Spatial Statistics Analysis on The Spatial Pattern of Eco-city Development in the Yangtze River Delta

Yuyan Zhao[1a] and Minjie Kang[2b*]

{441683967@qq.com[a], kangminjie@sina.com[b]}

School of Management, Shenyang Jianzhu University, 110168, Shenyang, China[1],
Department of Economics and Management, Dalian University, Dalian 116622, China [2]

Abstract. Future high-quality urban development will follow an eco-city model, which is a prerequisite for the harmonious growth of people and the environment. Geo-graphical variations of pertinent indicators of eco-city above prefecture level in the Yangtze River Delta were examined using spatial statistics and analysis methodologies. According to the study, there are clear geographical disparities among the principal eco-city progress indicators throughout the study region. Meanwhile, there is a clear imbalance in the ecological structure. Sub indicators share further traits in common. Areas that have had rapid growth are primarily located in provincial capitals and above, and the impact of growth pole spill over is quite small. Additionally, the construction of eco-city is focused on certain geographic areas, like rivers, major cities, etc. In conclusion, growth poles that are strongly tied to the urban hierarchy and have specific locational features continue to dominate the development of eco-city. Interaction between cities, policy execution, and local government assistance are crucial for the establishment of a regional integrated development system.

Keywords: Eco-City; Spatial Statistics; Spatial Pattern; Yangtze River Delta.

1 Introduction

City is the centre of national economic and social growth and a crucial indicator of a nation's degree of social civilization and economic progress [1]. According to UN figures, the amount of urbanization in the world's main nations has dramatically grown between 1980 and 2020. By 2020, the urbanization rate in the US, UK, Japan, Canada, and other wealthy nations had surpassed 82 percent. Urbanization in China is accelerating, rising from 19.4% in 1980 to 63.9% in 2020. China's urbanization rate has increased significantly over the past 40 years at an average annual rate of 1%, and the country's urban population has increased by more than 15 million per year. China is still in the period of fast development at the moment. The excessive concentration of population, industry and traffic has led to environmental degradation, resource depletion, housing tension, traffic congestion and other "urban diseases" [2]. The sustainable development of cities has been seriously hindered. Urban transformation has become an urgent need. The construction of eco-city is regarded by the academic community and urban managers as one of the important ways to deal with this dilemma [3]. China has carried out eco-city construction since the 1980s, and since 2002, the construction of ecological provinces, cities and counties led by the central government has been carried out nationwide [4]. At present, China's economic development has shifted from a stage of rapid

MSEA 2023, May 26-28, Nanjing, People's Republic of China

DOI 10.4108/eai.26-5-2023.2334321

growth to a stage of high-quality development [5,6]. As an important spatial carrier of economic development, cities need to comprehensively improve the quality of urbanization progress. Practicing the concept of high-quality development and improving the quality of eco-city construction are the objective needs to further promote the sustainable development of cities.

The Yangtze River Delta Urban Agglomeration is an important intersection of China's "the Belt and Road" and the Yangtze River Economic Belt, a leading development zone of the Yangtze River Economic Belt, and plays a decisive strategic role in China's overall modernization drive and the new pattern of all-round opening up. The Yangtze River Delta Urban Agglomeration Development Plan approved by the State Council in May 2016 proposed devoting to building an ecological urban agglomeration. Taking the major cities of the Yangtze River Delta urban agglomeration as an example, this paper explores the space-time characteristics of the current ecological level of the Yangtze River Delta urban agglomeration, with a view to providing useful reference for promoting the high-quality development of the eco-city of the Yangtze River Delta urban agglomeration.

2 Materials and Method

2.1. Study Area

According to Yangtze River Delta Urban Agglomeration Development Plan, the study area shown in figure 1 includes 26 cities above prefecture level in Jiangsu, Zhejiang, Shanghai and Anhui provinces and cities. According to the Notice on Adjusting the Standards for City Size Classification issued by the State Council in 2014, the Yangtze River Delta urban agglomeration in 2015 can be divided into 6 categories according to the permanent population of urban areas.

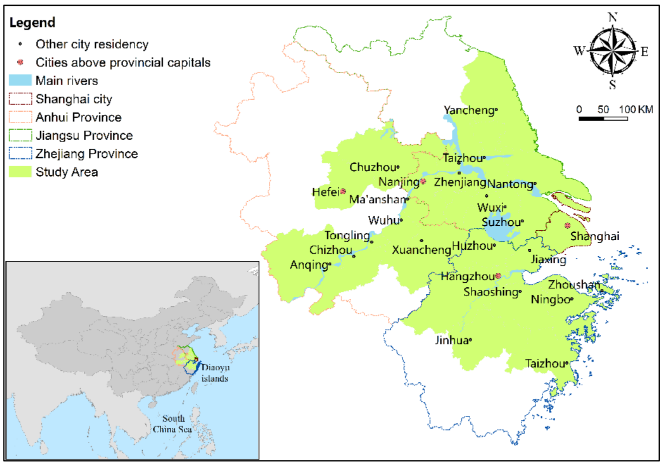

Fig. 1. The location of the study area (Yangtze River Delta, China).

2.2. Data Sources and Processing

The data used in this paper mainly include socio-economic environmental data and geospatial data. The ecological environment data comes from the 2022 Yangtze River Delta Urban Innovation Ecological Index Report and Environmental Quality Bulletin; The economic data comes from China Urban Statistical Yearbook of each year; The geospatial data are mainly from the 1:4 million full element map of China released by the National Geographic Information Surveying and Mapping Bureau, and some are from the official websites of local departments in Jiangsu Province, Zhejiang Province and Shanghai City. Considering the adjustment of administrative divisions in some regions, in order to ensure the consistency and comparability of statistical caliber, the administrative divisions of prefecture level cities in 2015 shall prevail. Social and economic data are mainly processed through standardization, and spatial data are mainly factorized for administrative regions.

2.3. Research method

In order to accurately reveal the spatial difference characteristics of regional eco-city construction, under the support of ARCGIS 10.2, spatial visualization and analysis methods are used to reveal the spatial difference and change trend of eco-city development, and objectively present the spatial pattern of eco-city construction and development in the Yangtze River Delta.

2.3.1. Jenks best natural fracture method. Jenks proposed a map grading algorithm, which considers that the data itself has breakpoints and can be classified by using this feature of data. The algorithm principle is a small cluster, and the clustering end condition is the maximum variance between groups and the minimum variance within groups. The Natural Breakpoints category is based on natural groupings inherent in the data. The classification interval will be identified to group the similar values most appropriately and maximize the differences between the various classes. Features will be divided into multiple classes.

2.3.2. GIS trend analysis. The Trend Analysis Tool provides a three-dimensional perspective view of the data. The basic principle is to plot the position of the sampling point on the x, y plane. Above each sampling point, the value is given by the height of the z-axis pole. The function of the Trend Analysis tool is that the numerical value will be projected on the x, z plane and y, z plane as a scatter plot, which can be regarded as a transverse view formed by 3D data, and then the polynomial will be fitted according to the scatter plot on the projection plane. By default, the tool will select a second order polynomial to display the trend in the data, or study a first order polynomial and a third order polynomial to evaluate their fit to the data.

3 Results

3.1 Spatial Characteristic Analysis

The spatial difference of the ecological development index in the study area is large, showing a multipolar scattered distribution. The clustering characteristics are not evident, and some regions have certain location orientation characteristics. Regions with good overall development are mainly concentrated in the provincial capitals and above. Eco-city construction of Shanghai is the most prominent, and the overall level is higher than other cities.

In terms of EIR in figure 2, Shanghai stands out from other cities, forming a clear gap with additional cities. The second-tier cities are Nanjing, Hangzhou and Suzhou. The development of urban areas in the northeast of the Beijing Hangzhou Grand Canal is relatively poor, while the progress of Tai Lake in the southwest is relatively centralized and highly integrated. The polarization effect of big cities did not drive the ecological construction and green development of surrounding cities. The development of northern Jiangsu, eastern Anhui and southern Zhejiang was poor.

In terms of EES in figure 3, the regions with effective construction are mainly concentrated in the provincial capital cities and Shanghai. The cities along Hangzhou Bay and Tai Lake have excellent ecological environment foundation and high concentration. However, the supporting role of the ecological environment of some cities in Anhui, which are inclined to the inland, is not obvious and lacks regional integration and interactive development.

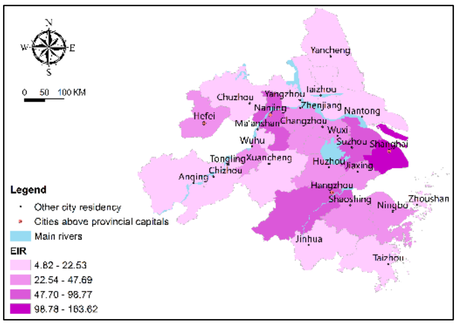

Fig. 2. Spatial characteristics map of EIR.

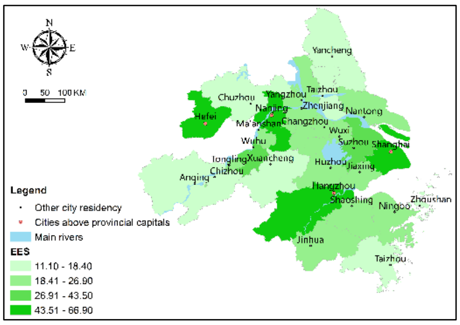

Fig. 3. Spatial characteristics map of EES.

In terms of EIP in figure 4, it can be seen that the spatial difference of ecological industry potential index is obvious. First of all, the best cities to be constructed are Shanghai, Suzhou, Hangzhou and Nanjing. Secondly, Hefei, Yancheng, Taizhou, Yangzhou, Jiaxing and Ningbo. The core regions are mainly concentrated in Suzhou Wuxi Changzhou and Hangzhou Bay. This region has completed modern industrial system and intelligent manufacturing capacity. The spillover effect of the growth pole is obvious. The degree of industrial transfer and upgrading is high. The economic foundation and industrial capacity are far higher than other regions.

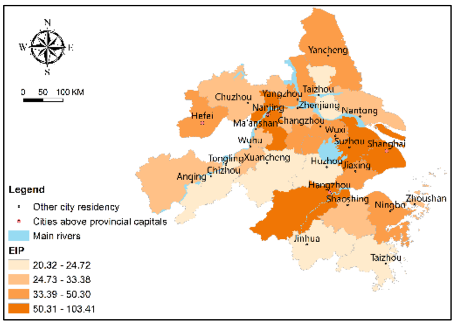

Fig. 4. Spatial characteristics map

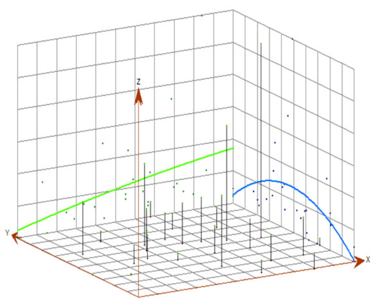

Fig. 5. Spatial trend of map of EIR.

3.2 Spatial Trend Analysis

The spatial trend of regional ecological innovation resource index (in figure 5) and ecological industrial potential index (in figure 6) is obvious. The development of ecological industry tends to the estuary area of the Yangtze River; The south-north trend shows an inverted U-shaped feature of first standing up and then falling. The central region is well developed, mainly concentrated in the core regions of Suzhou, Wuxi and Changzhou, Shanghai, etc. This region has a solid industrial foundation, and its economic, industrial, scientific and technological innovation is significantly higher than other regions, providing a solid objective basis for ecological industry and innovation. The ecological environment support index (in figure 7) is relatively slow and balanced from east to west; The south-north trend presents obvious inverted U-shaped characteristics. It shows that the natural ecological resources are evenly distributed in the east-west direction, with evident differences between the north and south.

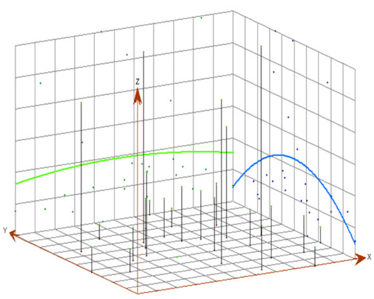

Fig. 6. Spatial trend of map of EES.

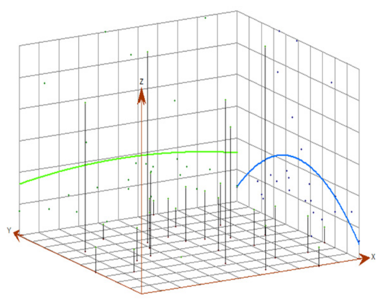

Fig. 7. Spatial trend of map of EIP.

4 Conclusion

This paper analyses the spatial difference and trend of eco-city development index of cities above prefecture level in the Yangtze River Delta urban agglomeration of using GIS geostatistical, visualization and spatial analysis methods. The main conclusions are as following.

First of all, the spatial differential characteristics of regional ecological innovation resources (EIR), ecological environment support (EES) and ecological industrial output (EIP) indicators are obvious, and the eco-city construction has obvious imbalance.

Secondly, in the spatial difference analysis of each sub index, each has its own independent characteristics. In terms of EIR, Shanghai has an observable differential with other cities. The Beijing Hangzhou Grand Canal and the Tai Lake region have certain natural location directionality. The municipal area on the northeast side of Beijing-Hangzhou Grand Canal is poorly developed, while the Tai Lake area on the southwest side is relatively concentrated and highly integrated. The polarization effect of big cities has not driven the ecological and green progress of surrounding cities, such as northern Jiangsu, eastern Anhui and southern Zhejiang. Ecological innovation resources are highly dependent on technology, and it is critical to improve the scientific and technological innovation capacity of the old city. In terms of EES, the regions with excellent construction are mainly concentrated in the provincial capital cities and Shanghai. The cities along Hangzhou Bay and Tai Lake have good ecological environment foundation and high concentration. The spill over effect of the growth pole is obvious.

Finally, the development of eco-city is closely related to the development stage of the city, urban resource endowment, location characteristics, economic and industrial level and other factors. Building a high-quality eco-city needs to be viewed from a systematic and developmental perspective, not just a partial change in ecological factors. The establishment of a regional integrated development system, the interaction between cities, the implementation of policies and the support of local governments is particularly important.

Acknowledgments.

This research is financially supported by the National Natural Science Foundation of China (NO. 41601591).

References

[1] Miao Miao and Liu Huang and Chen Jun: Factors affecting fluctuations in China's aquatic product exports to Japan, the USA, South Korea, Southeast Asia, and the EU. Aquaculture international: journal of the European Aquaculture Society 29(6), 21-27 (2021).

[2] Cai Xin, Chen Yongfu, Chen Jie: Empirical analysis of factors affecting the international competitiveness of China's aquatic products. Journal of Dalian University of Technology (Social Science Edition) (02), 182-192 (2018).

[3] Dong Jing, Mu Yongtong: Analysis on the competitiveness of China's sea shellfish export to South Korea. China Fisheries Economy 34 (04),91-98 (2016).

[4] Geng Yeqiang, Ma Zhimin: Current situation of aquatic products exported by China and ASEAN to Japan: competitiveness and policy options. International Trade Issues (12), 41-46 (2010).

[5] Liu Xuezhong, Chen Xiaoming, Gai Mingmei: Comparison of the international competi-tiveness of the aquatic industry of the world's major aquatic product exporters. World Ag-riculture (05),28-31(2008).

[6] Xu Wei, Hu Glacier: Research on the Relationship between Trade Facilitation and Chi-na's Aquatic Products Export under the Background of the "the Belt and Road". China Fisheries Economy (04), 86-94 (2020).