevant research results from the perspective of industrial agglomeration, the countermeasures and measures for the development of dairy industry and logistics industry agglomeration and the construction of overseas industrial agglomeration areas are demonstrated and analyzed (LI 2016); At the same time, based on different research scopes and regional differences, relevant scholars have conducted empirical research on the characteristics of industrial agglomeration and the impact of industrial agglomeration on economic growth (GUO 2021, LUO 2021). In summary, industrial agglomeration is a spatial agglomeration of various resource elements formed within a certain geographical range under the action of different influencing factors, which plays an important role in promoting regional social and economic development.

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Based on the provincial panel data of feed enterprises, this paper measures the agglomeration level of feed enterprises from the perspective of industrial agglomeration development, analyzes the spatial agglomeration level and spatial distribution characteristics of feed enterprises, aims to simulate the development stage and temporal and spatial evolution characteristics of feed industry, so as to obtain the level division of spatial agglomeration development of the national feed industry, and provide a scientific basis for optimizing the spatial layout of feed industry, promoting the large-scale development of feed industry and realizing the optimal allocation of feed industry resources.

2 RESEARCH MATERIALS AND METHODS

2.1 Research Materials

The national basic geographic data required for the study came from the Resource and Environmental

Science and Data Center (<https://www.resdc.cn/>) of the Chinese Academy of Sciences, and the data of China's provincial administrative boundaries in 2015, which was edited and operated based on ArcGIS 10.2, and used as the basic map data for kernel density spatial analysis.

The feed enterprise data comes from the official website (<https://www.tianyancha.com/>), and the directory of feed enterprises with a registered capital of more than 20 million yuan in each province (city) in the livestock breeding industry as of April 8, 2022 is obtained, including the enterprise name, registered capital, date of establishment, number of insured persons, registered address, business scope and other characteristic data, and a total of 4,775 feed enterprises were obtained after screening. ArcGIS 10.2 spatial analysis software was used to spatialize the obtained feed enterprises according to the address, and spatially matched with the national vector map to obtain the point data of the spatial distribution of feed enterprises (Figure 1).

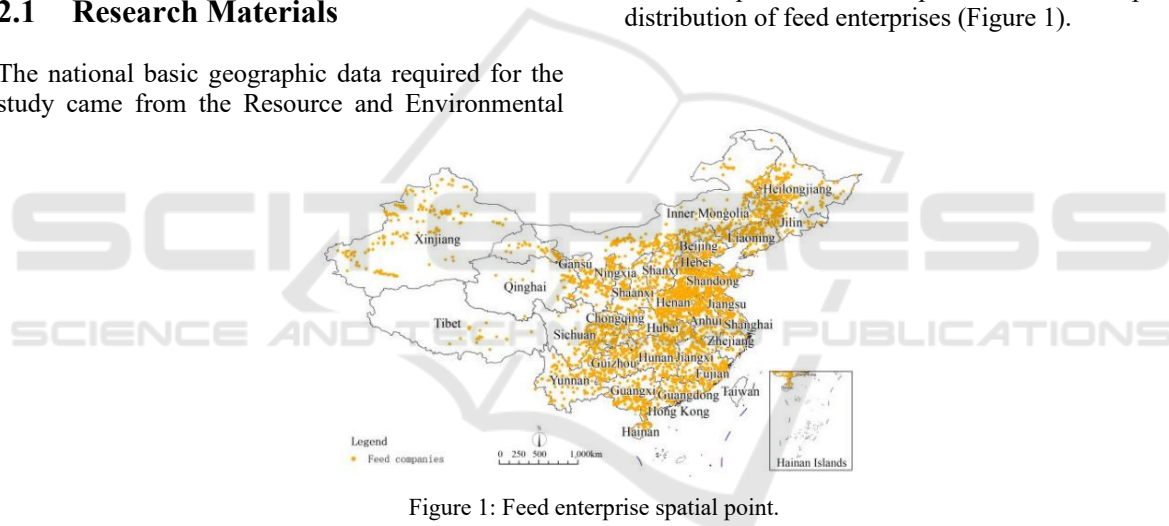


Figure 1: Feed enterprise spatial point.

2.2 Research Methods

Kernel density estimation (KDE) is a commonly used spatial analysis method to study the degree of distribution aggregation of spatial points, which can convert point features distributed in a geographical area into density polygons (Yin 2022), which is used to describe the distribution density and change trend of geographical events in regional space (FANG 2013), so as to calculate the following formula (WANG 2022):

$$F_n(x) = \frac{1}{nh} \sum_{i=1}^n K\left(\frac{x-x_i}{h}\right) \quad (1)$$

In equation (1), $F_n(x)$ represents the kernel density value, K represents the kernel density equation, h represents the radius of the search range, n represents the number of sample points in the

search range, $x-x_i$ is the estimated point, and the distance from x to the sample point x_i . In this paper, the kernel density analysis method was used to analyze the spatial agglomeration degree and distribution characteristics of feed enterprises in 30 provinces (cities) in China with the help of ArcGIS 10.2.

3 RESULTS AND ANALYSIS

3.1 Spatial Distribution Characteristics of Feed Enterprises in China

According to the spatial distribution and visualization results of feed enterprises (Figure 2),

since 1987, the distribution of feed enterprises with registered capital of more than 20 million yuan has obvious spatial differentiation characteristics, the main distribution areas are concentrated in Henan, Shandong, Inner Mongolia, followed by Hebei, Heilongjiang, Guizhou and Xinjiang, generally showing the characteristics of more north and south and less economically underdeveloped areas than

more economically developed areas, and the concentrated distribution areas of feed enterprises are mostly large agricultural planting provinces or animal husbandry provinces. To a certain extent, it shows that the geographical environment, economic conditions, agricultural planting, animal husbandry and other factors have a certain impact on the development and spatial layout of feed enterprises.



Figure 2: Spatial distribution of feed enterprises.

3.2 Spatial Evolution and Agglomeration Characteristics of Chinese Feed Enterprises

Based on the spatial distribution data of feed enterprises, use the ArcGIS10.2 spatial analysis module to analyze the kernel density of feed enterprises in China from 1984 to 2005, 2006 to 2015, and 2016 to 2022, and obtain the kernel density of feed enterprises in three different time periods Distribution map (Fig. 3a-c), the generated kernel density distribution map mainly reflects the density changes and hot spots of feed enterprises.

continuous planar layout had not yet been formed. However, in Beijing-Tianjin -Hebei-Henan-Hubei-Hunan (Jiangxi)-Guangdong (Fujian) has shown a trend of continuous spatial development. The highest density value during this period was 3.656, which respectively formed the Beijing-Tianjin-Hebei high-density area and the high-density area in Henan Province with Beijing as the core, as well as two sub-high-density areas in Fujian Province and Shanghai, and Tibet Autonomous Region and Qinghai Province. In low-density areas, feed enterprises present a distribution trend of multiple agglomeration centers.

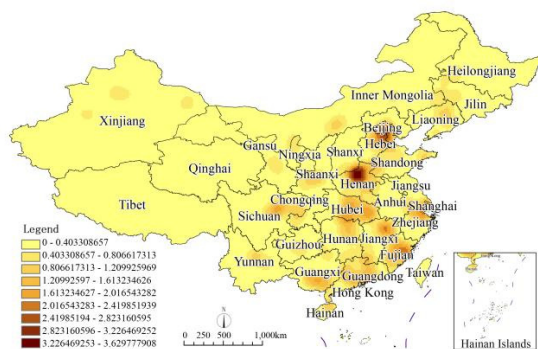


Figure 3(a): 1984-2005 the kernel density distribution of feed enterprises.

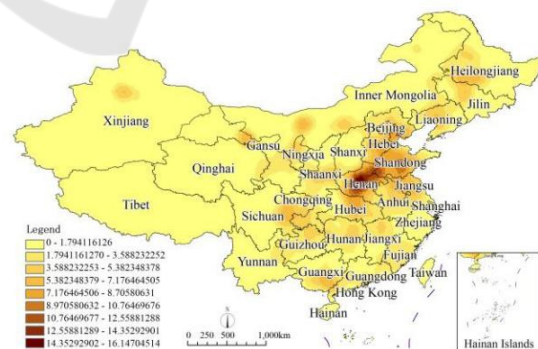


Figure 3(b): 2006—2015 the kernel density distribution of feed enterprises.

It can be seen from Figure 3(a) that the density distribution of feed enterprises in China from 1984 to 2005 was dominated by “dot-like” and adjacent provinces were relatively independent, and a

It can be seen from Figure 3(b) that from 2006 to 2015, China's feed enterprises had an obvious "band-shaped" distribution feature, and had similar characteristics with the "Hu Huanyong Line". The

distribution density of feed enterprises in southeastern China was generally higher than that in northwest China. The adjacent provinces in the southeast region are connected in series to form a belt-like layout, forming the Heilongjiang-Jilin-Liaoning-Tianjin-Hebei-Shandong-Henan-Hubei feed enterprise agglomeration development belt. The highest density value in this period is 16.208, forming A high-density agglomeration area centered on Henan Province. Compared with 1984-2005, the distribution density of feed enterprises in first-tier provinces and cities such as Beijing-Tianjin-Hebei, Shanghai and Fujian Province is lower, indicating that the proportion of feed industry in the national economy in economically developed areas has gradually declined, and it has become an area where feed enterprises have moved out; Tibet The Autonomous Region and Qinghai Province still maintain a low distribution density, which to a certain extent shows that ecological environment protection is still the main task of local social and economic development; the distribution density of feed enterprises in other provinces has increased to a certain extent, compared with the previous period It has been expanded outwards, and the overall distribution situation of "one center and multiple points" has been shown.

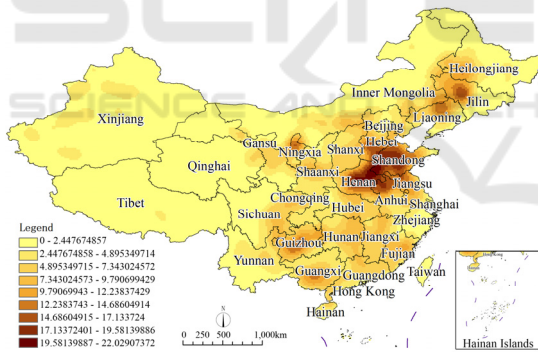


Figure 3(c): 2016—2022 the kernel density distribution of feed enterprises.

It can be seen from Figure 3(c) that the spatial distribution of China's feed enterprises from 2016 to 2022 has formed a "plane shape", and continues the characteristics of denseness in the southeast and sparseness in the northwest. Developed and formed four major agglomeration areas of Northeast, Northwest, Southwest and Henan-Shandong-Hebei (Henan, Shandong, Hebei), among which the core density value of the Henan-Shandong-Hebei group is 22.061, which is the highest in the region, and has become a national feed enterprise agglomeration highland. During this period, feed enterprises in

Beijing, Shanghai, Guangdong Province and other provinces and cities maintained a low distribution density, and became areas where feed enterprises moved out; different from the previous period, the distribution density of feed enterprises in Tibet Autonomous Region and Qinghai Province showed an increasing trend, indicating that the development of feed enterprises has expanded unprecedentedly; at the same time, the spatial distribution of feed enterprises in other provinces has also further expanded, and the density value of the distribution has been greatly increased, forming a regional agglomeration center, showing a multi-regional integrated development trend.

4 SPATIAL DEVELOPMENT STRATEGY OF FEED ENTERPRISES IN CHINA

4.1 Optimize and Adjust the Industrial Structure and Promote the Optimal Allocation of Resources

From the perspective of the development status and characteristics of the feed industry, the development of China's feed industry is in a period of transformation and development, and the large-scale benefits generated by feed industry agglomeration have a positive effect on promoting the development of the national economy. In the face of the problems of the overall competitive advantage of China's feed enterprises is not obvious, the degree of specialization is not high, etc., it is necessary for all departments to carry out structural reform from the supply side, adjust and optimize the spatial layout of feed enterprises, promote the optimal allocation of feed resources and the development of feed industry clusters, improve the overall competitiveness of feed enterprises, and drive the integrated and coordinated development of upstream and downstream industries, so as to form a new economic development highland and promote the sustainable development of regional economy.

4.2 Build a Cluster of Key Feed Enterprises and Play a Leading Role in Demonstration

From the perspective of industrial clusters and coordinated regional development, the country focuses on building four feed enterprise clusters in Liaojihei (Liaoning, Jilin, Heilongjiang), Shaanxi-

Gansu-Ningxia (Shaanxi, Gansu, Ningxia), Guiguichuan (Guangxi, Guizhou, Sichuan) and Yuluji (Henan, Shandong, Hebei), giving full play to the demonstration role of the four feed enterprise clusters, promoting and driving the coordinated development of surrounding areas, strengthening regional resource sharing and the circulation of production factors, and promoting the high-quality development of regional feed industry.

4.3 The Two Sides Will Strengthen Regional Division of Labor and Cooperation to Achieve Complementary Regional Advantages

From the perspective of regional differentiated development, regions with high agglomeration levels of feed enterprises should increase policy support and capital investment to develop the feed industry as a pillar industry; Areas with a high level of feed enterprise agglomeration can improve the regional competitive advantage of the feed industry by improving infrastructure construction, increasing industrial innovation, and strengthening the division of labor and cooperation between regions; Economically developed areas should increase scientific and technological investment in feed enterprises and develop technology-intensive and knowledge-intensive feed industries; The development of feed industry in ecologically protected areas should adhere to the ecological bottom line, develop green or pollution-free feed enterprises, and achieve the goal of coordinated development of development and protection.

5 CONCLUSION AND OUTLOOK

5.1 Main Conclusions

Based on ArcGIS spatial analysis technology, this paper uses kernel density estimation and statistical analysis to study the spatial agglomeration of feed enterprises in China, analyzes the development process of China's feed industry and its spatial distribution characteristics, and obtains the following main conclusions:

(1) Combined with the actual development of China's feed processing industry and the distribution characteristics of the registration sequence of feed enterprises with a registered capital of more than 20 million, the development process of feed industry

can be divided into four stages: start-up period (1974-1983), development period (1984-2005), mature period (2006-2015), and transition period (2016-2022), China's feed processing industry generally presents the characteristics of late start and rapid development, slow development in the early stage, and mainly policy-oriented. In the later stage, it grew rapidly, mainly based on market mechanisms, and actively responded to the call of national policies at all stages to promote regional national economic growth.

(2) From the overall temporal and spatial evolution and spatial distribution characteristics of feed enterprise layout, it can be seen that the development and layout of feed enterprises are affected by relevant factors such as geographical environment, economic conditions, related industries, regional policies, etc., and the overall spatial agglomeration phenomenon of Chinese feed enterprises is significant, and the agglomeration area is mainly concentrated in the southeast region, and the spatial agglomeration phenomenon becomes more obvious with the passage of time, showing that Henan, Shandong, Jilin, Guizhou, Ningxia and other places as the agglomeration center spreads to the peripheral areas, forming a "point-line-surface" The evolution of the spatial distribution of feed enterprises.

(3) The spatial agglomeration phenomenon of China's feed enterprises is obvious, but the level of spatial agglomeration is not high, and there is a lack of competitive advantage in the industrial composition, and the degree of clustering and specialization of feed enterprises need to be improved. At the same time, the regional difference in the spatial agglomeration level of feed enterprises is obvious, and there is a lack of high-level industrial agglomeration areas, and the three regions of Guangxi, Liaoning and Shandong have comparative advantages over other regions, and the level of feed enterprise clustering and specialization is relatively high, becoming a national feed industry development highland.

5.2 Research Outlook

Limited to the limitations of research materials and methods, there are still the following shortcomings: first, the analysis of the development stage of the feed industry is mainly based on the changes in the number of feed enterprises, without considering the industrial output value, scientific and technological innovation, policy environment and other variables, and multiple variables can be introduced for multi-

variable comprehensive analysis in the future, so as to more accurately divide its development stage; Secondly, the spatial agglomeration of feed enterprises is affected by the comprehensive effect of a variety of influencing factors, limited by data acquisition, and cannot comprehensively consider multiple factors, so the next research will conduct spatial superposition analysis from many aspects such as the number of enterprises, enterprise scale, industrial output value, operating income, etc., and comprehensively reflect the agglomeration level and spatial distribution characteristics of feed enterprises. Finally, the research method of spatial agglomeration of feed enterprises in this paper is not perfect, which will affect the change of spatial agglomeration level of feed industry, and new feed enterprise clusters will appear with the development of feed industry, so further research on the agglomeration level of feed enterprises and its development changes needs to be further studied.

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