

Analysis of the Current Status and Trend of Domestic Eco-city Research based on CiteSpace

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ABSTRACT

In today's era of rapid urbanisation and increasingly prominent ecological and environmental problems, creating a good living environment and building eco-cities to implement sustainable development has become the key to urban development in China. Based on the literature statistics and Citespace data analysis, this paper analyses the research papers on eco-city in CNKI database during 2001-2021, and analyses and summarizes the current situation and trend of eco-city research in China. The study shows that: ① the research and construction of eco-city still has great value. ② The research hotspots of eco-city have five major aspects: ecological civilisation, urbanisation/urbanisation, indicator system, eco-city construction and sustainable development. ③ The directions of ecological civilisation construction, eco-city construction and sustainable development still occupy a place in the future direction of research and development. ④ The cooperation of scholars in the field of eco-city research is not close enough. ⑤ The field of eco-city research is in the stage of multidisciplinary cross-discipline, covering a wider range of dimensions. The research perspective, research content, and research methods and technical means are all characterised by obvious multidisciplinary intersection.

KEYWORDS

Eco-city; Citespace; Research Hotspots; Research Trends.

1. DATA SOURCES AND RESEARCH METHODOLOGY

1.1. Data Sources

The data of this study comes from the Chinese Academic Journal Publishing Database (CNKI), and in order to reflect the hot spots of eco-city research and the trend of future development, the data used in this study are selected from the literature published in the last 20 years, i.e. from 2001 to 2021. Search on the theme of "eco-city". In order to ensure the accuracy and reliability of the analysis of the research results of domestic eco-cities, the "core journals", "CSSCI" and "CSCD" of CNKI journals were selected as the data sources. The final result was 1,582 valid papers. Retrieved on 15 December 2021.

1.2. Research Methodology

This paper adopts a combination of qualitative and quantitative research methods. Firstly, it explores the essential attributes of eco-city through qualitative research, and then studies the current status of research and development of eco-city through quantitative analysis, and predicts the research

development trend of eco-city. Using the literature analysis visualisation software citespace as an auxiliary means of data processing, through the title of the article, author, keywords, abstract, institution and other information for visual analysis, combined with the CNKI and Excel statistical analysis function for statistics, analysis, processing and graphical representation of the data.

CiteSpace is an application for data processing and visualisation and analysis of scientific literature. CiteSpace allows for the temporal and structural analysis of co-citation networks, author co-citation networks and collaborative networks from academic publications, and the rapid, comprehensive and effective processing and analysis of large quantities of literature data and its presentation in the form of images, which is helpful for understanding, analysing and predicting the current status and development of the eco-city field.

2. STATISTICAL OVERVIEW AND ANALYSIS OF ECO-CITY RESEARCH LITERATURE IN CHINA

2.1. Preliminary Statistical Analyses

The number and trend of annual publications reflect the importance and interest of the field in general. In the last two decades, the total number of publications on the topic of "eco-city" in the CNKI journal database is 15,205, and the overall trend is increasing (Fig. 1), among which there are 1,026 publications in 2020, but the number of publications on eco-city research shows a decreasing trend after a linear growth in the screened data between 2001 and 2021. research the number of published articles showed a trend of line birth and then decline (Fig. 2). In particular, the number of publications in eco-city research levelled off between 2019-202. The emergence of this result indicates to a certain extent that the research on eco-city has been paid attention to in China, and the construction of eco-city is being promoted in China. From the trend of the number of papers in "core journals", "CSSCI" and "CSCD", it can be seen that from 2008 to 2012, the research on eco-city was in the rapid development of the theory and practice of eco-city in China and high-level articles were continuously published. From 2014 to 2020, the domestic eco-city research concepts and practices do not have enough major breakthroughs, and the number of high-quality and high-level articles has declined, so it is necessary for the relevant people to continue in-depth research, and to introduce new research methods and new research concepts appropriately.

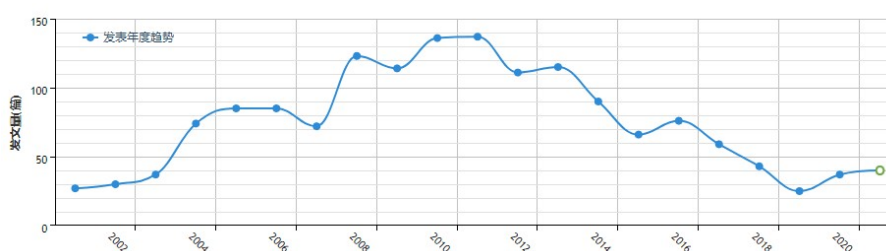


Fig. 1 Changes in the total number of articles on eco-cities in CNKI journal database between 2001-2021

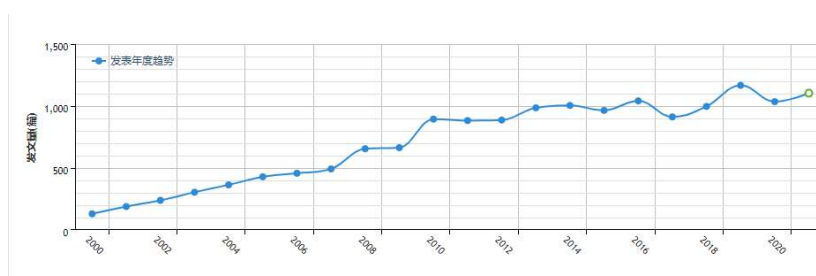


Fig. 2 Changes in the number of articles on eco-cities after screening in CNKI journal database between 2001-2021

2.2. Analysis Collaborative Relationships by Author of Publication

Among the scholars who have carried out eco-city research in China, the more influential scholars include Qiu Baoxing, Liu Yan, Xie Pengfei, Li Hailong, Zhu Xiaodong and so on. In terms of the cooperation network, a large team of China Urban Science Research Society has been formed with Liu Yan, Xie Pengfei, and Zhou Lanlan as the core, which mainly researches the indicator system and development countermeasures of eco-city[1] ; the research team of Nanjing University with Zhu Xiaodong and Li Yangfan as the core, which mainly focuses on ecological economy and ecological governance, builds a policy response system for urban ecological governance, proposes to build an ecological consumption system, and explores ecological strategic planning and its action planning[4] ; the research team from Jiujiang College of Environmental Science and Resource Utilisation led by Tao Chunyuan, Li Xiaoqiong, and Wang Yingxiang proposed the concept of digital eco-city and conducted a series of studies on its features, industries, environmental capacity, and indicator system[6] (Figure 3). Different teams belong to different institutions, and there are few exchanges and co-operation between research institutions in China in terms of eco-city (Fig. 4). By analysing the data in the figure, it can be found that there are three distinctive research teams in the study of eco-cities, i.e., research institutes, enterprises and governments, and the three teams are relatively independent, with little academic cooperation, and the communication and cooperation among different teams should be strengthened in the future.



Fig. 3 Collaborative network analysis of eco-city research authors

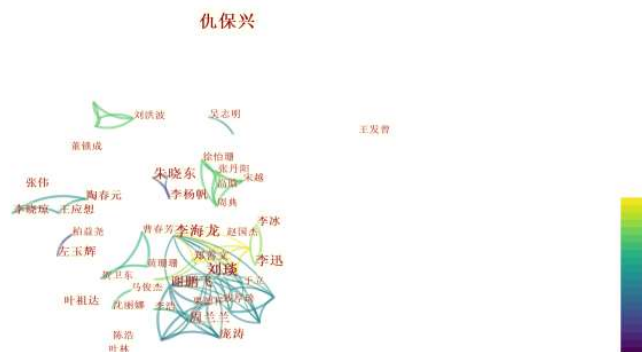


Fig. 4 Collaboration mapping of eco-city research institutions

3. HOT SPOTS AND TRENDS IN ECO-CITY RESEARCH

3.1. Eco-city Research Hotspots

In recent years, all aspects of China's rapid development, especially in the current state, society and individuals for the human habitat, nature conservation is paying more and more attention to the impact of epidemics, "recreation theory", "two mountains theory" and the concept of sustainable development under the guidance of the construction of eco-city is also particularly important, for the

hot spots of eco-city research also has a high academic value. Using CiteSpace to analyse the data retrieved in the past 20 years, we draw the keyword co-occurrence network knowledge map (Figure 5) and keyword clustering map (Figure 6) of the literature on the theme of "eco-city", the size of the nodes in the map indicates the value of the centrality index, the larger the circle, the higher the importance of the keyword. At the same time, through the data obtained by citespace to draw a high-frequency keyword table, through the analysis of the chart can be seen, the keywords of the domestic eco-city research are mainly indicator system, ecological civilisation, circular economy, urbanisation, urban planning, countermeasures, ecological, urban, evaluation, eco-city 10, eco-city keyword clustering mainly appeared in the eco-city, ecological civilisation, indicator system, Landscape gardening, urbanisation, city, low carbon city, urban planning, sustainability and low carbon city ten directions, through the analysis of the data and visualisation of the results of the domestic eco-city research hotspots are summarised as ecological civilisation, urbanisation/urbanisation, indicator system, eco-city construction and sustainability on the correlation of five aspects of the study (Table1).

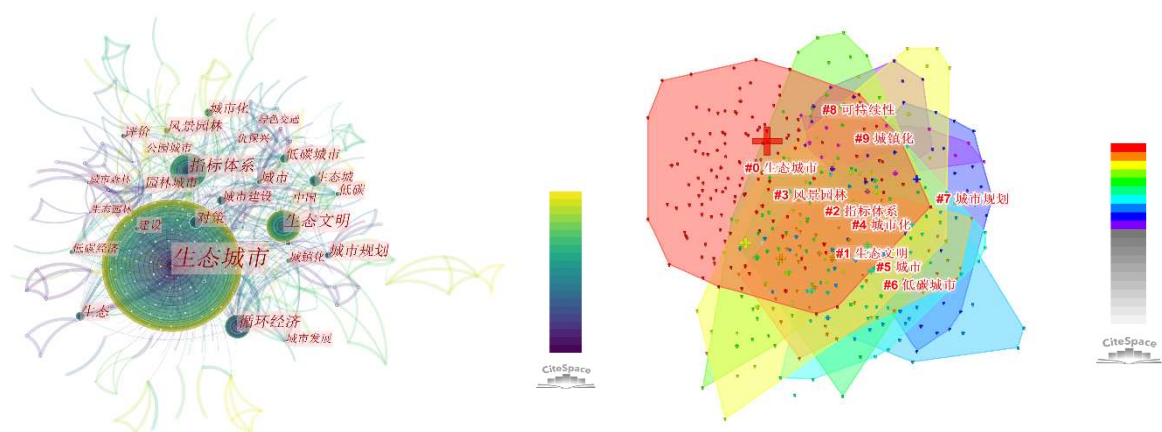


Fig. 5 Keyword co-occurrence network knowledge map **Fig. 6** Keyword clustering map

Table 1. Summary of research hotspots

Summary of research hotspots	Keywords
ecological civilisation	ecological civilisation、ecological、ecological environment、ecological economy
urbanisation	urbanisation、urban、urbanisation、urban development
indicator system	indicator system、evaluation
eco-city construction	urban planning、eco-city、urban construction、urban
Sustainable development	circular economy、countermeasures、low carbon city、low carbon 、low carbon economy

3.1.1. Ecological Civilisation

Among the 1582 articles retrieved, the keyword "ecological civilisation" appears 109 times in the summary of research hotspots, accounting for 6.7% of the total sample. Ecological civilisation is an inevitable choice for building a resource-saving and environment-friendly society. The construction of ecological civilisation means that in the course of economic development, the carrying capacity of natural resources and the ecological environment should be taken into account, the laws of nature should be respected, and the harmonious development of man and nature should be achieved. After the rise of the industrial revolution, the ecological and environmental problems have undergone qualitative changes and gradually shifted from developed countries to developing countries, and then evolved into a global crisis, the ecological and environmental problems have been widely concerned. Among them, the mainstream research on ecological civilisation in foreign countries first started from the ecological environment problem. The ecological problems revealed by Rachel Carson in her book *Silent Spring* triggered a great discussion on the study of the relationship between human beings and

nature.^[9] The ecological problems revealed in Rachel Carson's *Silent Spring* triggered a great discussion on the relationship between human beings and nature. It was only after the 1980s that the term ecological civilisation appeared as a formal academic concept. In the 21st century, the theoretical study of ecological civilisation has entered a new stage of diversification.

3.1.2. Urbanisation/Urbanisation

Among the 1,582 articles searched, the keywords "urbanisation/urbanisation" appear 77 times in the summary of research hotspots, accounting for 4.6% of the total sample. Cities are the inheritance of human civilisation, and more than 50% of the world's population now live in cities.^[13] China's urbanisation started in the 20th century. China's urbanisation started at the beginning of the 20th century and entered a period of rapid development after the reform and opening up: in 1977, China's urbanisation level was only 17.60%.^[14] In 1977, China's urbanisation level was only 17.60%, and by the end of 2016, the total number of urban residents in China exceeded 790 million, with the urbanisation rate reaching 57.35%.^[15] China's urbanisation process not only determines the future of China, but also has a profound impact on the urbanisation process of the whole world in the 21st century.^[16] At present, developed countries have basically completed urbanisation, with the urbanisation level mostly above 75%. 2011 saw China's urbanisation rate exceed 50% for the first time, reaching 51.27%, and in 2018 it reached 59.58%. In the next 20 years, China's urbanisation level will continue to increase, and it is expected that by 2030, China's urbanisation level will reach 70-75 per cent.^[18] . The rapid development of cities promotes economic development, but also leads to resource shortage, ecological degradation, environmental pollution and other problems, how to build eco-cities and solve the ecological and environmental problems brought about by urban development is an urgent problem in China at present, and it is also the key to China's construction of ecological civilisation of Chinese characteristics.

3.1.3. Indicator System

Among the 1,582 documents retrieved, the keyword "indicator system" in the summary of research hotspots appeared 112 times, accounting for 7.1 percent of the total sample. With the increase of population and the acceleration of urbanisation, urban resources and energy are rapidly consumed and the ecological environment is deteriorating. As one of the important strategies to alleviate the global ecological crisis, the theory of eco-city has attracted extensive attention from all walks of life since its birth. Eco-city construction is always in the process of dynamic development, at present, the indicator system of eco-city at home and abroad is basically a static system, only to establish a set of dynamic and open indicator system, update it according to the changes of external development conditions and internal factors, and guide the whole process of eco-city planning-construction-management, so as to ensure that eco-city can be effectively developed and managed. The system can only give full play to its leading role in supporting the development of eco-cities and continue to reflect its advanced and scientific nature^[21].

3.1.4. Eco-city Building

In the 1582 documents retrieved, the key words "eco-city construction" appeared 666 times in the summary of research hotspots, accounting for 42.1% of the total sample, which shows that the construction of eco-city has always been the focus of scholars' research. The concept of modern eco-city originated from Howard's idyllic city.^[19] The term "eco-city" was first proposed by the Man and the Biosphere (MAB) Programme initiated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1971, and rapidly received widespread attention from all walks of life. Since the 1980s, eco-cities have gradually become an emerging field of ecological research and practice in China, attracting the attention of a large number of ecologists. At present, there is still no internationally recognised definition of the concept of eco-city, which can be elaborated from different perspectives. However, from a comprehensive point of view, an eco-city should be a habitat with a more harmonious environment, a more efficient economy and a more progressive society that optimises the land space development pattern, promotes resource conservation, protects the natural

ecosystem and the environment, and organically integrates the social, economic and natural sub-systems. As an important theoretical and practical exploration topic of sustainable development, many cities around the world have actively explored eco-city planning and construction.^[20] Many cities around the world are actively exploring the planning and construction of eco-cities.

3.1.5. Sustainability

Of the 1,582 documents retrieved, the keyword "sustainable development" was found 120 times in the summary of research hotspots, accounting for 7.6 per cent of the total sample. The concept of sustainable development was proposed in the 1980s, and Our Common Future argues that sustainable development is development that meets the needs of the present without jeopardising the ability of future generations to meet their needs. The concept of sustainable development was then gradually formed into a theoretical system, and scholars have elaborated on it from different perspectives. 1993 saw the official publication of China's Agenda 21, which confirmed that sustainable development would be China's strategic decision for future development, and that it was an inevitable choice to adapt to China's national conditions.^[33] This is an inevitable choice adapted to China's national conditions. This is because sustainable development is a synthesis of the social, economic and ecological trinity, in which the basis of sustainable development is the effective use of ecological resources and the virtuous cycle of the ecological environment, the prerequisite of sustainable development is the sustained growth of the economy, and the purpose of sustainable development is the sustained progress of society. They interact, constrain and synergise with each other, constituting a harmonious relationship for sustainable development. Sustainable development is the result of joint collaboration between human beings and nature, and a necessary path for human survival and development. However, due to the unbalanced development of the country, resulting in the city where human beings live, there are also differences in the cities of developed countries concerned about environmental protection and the stability of the ecosystem, while cities in developing countries are more concerned about the development of the economy and solving the problem of poverty, emphasizing the sustainability of economic development, while the sustainability of the ecology has not been given enough attention, and part of the region is centred on the city of environmental pollution and deterioration of environmental quality. Problems of urban-centred environmental pollution and deterioration of environmental quality still exist in some areas.

3.2. Trends in Eco-city Research

3.2.1. Keyword Emergent Network Analysis

Keyword emergence mapping can reflect the hotspots and new directions of eco-city research in different time periods to a certain extent, and provide a certain theoretical and data basis for the research trend of eco-city. The Burst Detection of eco-city network research was obtained by visualising and analysing the data in CiteSpace. Burst words are words that are used more frequently or appear suddenly in a certain period of time, and they play an important role in demonstrating the stage of cutting-edge areas in the field of eco-city and the trend of eco-city research. The keyword emergence map is shown in Figure 7, which shows that there are 11 keywords in the eco-city research from 2001 to 2021, namely: countermeasures, circular economy, ecological economy, construction, low carbon, low carbon city, ecological civilisation, urbanisation, sponge city, landscape garden and park city. Among them, circular economy first appeared in 2001, with a burst intensity of 10.25, ranking first in terms of burst intensity, and the time of bursting was from 2004 to 2008, which to a certain extent indicates that this keyword was the hotspot and frontier of the research in the field of ecological city from 2004 to 2008. The keywords that have emerged from 2016 onwards and still exist today are sponge city, landscape garden and park city, of which landscape garden has the highest emergence intensity of 6.37, indicating that the research in the field of ecological city has become more and more closely connected with the discipline of landscape garden in the past four years, and that there are more and more cross-connections between the two fields; sponge city appeared the

earliest among the three keywords, which indicates to a certain extent that the keyword is a field of long-term concern in recent years, and will continue to be concerned for a certain period of time in the future.

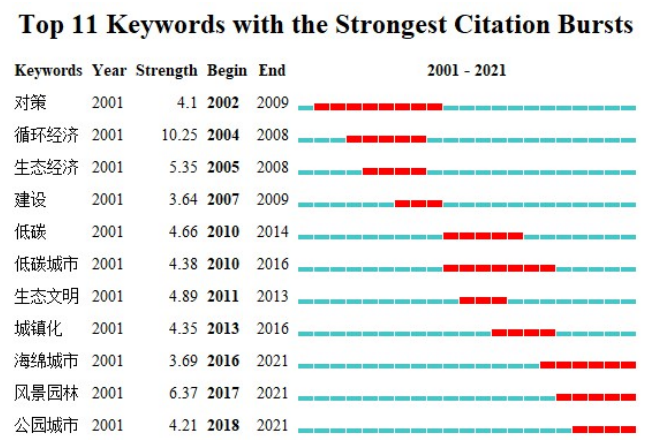


Fig. 7 Keyword emergence mapping

3.2.2. Keyword Timeline Co-occurrence Mapping

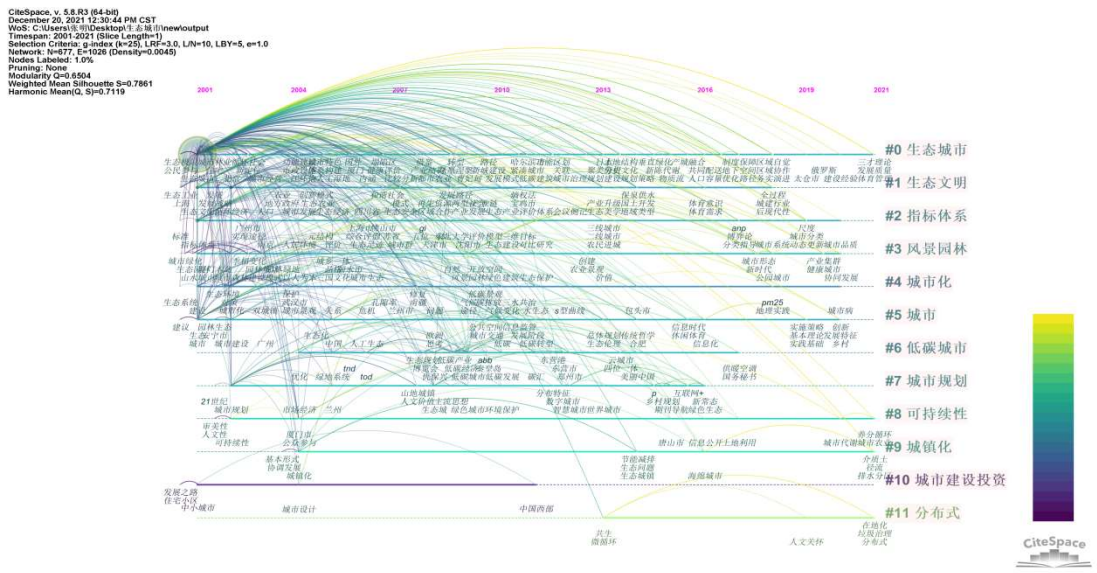


Fig. 8 Keyword timeline mapping

The keyword timeline co-linear mapping can to some extent reflect the emergence and duration of each research hotspot in the field of eco-city research, i.e., the clustering of keywords, and at the same time, it can show the keywords contained in the cluster and the year in which the keywords appeared and the number of times the keywords appeared, as well as whether or not there is a relationship between the keywords. The research data of this paper is analysed in the time dimension with Citespace software, and the timeline view is selected to obtain the keyword timeline mapping of urban ecological planning research (Fig. 8) The size of the nodes in the figure indicates the value of the centrality index, and the larger the circle is, the higher the importance of the keyword is. As shown in Figure 8, eco-city appeared in 2001, and eco-city has the largest circle and the highest importance, and the most keywords appeared in the eco-city cluster, and at the same time, the eco-city cluster has still appeared from 2001 to the present day, which can indicate to some extent that the research on the broad category of eco-city will continue to continue. The co-occurrence mapping of keywords in the Sustainability, Urbanisation and Distributed clusters in the figure shows that research in these three clusters has developed so far and will continue to develop for some time to come. As shown in Figure 8, in most of the time lines, the results of this cluster have maintained a certain level of number

of results from the beginning of its emergence, with few breaks. On the other hand, in the time zone mapping, the legacy relationship between any two time zones can be seen through the connecting relationships between the nodes of each time zone. This indicates that despite the constant emergence of new hot words and emergent theme words, the overall lineage of modern Chinese urban ecological planning research is continuous and interrelated, with no major, subversive trends or revolutions in thinking. Later generations have either dug deeper or branched out on the basis of their predecessors, and together they have constructed a mapping of China's eco-city research.

4. CONCLUSION AND DISCUSSION

By analysing the current situation and hotspots of domestic eco-city research and predicting the future development of eco-city, as well as analysing and summarising the characteristics of eco-city development, this paper obtains some conclusions and inspirations for eco-city research. It is divided into the following five aspects.

(1) The research and construction of eco-city is still of great value, and the total number of articles on the topic of "eco-city" in the CNKI journal database from 2001 to 2021 is 15,205, with a general trend of increase, but the number of articles published in the screened data from 2001 to 2021 shows a trend of increase and then decrease. This result shows to a certain extent that the research on eco-city has been paid attention to in China, and the construction of eco-city is being promoted in China. From the trend of the number of papers in "core journals", "CSSCI" and "CSCD", it can be seen that from 2008 to 2012, the number of papers on eco-city research is in the rapid development of the theory and practice of eco-city in China. From 2008 to 2012, the domestic eco-city was in a period of rapid development of theoretical and practical research, and high-quality and high-level articles were continuously published.

(2) The research hotspots of eco-city have five major aspects: ecological civilisation, urbanisation/urbanisation, indicator system, eco-city construction and sustainability. The keywords that appear more frequently in eco-city research are eco-city, indicator system, ecological civilisation, circular economy, urban planning, low-carbon city and sustainability, which have a high degree of centrality.

(3) In the research and development of eco-city field ecological civilisation construction, eco-city construction, sustainable development, low carbon development and other directions still occupy a place in the next research and development.

(4) Collaboration among scholars in the field of eco-city studies is not close enough. Although scholars in the field of eco-city research have initially formed a cooperation network, the degree of contact and cooperation is still low. Colleges and research institutes are the main body of eco-city research, and the two form an even lower level of cooperation network. Eco-city research should promote the integration of multifaceted research in the field, and strengthen the exchange and cooperation between scholars in the field of eco-city research and various colleges and research institutes.

(5) The field of eco-city research is at the stage of multidisciplinary intersection, with obvious characteristics of multidisciplinary intersection in research perspectives, research contents, and research methods and technical means. Under the changes in the global environment and in the face of the opportunities provided by new technological methods, eco-city research should promote the integration of multiple disciplines, study in depth the non-linear and complex characteristics of the urban composite ecosystem, and pay attention to the coupling mechanism between the key elements of the urban composite ecosystem as well as between the key subsystems.

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