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Spatiotemporal Evolution and Influencing Factors of A-Level Garden-Type Scenic Areas in Jiangsu Province, China

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Abstract

Garden-type scenic areas, as integrated carriers of cultural and natural resources, not only reflect the regional socio-economic development level but also embody the historical process of interaction between human cultural activities and the natural environment. As a major economic and cultural province in eastern China, Jiangsu features A-level garden-type scenic areas that are representative in terms of quantity, quality, and typology. This study constructs an analytical indicator system for assessing the spatial distribution patterns of garden-type scenic areas. Using GIS-based methods such as kernel density estimation, nearest neighbor index, and the geographic detector model, it systematically investigates the spatial characteristics of A-level garden-type scenic areas in Jiangsu Province. The results show a significant spatial clustering pattern, with high-density clusters mainly located in southern Jiangsu and around economically developed cities. Further exploration of influencing factors reveals that natural resource endowments, economic development levels, transportation accessibility, historical and cultural heritage, and policy support are the main determinants shaping the distribution patterns. The findings offer theoretical insights and practical guidance for optimizing garden-type scenic areas planning and promoting coordinated regional tourism development in Jiangsu.

Keywords: garden-type scenic areas; spatiotemporal evolution; spatial distribution; driving factors; geographic detector

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1. Introduction

With the growing popularity of cultural tourism in China, tourist attractions—key components of regional tourism resources—not only reflect the harmonious relationship between natural endowments and socio-economic development but also illustrate the long-term interaction between human activities and the environment. Against the backdrop of national strategies promoting cultural-tourism integration, all-for-one tourism, and high-quality development, the number of A-level garden-type scenic areas has steadily increased, with greater typological diversity and increasingly complex spatial structures [1]. In particular, in economically developed and culturally rich eastern regions, the spatial layout of garden-type scenic areas has become a critical metric for assessing regional tourism development and resource allocation efficiency.

Located at the heart of the Yangtze River Delta, Jiangsu Province is one of China's most economically dynamic and globally connected regions and also a significant cradle

and custodian of classical Chinese garden art. Historically renowned for its exquisite and elegant gardens, Suzhou gardens have been inscribed on the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage List. In recent years, accelerated urbanization and the deep integration of cultural and tourism industries have led to a steady rise in the number of A-level garden-type scenic areas, along with optimized rating structures and evolving spatial patterns. Investigating these distribution characteristics and evolutionary mechanisms not only helps elucidate the development patterns of cultural landscape heritage but also provides a scientific foundation for optimizing tour-ism resource allocation and promoting coordinated regional tourism development.

At present, research on the spatial distribution of tourist attractions in China has become increasingly mature, with significant progress made in the application of spatial econometric methods. Scholars from multiple disciplines—including geography and ecology—have systematically explored the spatial patterns of A-level garden-type scenic areas at both national and provincial scales, employing techniques such as kernel density analysis [2–5], nearest neighbor index [6–9], and spatial autocorrelation [5,6,10–12]. These studies generally indicate that A-level garden-type scenic areas exhibit pronounced clustering tendencies nationwide, with high-density clusters particularly prominent in economically developed regions such as the Yangtze River Delta, Pearl River Delta, and Beijing-Tianjin-Hebei metropolitan area [13,14]. Further evidence suggests that the Yangtze River Delta has formed a core high-density zone where A-level garden-type scenic areas display significant spatial agglomeration [11].

At the provincial scale, research has uncovered distinct spatial heterogeneity within regions. For example, Fang and Han [15], using standard deviation ellipse analysis, identified a "dense west–sparse east" spatial pattern in the Qinba Mountains, highlighting the dominant role of transportation networks in spatial differentiation. Zhao [16], using the Gini coefficient, revealed a "globally heterogeneous–locally concentrated" composite distribution pattern for high-grade garden-type scenic areas in Henan Province. In Guangdong, Liao and Zhang [17] demonstrated a strong coupling between A-level garden-type scenic areas and transportation networks, while in Jiangsu, Cheng and Jing [18] found significant positive correlations between scenic area distribution and both urban economic levels and population density [19]. In areas with complex terrain, such as Qimen County, vertical elevation differences lead to a polarized pattern in which natural and cultural garden-type scenic areas are dispersed at mid-high altitudes but concentrated at lower elevations. In northwest Yunnan, terrain barriers have given rise to a classic "central clustering–peripheral attenuation" distribution [20].

With regard to driving mechanisms, Qiu et al. [21] applied the geographic detector model to quantify the dynamic impacts of road network density and tourism revenue on scenic area distribution in Guizhou Province. Similarly, Min et al. [22] confirmed the accelerating role of policy guidance in restructuring spatial patterns in Shandong Province. Parallel findings in Jiangsu also suggest that natural geographic conditions (e.g., terrain undulation, hydrological distribution) and human factors (e.g., transportation accessibility, tourism investment) are primary drivers of scenic area distribution. Notably, Li and Zhang [23] challenged the traditional natural–economic framework by identifying demographic migration and genealogical lineage as explanatory variables surpassing topographical factors in determining the spatial distribution of traditional village-type attractions. This offers a novel lens for understanding the role of cultural genetics in shaping spatial layouts.

Despite the abundance of relevant research, most studies treat A-class garden-type scenic areas as a homogeneous unit of analysis, with limited attention paid to their internal

heterogeneity—particularly those that integrate significant cultural heritage with ecological functions. The current literature often subsumes garden-type scenic areas within broader categories of A-class tourist attractions, thereby overlooking their distinctive cultural attributes and unique spatial logic. For instance, while Cheng and Jing [18] identified Suzhou and Nanjing as major agglomeration centers for A-class tourist attractions, their analysis did not differentiate garden-type scenic areas from other types (e.g., mountain-, lake-, or theme park-type attractions), thus failing to reveal the spatial divergence specific to garden-type sites. Although Xie and Liang [24] examined the spatial proximity between museums and garden-type scenic areas using POI data, and Zhang et al. [13] demonstrated a positive correlation between urban governance capacity and overall scenic area density, these studies do not systematically elucidate the distinct spatial mechanisms driving the formation and evolution of garden-type scenic areas. As a result, the spatiotemporal patterns and underlying drivers of such culturally and ecologically significant sites remain insufficiently understood.

Existing research on garden-type scenic areas tends to focus on landscape aesthetics and vegetation design. For example, Yang et al. [25] demonstrated that spatial structure and heritage characteristics significantly affect visitor perception in temple gardens. Gu [19] emphasized that plant arrangement strategies in Jiang-su-Zhejiang gardens must balance ecological adaptability with cultural symbolism. Li and Zhang [23] investigated heritage trees in Jiangsu, revealing dynamic conflicts between ecological resources in garden-type scenic areas and urban expansion, offering new perspectives on garden conservation. However, most studies rely on cross-sectional data and fail to capture the dynamic evolution of gar-den scenic ratings and spatial expansion. Temporal correlations and longitudinal trajectories remain underexplored [26].

This study aims to: (1) depict the spatiotemporal evolution of A-level garden-type scenic areas in Jiangsu Province based on multi-temporal inventories; (2) reveal spatial clustering, diffusion, and hierarchy using kernel density estimation, Jenks natural breaks classification, and nearest neighbor analysis; and (3) identify and interpret the main drivers with the geographic detector, including interaction effects among factors. The contributions are threefold. First, we extend the temporal scope to 2024 and integrate multiple spatial analytical lenses to present a fine-grained evolution panorama. Second, by incorporating interaction detection within the geographic detector, we uncover nonlinear enhancement among accessibility, resource endowments, and socio-economic indicators, enriching explanatory power beyond single-factor effects. Third, we offer a policy-oriented framework that connects scientific findings to stakeholder governance, sustainability metrics, smart-tourism practices, and regional equity, providing an actionable reference for heritage-rich provinces beyond Jiangsu.

In light of this, the present study takes Jiangsu Province's A-level garden-type scenic areas as its focal subject. Drawing on multi-temporal data and diverse spatial analysis methods, it systematically examines the spatial distribution structure, typological composition, and inter-city differences in garden-type scenic areas. The aim is to transcend the limitations of generalized approaches to A-level garden-type scenic areas, address the current theoretical gap in garden spatial distribution research, and provide scientific support for refined tourism resource management and sustainable regional development.

2. Study Area and Data

2.1. Overview of the Study Area

Jiangsu Province, situated in eastern coastal China at the heart of the Yangtze River Delta, boasts a flat terrain, an extensive river network, and a mild, humid climate as shown in Figure 1. As a province rich in historical and cultural heritage, Jiangsu is home to nu-

merous classical gardens, such as those in Suzhou and Yangzhou, which are globally acclaimed for their intricate designs, unique landscaping techniques, and profound cultural significance.

Modern gardens in the region have evolved by integrating traditional forms with ecological concepts and contemporary technologies, resulting in a diverse and multi-layered spatial distribution. These gardens serve not only as a concentrated expression of Jiangsu's natural landscapes and cultural spirit but also as crucial drivers for urban ecological construction and cultural heritage preservation. They play a significant role in environmental improvement, ecological balance maintenance, and cultural dissemination. Therefore, this study focuses on high-quality A-level garden-type scenic areas in Jiangsu. By examining both temporal evolution and spatial distribution, we systematically analyze their development characteristics to explore synergies between distinctive tourism and regional economic growth. The findings aim to provide practical insights and actionable recommendations for the scientific development and optimized spatial layout of tourism resources in Jiangsu Province.

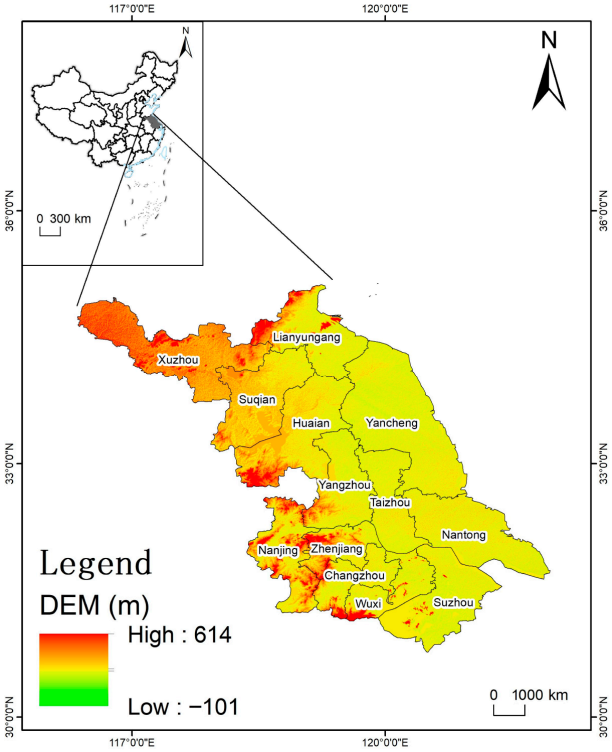


Figure 1. Geographic Map of Jiangsu Province.

2.2. Data Source

The data used in this study were collected from the "Digital Culture and Tourism" query system of the Jiangsu Provincial Department of Culture and Tourism (https://wlt.jiangsu.gov.cn/col/col86577/index.html, accessed on 1 December 2024). A total of 285 garden-type scenic areas were identified across the province, categorized into five types: 122 urban gardens, 119 suburban gardens, 31 private gardens, 6 religious gardens, and 7 gardens affiliated with public buildings.

To obtain their geographic coordinates, the addresses of these gardens were processed using the Baidu Geocoding API. Each coordinate was manually verified to ensure accuracy. Subsequently, the BD09 coordinate system (Baidu's proprietary format) was converted to the global WGS84 system using GIS data conversion tools, enabling spatial vectorization. Based on this process, a provincial-level spatial database of garden-type

scenic areas was established, which served as the foundation for creating the spatial distribution map and conducting further spatial analyses. (Figure 2).

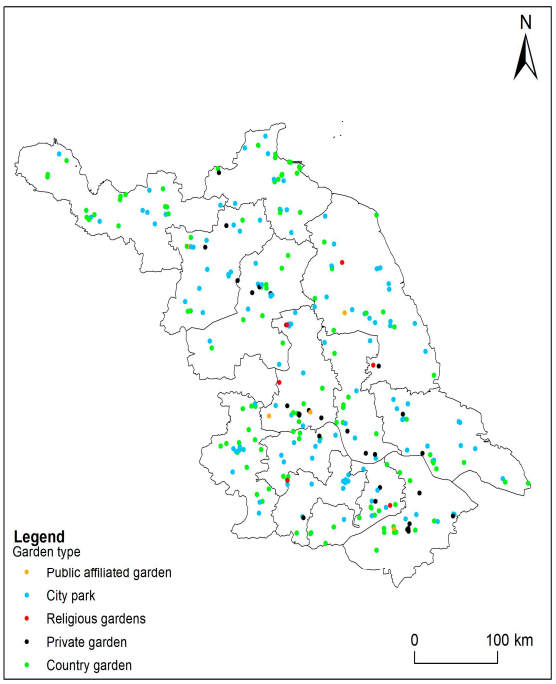


Figure 2. Distribution map of garden-type scenic areas in Jiangsu province.

2.3. A-Level Tourism Grading System in China

The A-level system is a national tourism grading framework administered by the Ministry of Culture and Tourism of China. It adopts a hierarchical structure ranging from 1A (lowest) to 5A (highest), where higher grades indicate stricter requirements on resource quality, infrastructure, service management, and safety standards. Within this system, garden-type scenic areas constitute a specific subcategory of tourist attractions, evaluated according to both their cultural–historical and ecological–landscape value. While this grading system is not an international standard, it functions as a widely recognized benchmark within China, ensuring comparability and consistency across provinces.

2.4. Classification of Garden-Type Scenic Areas

This study directly adopts the classification system proposed by Zhu Junzhen [27] in A History of Modern and Contemporary Chinese Gardens, which categorizes Chinese gardens according to their functional and social use. The five defined types—Rural and Mountainous Gardens, Private Gardens, Public Facility-Attached Gardens, Urban Parks and Gardens, and Religious Gardens—reflect distinct historical, cultural, and spatial roles within the urban and rural fabric of modern China. This typology, grounded in extensive historical research, provides a well-established framework for analyzing garden landscapes by function, enabling systematic comparison across regions and periods. All garden entries in this study are classified according to this standard, with detailed attributes documented in the supplementary garden data repository.

3. Methods

3.1. Kernel Density Estimation

Kernel density estimation is a widely used spatial analytical method to assess the density of features within a defined neighborhood. It visualizes the degree of concentration and dispersion of spatial elements such as garden-type scenic areas across a given

area. By introducing a bandwidth, the method assigns declining weights to features as their distance from the center increases, resulting in a smooth and continuous density surface without abrupt changes. This enables the identification of spatial clustering with greater precision [2]. The kernel density function is typically defined as:

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

where n is the number of features, h is the bandwidth, d is the number of dimensions, and x_i represents the position of the i-th observation.

3.2. Average Nearest Neighbor Index

The average nearest neighbor index is an essential metric for analyzing point pattern distributions in geographic space. It quantitatively classifies spatial patterns into clustered, random, or uniform [9]. The index is computed as:

$$ANN = \frac{\overline{D}_O}{\overline{D}_E} \quad (2)$$

$$\overline{D}_O = \frac{\sum_{i=1}^{n} d_i}{n} \quad (3)$$

$$\overline{D}_E = \frac{0.5}{\sqrt{n^2/A}} \quad (4)$$

where $\overline{D}_O$ is the observed average distance to the nearest neighbor, $\overline{D}_E$ is the expected distance under a random distribution, d_i is the distance between feature i and its nearest neighbor, n is the total number of features, and A is the area of the minimum bounding rectangle.

3.3. Geographic Detector

The geographic detector is a statistical method designed to identify spatial stratified heterogeneity and quantify the explanatory power of potential driving factors [12]. The core metric is the q-statistic, defined as:

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N\sigma^2} \quad (5)$$

where h represents a stratum, N is the total sample size across all strata, σ^2 is the variance of the entire sample, N_h is the sample size within each specific stratum h, σ_h^2 is the variance within each specific stratum h.

3.4. Time Node Selection

China's A-level garden-type scenic areas rating system was officially initiated in 1999 with the release of the national standard Classification and Evaluation of Quality Grades for Tourist Attractions (GB/T 17775-1999) [28], marking the beginning of a standardized evaluation framework for tourist destinations across the country. The first batch of A-level garden-type scenic areas was completed and publicly announced in 2001, laying the foundation for the national grading system.

However, due to policy inconsistencies and interdepartmental coordination challenges during the early stages of standard formulation, many high-quality garden-type scenic areas were excluded from the initial evaluations. This led to significant disparities in the actual quality of attractions within the same A-level category, undermining the system's credibility and effectiveness.

To address these issues, a series of national standards were introduced in 2003, including the General Principles for Tourism Planning and the Classification and Assessment of Tourism Toilet Facilities. These supplementary standards helped refine the evaluation criteria, enhancing the objectivity, comprehensiveness, and fairness of the A-level assessment process.

A major milestone was reached in 2007 with the official designation of the first group of 5A-level garden-type scenic areas—the highest grade within the system. This event marked the formal establishment of the current hierarchical A-level scenic area grading framework, emphasizing quality, service standards, and visitor experience.

Given this evolutionary trajectory, this study adopts a phased time-series analysis based on key developmental stages of the A-level system. The following periods are selected to reflect distinct policy and evaluation phases:

1999–2003: Initial Establishment Phase—Begins with the introduction of the GB/T 17775-1999 standard and covers the first round of A-level evaluations. This period reflects the foundational stage of the rating system, characterized by experimentation and structural limitations.

2004–2007: Standardization and Improvement Phase—Encompasses the implementation of key supporting standards (e.g., tourism planning and facility assessments) that strengthened the evaluation framework in preparation for higher-tier classifications.

2008–2011: 5A System Consolidation Phase—Follows the launch of the 5A designation and focuses on refining evaluation procedures, expanding the number of top-tier attractions, and enhancing management quality.

2012–2016: Expansion and Quality Control Phase—A period of rapid growth in the number of rated garden-type scenic areas, accompanied by increased scrutiny and dynamic management (e.g., downgrades and revocations) to maintain standards.

2017–2024: Modernization and Sustainable Development Phase—Reflects the current era, emphasizing smart tourism, ecological sustainability, cultural integration, and digital transformation in scenic area management.

This phased approach allows for a nuanced understanding of how policy evolution, standard revisions, and institutional reforms have shaped the development and quality trajectory of China's A-level garden-type scenic areas over the past two and a half decades.

4. Results

4.1. Overall Spatial Distribution Patterns of Garden Scenic Areas

4.1.1. Spatial Density Patterns

As shown in Figure 3, the spatial distribution of garden-type scenic areas in Jiangsu Province, analyzed using ArcGIS and the natural breaks classification method, reveals an overall dispersed yet locally clustered pattern. At the regional level, southern Jiangsu exhibits the highest density of garden spots, followed by central Jiangsu, while northern Jiangsu has relatively fewer spots, showing a clear decreasing trend from south to north.

Across the prefecture-level cities, garden-type scenic areas are present throughout all municipalities but show substantial variation in quantity. Suzhou and Nanjing represent the top tier with highly concentrated garden spots; Wuxi, Yangzhou, and Changzhou follow as the second tier with relatively dense distributions; Zhenjiang, Nantong, and Taizhou belong to the third tier with moderate densities; and Xuzhou, Huaian, Yancheng, Lianyungang, and Suqian form the fourth tier with relatively few spots.

In summary, the spatial distribution of garden-type scenic areas in Jiangsu is uneven, characterized by evident local clustering and an overall pattern of gradual decline from south to north.

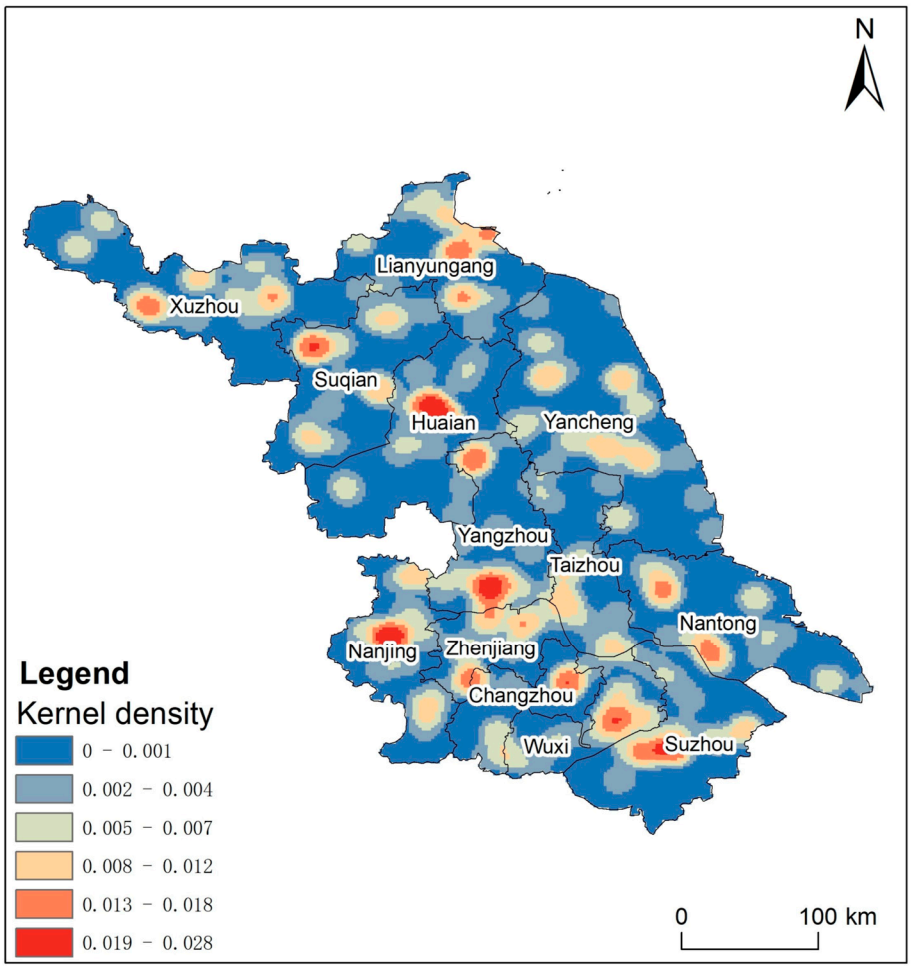


Figure 3. Kernel Density Map of garden-type scenic areas in Jiangsu Province.

4.1.2. Spatial Patterns of Rating Levels

In terms of quantity, Yancheng City has the largest number of A-level garden-type scenic areas, with a total of 32, accounting for 11.23% of the province's total, indicating its richness in garden resources. Xuzhou and Suzhou each have 24 spots, representing 8.42% of the provincial total. Yangzhou and Nantong both have 25 spots, each contributing 8.77%. Taizhou and Suqian each have 23 spots, making up 8.07%. Changzhou and Zhenjiang each have 13 spots, or 4.56%. Huaian has 22 spots (7.72%), Lianyungang has 26 spots (9.12%), Nanjing has 25 spots (8.77%), and Wuxi has 19 spots (6.67%) (see Table 1).

Table 1. Spatial Distribution Characteristics and Nearest Neighbor Analysis of garden-type scenic areas in Prefecture-Level Cities of Jiangsu Province (1999–2024).

City	Number	Percentage	Nearest Neighbor Index	Z-Score	*p*-Value	Pattern
Wuxi	19	6.67%	0.925757	−0.619102	0.535849	Random
Xuzhou	24	8.42%	0.835045	−1.545977	0.12211	Random
Yancheng	32	11.23%	0.868243	−1.425873	0.153905	Random
Yangzhou	25	8.77%	0.941389	−0.560632	0.575048	Random
Taizhou	16	5.61%	1.088181	0.674784	0.499813	Random
Suqian	23	8.07%	0.858215	−1.300847	0.193311	Random
Zhenjiang	13	4.56%	1.123297	0.850465	0.395067	Random
Lianyungang	26	9.12%	0.782717	−2.119545	0.034044	Dispersed
Changzhou	13	4.56%	0.728545	−1.87241	0.06115	Dispersed
Huaian	22	7.72%	0.848323	−1.361015	0.173509	Random
Nanjing	25	8.77%	0.924072	−0.726278	0.467668	Random

Nantong	23	8.07%	0.798212	0.798212	0.064118	Dispersed
Suzhou	24	8.42%	0.702506	−2.788138	0.005301	Dispersed

From the perspective of spatial distribution patterns, A-level garden-type scenic areas in most cities exhibit a random distribution pattern, except for Lianyungang, Changzhou, Nantong, and Suzhou. The z-scores for Lianyungang, Changzhou, Nantong are −2.11955, −1.87241, and 0.798212, respectively, with *p*-values of 0.034044, 0.06115, and 0.064118, indicating clustered distribution patterns—statistically significant for Lianyungang ($p < 0.05$) and suggestive but not statistically significant for Changzhou and Nantong ($p > 0.05$). In particular, Suzhou has a z-score of −2.78814 and a *p*-value of 0.005301, which suggests a significantly clustered spatial pattern. These differences may be related to variations in geographical environment, tourism resource distribution, and development conditions across cities.

Overall, there is a significant disparity in the number and proportion of A-level garden-type scenic areas among cities in Jiangsu Province. Cities such as Yancheng, Xuzhou, and Suzhou have relatively more A-level gardens, while cities like Changzhou, Zhenjiang, and Wuxi have fewer. While most cities show a random spatial distribution, Lianyungang and Suzhou exhibit significant clustered patterns, whereas Changzhou and Nantong display a clustering tendency, reflecting the diversity and complexity of garden-type scenic areas distributions in Jiangsu.

4.1.3. Spatial Distribution of Garden Types

Statistical data reveal a clear hierarchical structure among garden-type scenic areas in Jiangsu Province based on their A-level ratings. Overall, 3A- and 4A-level garden-type scenic areas dominate the distribution, with 149 and 81 spots, respectively, accounting for 72.6% of the total, indicating a relatively high overall development level and solid foundational conditions for garden tourism in Jiangsu (see Table 2).

Table 2. Distribution of Garden Scenic Area Types and Grade Levels in Jiangsu Province (1999–2024).

Type	A	2A	3A	4A	5A
Rural and Mountainous Gardens	0	5	55	49	10
Private Gardens	1	8	13	8	2
Public Facility-Attached Gardens	0	0	3	4	0
Urban Parks and Gardens	0	25	73	20	4
Religious Gardens	1	1	5	0	0
Total	0	39	149	81	16

Urban gardens are the most numerous, totaling 102, primarily concentrated at the 3A level (73 spots). Suburban gardens follow with 106 spots, including 49 rated at 4A and 10 at 5A, reflecting strong resource endowment and developmental advantages. Private gardens number 28 in total, mostly at medium to low levels, with 13 rated at 3A and only two achieving 5A status. Public-building-attached gardens and religious gardens are relatively scarce, with 7 and 2 spots, respectively, and none reaching the 5A standard, suggesting limited scale and influence.

Notably, the province has 16 5A-level garden-type scenic areas, predominantly concentrated among urban and suburban gardens, highlighting their superiority in resource quality, management capabilities, and visitor appeal. At the prefecture-city level, significant variation exists in the distribution of garden types. Urban gardens are the most widely distributed, with Nantong having 17 and Suqian 13 spots. Suburban gardens are also prominent, particularly in Yangzhou (16), Taizhou (15), and Nanjing (15). Private gardens show a more concentrated pattern, with Suzhou and Zhenjiang each hosting 7 spots

due to their rich traditional garden culture. Public-building-attached gardens are rare, found only in Nantong and Suzhou, each with 2 spots, while most cities report zero or one. Religious gardens are sparsely distributed, appearing only in Xuzhou, Huaian, Nantong, and Suzhou, with Nantong and Suzhou each hosting two (see Table 3).

Table 3. Distribution of Garden Scenic Area Types by City in Jiangsu Province.

City	Rural and Mountainous Gardens	Private Gardens	Public Facility-Attached Gardens	Urban Parks and Gardens	Religious Gardens
Wuxi	2	1	0	9	1
Xuzhou	8	3	1	10	0
Yancheng	16	1	0	9	0
Yangzhou	15	0	0	10	0
Taizhou	8	2	0	13	0
Suqian	11	7	1	5	0
Zhenjiang	6	3	1	13	0
Lianyungang	7	3	0	6	0
Changzhou	10	2	0	6	1
Huaian	15	0	0	9	0
Nanjing	10	1	2	17	2
Nantong	6	7	2	8	2
Suzhou	5	1	0	7	0

Spatial analysis reveals that suburban, urban, and religious gardens exhibit clustered distributions, likely influenced by geographical settings, resource availability, and development conditions. Private gardens follow a random distribution pattern, indicating a relatively even spatial layout without obvious clustering or dispersion tendencies. In contrast, public-building-attached gardens demonstrate a significantly clustered pattern, possibly due to their close association with fixed public infrastructure, leading to localized agglomeration (see Table 4).

Table 4. Nearest Neighbor Analysis of Different Types of garden-type scenic areas in Jiangsu Province.

Type	Nearest Neighbor Index	Z-Score	*p*-Value	Pattern
Rural and Mountainous Gardens	0.688008	−6.51101	0	Dispersed
Private Gardens	0.956651	−0.46174	0.64427	Random
Public Facility-Attached Gardens	1.615451	3.115111	0.001839	Clustered
Urban Parks and Gardens	0.823313	−3.73349	0.000189	Dispersed
Religious Gardens	0.823313	−3.73349	0.000189	Dispersed
Total	0.648076	−11.3659	0	Dispersed

Overall, the spatial distribution of garden-type scenic areas in Jiangsu is characterized by a dominant clustered pattern, reflecting the broad and diverse nature of garden tourism resources across the province. The province's A-level garden-type scenic areas are mainly composed of urban and suburban gardens, while private and religious gardens exhibit distinct regional characteristics. Public-building-attached gardens remain underdeveloped. These patterns reflect varying emphases on garden resource development and cultural heritage conservation across cities.

4.2. Local Spatial Clustering and Hotspot Analysis of Garden Scenic Areas

4.2.1. City-Level Temporal Changes

The development of garden-type scenic areas in Jiangsu exhibits notable temporal and spatial evolution characteristics across its cities. By analyzing changes across five time intervals—1999–2003, 2004–2007, 2008–2011, 2012–2016, and 2017–2024, we can clearly observe distinct developmental trajectories and regional patterns among the 13 prefecture-level cities.

Overall, all cities in Jiangsu have experienced a steady increase in the number of garden-type scenic areas, with particularly rapid growth occurring during and after the 2012–2016 period. This marks the beginning of a phase of rapid expansion. Specifically, Wuxi, Yancheng, Nanjing, and Suzhou have demonstrated the most significant increases. For example, Wuxi added 11 new garden-type scenic areas in both the 2012–2016 and 2017–2024 periods, reflecting sustained momentum in its garden development. Yancheng showed the highest growth rate in the province, adding 29 garden-type scenic areas in 2017–2024, highlighting its proactive efforts in ecological construction and tourism promotion. As major central cities, Nanjing and Suzhou maintained steady development, adding 14 and 10 garden-type scenic areas, respectively, in 2017–2024, demonstrating their ongoing commitment to improving urban greening and living environments.

In contrast, cities such as Changzhou and Xuzhou, which began developing garden-type scenic areas 1999–2003 (with 3 and 1 spots, respectively), have experienced slower growth in recent years. This may be due to factors including land use saturation, shifts in spatial planning priorities, and diminishing returns on investment. Meanwhile, emerging cities like Yangzhou and Suqian saw accelerated growth in 2017–2024, indicating a gradual spatial expansion of garden development from southern Jiangsu toward the central and northern regions. This gradient development not only promotes balanced regional growth but also enhances the integrity and connectivity of the province's overall ecological spatial structure (See Table 5).

Table 5. Number of A-Level garden-type scenic areas Established in Different Periods by City in Jiangsu Province.

City	1999–2003	2004–2007	2008–2011	2012–2016	2017–2024
Wuxi	3	0	3	3	6
Xuzhou	1	3	5	5	10
Yancheng	2	2	8	8	11
Yangzhou	2	3	3	3	14
Taizhou	0	1	5	5	13
Suqian	3	6	7	7	4
Zhenjiang	0	0	8	8	10
Lianyungang	0	1	6	6	6
Changzhou	3	1	7	7	5
Huaian	1	0	11	11	11
Nanjing	1	0	1	1	29
Nantong	0	1	4	4	19
Suzhou	0	2	5	5	6

In summary, the analysis at the city level reveals that Jiangsu's garden scenic area development follows a pattern of "targeted breakthroughs followed by comprehensive rollout." Through continuous investment, optimized ecological planning, and integrated tourism resource strategies, the province is gradually achieving full spatial coverage of garden-type scenic areas, laying a solid foundation for ecological civilization and sustainable urban development. This process has not only enhanced the attractiveness of local tourism resources but also improved the quality of life for residents by providing more beautiful and livable environments.

4.2.2. Evolution by Scenic Rating

From the perspective of scenic area classification, Jiangsu's garden-type scenic areas demonstrate a clear trend of progressive upgrading from lower to higher levels over time, as evidenced by statistical data across five time intervals (See Table 6).

Table 6. Distribution of A-Level garden-type scenic areas by Rating and Establishment Period in Jiangsu Province.

Rating	1999–2003	2004–2007	2008–2011	2012–2016	2017–2024
A	0	0	0	0	0
2A	4	4	5	10	16
3A	13	6	12	31	87
4A	2	9	9	22	39
5A	1	1	2	10	2

Among all classifications, 4A-level garden-type scenic areas have experienced the most significant growth, emerging as the fastest-expanding category within Jiangsu's grading system. As early as the 1999–2003 period, there were already 13 such sites in the province; by the 2017–2024 period, this number had risen to 39, reflecting continuous improvements in infrastructure, service quality, and overall development standards. The rapid expansion of 4A-level gardens indicates increased governmental investment in tourism services, environmental improvement, and facility upgrades, contributing to the systematic establishment and promotion of local garden culture and regional branding.

Meanwhile, 3A-level garden-type scenic areas have witnessed an explosive increase, particularly during the 2012–2016 and 2017–2024 periods. By the end of the 2017–2024 period, their number had surged to 87—the highest among all grades—marking them as the most prevalent category. This growth can be attributed to relatively flexible evaluation criteria, heightened enthusiasm for designation applications, and the accelerated construction of garden landscapes in medium-sized and emerging cities. Functioning as a critical transitional tier between basic and premium-level attractions, 3A-grade garden-type scenic areas play a vital role in meeting the demands of mass tourism while enriching the diversity of landscape offerings across urban and peri-urban areas.

In contrast, 5A-level garden-type scenic areas, although growing gradually from zero before 2016 to 10 by the end of the 2017–2024 period, have expanded at a significantly slower pace due to stringent evaluation standards and high comprehensive requirements encompassing management, service, ecological sustainability, and cultural authenticity. These top-tier sites represent excellence in ecological value, cultural depth, and aesthetic design, serving as benchmarks for high-quality urban green space development and symbolizing each city's commitment to building iconic, internationally competitive garden projects. Their gradual emergence highlights Jiangsu's ongoing transition toward a more refined, quality-driven phase of garden scenic area development.

Lower-grade garden-type scenic areas (2A and A levels) have shown steady but moderate growth across all five periods. Compared with higher-grade categories; however, they have received relatively less policy attention and investment in recent years—particularly during the 2017–2024 period—indicating a strategic shift in focus toward optimization, upgrading, and intensification within the provincial scenic grading system. This structural evolution reflects an overall improvement in the quality, efficiency, and hierarchical balance of garden scenic area development throughout Jiangsu.

4.2.3. Evolution by Scenic Type

The evolution of the typological structure of garden-type scenic areas in Jiangsu profoundly reflects the diversification of garden functions, the dynamic shifts in societal demands, and the continuous reconfiguration of urban spatial structures. The main types of garden-type scenic areas include urban gardens, suburban gardens, private gardens, public-building-attached gardens, and religious gardens, whose numerical changes over time clearly illustrate the transformation of garden spaces from functional specialization to multifunctional integration (See Table 7).

Table 7. Distribution of Garden Scenic Area Types by Time Period.

Type	1999–2003	2004–2007	2008–2011	2012–2016	2017–2024
Rural and Mountainous Gardens	7	10	16	39	47
Private Gardens	4	5	1	7	14
Public Facility-Attached Gardens	0	0	0	0	7
Urban Parks and Gardens	9	5	11	26	71
Religious Gardens	0	0	0	1	5

Among these, urban gardens have experienced the most significant growth, emerging as a core force in recent garden development. Their number increased from just 9 (1999–2003) to 71 (2016–2024), now accounting for a substantial proportion of all garden-type scenic areas. As essential components of the urban green infrastructure, urban gardens integrate aesthetic value, cultural expression, and recreational utility. Their rapid expansion not only highlights the deepening implementation of Jiangsu's urban greening strategies but also mirrors the public's growing demand for high-quality public spaces. This trend has played a key role in improving the overall quality of the urban living environment.

Suburban gardens, on the other hand, have shown a steady upward trajectory, increasing from 7 (1999–2003) to 47 (2016–2024). Typically located at the urban fringes or within rural areas, these gardens are characterized by their expansive size and favorable ecological conditions, making them ideal for ecotourism, leisure activities, and wellness-related programs. Their continued development enriches the ecological value of the garden system while helping alleviate pressure on central urban areas, thereby promoting the integrated development of urban and rural green space networks.

In contrast, private gardens, religious gardens, and public-building-attached gardens have expanded at a relatively slower pace and remain limited in total number. By 2016, there were only 7 private gardens, 1 religious garden, and 7 public-building-attached gardens. These types often embody specific historical, cultural, or functional values, yet their development is constrained by spatial limitations, policy support, and levels of social capital engagement. As such, they serve more as complementary elements within the broader garden ecosystem.

Overall, the typological structure of Jiangsu's garden-type scenic areas is undergoing a transition from homogeneity toward diversity, gradually forming a foundational framework led by urban gardens, supported by suburban gardens, and enriched by specialized garden types. This structural evolution not only optimizes the cityscape but also expands the multifaceted roles of gardens in ecological services, cultural heritage preservation, and social interaction.

Synthesizing insights from spatial distribution, grade classification, and typological composition, it becomes evident that over the past two decades, Jiangsu's garden scenic area development has evolved from a phase of quantitative expansion to one focused on qualitative improvement, from localized concentration to broader spatial diffusion, and from functionally narrow offerings to a diverse typology. Central and northern Jiangsu are increasingly emerging as new growth centers, while the rapid development of 3A-level and 4A-level garden-type scenic areas has laid a solid foundation for the system. Meanwhile, the gradual expansion of 5A-level sites continues to enhance the province's brand influence and cultural competitiveness. A green space network marked by multifunctionality and ecological balance—centered around urban gardens—is steadily taking shape across Jiangsu.

4.3. Driving Factors of Spatiotemporal Evolution

This study utilizes panel data from 13 cities across five key time intervals—1999–2003, 2004–2007, 2008–2011, 2012–2016, and 2017–2024—and applies the geographic detector model to explore the spatial heterogeneity and underlying mechanisms shaping the distribution of A-level garden-type scenic areas in Jiangsu. To comprehensively reveal the formation mechanisms and spatial distribution patterns of garden-type scenic areas, a standardized indicator system encompassing four dimensions—natural resources, cultural resources, socio-economic factors, and policy environment—was constructed with reference to multi-scalar case studies from existing literature [29–32]. Spatial data across these dimensions were processed and integrated within a GIS platform to ensure comparability, spatial alignment, and temporal consistency. Furthermore, to examine the spatial distribution characteristics of different-grade scenic areas, 4A- and 5A-level sites were classified as high-grade scenic areas, while those rated 3A and below were categorized as low-grade scenic areas (See Table 8).

Table 8. Indicator System for Analyzing the Influencing Factors of Garden Scenic Area Distribution.

Primary Dimension	Secondary Dimension	Variable Name	Description	Unit/Type	Data Source
Natural Resources	Natural Landscape	X1	Total number of national forest parks, nature reserves, and natural garden-type scenic areas	Count	Ministry of Natural Resources; National Forestry and Grassland Administration
	Urban Green Space	X2	Green coverage rate in built-up urban areas	%	Housing and Urban-Rural Development Bureau; Urban Yearbook
Cultural Resources	Historical and Cultural Heritage	X3	Total number of national key cultural relic protection units and cultural garden-type scenic areas	Count	Department of Culture and Tourism; Cultural Heritage Administration
Socio-economic Factors	Tourism Demand	X4	Annual number of tourist arrivals	10,000 person-times	Tourism Yearbook
	Economic Development	X5	Gross Domestic Product (GDP)	100 million CNY	Statistical Yearbook
	Tertiary Industry Share	X6	Proportion of tertiary industry value added in GDP	%	Statistical Yearbook
	Population Distribution	X7	Permanent resident population	10,000 persons	National Bureau of Statistics
	Transportation Conditions	X8	Total highway mileage at year-end	Kilometers	Transportation Yearbook
Policy Environment	Policy Orientation	X9	Frequency of the term "tourism" appearing in government reports	Count (text mining)	Government websites; text mining analysis

4.3.1. Natural Resources: The Ecological Foundation

Natural resources serve as a foundational prerequisite for the development of garden-type scenic areas. The ecological quality of these resources directly influences the aesthetic appeal and tourism attractiveness of a site, acting as the material basis for both spatial aesthetics and ecological value (See Table 9).

Within the indicator system, natural resources encompass key elements such as national forest parks, nature reserves, and world natural garden-type scenic areas—reflecting their direct role in shaping urban ecological spaces. According to the results of the geographic detector model, the *q*-value of natural resources increased significantly from 0.238 in the 1999–2003 period to 0.586 in 2016–2024, with all values passing significance tests across the five time intervals. This upward trend indicates that as Jiangsu has advanced its ecological governance and green infrastructure initiatives over the past two decades, the influence of natural resources on the spatial distribution of garden-type scenic areas has steadily intensified.

Notably, beginning in the 2008–2011 period, the province actively promoted the construction of an "ecological province," emphasizing the development of green corridors and integrated park systems. This policy momentum continued into the 2012–2016 and 2016–2024 periods, resulting in increasingly pronounced spatial differentiation of natural factors, thereby enhancing both their constraining and guiding roles in the site selection process for garden-type scenic areas.

Further comparative analysis reveals that natural resources exert a stronger influence on low-grade scenic areas (e.g., 2A and 3A), where the *q*-value reaches 0.501 in the 2016–2024 period. These areas are typically developed based on original natural landscapes such as topographic features and wetlands, and due to limited infrastructure and service capabilities, they rely heavily on natural scenery to attract visitors. In contrast, high-grade scenic areas (4A and 5A) show a slightly lower *q*-value of 0.435 during the same period, indicating reduced but still significant dependence on natural endowments.

Overall, natural resources play a fundamental role in shaping both the spatial configuration and hierarchical structure of garden-type scenic areas. Against the backdrop of deepening ecological civilization construction, environmental indicators such as urban green space ratio not only enhance livability but also reinforce the pivotal role of garden-type scenic areas within the broader urban greening framework.

4.3.2. Cultural Resources: The Core Cultural Driver of Scenic Appeal

On par with natural resources, cultural resources play a pivotal role in shaping the spatial distribution of garden-type scenic areas. These areas are not merely ecological spaces but also deeply cultural landscapes that require humanistic elements to convey aesthetic value, historical meaning, and symbolic significance. In this study, key indicators such as national-level protected cultural garden-type scenic areas, traditional Chinese villages, and UNESCO World Cultural garden-type scenic areas were selected to assess the spatial coupling between cultural assets and scenic area siting (See Table 9).

Geographical detector results reveal that the explanatory power (*q*-value) of cultural resources increased from 0.216 in 1999–2003 to 0.602 in 2016–2024, a growth comparable to that of natural resources. This increase reached a significance level above 5% in the 2008–2011, 2012–2016, and 2016–2024 periods. This trend highlights the growing importance of cultural factors in garden scenic planning, driven by improvements in Jiangsu's heritage conservation systems and the integration of tourism and cultural development strategies. Cities like Suzhou and Yangzhou—rich in historical and cultural heritage—exemplify this phenomenon particularly well. Their gardens, often themselves national cultural relics, form spatial clusters supported by adjacent garden-type scenic areas, establishing a networked, community-based development model for scenic gardens.

Table 9. Time-Series Correlation Analysis Between Influencing Factors and Garden Scenic Area Development in Jiangsu Province.

Year	Natural Resources (X1)	Cultural Resources (X2)	Tourist Visits (X3)	GDP (X4)	Tertiary Industry Share (X5)	Resident Population (X6)	Road Network Length (X7)	Policy Environment (X8)
1999–2003	0.238 *	0.216	0.294 *	0.321 *	0.342 **	0.305 *	0.278 *	0.133
2004–2011	0.376 **	0.421 **	0.405 **	0.390 **	0.310 *	0.511 ***	0.360 *	0.261 *
2012–2016	0.458 **	0.493 ***	0.468 ***	0.429 **	0.298 *	0.583 ***	0.447 ***	0.316 *
2017–2024	0.586 ***	0.558 ***	0.527 ***	0.456 **	0.289 *	0.628 ***	0.531 ***	0.481 ***

Note: * represents significance at the 95% confidence level, ** at the 99% confidence level, and *** at the 99.9% confidence level.

In high-grade scenic areas, the influence of cultural resources is particularly prominent. By the 2016–2024 period, the *q*-value had reached 0.558, slightly surpassing that of

natural resources. This indicates that top-tier gardens place greater emphasis on cultural symbolism and the continuity of historical context, fulfilling a strong "cultural bearer" function. For instance, iconic sites such as the Humble Administrator's Garden in Suzhou and the Sun Yat-sen Mausoleum in Nanjing are not only heritage landmarks but also possess high landscape aesthetic value, becoming dual cores of cultural identity and tourism economy.

Furthermore, cultural resources tend to cluster spatially, exerting an influence described as a "cultural landmark-driven" model. Scenic area development often occurs around pre-existing cultural nodes, forming a "core–radiation" spatial structure. This pattern is especially pronounced in southern Jiangsu and is a significant contributor to the regional imbalance observed in garden scenic area development. The concentration of cultural landmarks in these regions facilitates the clustering of tourist attractions, enhancing their appeal while exacerbating disparities in scenic area distribution across different parts of the province.

4.3.3. Socio-Economic Factors: The Internal Engine of Scenic Area Development

Socio-economic conditions fundamentally determine the carrying capacity, development potential, and consumer base of garden-type scenic areas, serving as an internal driving force for scenic area development. In this study, four indicators—tourist visits, GDP, proportion of tertiary industry output, and resident population—were selected to capture the socio-economic dimensions, reflecting tourism demand, economic strength, industrial structure, and demographic base, respectively (See Table 9).

Results from the geographic detector analysis indicate that these socio-economic variables have demonstrated a consistent upward trend in explanatory power over time, particularly from the 2008–2011 period onward. Specifically:

Tourism demand (X3) increased its *q*-value from 0.294 in 1999–2003 to 0.573 in 2016–2024, consistently maintaining a high level. This underscores the strong correlation between the distribution of scenic areas and tourist mobility.

GDP (X4) and the proportion of tertiary industry output (X5) reached *q*-values of 0.481 and 0.312, respectively, by 2016–2024, highlighting the growing influence of economic capacity and industrial orientation on spatial patterns.

Resident population (X6), with a *q*-value rising from 0.305 in 1999–2003 to 0.654 in 2016–2024, emerged as one of the most significant predictors.

In Jiangsu Province, cities in southern Jiangsu—such as Nanjing, Wuxi, and Suzhou—have long maintained high levels across these socio-economic indicators, corresponding with their leading positions in garden scenic area development. This spatial coupling between economic fundamentals and scenic area density further confirms the decisive role of socio-economic factors in shaping distribution patterns.

It is worth noting that some economic indicators showed fluctuations in the 2008–2011 and 2012–2016 periods—for instance, a temporary decline in the *q*-value of tertiary industry proportion. This may reflect the expansion of garden scenic area construction into central and northern Jiangsu, where economic levels are relatively lower but policy support and resource allocation have increased. These interventions have enabled such regions to achieve "leapfrog" development, surpassing traditional growth trajectories, particularly in the 2016–2024 period.

4.3.4. Policy Environment: Institutional Guarantee for Spatial Optimization

As a macro-level institutional force, the policy environment plays an irreplaceable role in guiding resource allocation and development direction. Drawing upon previous studies, this paper applies the frequency of the keyword "tourism" in annual government

work reports as a proxy variable to assess local government attention and support for garden scenic area development (Figure 4).

According to the data presented in Table 9, the *q*-value of the policy environment indicator (X8) was relatively low in the 1999–2003 period (0.133), but rose significantly to 0.481 by the 2012–2016 period and further increased to 0.512 in the 2017–2024 period, with the trend reaching the 1% significance level from 2012 onward. This result indicates that in the early stages of garden scenic area development, policy influence was minimal—development relied more heavily on natural endowments and economic foundations. However, with the implementation of province-wide strategies such as "All-for-One Tourism" and "Ecological Jiangsu" beginning in the 2008–2011 period, local governments have taken increasingly proactive roles in garden scenic planning, transforming policy orientation into a decisive force shaping spatial distribution.

For high-grade scenic areas in particular, policy has acted as a "strong guiding" force. On one hand, local authorities aiming to enhance regional tourism image and overall competitiveness tend to concentrate administrative and financial resources on the development of high-quality garden attractions. On the other hand, through mechanisms such as fiscal investment, scenic area rating incentives, and branding campaigns, policy direction has formed a robust administrative driving force. Cities with relatively weaker economic bases, such as Yancheng and Suqian, have leveraged targeted policy support to achieve "dual advancement"—in both the quantity and rating levels of garden-type scenic areas—exemplifying the compensatory function of policy in promoting more balanced spatial development.

It is important to note that the influence of the policy environment is inherently phased and context-dependent. In the short term, targeted policies can effectively stimulate growth in specific regions or for particular types of sites. However, their long-term sustainability and impact still depend on foundational factors such as resource endowment, economic capacity, and market demand. Therefore, the role of the policy environment in scenic area development is best understood as that of a "catalyst" and a "coordinator": it does not replace structural drivers but amplifies and aligns them, and its effectiveness hinges on synergistic interaction with other driving forces to achieve sustained and balanced growth.

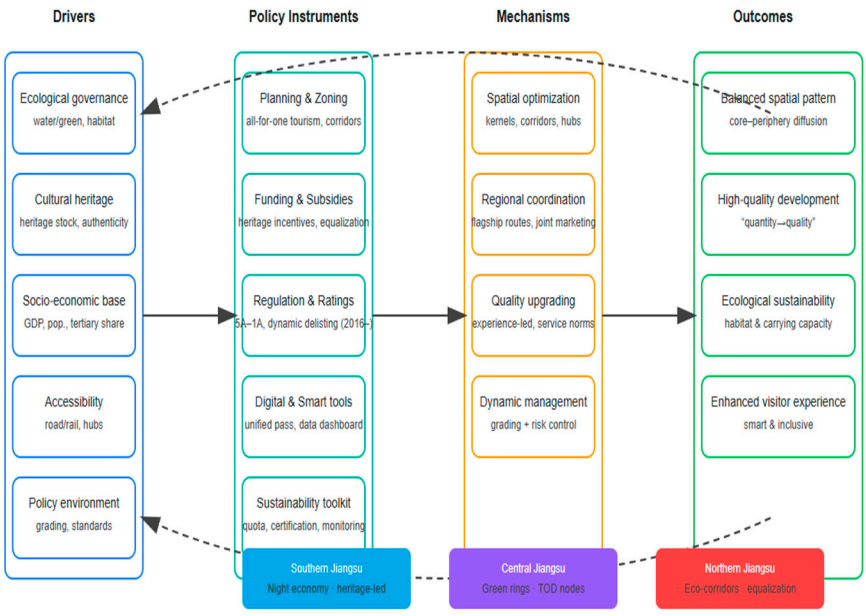


Figure 4. Analytical Framework of Drivers, Policies, Mechanisms, and Outcomes for Tourism and Sustainable Development in Jiangsu Region.

Case illustration—Suzhou's heritage protection subsidy policy: Since 2015, Suzhou Municipality has implemented a subsidy scheme for heritage conservation and garden restoration, channeling earmarked funds to UNESCO World Heritage gardens such as the Humble Administrator's Garden and the Lingering Garden, as well as to other historically significant sites. The program has improved restoration quality, alleviated operating pressures, and strengthened heritage safeguarding; for example, funded works at the Humble Administrator's Garden included conservation of traditional architectural elements and ecological rehabilitation of garden landscapes, which enhanced both visitor experience and protection outcomes. Nevertheless, implementation challenges persist: fiscal allocations are sometimes insufficient and unevenly distributed, constraining sustained support for small- and medium-sized gardens; moreover, the evaluation mechanism remains underdeveloped, with limited transparency in oversight and long-term follow-up assessment. These issues suggest that while policy acts as a catalyst, optimizing subsidy design, diversifying funding sources (e.g., public–private partnerships and earmarked tourism levies), and strengthening monitoring and evaluation are necessary to translate policy support into durable, sustainable outcomes.

The interaction detection results reveal that the spatial evolution of A-level garden-type scenic areas in Jiangsu has gradually shifted from resource-driven growth to multifactorial dynamics where nonlinear synergies dominate. (See Table 10) The strongest effects emerge when natural and cultural resources interact, confirming that the co-existence of environmental endowments and heritage assets creates disproportionate attraction compared to their individual roles. Market–economic interactions, such as tourist visits with GDP, and population–economic linkages, also show substantial enhancement, suggesting that demand intensity and development capacity are mutually reinforcing. Accessibility and structural upgrading further promote diffusion, with the road network and tertiary industry share working together to extend growth beyond core cities. Meanwhile, policy interventions amplify the role of cultural resources, steering spatial clustering toward heritage-rich areas. Overall, the analysis underscores that the explanatory power of scenic area evolution lies not in isolated drivers but in the compounded and nonlinear interplay among resources, economy, demographics, infrastructure, and governance, highlighting the need for integrated and policy-sensitive approaches to sustainable landscape tourism development.

Table 10. Interactive detection result table.

Interaction Pair	*q*-Value	Enhancement Type	Interpretation
X1 (Natural Resources) ∩ X2 (Cultural Resources)	0.712 ***	Nonlinear enhancement	Synergy between natural and cultural endowments creates stronger attraction.
X1 (Natural Resources) ∩ X3 (Tourist Visits)	0.695 ***	Bi-factor enhancement	Supply–demand dynamics reinforce scenic area growth.
X3 (Tourist Visits) ∩ X4 (GDP)	0.672 ***	Bi-factor enhancement	Tourism consumption and economic base strengthen each other.
X4 (GDP) ∩ X6 (Resident Population)	0.701 ***	Nonlinear enhancement	Population scale and economic strength jointly expand development capacity.
X5 (Tertiary Industry Share) ∩ X7 (Road Network)	0.668 ***	Bi-factor enhancement	Industrial upgrading combined with accessibility promotes diffusion.
X7 (Road Network) ∩ X8 (Policy Environment)	0.654 **	Bi-factor enhancement	Infrastructure and policy orientation shape spatial patterns.
X2 (Cultural Resources) ∩ X8 (Policy Environment)	0.693 ***	Nonlinear enhancement	Policy emphasis on heritage areas generates clustered effects.
X1 (Natural Resources) ∩ X6 (Resident Population)	0.684 ***	Bi-factor enhancement	Resource availability aligns with population concentration to elevate scenic status.

Note: *** and ** indicate significance at the 1% and 5% levels, respectively.

4.3.5. External Validity and Cross-Provincial Comparison

Notably, juxtaposition with other provinces further underscores the distinctive significance of the Jiangsu case. Zhejiang has developed a heritage-driven pathway, with garden resources concentrated along the Hangzhou–Shaoxing corridor; Guangdong, by contrast, leverages mountainous and coastal assets to advance an eco-leisure tourism model. Jiangsu exhibits a hybrid profile that couples deep cultural heritage with ecological functions and displays a pronounced "south-dense versus north-sparse" gradient. These contrasts indicate that natural endowments and historical–cultural transmission jointly shape diverse distributional patterns. The Jiangsu case thus not only reveals local specificities, but also provides a reference point for understanding similarities and differences in cultural landscapes across the Yangtze River Delta and South China.

Zhejiang (culture-oriented garden landscape): Zhejiang shares a long-standing garden tradition and dense heritage corridors. Similar to southern Jiangsu, high-grade garden-type scenic areas there are expected to cluster around economically vibrant belts and historic urban cores, with cultural resources and population agglomeration playing comparatively larger roles. This suggests that the indicator system and driver structure used here are portable, while the relative weight of cultural resources may be higher in culture-saturated locales.

Guangdong (ecotourism-oriented development): Guangdong's attraction system features extensive coastal wetlands, forest parks, and mountain reserves coupled with strong transportation corridors in the Pearl River Delta. Under such a resource–infrastructure configuration, natural resources and accessibility are expected to contribute more strongly, and policy–market interactions to be more salient. The interaction-detector insight in Jiangsu—nonlinear enhancement between accessibility and resource endowments—should generalize and potentially intensify under Guangdong's ecotourism model.

Transferable lessons and boundary conditions: Across these provinces, the five-dimensional framework (natural, cultural, socio-economic, accessibility, policy) is generalizable, but factor weights vary with heritage endowment, industrial structure, and ecological baselines. Direct policy transfer should therefore be calibrated: culture-led strategies are more applicable to heritage-dense cities (e.g., southern Jiangsu/Zhejiang), while resource–accessibility coupling is pivotal for ecotourism-led regions (e.g., Guangdong). A future controlled comparative study can operationalize this extension with the same indicator set and temporal staging.

5. Discussion

The development of A-level garden-type scenic areas in Jiangsu Province demonstrates a clear trajectory of quantitative growth and spatial optimization, yet several structural challenges remain. Building on our findings, the following discussion integrates regional, managerial, and policy perspectives with broader international debates.

(1) Enhancing regional coordination and cross-boundary integration.

While prefecture-level cities have made notable progress, the lack of a unified mechanism for cross-regional collaboration continues to limit resource efficiency. International experiences, such as UNESCO's thematic heritage corridors, show that integrated route planning and multi-stakeholder governance can enhance both accessibility and visibility [25,33]. For Jiangsu, a feasible pathway would be to establish inter-city tourism alliances—for example, a Nanjing–Suzhou cultural corridor—supported by unified digital platforms that integrate AI-powered trip planning, real-time crowd monitoring, and seamless mobile ticketing [34]. Such smart infrastructure enables dynamic visitor routing across re-

gions, reducing congestion in core sites and distributing economic benefits more equitably. A shared data ecosystem could further support coordinated marketing, joint heritage branding, and synchronized event scheduling.

(2) Strengthening the radiative role of core cities.

Although Suzhou and Nanjing form dense scenic clusters, their influence on surrounding areas remains insufficient. A hierarchical tourism network should be developed, with high-end cultural tourism (e.g., night gardens, immersive heritage experiences) concentrated in southern Jiangsu, while northern Jiangsu focuses on eco-tourism corridors linked to transport hubs [35,36]. This "core–periphery" structure can be amplified through smart diffusion mechanisms: AI-guided tour systems could recommend day-trip itineraries from Suzhou to nearby Taizhou or Yangzhou, while dynamic pricing models offer discounted rates during off-peak hours or low-season periods to incentivize travel to underutilized areas. These tools not only optimize visitor distribution but also enhance regional connectivity and economic inclusivity.

(3) Transitioning from the traditional ticket-based economy.

Changing consumer preferences demand a shift toward diversified and participatory models. Building on global smart-tourism practices, Jiangsu's garden-type scenic areas are increasingly adopting AI-guided tour systems that deliver personalized historical narratives, augmented reality (AR) plant identification, and multilingual interpretation via mobile apps—enhancing accessibility and educational value [37–39]. Dynamic pricing models, which adjust admission fees based on real-time visitor density, weather conditions, and seasonal demand, have been piloted in Suzhou's classical gardens, effectively smoothing attendance peaks and improving revenue management.

Furthermore, integrating IoT-enabled environmental sensors allows for real-time monitoring of microclimatic conditions, foot traffic pressure, and water quality—enabling predictive maintenance and early warning systems for ecological stress. Mobile app integration facilitates end-to-end visitor journeys, including reservation systems, indoor navigation, and digital cultural product sales [14,40,41]. These innovations collectively transform garden-type scenic areas from passive attractions into intelligent, responsive cultural ecosystems, extending the tourism value chain through nighttime experiences, creative cultural merchandise, and data-driven service personalization.

(4) Prioritizing ecological sustainability and resilience.

Sustained growth raises concerns of over-tourism and ecological degradation. To align with international low-impact tourism standards, Jiangsu should introduce sustainability metrics such as science-based visitor quotas, green certifications, and automated ecological monitoring systems [42,43]. Smart technologies play a critical role here: real-time crowd analytics can trigger automatic alerts when thresholds are exceeded, prompting on-site interventions or temporary access restrictions. AI-powered forecasting models can simulate long-term environmental impacts under different visitation scenarios, supporting adaptive management strategies. These practices not only protect fragile landscapes but also align with China's national strategy of building a "Beautiful China" and advancing green digitalization

(5) Broadening the research and policy agenda.

Our analysis highlights that socio-economic factors, accessibility, and cultural heritage intensity are key drivers, but operational challenges—tourist satisfaction, community benefits, and management costs—also shape long-term performance [44,45]. While our study focuses on macro-level spatiotemporal patterns, future research should integrate micro-level stakeholder perspectives through surveys and interviews, and methodologi-

cally advance toward SEM or machine learning to capture complex interactions. In parallel, policy discussions must embrace the dual transition: from physical infrastructure to digital intelligence, and from static conservation to adaptive, data-informed governance. Linking these developments to global frameworks—such as UNESCO's Living Heritage approach and the UNWTO's Digital Innovation Agenda—can position Jiangsu as a model for smart, sustainable, and culturally rich urban heritage tourism [46,47].

In summary, Jiangsu's future development should shift from quantitative expansion toward qualitative transformation. This requires moving from isolated scenic sites to integrated provincial networks, and from static sightseeing to dynamic, participatory, and sustainable experiences. Such a transformation will not only consolidate Jiangsu's leadership in China's garden tourism but also contribute insights of broader international relevance.

6. Conclusions

The development of A-level garden-type scenic areas in Jiangsu Province has undergone a comprehensive transformation—from quantitative expansion to qualitative improvement, from regional concentration to spatial diffusion, and from structural homogeneity to typological diversification. This study reveals that the spatial distribution of garden-type scenic areas in Jiangsu exhibits significant agglomeration characteristics, primarily concentrated in southern Jiangsu and around economically developed cities. Notably, Suzhou and Nanjing stand out as key hubs with high concentrations of garden attractions.

Over time, the number of garden-type scenic areas has shown a consistent upward trend across all prefecture-level cities in the province. Particularly marked growth occurred during 2012–2016 and 2017–2024. Cities such as Yancheng, Wuxi, Nanjing, and Suzhou have experienced the most notable increases in the number of scenic areas.

In terms of classification structure, 3A- and 4A-level garden-type scenic areas account for the majority, reflecting an overall high level of development. Meanwhile, 5A-level garden-type scenic areas have become emblematic projects symbolizing excellence in urban garden construction.

The spatiotemporal evolution of these garden-type scenic areas is shaped by multiple interrelated factors. First, continuous progress in ecological governance and green space construction has enhanced the role of natural resources in shaping the spatial pattern of garden-type scenic areas, providing a solid ecological foundation for their development.

Secondly, improvements in cultural heritage protection systems and the advancement of tourism-culture integration strategies have elevated the significance of cultural resources in scenic rated A-level upgrades, yet highlighted risks of "rating chasing" without corresponding service improvements. These findings underscore the need for balanced, adaptive governance frameworks that integrate ecological thresholds and sustainability accountability into policy evaluation criteria.

Third, from a comparative perspective, the explanatory framework developed here is portable to similar provinces; however, the relative importance of cultural versus natural and accessibility factors will vary (e.g., culture-led patterns in Zhejiang versus ecotourism- and accessibility-led patterns in Guangdong). We therefore recommend a follow-up, controlled comparative study using the same indicator system to quantitatively test external validity and to identify transferable policies and boundary conditions.

At the same time, socio-economic factors—including tourism demand, gross domestic product (GDP), the proportion of the tertiary industry, and resident population—play a crucial role in determining the carrying capacity, investment potential, and consumer base of garden-type scenic areas. These indicators collectively serve as key internal drivers of scenic area development.

Furthermore, policy support has been a critical external driver, though its effectiveness varies by implementation context. Case studies of Suzhou's heritage subsidies reveal that sustained funding and inter-agency coordination significantly improved conservation outcomes, but also exposed challenges in monitoring long-term impacts and ensuring equitable distribution across smaller garden-type scenic areas. Similarly, Nanjing's incentive-based promotion model successfully accelerated A-level upgrades, yet highlighted risks of "rating chasing" without corresponding service improvements. These findings underscore the need for balanced, adaptive governance frameworks.

In conclusion, the future development of A-level garden-type scenic areas in Jiangsu should focus on optimizing resource allocation while further enhancing regional collaboration and the driving capacity of core cities. The emphasis must shift from quantitative expansion to qualitative transformation—transitioning from isolated scenic sites to integrated all-region tourism systems, and from static displays to dynamic, participatory experiences. These strategic shifts will contribute to the high-quality integration and sustainable development of Jiangsu's cultural and tourism sectors.

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