ATLANTIS PRESS
Advances in Social Science, Education and Humanities Research, volume 455
Proceedings of the 2020 International Conference on Social Science, Economics and Education Research (SSEER 2020)

Bibliometric Analysis of Sustainable Development of Resource-Based Cities in China Based on Knowledge Map

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***Abstract*—The research object is the effective literature for the sustainable development of China's resource-based cities included in China Knowledge Network (CNKI). The research tool is the bibliometric software-Cite Space. This paper conducts related bibliometric analysis from four perspectives: time distribution, topic distribution, theme dynamic evolution and hotspot outlook. It is found that the time distribution is divided into three stages: development germination stage, rapid growth stage and maturity stage. The dynamic evolution is divided into three stages: macroscopic strategy discussion stage, classification detailed analysis stage, combined with multiple methods and theoretical analysis stage. The future research hotspots include that the action plans of the sustainable development of resource-based city in China, the establishment of models and indicators to quantify the sustainable development capacity of resource-based cities in China and the sustainable development of resource-based cities in China from the perspective of the government.**

Keywords—Resource-based cities; Sustainable development; Bibliometric

I. INTRODUCTION

Resource-based cities emerged with the development of mineral and forest resources. They provide the country with a large number of production materials and huge profits and taxes [1]. The development of resource-based cities should not only meet the needs of current generations, but also pose a threat to the needs of future generations [2]. There are 262 resource-based cities in China. In the 21st century, under the background of coordinated development of economy, society and environment, with the development of a large number of resources in resource-based cities, the exhaustion of resources in such cities has become a hot topic. As the sustainable development of resource-based cities is in urgent need of research and practice, it has become one of the key topics of many scholars. It is found that the literature on sustainable development of resource-based cities has different research focuses and objectives in different periods. Through bibliometric analysis, this paper conducts a bibliometric analysis of the knowledge map based on the literature on the sustainable development of resource-based cities in China from 1997 to 2019.This paper explores the time distribution, subject dynamic evolution and hot prospects of the literature on sustainable development of resource-based cities in China. It is helpful to sort out and summarize the research results of sustainable development of resource-based cities in China.

This work was support by National Social Science Fund Project of China (No.19BJY068).

II. RESEARCH DESIGN

A. Data Source

The data of this paper are from the literature on sustainable development of resource-based cities on CNKI database. The search criteria also meet the following requirements :(1) It will be published until December 2019; (2) The "title" of the search is "resource-based city" and includes "sustainable development"; (3) The conditions of retrieval are all set to "precision"; (4) The retrieval database and literature source category are not set. A total of 727 documents were retrieved. On this basis, the documents were sorted out, and some of the documents with no research value, such as news reports and media interviews, were excluded. After sorting out, a total of 676 valid documents were identified as valid documents for document measurement in this paper. By using the document export function of CNKI, 676 relevant articles were exported in Refworks format. The exported datas conform to the requirements of the research tool in this paper and were determined to be valid data in this study.

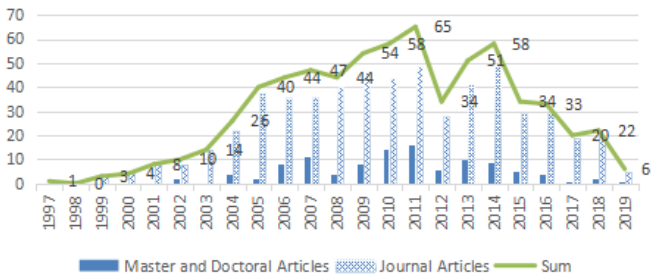
B. Research Method

After determining the valid data, the knowledge map was drawn. Then, the author made a manual collation to show the relevance of the research hotspots in the effective literature. The research tool was mainly CiteSpace, a literature visualization measurement software developed by professor Chen chaomei of drexel university based on JAVA language. After importing the effective data determined in this paper into CiteSpace, the techniques of keyword measurement, time line measurement and emergent word detection could be used. This paper explored the research topics, research hotspots and dynamic evolution of the literature on sustainable development of resource-based cities in China, and predicted the future research direction.

III. Descriptive Statistical Analysis of the Research Literature

A. General Description and Time Distribution

The distribution of the literature in this field varies from year to year, showing its different stages of development. After the effective literature was sorted out, the academic papers published in journals, conferences and newspapers were regarded as journal articles, and the graduation papers written by master and doctoral students were regarded as master and doctoral articles. The statistical results were shown in Fig. 1.



Data source: CNKI and author manually collated.

Fig. 1. General trend chart.

As can be seen from Fig.1, the literature on sustainable development of resource-based cities in China has experienced a process of "growth-peak-decline". After reviewing the policies of the central government and its subordinate organs on the sustainable development of resource-based cities from 1997 to 2019, the time distribution of effective documents could be divided into three stages:

1) Initial stage of development (1997-2000): Due to the lack of relevant theories and policy background, the amount of papers published in this stage was relatively small. Before 2000, there was relatively little advocacy of "sustainable development" in China. It was found that the relevant literature of this period was not focused on the topic, and the content was not specific.

2) Research rapid growth stage (2001-2014): In this stage, the number of literatures were increased significantly, and master and doctoral students began to conduct systematic research on the sustainable development of resource-based cities. In 2003, the National Development and Reform Commission set up a research group entitled "Transformation of economic structure of resource-based cities".It showed that the Chinese government also took the sustainable development of resource-based cities as one of the key research topics.

3) The mature stage (2015-2019): In this stage, the research progresses continuously, the theory and policy were mature gradually, and the research methods were improved gradually. At the same time, some resource-exhausted cities have transformed successfully, and some practical experience has been gained in sustainable development of resource-based cities.Therefore, in this stage, the number of research started to decline, but at the same time, it could be found that the research topic continued to deepen and diversify.

B. Theme Distribution

The effective data identified in this paper were imported into CiteSpace, and the time span was set as 1997-2019, the Years Per Slice was set as 1, the node type was selected as the keyword, and the Selection Criteria was set as Top N by using its keyword co-occurrence analysis technique.According to the experience of scholars and repeated tests, the threshold value was set to 30. After processing and manual sorting, the keyword classification was shown in Table I.

TABLE I. Keywords Classification Table of Effective Literature on Sustainable Development of Resource-Based Cities in China

Theme	Keyword
Region	Northeast China, Heilongjiang, Shanxi, Gansu, Xinjiang, Daqing, Yumen, karamay, Datong, Fuxin, Fushun
Resource	Mining, Forestry,Coal, Oil,Leather
Research Method	Index prediction, index system, innovation system, principal component analysis, factor analysis, data envelopment analysis, fuzzy comprehensive evaluation

a. Data source: According to the map of keyword co-occurrence generated by CiteSpace, the authorcollated it manually.

By sorting out effective literature, as shown in Table I, it could be found that most scholars study the sustainable development of China's resource-based cities from the perspective of regions, resources and research methods.

1) From the perspective of region, the paper discussed the sustainable development of cities in different regions:

In 1999, the publicity department of Huangshi Municipal Party Committee of China, together with the research group, discussed the sustainable development of Huangshi in Hubei province. This research group believed that the construction and management of Huangshi city should be strengthened to transform the urban functions and promote the sustainable development of its resources. For another example, Jie Luo studied the resource-based city of Inner Mongolia in China, and proposed to develop cultural industries with local characteristics of Inner Mongolia and promote industrial innovation to realize the sustainable development of Inner Mongolia [3].

2) From the perspective of resources, the paper discussed the sustainable development of cities with different resources:

With the development of the research, the view of resource type has become the focus of scholars. The experience of urban sustainable development with the same kind of resources can be learned from each other. For example, the research conclusion on the sustainable development of Yulin coal mine in Shanxi province of China has certain reference significance for Ordos in Inner Mongolia, which is also a large coal mining city. Ye Qiao studied the forestry resource-based cities in Heilongjiang province, China, and proposed strategies for the transformation of forestry resource-based cities, such as optimizing the industrial structure and encouraging forestry workers to start their own businesses [4].

3) From the perspective of research methods, through the scientific method to study the sustainable development of China's resource-based cities:

With the deepening of the research, the empirical research method was adopted.It has become a new research perspective for scholars to explore the ability of sustainable development of resource-based cities by establishing models, sorting out data and calculating indicators. For the first time, Shuying Zang et al. studied the sustainable development capacity of Daqing, Heilongjiang province, China by using the method of Ecological Footprint Calculation. Yanli Jing adopted the research method of Fuzzy Comprehensive Evaluation and found that the resource development of Pingdingshan in China was at "primary sustainable development level". It had a certain capacity for sustainable development and had a good potential for sustainable development [5].

IV. THE DYNAMIC EVOLUTION OF LITERATURE ON SUSTAINABLE DEVELOPMENT OF RESOURCE-BASED CITIES IN CHINA

Through the Time Zone map of keywords of CiteSpace, it could be found that the literature on sustainable development of resource-based cities in China changed with time. After the Time Zone map of keywords was generated, manual analysis and arrangement were carried out, as shown in Table II.

TABLE II. THE DYNAMIC EVOLUTION OF THE RESEARCH TOPIC OF SUSTAINABLE DEVELOPMENT OF RESOURCE-BASED CITIES IN CHINA

Stage	**Stage1**	**Stage2**	**Stage3**
Instroction	The stage of macroscopic countermeasure	The stage of classification and detailed analysis	The stage of combined with a variety of methods and theoretical analysis
Time	1997-2008	2009-2014	2015-2019
Keyword	Resource exhaustion, "resource curse", resource exploitation, alternative industry, innovation, transformation, circular economy	Regional and resource vocabularies, for example: Heilongjiang , Gansu , Daqing , Yumen , forestry, coal, oil	Analytic hierarchy process, DEA model, System Dynamics Model, Fuzzy Comprehensive Evaluation, SWOT analysis, Portfolio Weighting

According to Table II, the dynamic evolution of the theme of sustainable development of resource-based cities in China could be divided into three stages roughly:

1) Stage 1 (1997-2008): The stage of macroscopic countermeasure.

Most of the literatures in this stage discussed the relevant countermeasures to the sustainable development of China's resource-based cities from a macro perspective. The theme tended to focus on the problems in the sustainable development of China's resource-based cities, such as resource exhaustion, resource exploitation and "resource curse". The countermeasures and measures for sustainable development of China's resource-based cities were put forward, such as continuous industry, transformation and circular economy.

2) Stage 2 (2009-2014): The stage of classification and detailed analysis.

At this stage, most of the literature started from a more detailed perspective, such as the study of resource-specific cities or the sustainable development of specific resources. In this stage, the research conclusion had certain pertinence. For the cities where the research target was located and similar cities studied, it had certain theoretical reference value and practical feasibility.

3) Stage 3 (2015-2019): The stage of combined with a variety of methods and theoretical analysis.

In this stage, scholars mainly adopt empirical analysis and specific methods, such as analytic hierarchy process, factor analysis method and DEA model. Specific theory was adopted to make empirical analysis of specific resource-based cities. By collecting relevant data of a resource-based city, a model was established to calculate its sustainable development capacity and predict the potential of the research object's future sustainable development [6-7].

In summary, the dynamic evolution of literature on sustainable development of resource-based cities in China followed the following rules: the research object was from macro to micro, the research method was from qualitative to quantitative, and the research conclusion was from universal to specific.

V. PROSPECTS OF LITERATURE ON SUSTAINABLE DEVELOPMENT OF RESOURCE-BASED CITIES IN CHINA

CiteSpace Burst Detection technology can be used to predict future research hotspots and better grasp the topics of relevant literature. After combing the detection results of emergent words generated by CiteSpace, the emergent keywords in the literature on sustainable development of resource-based cities in China were obtained, as shown in Table III.

As shown in table III and through review of relevant literature, it could be found that the theme since 2013 could be confirmed as the theme of trend. It could be regarded as the basis of the literature on sustainable development of resource-based cities in China. By combing the literature, we can confirm the following future research hotspots and research directions.

1) Discuss the action plans of sustainable development of a certain resource-based city in China:

In Table III, the three keywords "transformation of resource-based cities", "long-term plan" and "planning" could be used to determine the research focus.

Declining resource-based cities in China need to take measures to pursue sustainable development urgently. However, the state and degree of their decline were not the same, and the reasons for their decline were also different. Therefore, different action plans should be adopted for different resource-based cities, so as to be targeted.

2) Establish models and indicators to quantify the sustainable development capability of China's resource-based cities:

The keywords "sustainable development capability" and "influencing factors" in Table III could be used to determine the hot spots of this kind of research. As mentioned above, some scholars have adopted empirical analysis since 2015.The sustainable development capability of a given resource-based city was measured in a specific way. This type of research was relatively scientific, objective and persuasive, so the hot spot will continue in the future.

3) Discuss the role of government in sustainable development of resource-based cities from the perspective of public management:

The keywords of "the State Council" in table III could be used to identify such research hotspots. The literature review showed that the government should play the role of governance, management and guidance in the process of sustainable development of resource-based cities. However, in the effective literature, fuzzy search with "government" as the key word was broad generally. The future research focus may tend to focus on how the government plays the role of public management in resource-based cities.

TABLE III. THE HIGHLIGHT KEYWORDS OF LITERATURE ON SUSTAINABLE DEVELOPMENT OF RESOURCE-BASED CITIES IN CHINA

Serial Number	Keyword	Starting Year	End Year
1	Resource-based city	1999	2001
2	Sustainable development	2000	2004
3	Industrial transformation	2004	2007
4	Old industrial base	2005	2006
5	The economic transformation	2005	2006
6	Sustainable urban development	2005	2006
7	The indicator system	2006	2009
8	Enterprise	2006	2007
9	The enterprise management	2006	2007
10	City	2007	2010
11	Resources	2007	2010
12	The circular economy	2008	2009
13	Scientific outlook on development	2009	2010
14	Alternative industries	2009	2010
15	Coal	2010	2011
16	The ecological environment	2011	2012
17	Article	2012	2014
18	Magazine	2012	2014
19	Mining cities	2012	2016
20	Resource-based city transformation	2013	2015
21	Long-term planning	2013	2014
22	Sustainable development capability	2013	2015
23	Planning	2013	2014
24	The State Council	2013	2014
25	Factors affecting the	2014	2016

VI. CONCLUSION

In this paper, the literature metrology tool CiteSpace is used to analyze the literature related to the sustainable development of China's resource-based cities from four dimensions of time distribution, topic distribution, dynamic evolution and hot spot prospect. It is found that the literature on sustainable development of resource-based cities in China has experienced three periods from the perspective of time, namely, the initial stage of development (1997-2000), the stage of rapid growth (2001-2014) and the mature stage (2015-2019). Major topic distributions include regions, resources, strategies, and research methods. The dynamic evolution of the research topic is divided into three stages: the stage of macroscopic countermeasure (1997-2008), the stage of classification and detailed analysis (2009-2014), and the stage of combined with a variety of methods and theoretical analysis (2015-2019). The future research focuses include: discussing the action plan of the sustainable development of a resource-based city in China, establishing models and indicators to quantify the sustainable development capability of resource-based cities in China, and discussing the role of the government in the sustainable development of resource-based cities from the perspective of public management.

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