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Application of Cite Space Software in Visual Analysis of Land Use Coupling Research Progress

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***Abstract*—**The coupling of land use system in geographical research is mainly the coupling of pattern and process, which is essentially the human-land coupling, and is an important part of the research and discussion of human-land relationship. Based on the Web of Science database, the paper titles, authors, keywords, and references from 1997-2020 related to land use coupling were used as data sources to explore the research progress of land use coupling. Cite Space bibliometric tool was used for co-occurrence analysis of the issuing country, issuing institution, co-cited author, disciplinary institution, and keywords. The results are shown as follows: (1) From 1997 to 2020, the United States, China, and Germany rank the top, with more than 250 published papers. Although China ranks second in the number of published papers on foreign literature, it has less centrality and less influence. (2) The top 10 institutions (universities) in the number of published papers (more than 300 articles) are mainly from the United States and China, and the University of Chinese Academy of Sciences has the highest output of papers. At the same time, the phenomenon of multi-institutional cooperation has increased in the field of land use coupling research. (3) From 1997 to 2020, land sensitivity research and the impact of climate change on land use patterns are the main directions of land use coupling research. However, in the past five years, scholars have mainly focused on the coupling research methods of land use and the coupling relationship between ecological and environmental factors and land use.

***Keywords*—**Land use coupling, cite space, knowledge graph, visual analysis, research progress.

I. Introduction

THE concept of "coupling" in geography actually originated from physics, which refers to the synergy of two or more systems through various interactions, or the dynamic relationship between the elements of the system and the interaction [1]. It mainly discusses the mutual feedback, coordination and action mechanism between systems and elements within the system. It has been widely used in geography, ecology, environment, and other disciplines [2], and has become a very challenging theoretical method [3]. With the rapid development of social economy and the continuous improvement of urbanization level, the links between regions have been strengthened, the exchange and flow of resources, population, capital, and other elements inside and outside the system are accelerated, the regional industrial agglomeration or function dispersion is constantly replaced, and the interaction between human and nature has also changed significantly. In a specific regional spatial range or across spatial scales, major states such as internal coupling, peripheral coupling and remote coupling are presented [4]. The core field of geographical research is human-land relationship regional system [5], and coupling "pattern and process" is an important approach and method for comprehensive geographical research [6]. The coupling of land use system studied in geography is mainly the coupling of pattern and process, which is essentially human-land coupling. As an open and complex large system involving social, economic, and natural elements, the land use system contains complex inter-coupling mechanisms and the unity of opposites between the elements [7]. Driven by global climate change and social development, land use is faced with problems such as out-of-control construction land, land pollution, serious land waste, and soil erosion [8]-[10]. Carrying out land use coupling research to explore the internal and external driving factors of land use is conducive to the coordinated development of social economy, climate change and land use.

As scholars pay increasing attention to the land use coupling, a large number of research findings have been accumulated, especially in the interactive coupling between the social and economic development and ecological environment [11], [12], and the cross-coupling of the socio-economic development and land use change [[13], [14]. The mechanism and law of the interaction and coupling between urbanization and eco-environment in mega-regions have been studied. For example, Fang first analyzed the theoretical framework and technical approach of the interaction and coupling between urbanization and eco-environment in mega-regions, and then conducted an empirical study on the Beijing-Tianjin-Hebei urban land group [11], [15]. There are also discussions on the interactive coupling mechanism between rural land use transition and economic change in mountainous areas [16], [17]. From a practical point of view, the existing land use coupling studies mainly focus on land use benefits, land use patterns, and the coupling and coordination relationship between land use change and the social and economic environment [18], [19], focusing on building a coupling coordination degree model with reference to coupling concepts and coupling coefficients [20], [21], and exploring the coupling relationship between land use and socio-economic development with the correlation analysis method 13], [14], [22]. Research content shifts from

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the coupling between urban or urban land use and socioeconomic development [11], [12] to rural land use [2], [23], [24]. However, it is worth noting that although many research achievements have been obtained, it is urgent to sort out the research progress of long-term land use coupling, especially the visual analysis of research hotspots and development trends based on bibliometric methods.

With the development of bibliometrics, Cite Space software has gradually become the main tool for analyzing research progress in a certain field [25]-[27]. Bibliometric analysis can quantitatively analyze and mine the development trend of a certain field through statistical methods [28], [29], and can help to explore the research frontiers in related fields [30]. It provides an effective way to deeply explore the historical development and current characteristics of land use coupling. In view of these, Cite Space and Origin software tools were applied to analyze the English literature included in the Web of Science (WOS) for more than 20 years, to grasp the evolutionary context, research hotspots and trends of land use coupling research, to provide scientific support for land use coupling research and discipline development.

II. Materials and Methods

A. Data Sources

In order to more objectively show the international research frontier on the land use coupling relationship, the core data collection (including SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH) in the WOS database was used as the literature source. The search criteria selected the following three topics: land use evaluation coupling, OR land use structure coupling, OR land use efficiency coupling. Literature types were selected from core collections such as proceedings paper, article, and editorial material. A total of 2982 literatures were retrieved from 1997 to 2020. By removing, sorting, and deleting less relevant items from the search results, 2556 high-quality literatures were obtained. Then, the selected literatures were downloaded and saved in "Reforks" format as analysis data samples.

B. Research Methods

In this study, the methods of scientific knowledge map and bibliometrics were adopted, and information visualization software CiteSpace (V.5.8.R3) was used to realize literature analysis [31]. Before using the software to analyze, the parameters were set first. Time zone segmentation was set from 1997.01 to 2020.12, and the time slice was set to 1 year. The node type can be Keyword or Country. In keyword co-occurrence analysis, the node threshold was Top 30, while in country cooperation analysis, the node threshold was Top 50. For network cutting mode, the Pathfinder, Pruning the Merged network, and Pruning networks were selected. For other options, select the default options. Then, the "Country" was taken as the node for cooperative network analysis, the "Keyword" was taken as the node for co-occurrence analysis, Cluster analysis and Burst analysis. Finally, relevant charts were drawn to explore the hot spots of land use coupling research.

III. Results and Analysis

A. Analysis on the Number of Published Papers

Through the preliminary statistical analysis of the annual distribution of literature data, a preliminary understanding of the land use coupling research field was formed (Fig. 1). As can be seen from Fig. 1, from 1997 to 2020, with the prominence of a series of problems such as economic development and climate change, the coupling relationship between land use and economic, climate and other factors had attracted the attention of scholars. Scholars all over the world have been paying more and more attention to land use coupling research. It can be divided into three stages: (1) The period from 1997 to 2003 was a slow start stage, and the number of published papers in this stage was very small, and scholars did not pay much attention to this field. (2) The period from 2003 to 2012 was a slow rising stage, in which the number of published papers began to increase to a certain extent, but the rising speed was slow, and the number of published papers was still not high, but the upward trend was obvious. (3) The period of 2012-2020 was the rapid growth stage, the research interest in this stage has increased significantly, which is mainly closely related to the great rise in the global human-land coupling research interest in recent years.

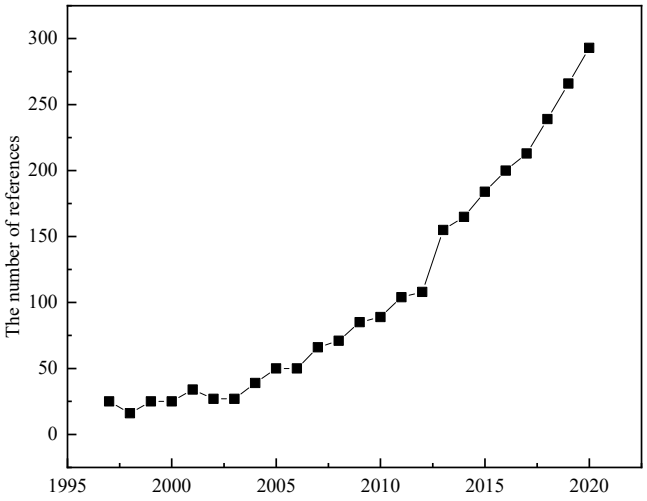

Fig. 1 The number of literatures on land use coupling research from 1997 to 2020

In order to explore countries with more research on land use coupling and higher influence, CiteSpace software was used for visualization analysis of 2556 samples. In the "Time Slicing" column, Years Per Slicing was set as 1 year. The option of "Country" in the "Node Types" panel was selected, and the “Top N = 50” was set, and other options was set as the default setting of the system. The visualization map of the distribution of high-yield countries in the land use coupling study can be obtained by running it (Fig. 2). From the perspective of the centrality of the issuing country, nodes with a centrality greater than 0.1 were considered as key nodes [32]. Countries

belonging to key nodes were the United States (0.44), France (0.25), Germany (0.18), the United Kingdom (0.16), Japan (0.13), Italy (0.11), and the Netherlands (0.1). As can be seen from Fig. 2, the above seven countries played an important role in the development of land use coupling research and had a great influence on this research. In terms of the number of papers produced, the United States (1028), China (555), Germany (258) ranked the top three countries in terms of the output of land use coupling research papers (Fig. 2). Among them, the United States had the highest amount of paper output and made outstanding contribution to land use coupling research, indicating that the United States was relatively active in land use coupling research. It was followed by China, Germany, France, and other countries. Although China ranked second in the number of publications, it still needed to strive for high-quality research achievements because of its low centrality and less influence.

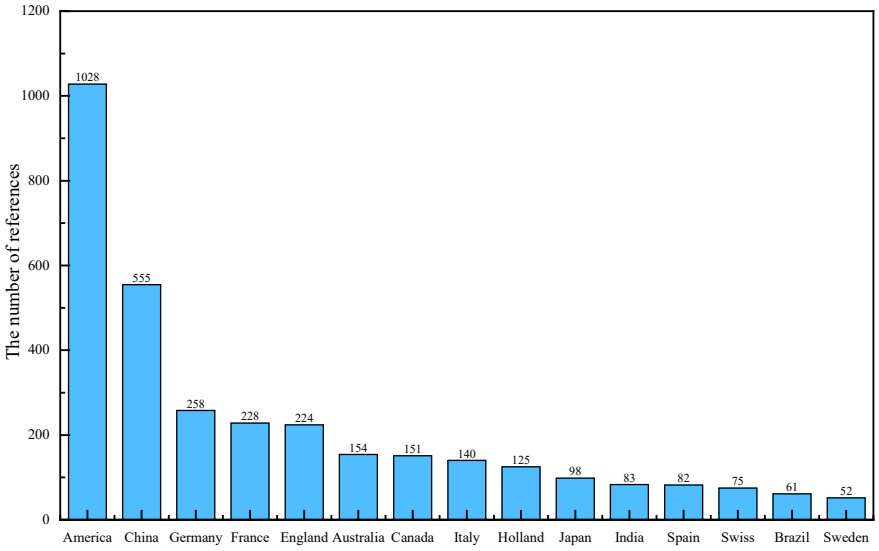

Fig. 2 The number of papers published by high-yield countries in land use coupling research

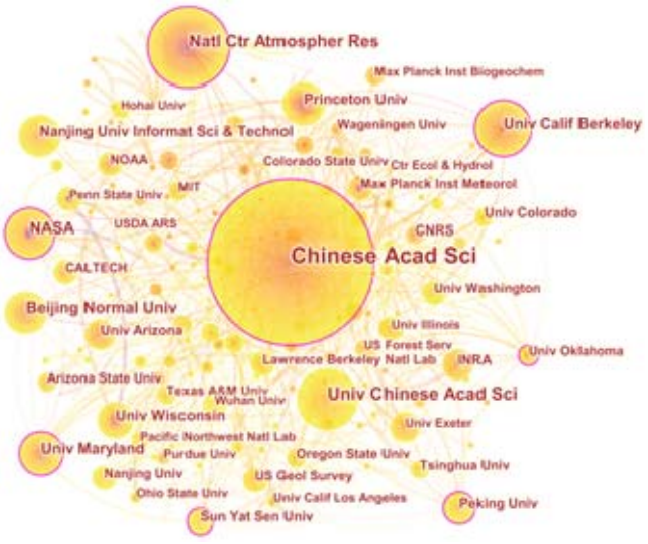

Fig. 3 The visual knowledge map of high-yield research institution in land use coupling study

In the "Node Types" panel, the "institution" option was selected, 50 was selected for Top N, 50% was selected for TOP N%. On the Pruning Panel, the “Minimum Spanning Tree” and “Pruning networks” options were selected. Other options were the default settings in the system, and the visualization network diagram of the distribution of high-yield research institutions in this field can be obtained by running the software (Fig. 3). There were 389 nodes and 703 lines in the distribution visualization network of high-yield research institutions. The circle size of each node represented the number of papers produced by the research institution, and the line between the two nodes represented the connection between the two research institutions (Fig. 3). The more connections each node had to other nodes, the more connections it had to other research institutions. As can be seen from Fig. 3, 8 research institutions become key nodes. They included Univ, Calif Berkeley (0.18), Natl Ctr Atmosphere Res (0.16), Chinese Acad Sci (0.15), NASA (0.13) and Sun Yat Sen Univ (0.12), Peking Univ (0.11), Univ Maryland (0.11) and Univ Oklahoma (0.11), indicating that these institutions played an important role in the study of land use coupling.

According to the publishing organization, the top ten institutions with high yield of papers in the field of land use coupling research (Table I) were Chinese Acad Sci (210), Univ Chinese Acad Sci (63), Natl Ctr Atmosphere Res (60), NASA (48) and Beijing Normal Univ (46), Univ, Calif Berkeley (37), Univ Maryland (37), but the centrality of Univ Chinese Acad Sci and Beijing Normal Univ were lower than 0.1, and no key nodes were formed. From the perspective of the countries to which the institutions belong, the number of agency publications in China and the United States were in the top ten, indicating that the two countries had relatively active research on land use coupling. From the perspective of institutional

attributes, the high-yielding institutions were mostly universities, indicating that universities were the main force in land use coupling research.

TABLE I
TOP 10 INSTITUTIONS WITH THE NUMBER OF PUBLISHED PAPERS ON LAND USE COUPLING RESEARCH

Rank	Frequency	Centrality	Institution	Country
1	210	0.15	Chinese Acad Sci	China
2	63	0.04	Univ Chinese Acad Sci	China
3	60	0.16	Natl Ctr Atmosphere Res	the United States
4	48	0.13	NASA	the United States
5	46	0.03	Beijing Normal Univ	China
6	37	0.18	Univ Calif Berkeley	the United States
7	37	0.11	Univ Maryland	the United States
8	30	0.06	Princeton Univ	the United States
9	29	0.05	Univ Wisconsin	the United States
10	28	0.04	Nanjing Univ Informat Sci & Technol	China

B. Analysis on the Academic Influence

The citation times of authors can reflect their influence in a certain discipline to a certain extent [33]. In order to explore the authors with high influence in land use coupling studies in foreign literatures, the node type was used as the Reference and Cited Author, Slice was 2 years, Top N was 35, Top N% was 10%, and others were the default settings, and the co-cited clustering view was drawn (Fig. 4). There were 443 nodes and 1983 lines in the co-cited cluster view. In terms of total citations, in the WOS database, Taylor's articles had been cited 97 times since 1997, ranking first in the search period and field, followed by the research results of Bonan, Lawrence, Dee, Ipcc, Seneviratne, Core, Liu, etc., which were cited 52 ~ 81 times and relatively ahead. In terms of the degree of centrality, Bonan (0.22), Betts (0.22), Trenberth (0.14) and Lawrence (0.11) had centrality greater than 0.1. From the perspective of clustering, a total of 10 clusters were obtained. #0, #3, #4 and #9 were mainly used to study the land use coupling, and #6 was mainly used to study the land use coupling in land use transformation. #1 and #8 mainly were used to study the land use coupling in the aspects of climate affecting land use and land use affecting vegetation. It can be seen that scholars mainly conducted coupling studies on the impacts of land use transition, climate, vegetation and land use, and studied the research methods of land use coupling.

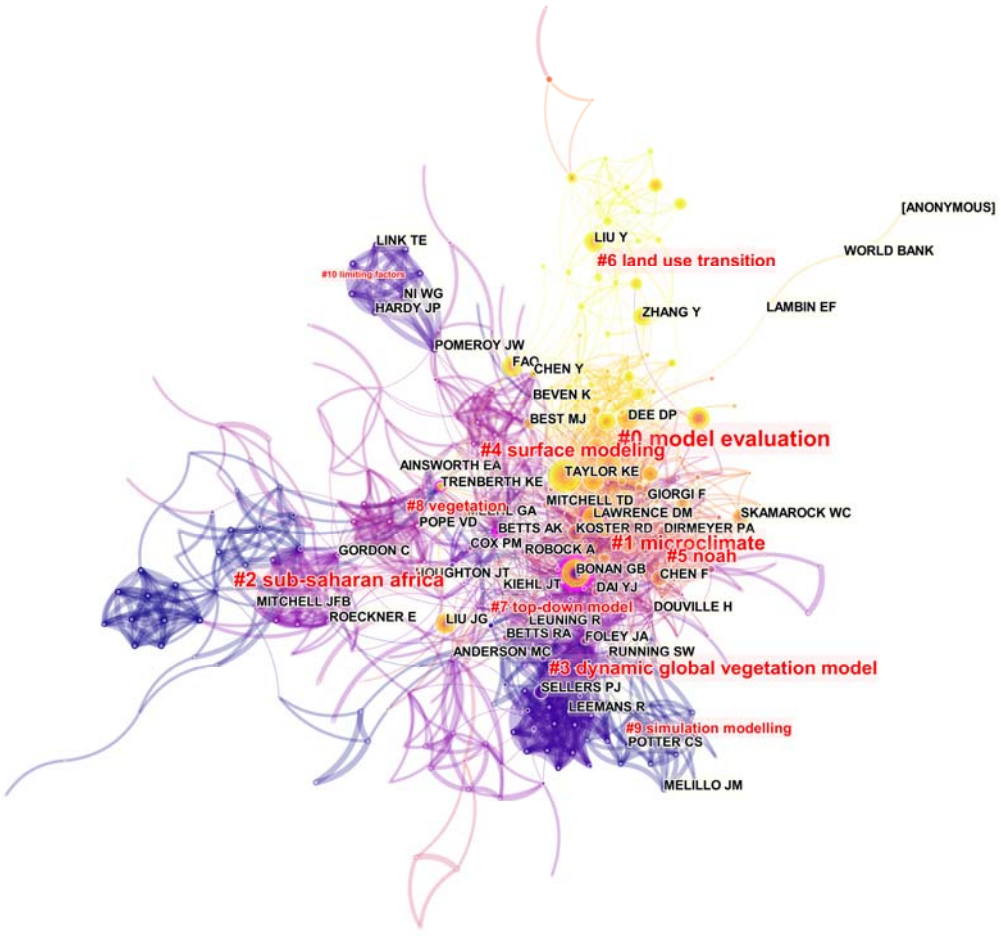

Fig. 4 The visual knowledge maps of high-impact authors in land use coupling studies

The literature category can be used to explore the research fields of various disciplinary institutions in land use coupling [34]. Select Category in the "Node Types" control panel, and the others were the system default settings to get the subject

structure clustering diagram (Fig. 5). As can be seen from the structural clustering map, the top five publications were Environmental Science & Ecology (918), Environmental Science (663), and Meteorology & Atmospheric Science (580), Meteorology & Atmospheric Sciences (580), and Geology (430). Ecology and Environmental Science were the main dominant disciplines of land use coupling research. Literatures on land use coupling research were mainly published in such journals, among which Environmental Science & Ecology accounted for about 1/3 of the publications. It can fully explain the importance and relevance of this research direction in land use coupling research. In addition, research directions such as Geosciences, Multidisciplinary (427), Engineering (338), Water Resources (313) and Ecology (309) had strong connections with land use coupling. It indicated that the coupling research of land use had gradually changed from a single subject to a multidisciplinary research trend.

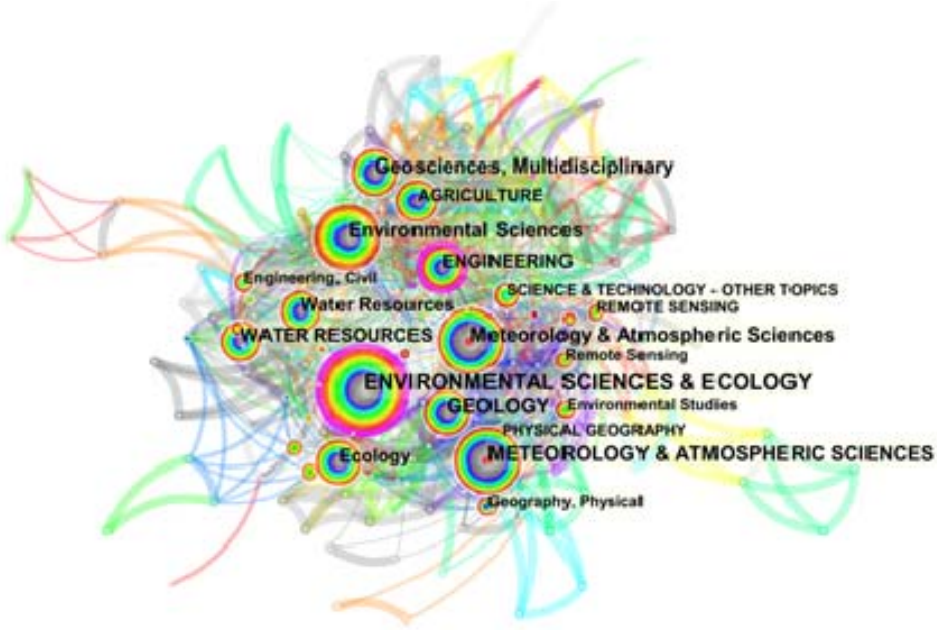

Fig. 5 The visualized knowledge graph of disciplinary institutions researching on land use coupling

C. Analysis on the Research Progress and Trend

Keywords are a high-level summary of the themes and core contents of literature research [35]. Through keyword detection, the research trends and hotspots in land use coupling can be obtained. We select the "Term" and "Keywords" options in the "Node Type" control panel, and let Top N be equal to 30. On the Pruning panel, the "Pathfinder", "Pruning networks" and "Pruning the merged network" options were selected to obtain the keyword co-occurrence graph (Fig. 6). There were 213 nodes and 402 lines in the keyword co-occurrence map (Fig. 6). Judging from the co-occurrence frequency of keywords, the top three keywords were "model" (299), "climate change" (249), "land use" (240). The foreign literature focused on land use coupling research, coupled model and climate change. From the perspective of keywords centrality intensity, the top five centralities were land use (0.34), sensitivity (0.30), climate change (0.29), pattern (0.28), climate (0.27). Therefore, it can be seen that land use pattern, sensitivity research and climate change were the main directions of land use coupling research.

In the Control Panel Control Panel, we click Burstness options, with the system default settings, the former 20 highlight words were highlighted by time to get the key words emergence time graph (Fig. 7). The chronology of keyword emergence was further obtained through time highlighting. From the perspective of emergent intensity, among the 20 emergent words, the ones with higher connection intensity were "ecosystem service" (12.48), "China" (13.23), "biodiversity" (8.98), "conservation" (9.47), "scale" (8.61), reflecting the degree of its impact on land use coupling research. Judging from the starting year of the emergent keywords, the "Sensitivity" (1997-2004), "Landscape" (2009-2012) and "Prediction" (2001-2011), indicated that there were many studies on sensitivity, landscape, and prediction of land use coupling during 1997-2012. From "ecosystem" (2011-2014) and "gi" (2012-2014), it can be seen that in 2011-2014, scholars began to link land use coupling research with ecosystems, and the hot research method was “gi” index. From "modi" (2015-2016), "conservation" (2016-2018), "scale" (2016-2018), "China" (2017-2020), "ecosystem service" (2017-2020), “biodiversity” (2017-2020) and “land surface” (2018-2020), it can be seen that in the past five years, scholars have mainly focused on the methods of land use coupling research, the coupling research on land use and ecosystem services, and the research on land use coupling in China was relatively active.

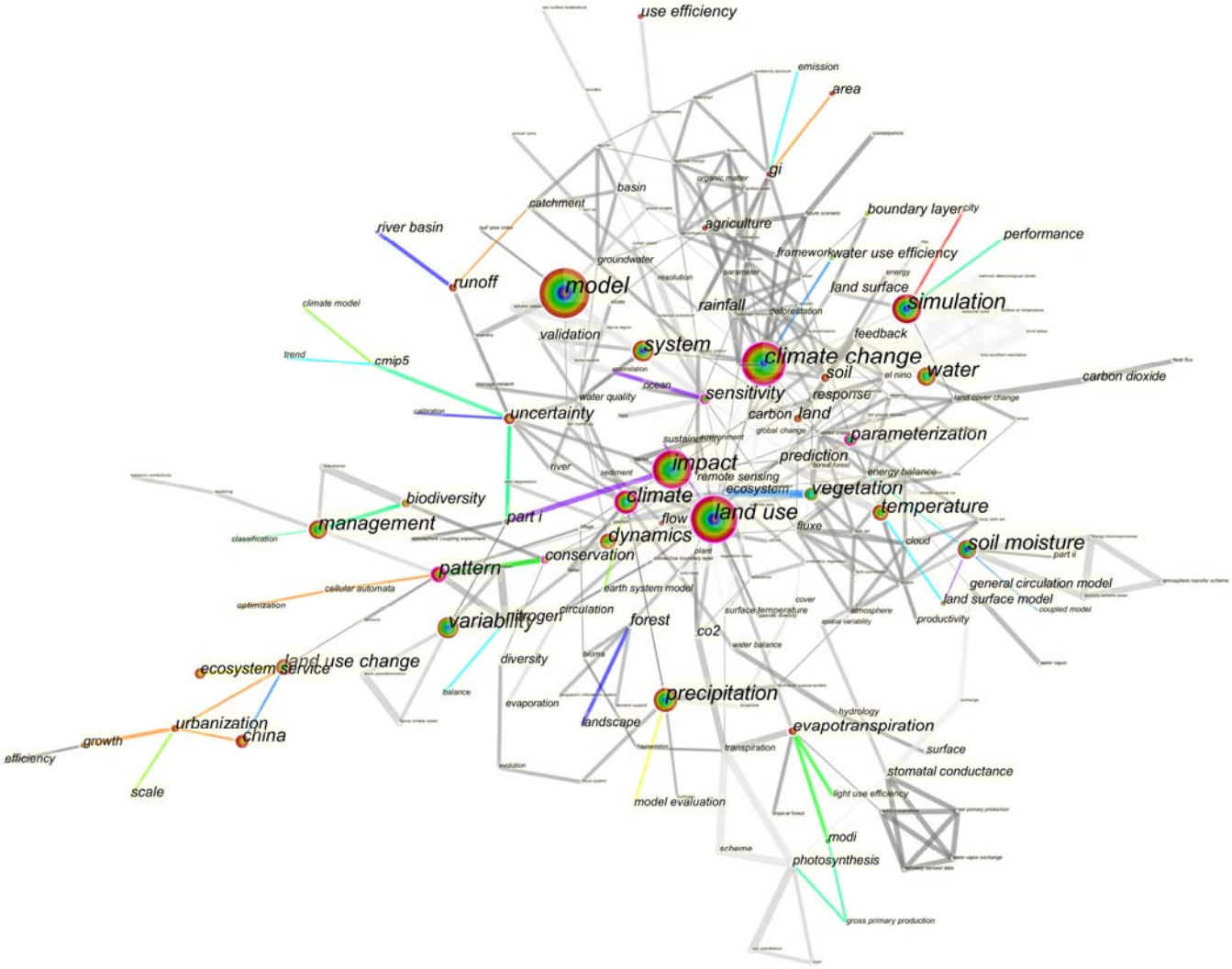

Fig. 6 The visual knowledge graph of keywords in land use coupling research

Keywords	Year	Strength	Begin	End	1997 - 2020
sensitivity	1997	6.86	1997	2004	
general circulation model	1997	8.19	1998	2009	
prediction	1997	7.36	2001	2011	
carbon dioxide	1997	7.56	2002	2011	
landscape	1997	7.19	2009	2012	
rainfall	1997	6.67	2010	2014	
ecosystem	1997	7.01	2011	2014	
runoff	1997	6.87	2011	2015	
gi	1997	7.1	2012	2014	
emission	1997	6.79	2013	2014	
cmip5	1997	7.84	2014	2017	
photosynthesis	1997	6.81	2014	2015	
modi	1997	9.27	2015	2016	
conservation	1997	9.47	2016	2018	
water use efficiency	1997	8.78	2016	2017	
scale	1997	8.61	2016	2018	
china	1997	13.23	2017	2020	
ecosystem service	1997	12.48	2017	2020	
biodiversity	1997	8.98	2017	2020	
land surface	1997	7.39	2018	2020	

Fig. 7 The top 20 key words emergence map of land use coupling study

IV. Discussion and Conclusions

A. Discussion

The conflicts between the characteristics of ecosystem vulnerability and high-intensity human activities, and the problems of resource, environment and ecological security brought by land use change are increasingly prominent [36], [37]. With the help of software analysis, it can be known that the coupling of land use and ecosystem services has become a hot and frontier field of land use coupling. Land use/land cover is an important carrier of social and economic development and human activities [38]. Land use/land cover change mainly refers to the spatio-temporal change of regional land use, which is the result of long-term effects of natural and human factors and reflects the long-term cumulative impacts of natural and human factors, can reflect the coupling relationship between human and land [39], [40]. At present, it has become the research focus of many scholars to discuss the dynamic change process and formation mechanism of land use from the perspective of the coupling of human activities and natural environment, and explore the dynamic change law of land use

[41] and its impact on environmental ecology from different levels [42], [43].

Through the visual analysis of more than 20 years of published English literature, it can be clear that the land use coupling research had achieved comprehensive and continuous development and progress, but there were some obvious shortcomings. At present, most research focused on key or hot spots such as rapid socio-economic development areas, fragile ecological environment areas, urban fringe areas, etc., but there were relatively few researches below the county scale, especially in some economically backward mountainous areas, which had not attracted enough attention and formed a weightier research system. At the same time, there were few top journals with published literatures, the industry influence was not high, the regional restrictions had not been broken, and the cooperation among research institutions was still not enough.

B. Conclusions

1. The United States, China, and Germany issued many documents. It showed that the United States had invested a lot in scientific research in land use coupling research, and the research results had been remarkable. Although China ranked second in the number of foreign-language literature, its centrality was small, its influence was insufficient, and its research achievements were not significant enough, and higher-level research efforts were still needed.
2. From the perspective of research institutions, the number of papers produced by the Chinese Academy of Sciences was the highest. Among the top ten paper producing institutions, the countries of these institutions were China and the United States, indicating that China and the United States were active in the study of land use coupling, and most of the high-yielding institutions were universities.
3. Judging from the number of papers published by disciplinary institutions, the top ten institutions had published more than 300 papers, and the phenomenon of multi-disciplinary crossover had gradually appeared in the field of land use coupling research. The literature published by these research institutions had certain representativeness and reference value in the field of land use coupling research.
4. From the perspective of co-occurrence of keywords, land use coupling mainly focused on the study of land use, land use coupling model, climate change, etc.

To sum up, Cite Space software was applied to make a visual map analysis of the literature on land use coupling in WOS database. It had been showing the research hotspots in this field, delineating the research context, and sorting out the research progress. Land use pattern, land sensitivity research, and the impact of climate change on land use pattern were the main directions of land use coupling research. In the past five years, scholars have mainly focused on land use coupling research methods, coupling research on land use and ecosystem services, and the research on land use coupling in China was more prominent.

REFERENCES

[1] W. Zhang, Y. Y. Zhou, and G. W. Hu, "Coupling mechanism and space-time coordination of new-approach urbanization, new-approach Industrialization and service industry modernization in megacity behemoths: a case study of ten cities in China," Scientia Geographica Sinica, vol. 33, no. 5, pp. 562-579, 2013.

[2] Z. L. Li, "Research on the coupling mechanism and coordinated development of rural revitalization-rural tourism system: A case study on Fenghuang County in Hunan," Geographical Research, vol. 38, no. 3, pp. 643–654, 2019.

[3] K. E. Weich, "Educational organizations as loosely coupled system," Administrative Science Quarterly, vol. 21, no. 1, pp. 1–19, 1976.

[4] J. G. Liu, "Integration across a metacoupled world," Ecology and Society, vol. 22, no. 4, pp. 19, 2017.

[5] C. J. Wu, "On the research core of geography-regional system of human-land relationship", Economic Geography, vol. 11, no. 3, pp. 1–6, 1991.

[6] B. J. Fu, "The integrated studies of geography: Coupling of patterns and processes," Acta Geographica Sinica, vol. 69, no. 8, pp. 1052–1059, 2014.

[7] Y. L. Zhao, X. F. Wei, and X. B. Li, "Study on the land use coupling evolution of mountain-basin systems in karst areas," Carsologica Sinica, vol. 39, no. 1, pp. 48–53, 2020.

[8] J. Interová, J. Krása, M. Bauer, N. Noreika, and T. Dostál, "Using WaTEM/SEDEM to model the effects of crop rotation and changes in land use on sediment transport in the Vrchlice Watershed," Sustainability, vol. 14, no. 10, pp. 5748–5748, 2022.

[9] M. Lippe, L. Rummel, and S. Günter, "Simulating land use and land cover change under contrasting levels of policy enforcement and its spatially-explicit impact on tropical forest landscapes in Ecuador," Land Use Policy, vol. 119, no. 2022, 2022.

[10] T. Y. Lu, D. X. Xu, J. X. Song, J. H. Guo, X. J. You, and Y. Jiang, "Impacts of land use changes on ecosystem services at different elevations in an ecological function area, northern China," Ecological Indicators, vol. 140, no. 2022, 2022.

[11] C. L. Fang, C. H. Zhou, C. L. Gu, L. D. Chen, and S. C. Li, "Theoretical analysis of interactive coupled effects between urbanization and eco-environment in mega-urban agglomerations," Acta Geographica Sinica, vol. 71, no. 4, pp. 531–550, 2016.

[12] Y. F. Ren, C. L. Fang, C. Bao, G. D. Li, and R. W. Liu, "Progress in local and tele-coupling relationship between urbanization and eco-environment," Acta Gegographica Sinica, vol. 75, no. 2, pp. 1–18, 2018.

[13] Y. Xing, L. Yue, W. L. Zhang, and Q. J. Hu, "Research on coordination of land use and economic growth in Duyun based on coupling coordination degree model," Chinese Journal of Agricultural Resources and Regional Planning, vol. 40, no. 4, pp. 128–134+216, 2019.

[14] X. Y. Xiong and Y. M. Xu, "Linear coupling and canonical correlation analysis on land use change and economic effects," Statistics & Decision, vol. 34, no. 10, pp. 104–107, 2018.

[15] C. L. Fang, Y. F. Ren, "Analysis of near-distance coupling energy metabolic efficiency and environmental pressure between urbanization and eco-environment in Beijing-Tianjin-Hebei urban agglomeration," Scientia Sinica Terrae, vol. 47, no. 7, pp. 833–846, 2017.

[16] K. C. Su, Q. Y. Yang, B. L. Zhang, and Z. X. Zhang, "The coupling mechanism between rural land use transition and small-scale peasant economy change in mountainous areas," Geographical Research, vol. 38, no. 2, pp. 399–413, 2019.

[17] H. L. Long, D. Z. Ge, J. Y. Wang, "Progress and prospects of the coupling research on land use transitions and rural transformation development, Acta Geographica Sinica, vol. 74, no. 12, pp. 2547–2559, 2019.

[18] X. Wang, L. L. Yao, Y. Li, and X. H. Chen, "Coordination and its spatio-temporal differentiation of new-type urbanization and intensive land use: case studies of the cities in Heilongjiang Province," Economic Geography, vol. 37, no. 5, pp. 173–180, 2017.

[19] X. H. Lu, D. L. Chen, and B. Kuang, "Coupling effect of industrial integration and urban land use efficiency: taking the urban agglomeration of the middle reaches of the Yangtze River as a case," China Land Science, vol. 32, no. 9, pp. 66–73, 2018.

[20] X. Q. Li, B. Jiang, Y. Mi, Y. Sun, and Y. Han, "Characteristics of spatial and temporal differentiation of coupling coordination between intensive land utilization and new urbanization in urban agglomerations in middle and upper reaches of the Yangtze River," Research of Soil and Water Conservation, vol. 24, no. 5, pp. 291–297, 2017.

[21] Z. Q. Zhang, Y. L. Lao, C. Z. He, J. H. Wei, and B. Q. Hu, "Mechanism of land use functions and their spatio-temporal differentiation of coupling coordination degree: Taking Guangxi as an example," Journal of Agricultural Resources and Environment, vol. 38, no. 2, pp. 317–331, 2021.
[22] Q. Zhang, J. A. Li, and H. Y. An, "The study on coupling coordination degree and spatial-temporal change of land use comprehensive benefits in plain-mountainous transitional belt: take Leshan City as an example in Sichuan," Journal of Sichuan Normal University (Natural Science), vol. 44, no. 2, pp. 262–269, 2021.
[23] F. Wang and C. S. Ye, "Coupling relationship between rural transformation and land use change in ecological economic zone of Poyang Lake," Research of Soil and Water Conservation, vol. 25, no. 6, pp. 284–231, 2018.
[24] Y. L. Liu et al., "Spatio-temporal coupling relationship between multi-functionality of land use and multi-dimensional poverty in China's southwestern mountainous areas," China population, resources and environment, vol. 30, no. 10, pp. 154–164, 2020.
[25] K. Y. Zhu, R. Lin, and H. Li, "Study of virtual reality for mild cognitive impairment: A bibliometric analysis using CiteSpace," International Journal of Nursing Sciences, vol. 9, no. 1, pp. 129–136, 2021.
[26] H. F. Luo et al., "Study on pain catastrophizing from 2010 to 2020: a bibliometric analysis via CiteSpace," Frontiers in Psychology, vol. 12, no. 2021, pp. 759347, 2021.
[27] J. S. Chu, M. Cao, L. L. Zhao, Y. G. Zhu, and X. G. Hong, "Bibliometrics and visualization analysis of EwE model based on CiteSpace," Chinese Journal of Applied Ecology, vol. 32, no. 2, pp. 763–770, 2021.
[28] Y. Z. Liu, "Research progress and trend analysis of computer vision based on cite space," Journal of Physics: Conference Series, vol. 1941, no. 1, 2021.
[29] T. Z. Cao, D. M. Han, X. F. Song, W. Liu, and D. Du, "Bibliometric analysis of research progress on coastal surface water and groundwater interaction," Advances in Earth Science, vol. 35, no. 2, pp. 154–166, 2020.
[30] L. Yang et al., "Phytoremediation of heavy metal pollution: Hotspots and future prospects," Ecotoxicology and Environmental Safety, vol. 234, no. 2022, pp. 113403, 2022.
[31] Y. Li and X. Qi, "CiteSpace-based government WeChat research literature measurement and research trend analysis," Procedia Computer Science, vol. 199, no. 2022, pp. 665–673, 2022.
[32] X. N. Liu, "A visualization analysis on researchers of internet finance credit risk in coastal area," Journal of Coastal Research, vol. 103, no. 1, pp. 85–89, 2020.
[33] W. R. Zhang, K. Yan, H. Z. Wang, and J. M. Xu, "Bibliometric analysis of research progress on polycyclic aromatic hydrocarbons degrading genes during 1983–2019," Acta Scientiae Circumstantiae, vol. 40, no. 3, pp. 1138–1148, 2020.
[34] C. X. Deng et al., "Progress of research regarding the trade-offs of ecosystem services," Chinese Journal of Eco-Agriculture, vol. 28, no. 10, pp. 1509–1522, 2020.
[35] H. L. Zhao and J. Zhang, "Research progress and hotspot analysis of flood and drought disasters in China based on Citespace and Vosviewer," Acta Ecologica Sinica, vol. 40, no. 12, pp. 4219–4228, 2020.
[36] X. F. Chen, S. M. Yao, L. C. Zhang, "The theory and practice of urban-rural integration in China under the new urbanization," Scientia Geographica Sinica, vol. 36, no. 2, pp. 188–195, 2016.
[37] L. Wu, J. Zhou, B. Xie, S. Yang and J. Li, "Spatiotemporal differences of land use pattern between mountainous areas and basin areas at township scale: A case study of Yuxi City, " Front. Environ. Sci., vol. 10, 1029917, 2022.
[38] D. Smiraglia, T. Ceccarelli, S. Bajocco, et al. "Unraveling landscape complexity: land use/land cover changes and landscape pattern dynamics (1954–2008) in contrasting peri-urban and agro-forest regions of Northern Italy," Environmental Management, vol. 56, no. 4, pp. 916–932, 2015.
[39] M. F. Gondwe, M. A. Cho, P. W. Chirwa, et al. "Land use land cover change and the comparative impact of co-management and government-management on the forest cover in Malawi (1999–2018), " Journal of Land Use Science, vol. 14, no. 4-6, pp. 281–230, 2019.
[40] I. E. Olorunfemi, J. T. Fasinmirin, A. A. Olufayo, et al. "GIS and remote sensing-based analysis of the impacts of land use/land cover change (LULCC) on the environmental sustainability of Ekiti State, southwestern Nigeria," Environment Development and Sustainability, vol.22, no. 2, pp. 661–692, 2020.
[41] H. Solomon, W. Bewket, J. Nyssen, et al. "Analyzing past land use land cover change and CA-Markov-based future modelling in the Middle Suluh Valley, Northern Ethiopia," Geocarto International, vol. 35, no. 3, pp. 225–255, 2020.
[42] N. K. Msofe, L. X. Sheng, Z. X. Li, et al. "Impact of land use/cover change on ecosystem service values in the Kilombero Valley Floodplain, Southeastern Tanzania," Forests, vol. 11, no. 1, pp. 17, 2020.
[43] M. S. Meer, A. K. Mishra. "Land use/land cover changes over a district in Northern India using remote sensing and GIS and their impact on society and environment," Journal of the Geological Society of India, vol. 95, no. 1, pp. 179–182, 2020.