Analysis of Research Hotspots on Coordinated Evaluation of Water Resource Utilization and Economic Development Based on CiteSpace

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ABSTRACT

In response to the research literature on the coordinated evaluation of water resource utilization and economic development in the core database of WOS (Web of Science) from 1994 to 2020, Cite space6.1.R6 visualization software was used to systematically analyze the literature characteristics, deeply explore the research hotspots and evolution context of the field, and explore the core research themes and future development trends of the field. Research has shown that, from the perspective of publication time and distribution, the number of publications in this field shows a fluctuating upward trend, going through three stages: initiation, growth, and surge. The trend of changes in publication volume is closely related to water conservancy policies; From the perspective of institutional cooperation distribution, research institutions as a whole exhibit a phenomenon of "large dispersion and small aggregation"; From the perspective of scholar cooperation characteristics, scholars in the field generally exhibit a phenomenon of close cooperation; From the perspective of keyword co-occurrence network graph, "sustainability", "model", "system", "coordination", "water policy", "climate change", "water resource management", "ecosystem service" and other hot words in this field have become popular in the past decade; From the perspective of the keyword timeline graph, the application of the society-economy-water resources-ecology coupling coordination model in the study of regional spatiotemporal evolution has become an emerging hot topic in this academic field.

Keywords: *Water resources, Economic development, Coordinated evaluation, Keywords, Graph.*

1. INTRODUCTION

Water resources are essential material resources for the survival and development of human society. Reasonable utilization of water resources is the key to ensuring residents' lives, protecting the ecological environment, and promoting high-quality economic development. But since the 21st century, the rapid expansion of economic activities has caused a series of problems such as water resource shortage, water environmental pollution, and unreasonable water use structure. Since the 18th Party Congress, all regions in China have thoroughly implemented Xi Jinping's thought on ecological civilization, and in the process of vigorously promoting water conservation, remarkable results have been achieved in the construction of a water-saving society. Government departments have launched a series of water resource management policies while taking advantage of the heat. In 2015, the State Council issued the "Notice on Issuing the Action Plan for Water Pollution Prevention and Control" with the core task of improving the water environment. The report of the 19th National Congress of the Communist Party of China in 2017 proposed the basic national policy of adhering to resource conservation and environmental protection. In 2021, the National Development and Reform Commission issued the "14th Five Year Plan for the Construction of a Water-saving Society". The guidance of national policies has effectively improved the coordination between water resource utilization and economic development while improving the efficiency of water-saving and water control actions.

2. DATA SOURCES AND RESEARCH METHODS

Data sources were identified and quantitative analysis software Cite Space was used to visualise and analyse the research on the coordinated evaluation of water resource utilization and economic development.

2.1 Data Sources

This article uses academic journals from the Web of Science database as the data source and selects "theme" for retrieval in WOS. The search criteria are: subject="water resource" and "economy" and "coordinate", source category=core journal library, time span from 1994 to 2020, article type selected as paper (excluding conference paper directory), and a total of 366 journal literature texts were obtained for analysis.

2.2 Research Methods

CiteSpace software is a literature quantitative analysis software that can be used to discover research hotspots and trends in the field. It has been widely applied in the academic community to explore the development of the field [1-4]. This article mainly uses Cite Space6.1.R6 to conduct visual analysis on the coordinated evaluation of water resource utilization and economic development, and obtains institutional cooperation network graph, scholar cooperation network graph, keyword co-occurrence graph, and keyword timeline graph.

3. LITERATURE FEATURE ANALYSIS

Based on the data processed by CiteSpace, a preliminary exploration of the characteristics of the field literature in terms of distribution of literature, tightness of author collaboration, and institutional collaboration is carried out.

3.1 Statistics of Publication Volume and Distribution of Publications

In the following, it explores the culmination of research in the field and core publications, in terms of both temporal trends in the publication of literature and the distribution of publications.

3.1.1 Number of Publications Statistics

The annual publication volume can be used to reveal the development process of the research field, and can also serve as a standard for evaluating the importance of the research field in the academic community. According to "Figure 1", from 1994 to 2020, the overall publication volume of the WOS core library in this research field showed a fluctuating upward trend, with significant phased characteristics: First, in the initial stage (1994-2006), the number of publications was only 36, accounting for 10% of the total number of publications. During this stage, the average annual number of publications was 3, with SCI having 2 publications and SSCI having less than 1 publication; Second, in the growth stage (2007-2015), the number of publications increased to 112, accounting for 30% of the total. During this stage, the average annual number of publications increased to 12, including 12 for SCI and 2 for SSCI; Third, during the surge period (2016-2020), the number of publications reached 217, accounting for 60% of the total. During this period, the average annual number of publications skyrocketed to 43, with SCI having an average of 35 publications and SCI having an average of 15 publications. Analyzing the trend of changes in publication volume, it can be seen that 2016 is the watershed for breakthrough progress in the research field's publication volume. From the continuous increase in the number of articles published between 2016 and 2020, it can be seen that this field is currently on the rise, with numerous research hotspots and huge development space. However, at the same time, the number of articles that are showing a surge also urgently needs to be summarized and sorted out through a comprehensive evaluation theoretical system.

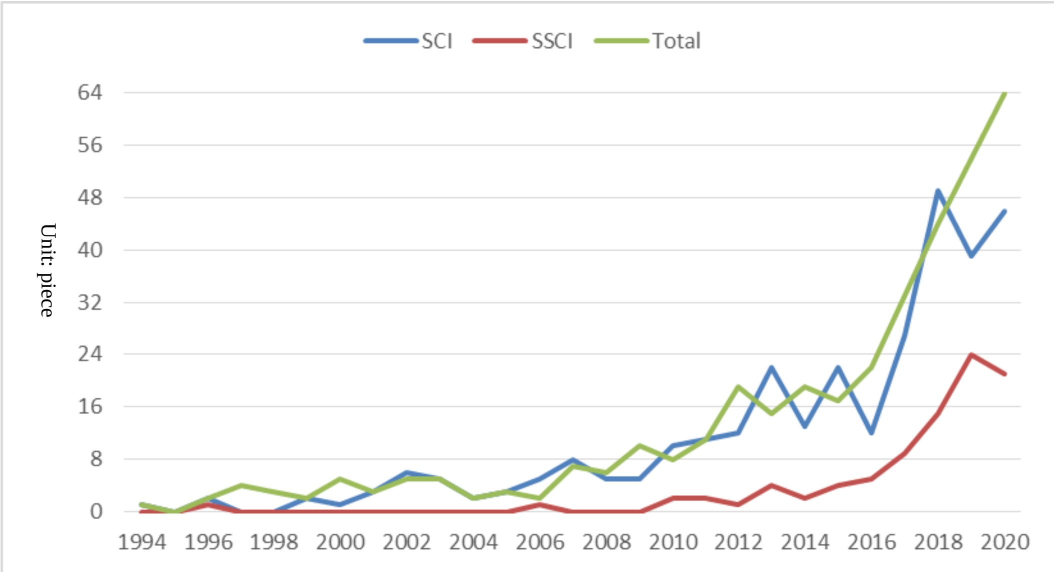

Figure 1 Number of WOS publications between 1994 and 2020.

3.1.2 Distribution of Publications

Bradford's law proposes that the professional level and domain recognition of a scientific journal can be determined based on the number of professional discipline papers published. Generally speaking, the number of academic journal published discipline papers is directly proportional to the professional level of the journal [5]. Therefore, based on the number of journal publications in the research field shown in "Figure 1", the Bradford core area number calculation method [5] can be used to determine the number of journals in the core area of the field. The algorithm formula is expressed as

$$r_0 = 2\ln(e^E * Y) \quad (1)$$

In equation (1), r_0 refers to the number of journals in the core area, E refers to the Euler coefficient, E is usually taken as approximately 0.5772, and Y refers to the number of published papers corresponding to the journal with the highest number of publications in a certain field.

According to equation (1), after reviewing the literature, it can be seen that the journal with the highest number of publications in this field between 1994 and 2020 was Agricultural Water Management, with a total of 25 articles. Substituting it into equation (1), it can be concluded that $r_0 = 2\ln(1.8 \times 25) \approx 8$ indicates that there are 8 core area journals related to this field in the WOS core library, and the publication status of these 8 core area journals is shown in "Table 1".

Table 1. Publication status of core area journals in WOS core library from 1994 to 2020

Periodical name	Number of articles published (piece)	Proportion in the total number of publications (%)
AGRICULTURAL WATER MANAGEMENT	25	6.8%
JOURNAL OF CLEANER PRODUCTION	19	5.2%
SUSTAINABILITY	19	5.2%
WATER	15	4.1%
IRRIGATION AND DRAINAGE	11	3.0%
FIELD CROPS RESEARCH	10	2.7%

According to "Table 1", the total publication volume of the 8 WOS core area journals related to this field is 99, accounting for approximately 27% of the total publication volume of the WOS core library. From the above 8 core area journals, it can be seen that the research field focuses on the disciplines of agriculture and forestry, water conservancy, and environmental sustainable development, with the three major disciplines intersecting and influencing the development of the field.

3.2 Distribution of Cooperation Among Research Institutions

Analyzing the cooperation distribution of research institutions in the field of discipline can explore the distribution of research forces. Using CiteSpace visualization analysis software, obtain the top ten research institutions in terms of publication volume (see "Table 2") and the graph of research institution cooperation network (see "Figure 2").

It can be seen from "Table 2" that the Chinese Academy of Sciences ranks first, with its number of papers accounting for about 6%; Hohai University ranks second, with a publication volume accounting for about 4%; The number one Chinese Academy of Sciences and the number three University of Chinese Academy of Social Sciences are closely linked, and the total number of papers issued by them accounts for about 9%. In general, China's colleges and universities and professional research institutions account for the majority of the number of papers issued. Universities are currently the main research force in this field, such as Hohai University, University of Chinese Academy of Social Sciences, Nanjing University, etc. Among them, Hohai University, as the leader in water conservancy research in Chinese domestic universities, has a strong faculty and strong scientific research strength, and its number of papers issued in the field of hydrology has always been in the forefront.

Table 2. Number of publications by top ten research institutions from 1994 to 2020

Ranking	Unit name	Number of articles published
1	Chinese Academy of Sciences	20
2	Hohai University	16
3	University of Chinese Academy of Sciences	11
4	Nanjing University	9
5	China Institute of Water Resources and Hydropower Reserach	8
6	Huazhong University of Science and Technology	7
7	Beijing Normal University	6
8	Arizona State University	6
9	Stanford University	6
10	China Agricultural University	6

In "Figure 2", there is a positive correlation between font size and the number of publications by the institution. The larger the font size, the more publications the research institution has. The connection between institution names shows the cooperative relationship between research institutions in the field, and the thickness of the connection is positively correlated with the degree of cooperation. Without a connection, it indicates that there is no cooperative relationship. According to "Figure 2", it can be seen that the cooperation between universities and research institutions in this research field is relatively close, presenting a decentralized team layout, with the majority of research groups composed of domestic universities and research institutions collaborating, for example, ① Fuzhou University - Fudan University; ② Stanford University Arizona State University; ③ China Agricultural University - Northeast Agricultural University; ④ Humboldt-Universität zu Berlin) - Arizona State University; ⑤ Tsinghua University - Tianjin University; ⑥ Tsinghua University - Beijing Forestry University.

In addition, according to "Figure 2", it can be seen that a certain scale of core cooperation team has been formed in this field. For example, ① the cooperation team with the Chinese Academy of Sciences as the center, Chinese Academy of Sciences - University of Chinese Academy of Sciences - Huazhong University of Science and Technology - Nanjing University; ② The cooperation team centered on Hohai University, Hohai University - Pennsylvania State University Sichuan University - China Institute of Water Resources and Hydropower Research - Ministry of Water Resources - Beijing Normal University - Shandong University.

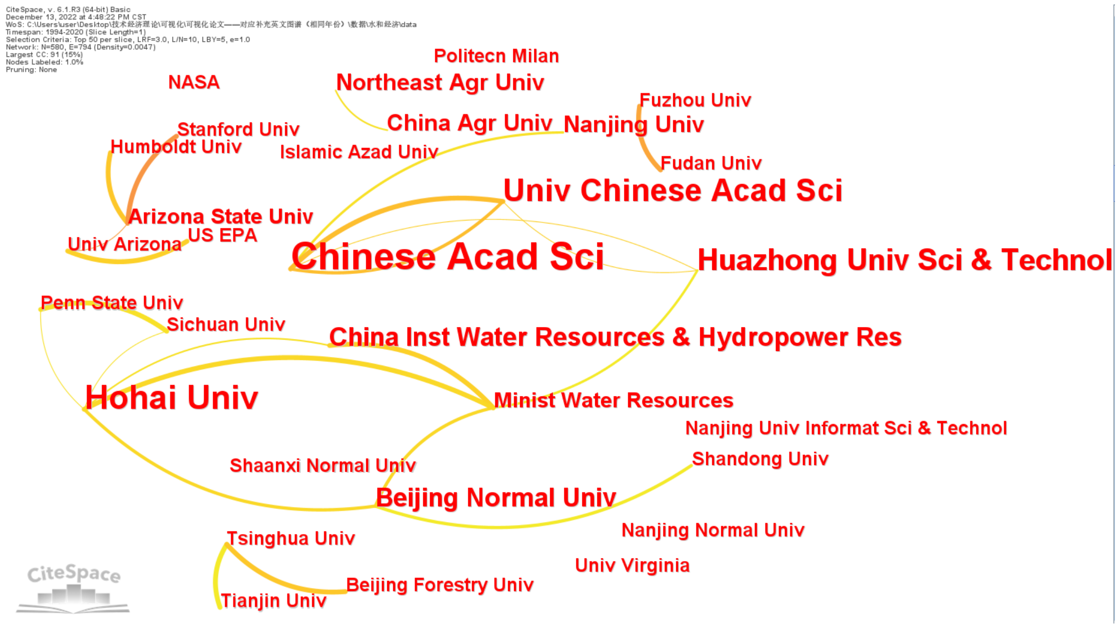

Figure 2 Organizational cooperation network graph.

3.3 Characteristics of Scholar Collaboration

Scholar cooperation networks directly reflect the sharing of academic resources and citation of academic achievements in this academic research field. Analyzing the characteristics of cooperation among scholars has important guiding significance for improving their academic influence and quality of academic achievements in this research field. Using CiteSpace, the researchers can obtain a graph of scholars' collaboration networks in this research field from 1994 to 2020 (see "Figure 3"). In "Figure 3", there is a positive correlation between the size of the node and the number of publications by the scholar. The larger the font size of the node, the more publications the scholar has. If there are more rays starting from the scholar at the same time, it indicates that the scholar has a greater academic influence. The thickness of the connections between nodes represents whether the cooperation between scholars is close, and the thicker the connections, the closer the cooperation between scholars.

According to "Figure 3", it can be seen that scholars in this research field collaborate closely and form a core collaborative team. For example, in China, there are mainly three or more collaborative teams of scholars: Zhang Fan - Mo Li - Guo Ping - VIJAY P. SINGH, Wei Yuhang - Tang Deshan - Ding Yifan, Niu Wenjing - Feng Zhongkai - Wang Jiayang; Foreigners mainly rely on multi person collaborative teams: Mark P. Robertson - Arthur Chapman - David Le Maitre- Andrew Wannenburgh - Andrew Brown - Greg G Forsyth - David Mark Richardson - Nuria Roura-Pascual - Brian W. van Wilgen - Rainer M Krug. Overall, the number of Chinese domestic scholars is not as large as that of foreign scholars, but the number of articles published by Chinese domestic scholars is greater than that of foreign scholars.

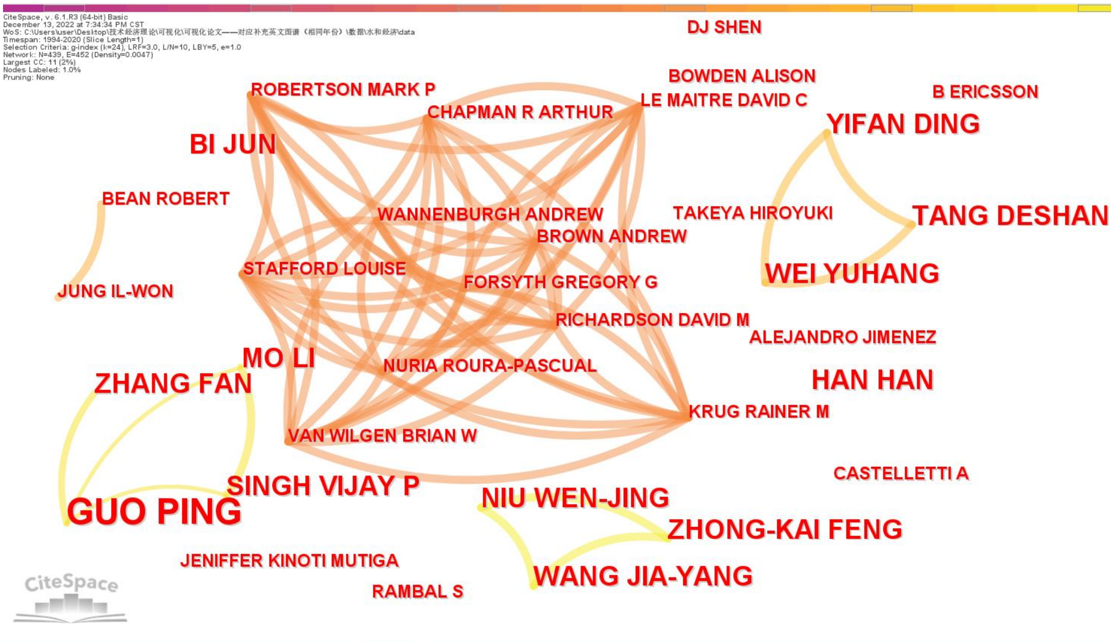

Figure 3 Graph of scholar collaboration network.

According to "Figure 3", the lead author of the paper is defined as the main research object, and the Price formula [6] is used to screen the core authors in this research field, namely

$$m = 0.749\sqrt{n_{\max}} \quad (2)$$

In equation (2), m represents the screening criteria, and scholars with a publication volume greater than or equal to m are the core authors in the field; n_{max} represents the number of publications by the most prolific scholars.

According to equation (2), the number of articles published by the author who has the highest number of articles in the research field is substituted. After calculation, m=1.3 indicates that the core author is one who has published 2 or more articles in this field. The core authors ranked among the top ten in terms of research publication volume in this field are shown in "Table 3" by sorting out the retrieved literature data and combining the results calculated by the Price formula.

According to "Table 3", the characteristics of the core author group in this field are as follows: First, the core author group can be divided into leading and supporting types. Scholars with a publication volume of ≥ 2 and an average publication time earlier than 2016 are leading figures in this field. For example, Wei Yuhang, who focuses on water resource management, and Tang Deshan, who focuses on water conservancy and hydropower engineering, are leading figures in this field, laying the academic foundation for collaborative research on water resource utilization and economic development. Scholars with a publication volume of ≥ 2 and an average publication time between 2016 and 2020 are supportive, such as Cheng Jinhua, Niu Wenjing, VIJAY P. SINGH, and others. The above scholars actively engage in academic activities during the period of academic attention in the field, promote the development of the field, enhance the influence of the field, and make important contributions to the theoretical or practical aspects of the field. Second, according to Price's Law [9], if the total number of publications by core authors in a research field accounts for 50% or more of the total number of publications in the field, it indicates that the field has formed a stable core author group, and academic resource sharing between fields is more common, and significant academic achievements have been successfully radiated. However, the total number of articles published by the core author group in this field accounts for 8% of the total number of articles published in the field (366 articles), far less than the standard 50%. Therefore, there is an urgent need to strengthen cooperation among scholars in this field, in order to form a stable core author group.

Table 3. Ranking of core authors

Core author (lead author)	Research direction	Number of articles	Year
GUO PING	Research on water resources and environmental management under uncertain conditions	3	2019
CHENG JINHUA	Resource environmental economics	2	2016
NIU WENJING	Watershed management	2	2020
VIJAY P. SINGH	Surface and groundwater resources	2	2019
BI JUN	Watershed environment management	2	2018
WEI YUHANG	Water resource management	2	2014
TANG DESHAN	Water resources and hydropower engineering	2	2014
ZHANG FAN	Water footprint	2	2019
MO LI	Water resources and hydropower engineering	2	2019
FENG ZHONGKAI	Water resources and hydropower engineering	2	2020

4. ANALYSIS OF RESEARCH HOTSPOTS

On the basis of an initial grasp of the characteristics of the field literature, the distribution and evolution of hot keywords in the field are further studied.

4.1 *Keyword Co-occurrence Analysis*

The keywords that condense the core research content of the paper can represent the core topic and research field of the literature, and the keywords that frequently appear in the retrieved literature data can be regarded as research hotspots in this field. [7] By conducting keyword co-occurrence network analysis on the WOS core database in this research field from 1994 to 2020, a keyword co-occurrence graph was obtained (see "Figure 4"), and the top 20 keywords were selected based on frequency and centrality as ranking criteria (see "Table 4").

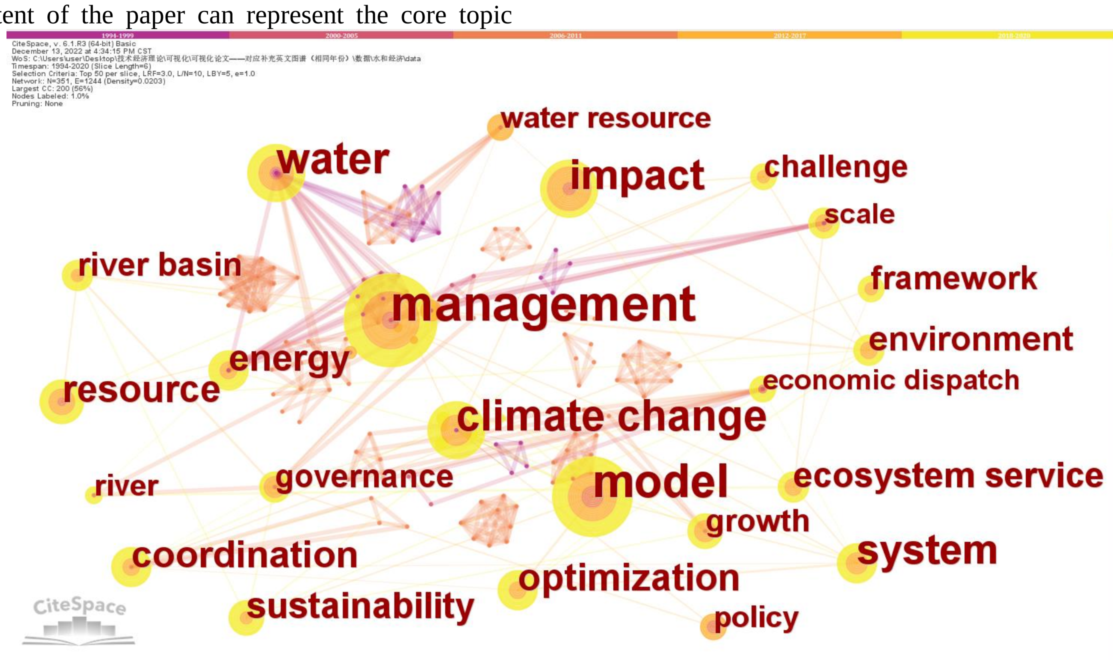

Figure 4 Keyword co-occurrence network graph.

Table 4. Keyword ranking list

Ranking	Frequency			Ranking	Centrality		
	Frequency	Centrality	Keywords		Centrality	Frequency	Keywords
1	52	0.05	management	1	0.11	18	energy
2	39	0.01	model	2	0.1	5	vulnerability
3	29	0.08	water	3	0.08	29	water
4	29	0.05	climate change	4	0.08	4	water policy
5	26	0.07	China	5	0.07	26	China
6	26	0.01	impact	6	0.06	11	governance
7	25	0.02	system	7	0.06	6	area
8	19	0.02	optimization	8	0.06	4	risk
9	19	0.02	resource	9	0.05	52	management
10	18	0.11	energy	10	0.05	29	climate change
11	17	0.04	coordination	11	0.04	17	coordination
12	15	0.01	sustainability	12	0.04	10	growth
13	14	0	ecosystem service	13	0.04	9	water resource
14	13	0	environment	14	0.04	6	resilience
15	12	0.03	framework	15	0.04	5	allocation
16	12	0.01	river basin	16	0.04	5	conservation
17	11	0.06	governance	17	0.03	12	framework
18	11	0	sustainable development	18	0.03	8	economic dispatch
19	10	0.04	growth	19	0.03	5	basin
20	10	0.01	challenge	20	0.03	4	wind power

In "Figure 4", the thickness of the connection between each keyword represents the frequency of two keywords co-occurring in the same literature. The thicker the connection, the higher the co-occurrence frequency. The thickness of node circles and font size are directly proportional to the frequency of keyword occurrence. The thicker the annual ring and the larger the font, the higher the frequency of keyword occurrence [10]. In "Table 4", the centrality of a keyword is closely related to its importance in the co-occurrence network graph. If the centrality of a keyword is greater than or equal to 0.1, it indicates that the keyword has significant influence in the co-occurrence network graph. Generally speaking, high-frequency and high mindedness keywords in co-occurrence network graphs require researchers to focus on, representing the core research topics and hot research frontiers in this field.

Overall, according to "Figure 4" and "Table 4", it can be seen that firstly, based on the analysis of the thickness of the annual rings and the density of the connecting lines, the node "water" has both high-frequency and high centrality, occupying an important position in the keyword co-occurrence network graph. Secondly, words such as "management'", "sustainability", "model", "system", "coordination'", and "impact" also have both high frequency and high mindedness. From this, it can be seen that the core research topic in this field from 1994 to 2020 focused on the model construction and system evaluation of the coupling and coordination between water resource utilization and economic development.

4.2 Research Frontier Evolution Analysis

Based on the keyword co-occurrence network graph, using Cite space visualization software to draw a keyword timeline (see "Figure 5") can further reveal the research hotspots and evolutionary context of the coordinated evaluation of water resource utilization and economic development in WOS at different periods. In "Figure 5", there is a positive correlation between the size of node rings and the frequency of the keyword appearing in the corresponding year. The lines between nodes indicate that different keywords coexist in the same literature.

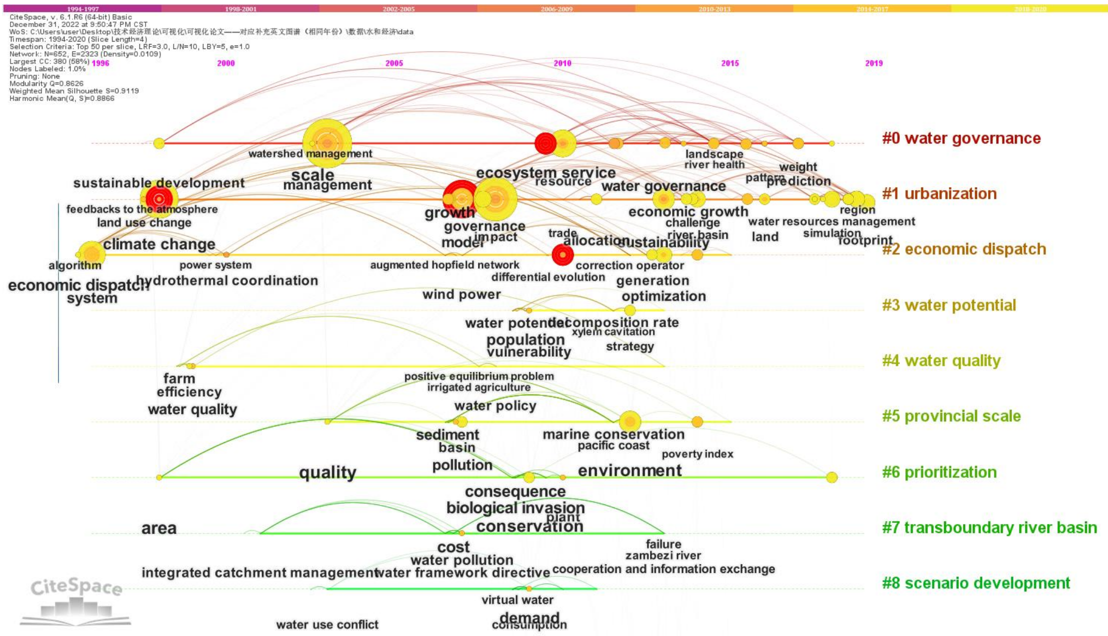

Figure 5 Keywords timeline in the field of WOS water resource utilization and coordinated economic development.

According to "Figure 5", the evolution of hot topics in this research field from 1994 to 2020 can be divided into three stages, which can be expressed as follows:

The embryonic stage (1994-2006) focused on keywords such as watershed management, sustainable development, climate change, water use, water quality, hydrothermal coordination, efficiency, and economic dispatch. The key research issues at this stage can be summarized as: water resource management research, resource - environment - economy sustainable development research. Glenn-Marie Lange [8] took South African countries as the research object, and proposed that calculating and clarifying the opportunity cost of water resources while strengthening the coordination of strategies in agriculture, energy, mining and trade sectors can better improve the water resources management system; Heikkila [9] took the water management plan of California as the research object to study how political jurisdiction boundaries affect natural resource management. The results show that institutional boundaries consistent with natural resources may be related to the implementation of more effective resource management plans; Baruch [10] proposed that there are contradictions in China's water sector caused by the interconnection of physical, institutional, historical, cultural, and ideological foundations. Correct water resource management strategies and policies can help alleviate deep-rooted contradictions in the water economy; Songbei et al. [11] based on the theory of sustainable water resources and complex systems, defined the water-socio-economic-environmental composite system as a complex water resources system (WRCS), established the WRCS indicator system according to the indicator framework of Bothell's sustainable development, and used the synchronous development equation to construct a coordinated model of WRCS to measure the spatial distance between the comprehensive assessment value of WRCS and the expected assessment value and the degree of coordination of WRCS; DU Hongru et al. [12] took Urumqi as an example to study the forms of collaborative adaptation between water resources development and urban development in different urbanization stages through the interaction between water supply and population, economy and environmental expansion of oasis cities, and the results showed that the manifestations of collaborative adaptation can be summarized into five stages: basic coordination, expanded coordination, expanded contradiction, adaptation contradiction, and adaptation coordination. The cost, proportion, and efficiency of water consumption are the main factors affecting collaborative adaptation.

The development stage (2007-2015) focuses on the keywords of ecosystem service, model, irrigated agriculture, water policy, sustainability, and water framework directive. The key research issues at this stage can be summarized as: research on the relationship between agriculture and water resource utilization, research on the coupling and coordination of water resource utilization and economic development, and research on water resource policies. Ignacio Cazcarro et al. [13] took the agriculture and food industry in Aragon, Spain, as the case to study the impact of agriculture and food industry on the regional environment. Through scenario analysis, the general equilibrium theory model applicable to the region was used to assess the impact of agriculture and food industry on the environment. The results showed that the impact of agriculture and food industry on the environment, especially on water resources, was significant; Han Rongqing et al. [14] tracked and evaluated the harmony between the environmental status of water resources and economic and social development in the Shandong Peninsula, and used the Delphi method and analytic hierarchy method to construct a comprehensive evaluation index system from five aspects: harmony, sustainability, openness, stability and controllability, and discussed the main factors restricting the coordinated economic-social and environmental development of the Shandong Peninsula. Wei Wang et al. [15] believed that the analysis and evaluation of water resources carrying capacity is the key issue to promote sustainable social and economic development, so taking the Yellow River Delta as an example, a composite system index system including four subsystems of economy, society, ecology and water resources is constructed, and a water resource carrying capacity evaluation method is established based on the projection tracking evaluation model and particle swarm optimization algorithm; Wheater et al. [16] proposed that water science research including the dimension of human activities should be regarded as an endogenous component of water system dynamics, strengthen cross-departmental coordination of research and policy, integrate science and policy, and use large-scale water-harvesting observation stations to integrate interdisciplinary scientific resources and solve water problems in the new century.

The mature stage (2016-2020) focuses on keywords such as water resource management, prediction, pattern, and water footprint. The key research questions at this stage can be summarized as follows: establishment of coordinated evaluation model of water resources utilization and economic development, and research on water footprint. Cheng Kun et al. [17] used Heilongjiang Province as an example to introduce a dynamic coupling coordination model to study the coordinated development of water resource systems, analyze the coupling coordination scheduling between resource subsystems, ecological, socio-economic subsystems, and the entire water resource system, and explore key factors that affect the efficiency and sustainability of water resource systems; Yao Jiping et al [18] proposed an integrated coevolutionary model of water resources systems based on the conditions of the elements and the mechanisms of their interactions, and used grey correlation analysis to calculate the system coordination degree, introducing element weights in the calculation of the correlation degree to reflect the influence of the uncertain relationship between the elements on the absolute adaptation degree, and introducing fluctuation coefficients to reflect the influence of the correlation degree between the reference and comparison series on the overall correlation degree; Fu et al [19] combined two-stage interval parametric stochastic programming with an adaptive water management model to study and develop water management strategies that could improve the adaptability of water resources systems; Luo Zengliang et al [20] established an integrated distributed socio-economic-water-ecological model combining rainfall-runoff, river water quality and ecological models in the Shaying River basin, and constructed a harmonious regulation model based on the harmonious theory approach, and the results of the study showed that socio-economic development has a significant impact on river water quality and ecology; Liu Yu et al [21] constructed a coupled water-social-economic-ecological coordination index system based on the generalized regression neural network model and the basic model of water-ecological footprint in Ji'nan city from 2006 to 2015, and established a predictive assessment model that can simulate the water-ecological sustainability of Jinan in the next five years based on the calculation results.

Combining "Figure 4", "Table 4" and "Figure 5", a review of the literature shows that research on the coordinated evaluation of water use and economic development in the WOS between 1994 and 2020 focused on the development of coupled models, mainly: dynamic coupling model [17], projection pursuit evaluation model [15], comprehensive co evolution model [18], random multi-objective nonlinear programming model [22], generalized regression neural network model [21], coupled coordination model combined with system dynamics model [23], coupled coordination model [24], data envelopment model [25], etc. In addition, as shown in "Figure 5", in the past three years, scholars in the field have mainly applied the coupling coordination degree model to study the spatiotemporal evolution of regional water resource utilization and economic coordinated development in China. From the perspective of the research area, areas with scarce water resources, areas with fragile ecological environment, areas with accelerated urbanization development, and major river basins have all become key research objects. In the future, this field should focus on global water resource issues, promote changes in watershed management policies, and focus on the coupled development system of water resources, economy, ecology, and society, and conduct in-depth research on the coordinated evaluation of water resource utilization and economic development.

5. CONCLUSION

In response to the research on the coordinated evaluation of water resource utilization and economic development in WOS, a scientific quantitative analysis and visualization study were conducted on 366 literature included in the core database of WOS from 1994 to 2020 using CiteSpace software. The literature characteristics and research hotspots were systematically sorted out, and the following conclusions were drawn: First, from the analysis of literature characteristics, the overall publication volume of the WOS core library in this research field showed a fluctuating upward trend from 1994 to 2020, with significant phased characteristics. It can be divided into the initial stage from 1994 to 2006, the growth stage from 2007 to 2015, and the surge stage from 2016 to 2020; Institutional cooperation in the field presents a decentralized team layout, in which the majority of research groups are composed of domestic universities and research institutions, such as the core cooperation team with the Chinese Academy of Sciences and Hohai University as the backbone; The cooperation among scholars in the field shows a close gathering feature, with scholars such as Wei Yuhang and Tang Deshan serving as leading figures, laying an important academic foundation for theoretical research and practical exploration in the field. Second, from the analysis of research hotspots, the core research topic in this field focuses on the model construction and system evaluation of the coupling and coordination between water resource utilization and economic development. Words such as "water management", "sustainability", "model", "system", "coordination", "water policy" have become hot keywords in the field. The research topics represented by keywords such as "water footprint", "water resource management", "prediction", "pattern", etc. develop into emerging research hotspots in the field. The application of the coupling coordination model of society economy water resources ecology in the study of regional spatiotemporal evolution may occupy the forefront of research in the field.

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