Pertanika J. Soc. Sci. & Hum. 34 (5): 2401 - 2423 (2026)

PERTANIKA JOURNALS

SOCIAL SCIENCES & HUMANITIES

Journal homepage: http://www.pertanika.upm.edu.my/

Review Article

Research Trends in Chinese Traditional Gardens: A Bibliometric Analysis

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ABSTRACT

Traditional Chinese gardens, as an important form of cultural heritage, embody China's unique philosophy, values, and aesthetic sensibilities. Most existing reviews are primarily qualitative and lack a systematic analysis of the bibliometric characteristics of research on Chinese traditional gardens. This study used CiteSpace and VOSviewer to examine the research trends and future directions of Chinese traditional garden studies. The analysis covered 203 publications published between 2006 and 2025, focusing on bibliometric characteristics such as publication trends, core journals and cited sources, keyword visualisation and clustering, geographical distribution, and temporal evolution. The results indicate that both research output and thematic interest in this field have generally increased in recent years. However, the geographical distribution remains uneven, with research activity primarily concentrated in East Asian countries, particularly China, Japan, and South Korea. Temporal evolution and clustering analyses identified five major thematic trajectories in this field: garden history and contemporary significance, aesthetic properties and humanmade paradise, audiovisual interaction and Chinese landscape painting, classical Chinese royal garden, and cold-winter zone. Based on these themes, the study identified several key challenges, including the limited use of mixed methods, insufficient attention to the sustainable development of regional gardens, and an imbalance between authenticity conservation and heritage revitalisation. This

ARTICLE INFO

Article history:
Received: 04 February 2026
Accepted: 10 August 2026
Published: 05 October 2026

DOI: https://doi.org/10.47836/pjssh.34.5.03

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e-ISSN: 2231-8534

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review provides directions for advancing Chinese traditional garden research from aesthetic and historical interpretation toward a measurable, verifiable, applicable, and interdisciplinary field.

Keywords: Bibliometric analysis, CiteSpace, cultural heritage, traditional Chinese gardens, VOSviewer

INTRODUCTION

The International Council on Monuments and Sites (ICOMOS, 1982) defined historic gardens in the Florence Charter (1982) as cultural landscapes formed through the joint composition of architecture and horticulture, and possessing historical and artistic value (Scazzosi, 2004). As a category of heritage that carries cultural memory, the historic garden continues to shape human aesthetic judgment and spatial cognition across temporal distance and provides critical insights for contemporary culture and design practices (Hall & Ames, 1987; Hunt, 1992; Li, 2012; Rinaldi, 2012). The conservation and study of historic gardens therefore contribute to the transmission of cultural memory and aesthetic tradition (Rinaldi, 2012; Zhang & Zhang, 2024).

Chinese traditional gardens (CTGs) can be traced back to the ritual-oriented royal parks of the Yellow River Basin and the Central Plains during the pre-Qin period (before 221 BCE). During the Han dynasty (206 BCE-220 CE), imperial palace gardens developed in Chang'an (present-day Xi'an, Shaanxi Province) and Luoyang in the Central Plains (present-day Luoyang, Henan Province) and reached their height during the Tang dynasty (618-907 CE). From the Song dynasty onward (960-279 CE), literati gardens gradually matured in Kaifeng, Lin'an, and the Jiangnan region, forming a distinctive system characterised by "conceiving the garden through poetry and shaping it according to painting" (K Gholinejad Pirbazari et al., 2021; Keswick & Hardie, 2003).The art of garden-making in CTGs was shaped by Confucian, Buddhist, and Daoist thought, emphasising the philosophical notion of the "unity of heaven and humanity" (Kiani & Khakzand, 2024; Needham, 1974) and its spatial organisation and planting schemes often embodied the ideals and sensibilities of the scholarly elite (Cooper, 2017; Xia & Zhou, 2024). CTGs organise spatial experience and construct aesthetic atmosphere through techniques such as borrowed scenery, aligned or opposing vistas, screened views, and framed views, and they simultaneously fulfill multiple roles, including sightseeing, self-cultivation, repose, and cultural exchange (Cooper, 2017; Xia & Zhou, 2024). As a key symbolic expression of Chinese culture, CTGs are not only a landscape form but also a vehicle for aesthetic ideology and cultural ethos (Thacker, 1985; Wang, 2015).

The generative philosophy of traditional Chinese gardens emphasises respecting and revering nature, while undertaking highly artistic creation based on natural landscapes (Liu, 2012). Chinese horticulturists believe that nature should not be an object to be

conquered and reconstructed, but rather a model to be imitated and learned from (Huang, 2008). Spatial imagery is one of the artistic characteristics of garden aesthetics and spiritual features, extending the depth of the spatial landscape and creating spatial hierarchical sequences to enhance the visitor's appreciation (Tsu, 1988). On the other hand, traditional Chinese painting, poetry, and calligraphy play a key role in the creation of garden space, integrating their spiritual and cultural connotations into pavilions, plaques, couplets, stone carvings, etc., constructing a comprehensive space of garden spatial imagery and artistic realm (Xu et al., 2016). Garden architecture commonly appears in the form of pavilions, terraces, towers, and waterside pavilions, which are located within the garden according to their function and design form, providing architectural spaces for tourists to visit, rest, and appreciate (Feng, 2007). Water features and artificial hills are important elements in gardens. Water, as a flowing product of nature, creates a tranquil space within the garden through its form, color, and sound, enhancing the auditory and visual experience of visitors and purifying the mind (Wu et al., 2020). Artificial hills are an important element of traditional Chinese gardens, showcasing the formal carriers of Chinese landscape painting culture and creating a layered, enchanting space within the garden (Liang et al., 2019).

Previous studies on Chinese traditional gardens have primarily addressed their aesthetic characteristics and cultural meanings, the conservation and revitalisation of historic gardens, and interdisciplinary topics such as cultural heritage tourism and tourists' perceptions of authenticity. Despite the substantial body of research accumulated in these areas, the literature remains fragmented across different disciplines, with limited systematic synthesis of the overall knowledge structure and interdisciplinary relationships within the field. Bibliometric analyses of Chinese traditional garden research published between 2006 and 2025 remain limited. Existing reviews are predominantly descriptive and qualitative, with insufficient use of bibliometric visualisation and limited integration of the PRISMA process with the PCC framework. Therefore, a systematic bibliometric review of this field is warranted. This study uses CiteSpace and VOSviewer tools to conduct bibliometric analysis on the field of traditional Chinese gardens. Specifically, (1) what are the academic hotspots and development trends in the field of traditional Chinese gardens? (2) How are the research topics distributed in this field? (3) What are the future research directions? In summary, this review identifies the development trends and future research directions of Chinese traditional gardens and contributes to a more systematic bibliometric knowledge framework for the field. The findings can help cultural heritage managers, garden conservation practitioners, and landscape designers identify conservation priorities, while also providing guidance for advancing digital management and achieving a better balance between heritage conservation and revitalisation.

METHODS AND MATERIALS

Search Strategy and Criteria

This study searched the Web of Science database up to September 2025 using the search terms "Classical Garden" OR "Traditional Garden" OR "Historic Garden" OR "Scholar Garden" OR "Private Garden" AND "Chinese" OR "China". The search operations used the Boolean AND and OR operators. The PCC (Population, Concept, Context) framework was employed to guide the development of the search strategy (Munn et al., 2019), as presented in Table 1. (1) The object of study is Chinese Traditional Gardens (CTGs) (including classical gardens, historic gardens, literati gardens, and private gardens), with no restriction on specific garden subtype. (2) The study addresses disciplinary themes related to CTGs, such as knowledge structures, cultural value, conservation and utilisation, historical research, digital documentation and analysis, and landscape characteristics. (3) The data source is the Web of Science Core Collection; the publication year falls between 2006 and 2025; and both the title and keywords contain terminology associated with traditional gardens. All retrieved records were exported to EndNote 21 for reference management and duplicate removal, after which subsequent screening was conducted.

Table 1
PCC criteria for inclusion of studies

Items	Detailed Inclusion Criteria
Population	Chinese Traditional Gardens
Concept	Academic studies concerning the theories, methodologies, or practices related to Chinese Traditional Gardens (CTGs)
Context	Web of Science Core Collection (2006–2025); Article

Source: Authors' own work

Study Selection

The screening procedure in this study followed the PRISMA 2020 workflow (Page et al., 2021), and the number of excluded records together with the specific reasons for exclusion are reported in the flow diagram (Figure 1). An initial screening was conducted on articles whose titles and abstracts indicated relevance to the research scope, together with their publication of information. Applying to the inclusion and exclusion criteria described above, an initial set of N = 1,309 records was identified, from which N = 203 studies were ultimately retained. The literature screening process is handled by two staff members. If any disagreements arise during the screening process, a third party will be invited to intervene to ensure the rationality and scientific validity of the included literature.

Data Analysis

This study employs a combined approach using CiteSpace and VOSviewer to perform bibliometric analysis (Figure 2). CiteSpace is a knowledge mapping tool that integrates principles of bibliometrics and information visualisation; it presents, through an intuitive visual interface, the interactions, evolution, and complex relationships among knowledge units and clusters

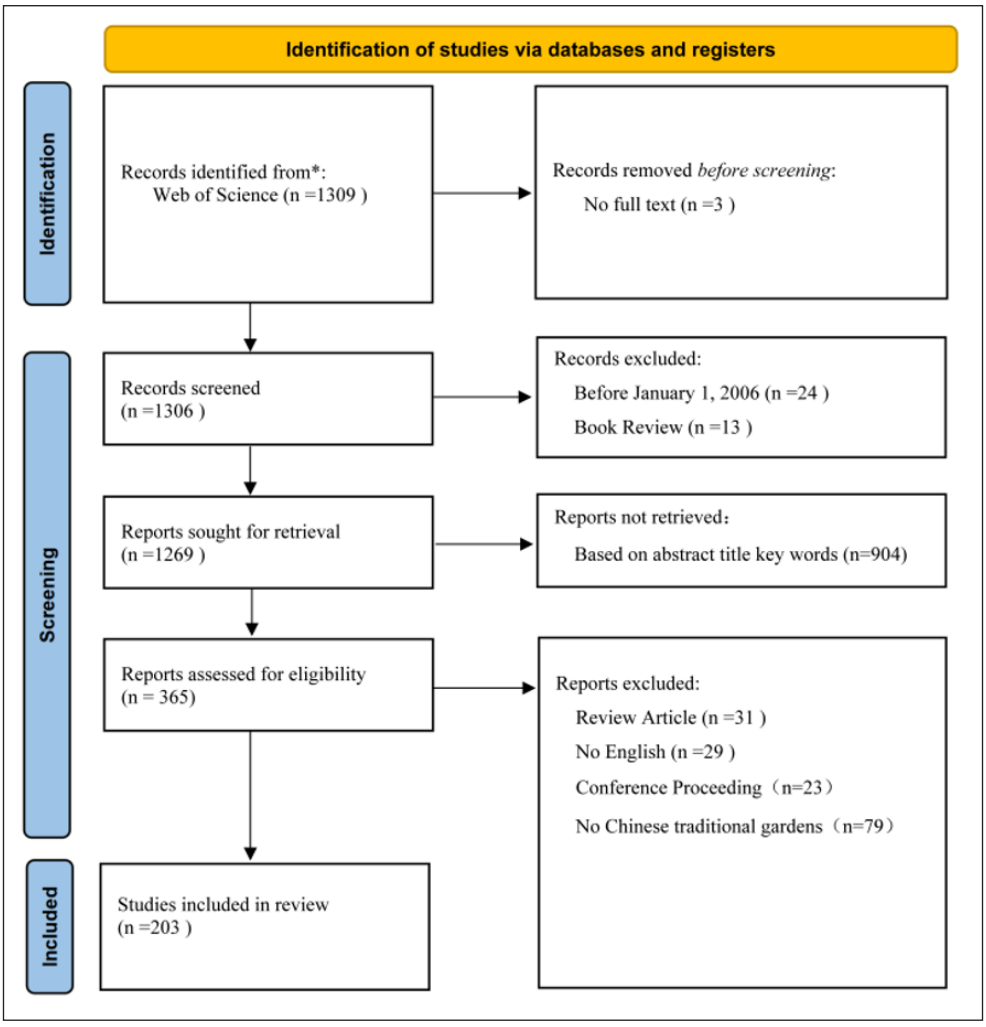

Figure 1. PRISMA flow diagram

within a research network (Chen, 2006). By generating knowledge mapping with CiteSpace, this study conducts a systematic review of the literature within the defined research domain and explicitly visualises the research structure, developmental trajectory, and patterns of evolution. In contrast, VOSviewer places greater emphasis on revealing structural relationships among publications through network clustering, and it applies association-strength normalisation to process co-occurrence matrices in order to ensure the reliability of link strength between nodes (van Eck & Waltman, 2010). This study applies CiteSpace to construct knowledge mapping and generate visual analyses of the screened literature, in order to systematically sort out the knowledge structure and evolutionary trajectory of research on Chinese Traditional Gardens

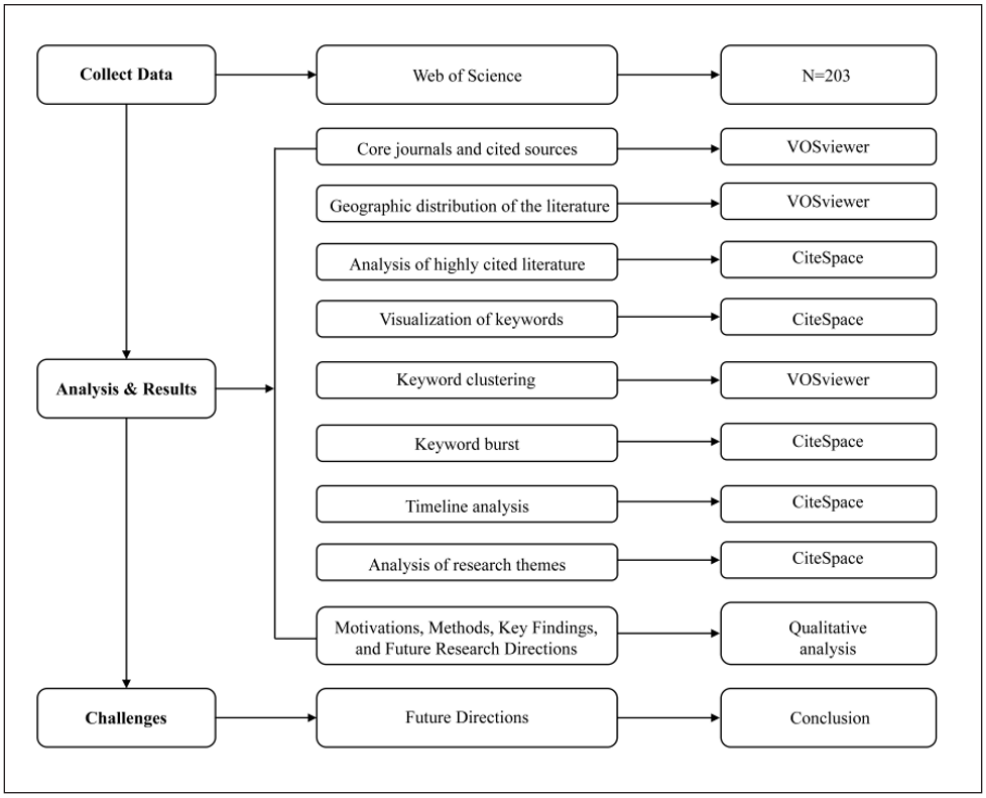

Figure 2. Outline of the research framework

(CTGs). The analysis includes highly cited literature, keyword visualisation and burst detection, temporal evolution patterns, and co-citation clustering, with the aim of identifying major research hotspots and emerging frontiers. On the other hand, VOSviewer software was used to analyse core journals and citation sources, geographical distribution of literature, and keyword clustering analysis.

RESULTS AND DISCUSSION

Publication Volume

This review, based on the WOS database, statistically analyses the publication volume of the 203 included articles (Figure 3). From 2006 to 2025, research on traditional Chinese gardens generally showed an upward trend, with the highest number of publications in 2024, reflecting the peak of academic output. From 2006 to 2009, the number of publications was extremely low, with only 4 articles, indicating that the field was in its nascent stage and did not receive much attention from the academic community. From 2010 to 2015, the number of publications rose each year, though at a relatively slow pace. After 2016, a second downturn emerged, and output reached its lowest level in 2019 to 2020, with only five articles published, suggesting that research on traditional Chinese gardens had

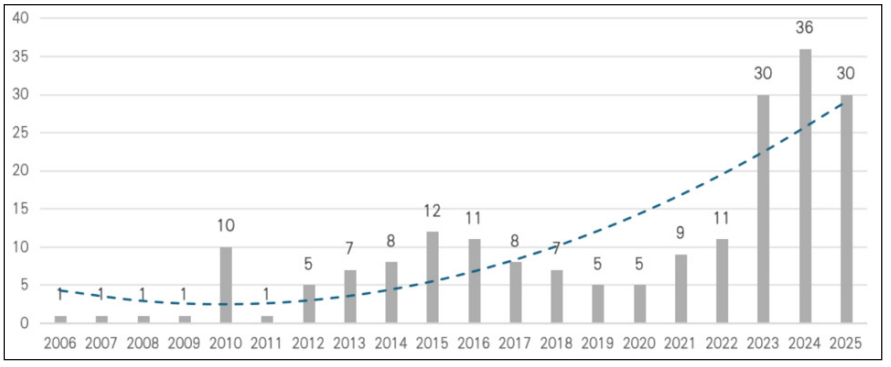

Figure 3. Annual publication trends in historical garden research, 2006-2025

approached saturation and that foundational disciplinary discussions had largely been consolidated. From 2021 to 2025, publication volume increased substantially and peaked in 2024. This pattern indicates that, on the basis of consolidated disciplinary knowledge, methodological innovation and interdisciplinary integration have become more evident in the field.

Core Journals and Cited Sources Overview

This study used VOSviewer to analyse the most frequently cited publications (Table 2) and the foundations of citation analysis were laid by Garfield (1955), while co-citation analysis was introduced by Small (1973). Through cited-source profiling, to identify emerging hotspots and future research directions in the field of traditional Chinese gardens. We identified the top 16 core journals with the highest citation counts, which serve as key platforms for scholarly production and dissemination in this area. The Journal of Cultural Heritage had the highest co-citation frequency, with a total link of strength of T=32 and 123 co-citations, indicating strong authority and influence within the cultural heritage domain.

Secondly, Sustainability and Heritage Science have citation counts of 90 and 78 respectively, with total link strengths (T=39 and T=36). Their academic contributions and research scope have had a significant impact, promoting the dissemination of traditional landscape architecture in international journals and driving its core role in constructing disciplinary knowledge.

Analysis of Article Regions

To present research output and collaboration networks more clearly, VOSviewer was used with inclusion thresholds set at a minimum of one publication and at least two citations. Among the 23 identified countries/regions, 17 met these initial thresholds. To ensure that the collaboration network reflected only actual collaborative relationships, nodes with a Total Link Strength (TLS) of 0 (Denmark, Poland, Romania, Ukraine) were further excluded. Ultimately, 13 countries/regions were retained for quantitative analysis (Table 3).

Table 2
Cited journals and sources

Year	Journal	Total Link Strength	Article Number	Citation Number	Norm Citation	Avg. Citation	Avg. Norm Citation
2022	Sustainability	39	11	90	12.9	8.1	1.17
2023	Heritage Science	36	11	78	16.1	7.0	1.46
2019	Journal of Cultural Heritage	32	3	123	7.4	41	2.50
2024	Journal of Asian Architecture and Building Engineering	28	10	18	7.5	1.8	0.76
2023	Land	19	6	39	9.5	6.5	1.59
2018	Studies in The History of Gardens & Designed Landscapes	18	9	32	4.6	3.5	0.52
2022	Frontiers of Architectural Research	14	4	23	3.9	5.7	0.97
2021	Environment and Planning B: Urban Analytics and City Science	13	2	10	1.2	5.0	0.63
2023	Landscape Research	13	7	21	2.6	3.0	0.38
2020	Nexus Network Journal	12	4	23	3.5	5.7	0.87
2025	Npj Heritage Science	9	3	1	0.8	0.3	0.29
2022	Frontiers In Psychology	6	2	10	1.0	5.0	0.52
2024	Herd-Health Environments Research & Design Journal	6	2	1	0.3	0.5	0.17
2022	Landscape Architecture Frontiers	4	3	2	0.4	0.6	0.16
2024	Cultura-International Journal of Philosophy of Culture and Axiology	1	2	1	0.3	0.5	0.17
2023	Energy And Buildings	1	2	43	7.5	21.5	3.76

Note. Norm. Citation refers to a standardised citation indicator based on the average annual citation rate; Avg. Norm. Citation represents the average standardised citations per article
Source: Authors' own work

As shown in Table 3, the TLS / number of publications / number of citations / representative characteristics is as follows: China (168 / 169 / 668) occupies a central position in this field and plays a key role in international academic collaboration networks. Australia (52 / 11 / 55), Japan (43 / 9 / 26), the United Kingdom (28 / 7 / 27), and the Republic of Korea (21 / 6 / 36) exhibit differences in both scale and impact. Although Australia has a relatively small publication volume, it shows a comparatively high average citation rate (Avg. citation = 5.0), as well as a notable average normalised citation indicator (Avg. norm. citation = 0.92). Italy (4 / 1 / 8), despite its low publication volume, demonstrates a markedly elevated average normalised citation score (7.47). By contrast, the Netherlands (15 / 2 / 16), Wales

Table 3
Academic contributions at the national/regional level

Year	Countries/regions	Total Link Strength	Article Number	Citation Number	Norm Citation	Avg. Citation	Avg. Norm Citation
2020	China	168	169	668	134.7	3.9	0.81
2019	Australia	52	11	55	10.1	5.0	0.92
2023	Japan	43	9	26	5.0	2.8	0.56
2019	England	28	7	27	7.3	3.8	1.05
2019	South Korea	21	6	36	6.2	6.0	1.04
2023	Netherlands	15	2	16	3.9	8.0	1.99
2025	Wales	14	1	1	0.9	1.0	0.92
2017	Germany	13	4	4	0.4	1.0	0.1
2012	Canada	9	1	10	2.3	10	2.33
2024	Egypt	9	1	1	0.31	1.0	0.30
2025	Malaysia	5	2	2	1.8	1.0	0.92
2017	Italy	4	1	8	7.4	8.0	7.47
2024	France	2	1	2	0.6	2.0	0.60

Note. Norm. Citation refers to a standardised citation indicator based on the average annual citation rate; Avg. Norm. Citation represents the average standardised citations per article
Source: Authors' own work

(14 / 1 / 1), Germany (13 / 4 / 4), Canada (9 / 1 / 10), Egypt (9 / 1 / 1), Malaysia (5 / 2 / 2), and France (2 / 1 / 2) show comparatively modest citation scales and limited network connectivity, indicating potential for further development in terms of international visibility and research integration.

In terms of the geographical distribution of the case studies, research has primarily focused on Suzhou, Beijing, Nanjing, Hangzhou, and Chengdu. Despite differences in regional conditions, these gardens share common design principles, including drawing inspiration from nature, integrating mountains and water, and creating poetic and pictorial settings. Consequently, they exhibit similarities in spatial layout and aesthetic characteristics.

Highly Cited References Analysis

Through the analysis of highly cited literature using CiteSpace (Table 4), research on Chinese Traditional Gardens (CTGs) in the past five years has concentrated primarily on digital conservation, spatial reconstruction, and cultural heritage management. The prevailing research paradigm has shifted from traditional historical-interpretive analysis toward a technology-driven, interdisciplinary integration. The most frequently cited studies were largely published between 2019 and 2020. For example, Liang et al. (2018) and Liang et al. (2019) systematically examined three-dimensional scanning and digital printing technologies, marking a transition in the study of CTGs from visual

Table 4
Highly cited references analysis

Author	Journal Article Title	Source	Centrality	Count
Dong et al., 2020	3D scanning, modelling, and printing of Chinese classical garden rockeries: Zhanyuan's South Rockery.	Heritage Science	0.07	12
Liang et al., 2019	Semantic-based 3D information modelling and documentation of rockeries in Chinese classical gardens: A case study on the rockery at Huanxiu Shanzhuang, Suzhou, China.	Journal of Cultural Heritage	0.04	12
Liang et al., 2018	The integration of terrestrial laser scanning and terrestrial and unmanned aerial vehicle digital photogrammetry for the documentation of Chinese classical gardens—A case study of Huanxiu Shanzhuang, Suzhou, China.	Journal of Cultural Heritage	0.03	10
Liang et al., 2020	How to survey, model, and measure rockeries in a Chinese classical garden: a case study for Huanxiu Shanzhuang, Suzhou, China.	Landscape Research	0.10	10
Jia et al., 2022b	Methods of Conserving and Managing Cultural Heritage in Classical Chinese Royal Gardens Based on 3D digitalisation.	Sustainability	0.10	8
Jia et al., 2022a	Conservation and management of Chinese classical royal garden heritages based on 3D digitalisation — A case study of Jianxin courtyard in Jingyi garden in Fragrant Hills	Journal of Cultural Heritage	0.03	7
Guo et al., 2023	Digital Preservation of Du Fu Thatched Cottage Memorial Garden.	Sustainability	0.04	6
Ding et al., 2023	Fractal dimension-based analysis of rockery contour morphological characteristics for Chinese classical gardens south of the Yangtze River.	Journal of Asian Architecture and Building Engineering	0.01	5
Yang et al., 2023	Digital characterisation of the surface texture of Chinese classical garden rockery based on point cloud visualisation: small-rock mountain retreat.	Heritage Science	0.01	5
Chen & Yang, 2023	Analysis of Narrative Space in the Chinese Classical Garden Based on Narratology and Space Syntax—Taking the Humble Administrator's Garden as an Example.	Sustainability	0.04	4
Fu et al., 2023	A multi-criteria decision-making approach to assessing the health risk of rockeries in Chinese classical gardens.	Heritage Science	0.01	4
Xie et al., 2022	A preferred road to mental restoration in the Chinese classical garden.	Sustainability	0.04	4

Table 4 (*continued*)

Author	Journal Article Title	Source	Centrality	Count
Zhang, Wang, & Brown, 2021	The Charm of a Thousand Years': exploring tourists' perspectives of the 'culture–nature value' of the Humble Administrator's Garden, Suzhou, China.	Landscape Research	0.01	4
Zhang, Zhao, et al., 2021	Intelligent Recognition Method of Decorative Openwork Windows with Sustainable Application for Suzhou Traditional Private Gardens in China.	Sustainability	0.01	2
Zhang & Lian, 2021	Research on the Distribution and Scale Evolution of Suzhou Gardens under the Urbanisation Process from the Tang to the Qing Dynasty.	Land	0.01	2
Yan & Gong, 2023	The restoration design of the main building of "Huancui Hall" in Zuoyin Garden is based on graphics and text derivation.	Cogent Arts & Humanities	0.01	2
Shen & Yu, 2024	The virtual-real measurement of Chinese garden impression: A quantitative analysis of cognitive experience of Jiangnan gardens with virtual reality experiments.	Frontiers of Architectural Research	0.02	2

Source: Authors' own work

image documentation to three-dimensional information modelling. At the same time, Wang et al. (2020) further applied terrestrial laser scanning (TLS) and unmanned aerial vehicle (UAV) surveying to establish digital surveying and high-precision modelling frameworks for garden spaces, thereby providing a robust methodological foundation and technical pathway for subsequent work.

Since 2022, research priorities have increasingly shifted toward the digital conservation and management of imperial garden heritage, advancing pathways for dynamic management systems of cultural heritage and promoting the modernisation of conservation practices for historic palace gardens (Jia et al. 2022b). In recent years, scholars have further extended digital methodologies into the domains of spatial narrative and cultural expression. Yang et al. (2023) and Ding et al. (2023) conducted quantitative analysis of surface texture characteristics in rockeries, while Chen and Yang (2023) employed space syntax methods to examine the relationship between spatial configuration and aesthetic experience in Chinese Traditional Gardens (CTGs). These developments indicate a deepening integration from the technical dimension into the domain of cultural cognition.

Keyword and Burst Analysis

Keyword visualisation and clustering

Based on CiteSpace, this study visualised the keyword co-occurrence network for research on Chinese classical gardens (Figure 4). The results show an early focus on "Chinese

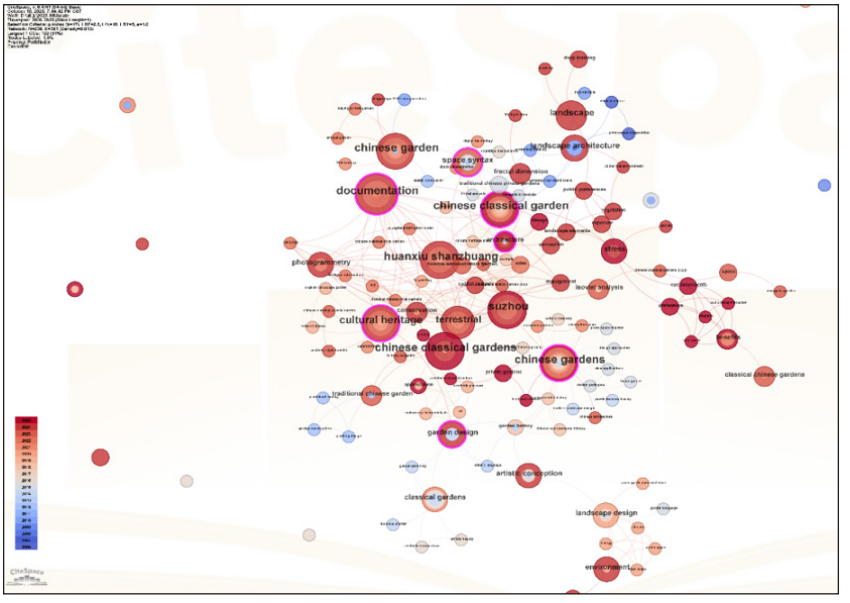

Figure 4. Keyword co-occurrence network map

classical garden," "cultural heritage," and "conservation." In addition, recently active keywords such as "stress," "benefits," and "environment" indicate that current research is expanding toward interdisciplinary areas that include environmental psychology and health values. Overall, keywords in this field efficiently capture essential information and research hotspots in the literature, and co-occurrence together with clustering forms of thematic groupings that can reveal future research challenges and development trajectories.

VOSviewer was used to quantitatively compare the network connectivity and citation influence of keywords. Among the 836 extracted keywords, 21 met the minimum occurrence threshold of 6 and were included in the analysis (Table 5).

The high-frequency keywords (occurrences ≥10)—including "landscape" (15), "documentation" (12), "Huanxiu Shanzhuang", "Suzhou" (12), "cultural heritage" (12), "Chinese classical gardens" (10), "Chinese garden" (10), and "space syntax" (10)—indicate that this field centers on Suzhou and focuses primarily on the conservation of cultural heritage and the analysis of spatial characteristics. Mid-frequency keywords (7 ≤ occurrences ≤ 9)—including "terrestrial" (8), "photogrammetry" (8), "conservation" (7), "rockery" (7), "environment" (7), and "garden" (8)—reflect a trend of increasing technological support for cultural heritage conservation. Low-frequency keywords (occurrences ≤ 6)—including "design" (6), "traditional Chinese garden" (6), "landscape architecture" (6), "space" (6), and "traditional Chinese private gardens" (5)—reveal trends toward interdisciplinary integration, greater refinement in the classification of objects

Table 5
Keyword clustering analysis based on VOSviewer

N	Year	Keywords	Total Link Strength	Occurrences	Avg. Citation	Avg. Norm Citation
1	2023	documentation	57	12	10.4	1.95
2	2022	huanxiu shanzhuang	57	12	16.0	2.19
3	2023	Suzhou	53	12	7.7	1.67
4	2022	terrestrial	37	8	13	2.15
5	2021	photogrammetry	35	8	24.3	2.84
6	2023	Chinese classical gardens	26	10	5.6	2.26
7	2019	landscape	25	15	4.9	1.62
9	2019	conservation	22	7	7.1	1.61
10	2022	rockery	20	7	9.2	1.68
11	2022	cultural heritage	18	12	8.4	1.39
12	2021	design	14	6	3.8	1.31
13	2019	traditional Chinese garden	12	6	6.3	0.80
14	2016	landscape architecture	11	6	2.3	1.00
15	2021	environment	9	7	8.4	1.38
16	2020	Chinese garden	8	10	1.7	0.43
17	2018	space syntax	7	10	5.1	1.68
18	2022	Space	5	6	2.1	0.63
19	2017	traditional Chinese private gardens	4	5	6.4	2.30
21	2021	garden	2	8	0.8	0.41

Note. TLS refers to the strength of co-occurrence links between keywords; Avg. Citation and Avg. Norm. Citation are used to indicate the academic impact associated with each keyword
Source: Authors' own work

of study, and increased terminological standardisation.

Keyword bursts

Burst strength is used to measure the academic growth of a given keyword within a specific period and is used to identify research areas that become particularly prominent during specific stages. Based on the burst visualisation generated by CiteSpace, this table presents 20 keywords (Table 6). "Keywords" denotes the burst terms; "Year" indicates the first year in which the keyword appeared; "Strength" refers to the burst strength; and "Begin" and "End" correspond to the starting and ending years of the burst period. On the right-hand side, blue bars indicate the overall time span during which the keyword was retrieved, whereas red bars indicate the duration of the burst period. A longer red bar together with a higher Strength value indicates that the topic received a higher level of attention during that period.

Table 6
High-intensity burst keywords in the research field, 2006-2025

Keywords	Year	Strength	Begin	End	2006 - 2025
landscape architecture	2007	1.75	2007	2010	
landscape planting	2010	1.17	2010	2013	
classic garden	2010	0.97	2010	2015	
space syntax	2012	1.28	2012	2015	
garden design	2013	1.05	2013	2014	
garden history	2013	0.85	2013	2018	
classical gardens	2014	1.53	2014	2016	
chinese gardens	2014	1.21	2014	2018	
landscape design	2015	1.69	2015	2020	
chinese classical garden	2010	0.96	2018	2021	
cultural heritage	2019	1.56	2019	2021	
chinese garden	2010	1.53	2021	2023	
documentation	2020	2.64	2022	2025	
suzhou	2022	2.34	2022	2025	
terrestrial	2022	2.11	2022	2025	
huanxiu shanzhuang	2018	1.92	2022	2025	
classical chinese gardens	2022	1.44	2022	2023	
photogrammetry	2022	1.19	2022	2025	

Source: Authors' own work

Timeline Analysis

The timeline visualisation is constructed on the basis of the keyword co-occurrence network and arranged according to the first year in which each keyword appears (Chen, 2006), providing an intuitive representation of the developmental process of research on CTGs. In this study, a timeline was generated using CiteSpace (Figure 5), Node size is proportional to the literature's co-citation frequency, and different studies correspond to different time periods. Accordingly, the analysis is organised into three-time spans below.

The time span for research on garden aesthetics and culture is from 2006 to 2015. During this period, scholarly outputs primarily focused on the aesthetic characteristics of gardens, philosophical thought, and metaphorical culture within traditional discourse, gradually establishing the disciplinary concepts and a research system of historical aesthetics in garden studies. This body of work provided a solid theoretical foundation for the subsequent adoption of space syntax, GIS, and point-cloud-based digital technologies, thereby fostering the sustainable development of the field in contemporary society.

The time span marking the field's methodological shift is 2016 to 2020, with studies largely centred on Suzhou private

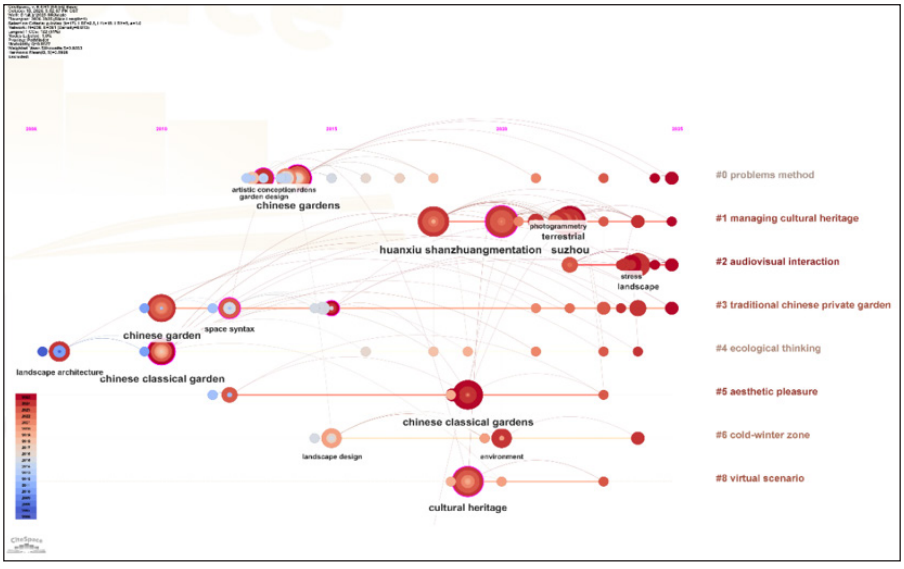

Figure 5. Timeline analysis

gardens. Photogrammetric scanning, three-dimensional modelling, laser scanning and surveying, and the integration of space syntax with GPS became the principal methodological tools during this period, indicating breakthrough progress in digitalisation at this stage.

The time frame for interdisciplinary integration is from 2021 to 2025. During this period, emerging keywords such a",stress," "environment," and "landscape" appear. New technologies are combined with environmental psychology and health benefits, and multimodality along with audiovisual interaction becomes a hot topic. This trend indicates a shift from single-focus spatial feature analysis to research on behavior and psychology, opening new avenues for investigating the therapeutic functions of garden environments.

Analysis of Research Themes

The analysis of research topics is based on co-citation clustering of literature. Citations serve as the cornerstone of literature co-citation analysis, whereby scholars employ references to substantiate their viewpoints, thereby generating new knowledge. The perpetual inter-citation of documents gives rise to a multitude of reference clusters, and the process of extracting multi-co-citation relationships within the literature network is designated as literature co-citation analysis. Based on the 203 included publications, this study constructed a literature co-citation network using CiteSpace and, employing the Log-Likelihood Ratio (LLR) algorithm, generated the literature co-citation map (Figure 6). The results show $Q = 0.8527$ and $S = 0.9363$, indicating that the clustering results exhibit significant

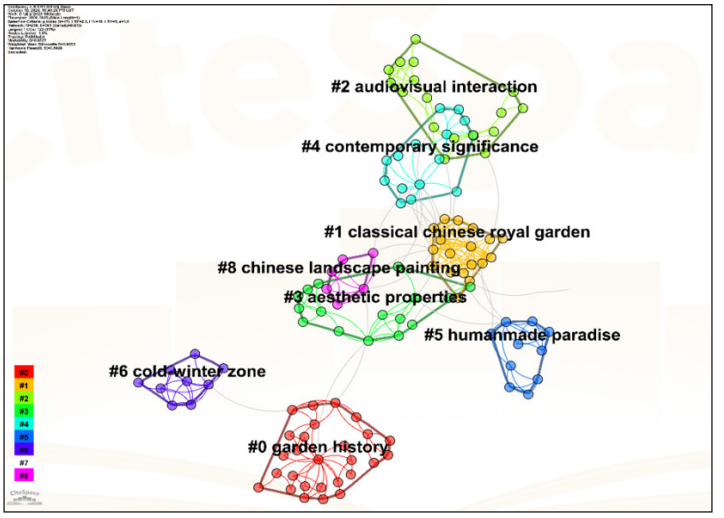

Figure 6. Document co-citation and cluster analysis

structural distinctiveness and high internal consistency.

To maintain the clarity of the clustering results, this study extracted only the eight clusters characterised by high citation counts and strong homogeneity, namely #0 garden history, #1 classical Chinese royal garden, #2 audiovisual interaction, #3 aesthetic properties, #5 contemporary significance, #6 humanmade paradise, #7 cold-winter zone, and #8 chinese landscape painting (Table 7). The five overarching themes were derived through a second-stage synthesis based on semantic similarity, the relationships among research objects, methodological commonalities, and temporal connections. Specifically, clusters #0, "garden history," and #5, "contemporary significance," both focus on the historical development, evolution, and present-day relevance of gardens and were therefore integrated into the theme "garden history and contemporary significance." Clusters #3, "aesthetic properties," and #6, "human-made paradise," emphasise the idealised representation of natural space in gardens and were combined into the theme "aesthetic properties and human-made paradise." Clusters #2, "audiovisual interaction," and #8, "Chinese landscape painting," concentrate on interactions between people and gardens through digital technologies and immersive sensory experiences and were grouped under the theme "audiovisual interaction and Chinese landscape painting." Cluster #1 independently represents the theme "classical Chinese royal garden." Cluster #7, "cold-winter zone," highlights the adaptability of traditional gardens to different climatic and regional conditions and was retained as the theme "cold-winter zone."

These five research themes reflect the overall trajectory of Chinese traditional garden studies and remain highly relevant to current scholarship. Garden history, aesthetic

Table 7
Document co-citation clusters

Cluster ID	Size	Silhouette	Mean(Year)	Label (LLR)
0	27	0.982	2016	garden history
1	18	0.832	2022	classical chinese royal garden
2	17	0.990	2024	audiovisual interaction
3	16	0.939	2020	aesthetic properties
5	15	0.812	2014	contemporary significance
6	10	0.977	2016	humanmade paradise
7	9	0.993	2019	cold-winter zone
8	6	1	2020	chinese landscape painting

Source: Authors' own work

characteristics, and the conservation of royal gardens continue to constitute core research areas. Audiovisual interaction represents an emerging trend integrating digital technologies with environmental perception, while research on cold-winter regions indicates a potential expansion of the field toward climate adaptation and regional specificity.

Challenges and Future Development

We analyse five themes to provide an evidentiary basis for identifying research gaps and determining priorities for future research. Table 8 synthesises the principal challenges and future development trends across these five themes, providing a reference and guide for subsequent scholarly inquiry. The following subsections elaborate on each theme in turn.

1. Garden history and contemporary significance: Current research in this thematic area remains predominantly descriptive and grounded in art-historical narration, with a clear lack of quantitative and systematic spatiotemporal comparison. The lack of quantitative and hybrid research methods has hindered the development of contemporary urban landscapes. To address these limitations, future studies should not only incorporate GIS and spatial narrative approaches but also establish digitised historical knowledge bases and cultural evolution models, thereby moving toward standardised and replicable research workflows.
2. Aesthetic properties and humanmade paradise: Research in this thematic area has long relied on aesthetic theory and experiential interpretation, making it difficult to quantitatively measure visitors' aesthetic experience and hindering the establishment of standardised criteria for historical value. Future research may incorporate GPS tracking, eye-tracking, and EEG experiments, together with behavioral trajectory modelling of aesthetic experience, to achieve quantitative assessment of aesthetic responses. At the same time, by linking spatial layout

with aesthetic experience, such work can generate verifiable data to inform garden design.

3. Audiovisual interaction and Chinese landscape painting: At present, there is insufficient precise alignment between the compositional logic of Chinese landscape painting and multimodal audiovisual interaction data, and experimental reproducibility remains relatively weak. Future development should establish standardised multimodal experimental systems and open, shareable datasets, and further promote cross-institutional collaboration and data sharing in order to enhance the scientific rigor and reproducibility of research in this area.
4. Classical Chinese Royal Garden: An inherent conflict exists between authenticity-oriented conservation and revitalisation-oriented use; future research should employ minimal-intervention technologies and digital reconstruction methods to achieve a balance between protection and revitalisation, encourage new forms of civic participation, and enhance social value and functions.
5. Cold-Winter Zone: Cold-winter zone: The current theme lacks specific design for regional climate. Future research needs to be combined with regional culture and climate to improve the sustainable development of regional gardens.

CONCLUSION

Traditional Chinese gardens, as one of the most significant cultural heritages, are not merely a form of landscape but also a vital vehicle for conveying traditional Chinese philosophy, culture, and aesthetic sensibilities. To elucidate the present status and developmental trajectory of traditional Chinese gardens and to define future directions, this study employs CiteSpace and VOSviewer tools to conduct a bibliometric analysis of the field. From the perspective of publication volume, the field is in a phase of sustained growth. Publishing venues are concentrated in cultural heritage, architecture, landscape, and interdisciplinary outlets, while the geographic distribution of publications is centred in East Asia, as well as Australia and the United Kingdom. These patterns indicate a gradual shift from traditional theoretical inquiry toward interdisciplinary integration, alongside an expansion of the contributing research community from East Asia outward. In addition, analyses of highly cited literature, keyword bursts, and document co-citation clustering indicate that research on Chinese traditional gardens is primarily organised around five themes: garden history and contemporary significance, aesthetic properties and humanmade paradise, audiovisual interaction and Chinese landscape painting, classical Chinese royal garden, and cold-winter zone. Current research on Chinese traditional gardens (CTGs) remains heavily grounded in art history, aesthetic theory, and

Table 8
Research themes, challenges, and future research trends

Research Themes	Cluster Mean Year(s)	Challenges	Future Research Trends
Garden history and contemporary significance	2014, 2016	Historical sources are fragmented, terminology is not standardised, and spatiotemporal validation is lacking, making it difficult to form a unified evaluation	Develop evaluation models supported by historical GIS-based spatiotemporal analysis
Aesthetic properties and humanmade paradise	2016, 2020	Aesthetic concepts are abstract, and there is a lack of scientifically measurable evaluation systems	Introduce eye-tracking and EEG-based aesthetic experiments; model behavioral trajectories of aesthetic experience
Audiovisual interaction and Chinese landscape painting	2020, 2024	Comparable empirical evidence linking audiovisual interaction and the compositional logic of Chinese landscape painting remains weak, and findings are difficult to reproduce	Establish standardised multimodal experimental frameworks and open-source datasets
Classical Chinese royal garden	2022	Tension between authenticity-oriented conservation and adaptive reuse	Apply quantitative authenticity management and minimal-intervention techniques
Cold-winter zone	2019	Insufficient ecological resilience and high maintenance costs	Enhance cold-resistant ecological systems and develop low-maintenance technical strategies

Source: Authors' own work

empirical inquiry. Although interdisciplinary approaches have begun to emerge, the application of advanced methodologies—such as audiovisual interaction, digital modelling, and experiment-based analyses—remains limited. Moreover, tensions persist between authenticity-oriented conservation and adaptive reuse. In sum, research on CTGs is still in an ascendant phase with substantial room for growth. Future efforts should continue to advance theoretical research, practice-oriented exploration, and methodological innovation, integrating multidisciplinary perspectives to foster sustained development of the field.

LIMITATIONS

This study relied primarily on the Web of Science platform. Although the platform is authoritative and widely representative—and the search strategy sought to comprehensively cover all relevant keywords—it does not fully capture

literature published in other languages. Given the regional specificity of Chinese traditional gardens, a substantial body of relevant research remains in Chinese-language databases. To address these limitations, future studies should implement comprehensive, systematic searches across multiple databases and multiple languages to enhance the completeness and representativeness of the evidence base.

ACKNOWLEDGMENT

The authors would like to thank the reviewers for their valuable comments and constructive suggestions, and the journal editorial staff for their assistance during the final formatting process.

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