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Review

Research Progress on Features and Characteristics of Rural Settlements: Literature Distribution, Key Issues, and Development Trends

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Abstract: During the development of rural settlements, the loss of distinctive rural characteristics, caused by the contradiction between urban expansion and the ideal of pastoralism, has attracted widespread attention from researchers worldwide. To effectively understand the development and trends of the Research of Features and Characteristics of Rural Settlements (abbreviated as RFCRS), this paper uses the knowledge mapping software CiteSpace to conduct co-citation analysis, research collaboration analysis, keyword clustering, and keyword co-occurrence. The study analyzes the basic concepts, the literature distribution characteristics, research clusters, key issues, and development trends of RFCRS. The research found that the current key research topics in RFCRS include "Ecological services and environmental protection of rural settlements", "Sustainable planning and architectural design issues of rural settlements", and "Human settlement environment and service facility construction of rural settlements". This paper predicts that future RFCRS research trends will focus on the study of landscape features and characteristics based on ecology, climate, and aesthetics; study of architectural features and characteristics based on characteristic factors and hierarchical structure; and research on rural revitalization based on sustainable development principles. The paper also offers four priority research suggestions for researchers from different disciplines.

Keywords: rural settlements; features and characteristics; literature distribution; key issues; development trend; bibliometric; knowledge mapping

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1. Introduction

Settlements, as places for human habitation and life, encompass various forms of population concentration within specific geographic environments. The definition and understanding of rural settlements exhibit subtle variations across different academic disciplines and theoretical frameworks. For instance, when viewed from the perspectives of settlement geography [1] and human settlement studies [2,3], settlements can be subdivided into rural settlements and urban settlements, with the two considered as parallel entities within this framework. However, within the context of urban and regional planning, rural settlements are more often regarded as a specific stage or component of the urbanization process, as elaborated upon in the detailed discussions by Pan and Gencer in their papers [4,5]. Rural settlements are fundamental social spaces formed by residents based on their production and living needs, serving as the basic units of traditional agrarian societies [6]. They are significant social entities that reflect the relationship between people

and the land, historical backgrounds, and socio-political relationships [7–9]. Rural settlements are characterized by low population density, close-knit social structures, and reliance on local resources. The distinctive feature of the countryside comes from its antithetical position to the city, and its rurality is expressed as multiple social spaces overlapping in the same geographic area [10]. Cloke defined rurality as "a condition of place-based homeliness shared by people with common ancestry or heritage and who inhabit traditional, culturally defined areas or places statutorily recognized to be rural [11]". Some researchers have also defined rurality in terms of three aspects of land use, the relevance between architecture and landscape, and lifestyle in rural settlements [10,12]. Researchers from different professional backgrounds have different definitions of the features and characteristics of rural settlements. In this paper, the features and characteristics of Rural settlements are regarded as unique settlement attributes that have developed over extended periods of human production and life. They are specific to the local natural environment and regional culture, manifested in the material and non-material elements of rural settlements, including site selection and layout, landscape patterns, spatial forms, architectural styles, production and life, historical and cultural aspects, folk customs, and religious elements, all adapted to the local context.

RFCRS originated in Western Europe in the 1840s. Early researchers such as Kohl, J. G., Meitzen, A., Lugeon, M., Blache, V., and Brunhes, J. were primarily concerned with the formation, evolution, and the relationship between rural settlements and the natural environment. Research methods during this period were predominantly descriptive [13]. Starting from the 1920s, as research progressed, the features and characteristics of rural settlements gradually became a common subject of study across disciplines such as architecture, urban and rural planning, landscape architecture, and rural geography. In architecture, RFCRS primarily approached the topic from two dimensions: people's perceptions of the spiritual and traditional cultural aspects of rural settlement places and the material representations required to form the features and characteristics of rural settlements. It included research on overall layouts, street and alley spaces, architectural complexes, and decorative elements [14,15].

In comparison, the urban and rural planning discipline pays more attention to the coupling between the morphological changes in villages and the spatial evolution of cities [4]. It pays attention to the influence of environmental characteristics such as the natural environment, topography, climate, and economic conditions on rural settlements' planning, design, and architectural features [5]. In the discipline of landscape architecture, researchers generally believe that features and characteristics of rural settlements are a form of landscape that carries information about the ecology of rural habitat, history and culture, and construction and creation, and introduces the "gene (genes) [16]", "morphology", and "architecture". "Genetic concepts such as "genes" and "morphogenesis" [17] are introduced, and "cultural landscape" [18,19] is proposed, "landscape genes" [20] to explain the landscape pattern of rural settlements, ecological landscape, humanistic landscape, landscape aesthetics, and other topics. In rural geography, RFCRS started from the descriptive analysis and causal explanation between the static spatial pattern and natural geography at the village scale. Since the 1990s, it has gradually moved towards the spatial analysis and development prediction of rural settlements at the regional scale [21,22] and begun to pay attention to the role of human decision-making behaviors in changing the macroscopic layout and spatial structure of rural settlements [23].

In rural settlement development, the expansion of urbanization and the ideals of pastoralism inevitably give rise to certain contradictions and conflicts. With the accelerated global urbanization process, issues have emerged, such as the urbanization of village forms, homogenization of architectural styles, industrialization of building materials, and urbanization of rural landscapes, all related to the features and characteristics of rural settlements. Given the broad disciplinary scope and complex research topics of Research on Features and Characteristics of Rural Settlements (hereinafter referred to as RFCRS), new characteristics are evident in research perspectives, content, methods, and paradigms.

Hence, a diverse, temporal, and visual literature measurement analysis of existing RFCRS research results is necessary. Currently, RFCRS research involves content, theory, and methodology across multiple dimensions, including social, economic, and cultural, and is important in six areas: historical and cultural preservation [24], rural development and planning [25], ecological and environmental impacts [26], socio-economic dynamics [27], climate change and sustainability [28], and health and well-being [29]. The RFCRS study not only helps to recognise the relevance of the regional culture, landscape pattern and architectural form of rural settlements, but also provides guidance for their planning and construction, industrial layout, and sustainable development. This study aims to accurately and intuitively grasp the fundamental features, evolutionary patterns, research topics, and development nnnnnnnnnn of current RFCRS research. This endeavor aims to provide valuable references and suggestions for researchers with varying professional backgrounds undertaking subsequent studies. The research framework of this paper is shown in Figure 1.

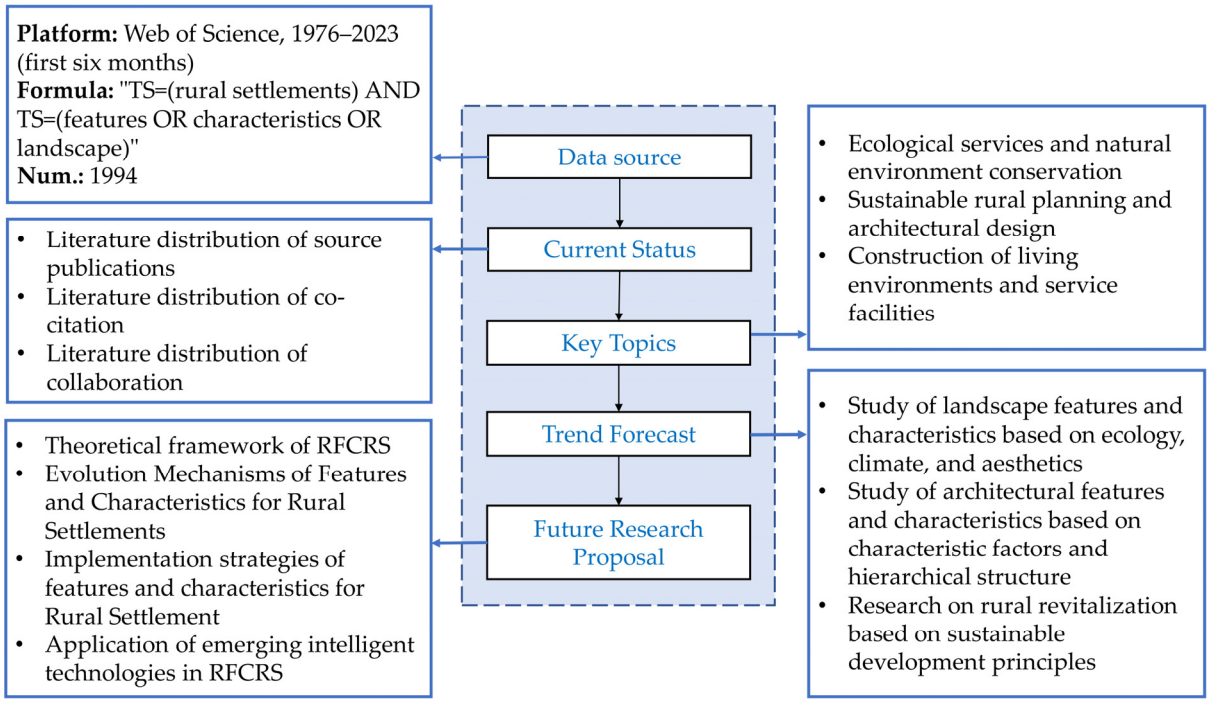

Figure 1. Research Framework of RFCRS.

2. Materials and Methods

CiteSpace, a knowledge mapping software based on the principle of bibliometrics, can detect and visualize the emerging trends and evolutionary features of a topic in different disciplines, reflecting the research dynamics based on the time-varying mapping of the research frontiers and knowledge base [30,31]. In this paper, we use CiteSpace (version 6.2.R3) to analyze the knowledge mapping of the RFCRS literature data to discover the potential knowledge links between many research results and clarify their development. According to the definition of the concept of "features and characteristics of Rural Settlements" above, and taking into account the differences in the expression of the concept in architecture, urban planning, landscape architecture, geography, and other disciplines, features, characteristics, and landscapes were used in the literature search. In the literature search, "features", "characteristics", and "landscape" were used as keywords.

In this paper, the core library of the world's largest English literature database, Web of Science (hereinafter referred to as WOS), was selected as the data source, and the retrieval time was 25 June 2023, and the retrieval time was "all years" (the default was 1975–2023), and the search mode was "subject" + "literature type". The search mode of "subject" + "document type" was selected, and the search formula was TS = (rural settlements) AND TS

= (features OR characteristics OR landscape). The language of the documents was limited to "English", and a total of 1994 entries were obtained, of which the earliest year of appearance was 1976. The bibliometric analyses of 1994 RFCRS documents in the Web of Science core database from 1976 to 2023 aimed to identify the distribution characteristics, research hotspots, and development trends of RFCRS. (1) Based on the WOS literature search data, to find the literature distribution characteristics of RFCRS including annual publication volume, discipline distribution, source publication and country distribution; (2) based on the bibliometric analyses of keyword co-occurrence, literature co-citation and temporal partitioning in CiteSpace, to clarify the developmental lineage and collaborative linkages of RFCRS; (3) based on the bibliometric analyses of keyword clustering and keyword emergence bibliometric analyses, to discover the current research hotspots and Key Issues of RFCRS; and (4) to predict the development trend of RFCRS, and to suggest priority research for its future development.

3. Results

3.1. The Literature Distribution Characteristics of RFCRS

3.1.1. The Trend of Annual Publications

The amount of knowledge, disciplinary characteristics, and leading countries in the research field can be reflected by the change in the volume of the literature, disciplines, and country distribution. Based on the online analysis function of WOS (Figure 2), it can be seen that the earliest RFCRS literature appeared in 1976, and the number of annual publications before 2010 was small (less than 50 publications per year), indicating that RFCRS was still in the exploratory stage at this time and had not yet been paid attention to; the number of publications during the period of 2010–2016 has shown a continuous and steady trend of growth, and the research has been gradually attracted attention. As of June 2023, the total number of pieces of RFCRS literature in the WOS core database is 1994. Among them, 225 documents were published in 2021, 245 documents were published in 2022, and 86 documents have already been published in 2023 (first 6 months). It is expected that the total number of publications in 2023 will exceed 300. The yearly increase in the attention of RFCRS indicates that this research is gradually becoming one of the current research hotspots.

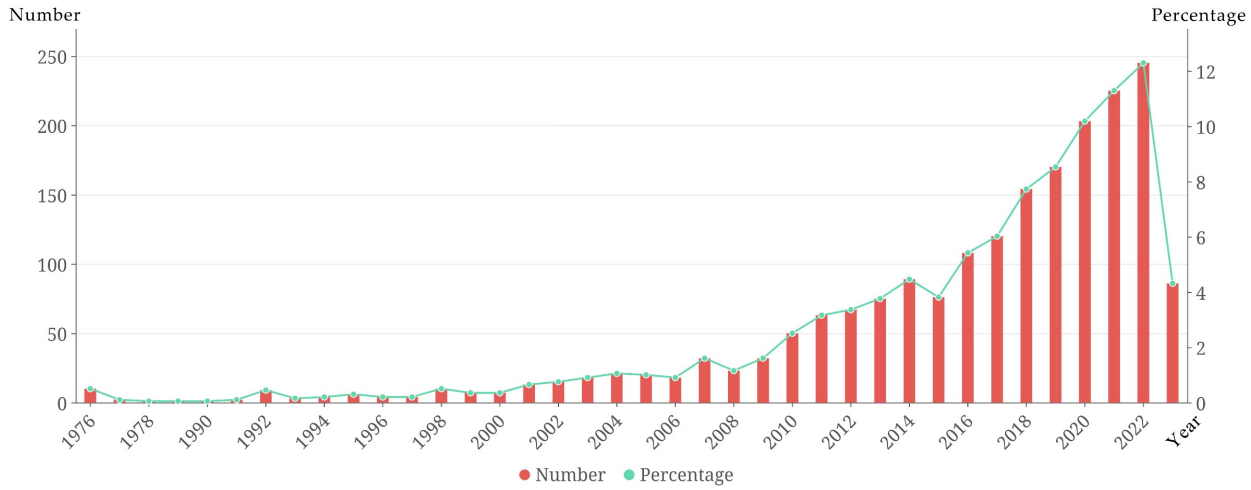

Figure 2. Analysis of annual publications of RFCRS from 1976 to 2023 (first 6 months).

3.1.2. Source Disciplines of the Literature

In terms of discipline distribution, RFCRS is concentrated in the disciplines of Environmental Studies (21.31 per cent), Environmental Sciences (20.21 per cent), and Geography (11.84 per cent). In addition, Regional Urban Planning (8.68%), Urban Studies (8.02%), Ecology (7.87%), Architecture (4.56%), Civil Engineering (Engineering Civil (3.66%), and

Economics (2.36%) are also covered. The above data indicate that RFCRS has gained wide attention from researchers and thus has multidisciplinary attributes (Figure 3).

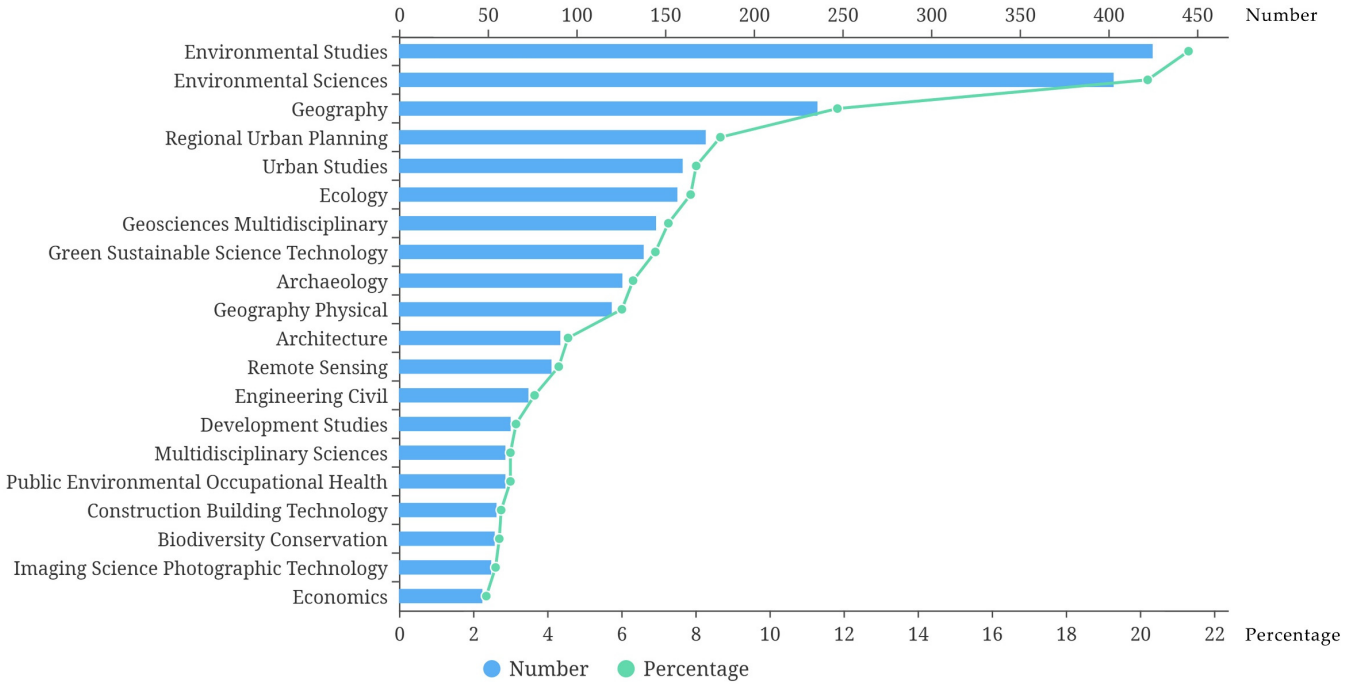

Figure 3. Distribution analysis of disciplines in RFCRS (top 20).

3.1.3. Source Publications of the Literature

In terms of source publications, there are a total of 1064 publications, of which the journals with the most significant number of articles are Sustainability and Land, accounting for 4.26 per cent and 3.86 per cent, respectively, while the proportion of other publications is not very different (Figure 4), and the top 10 publications are mainly on the theme of land use, urban planning, and human settlements development.

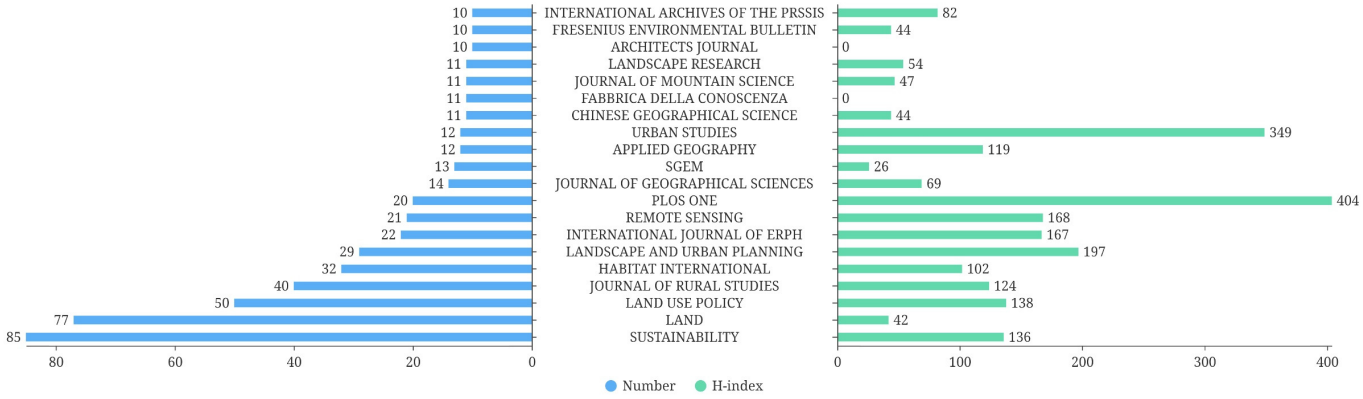

Figure 4. Distribution of RFCRS source publications (top 20).

3.1.4. Source Countries of the Literature

An analysis of the research literature by country shows that China has the most significant number of publications in the field of RFCRS (Figure 5, Table 1), with a total of 506 papers, followed by the United States, Italy, and the United Kingdom. Since 1976, RFCRS has been started in the UK, and the research results have steadily increased. In contrast, RFCRS in China started in 1999, which is a late start, but the number of RFCRS

papers published has increased dramatically in recent years, which indicates that the future development potential of RFCRS in China is enormous.

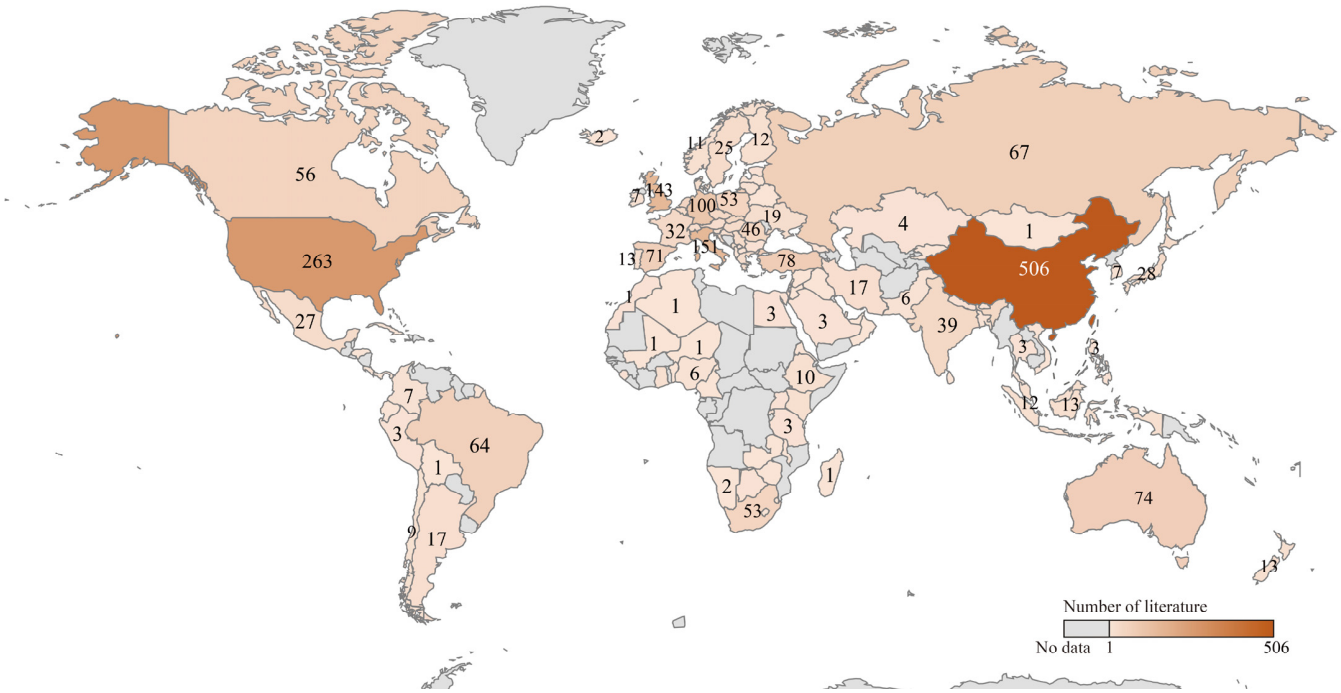

Figure 5. Analysis of source countries of the RFCRS literature.

Table 1. Numbers of publications in the top 20 countries of the RFCRS literature.

Numbers of Publications	Percentage	Country
506	25.38	China
263	13.19	USA
151	7.57	Italy
143	7.17	UK
100	5.02	Germany
78	3.91	Turkey
74	3.71	Australia
71	3.56	Spain
67	3.36	Russia
64	3.21	Brazil
56	2.81	Canada
53	2.66	Poland
53	2.66	South Africa
46	2.31	Romania
44	2.21	Netherlands
39	1.96	India
38	1.91	Slovakia
35	1.76	Czech Republic
32	1.60	France
28	1.40	Japan

3.2. Analysis of Co-Citation Characteristics of RFCRS

3.2.1. Co-Citation Journals

As an analytical method for investigating the structure of any specific research field, journal co-citation analysis can unveil the core journals and disciplinary attributes of the research area [32]. In this paper, we use the journal co-citation feature of CiteSpace to assess the importance of journals using citation rates. Citation rate means that two journals can be

considered co-cited when at least one of their articles is cited by another citing article [33], as shown in Figure 6. Each node represents a journal, and the lines between the nodes represent links that reflect the strength of the co-citation relationship, with the node size being proportional to the number of citations a particular journal receives. The larger the node, the more times the journal is cited, and the red circle represents the node's centrality, indicating that the journal has stronger links to other journals.

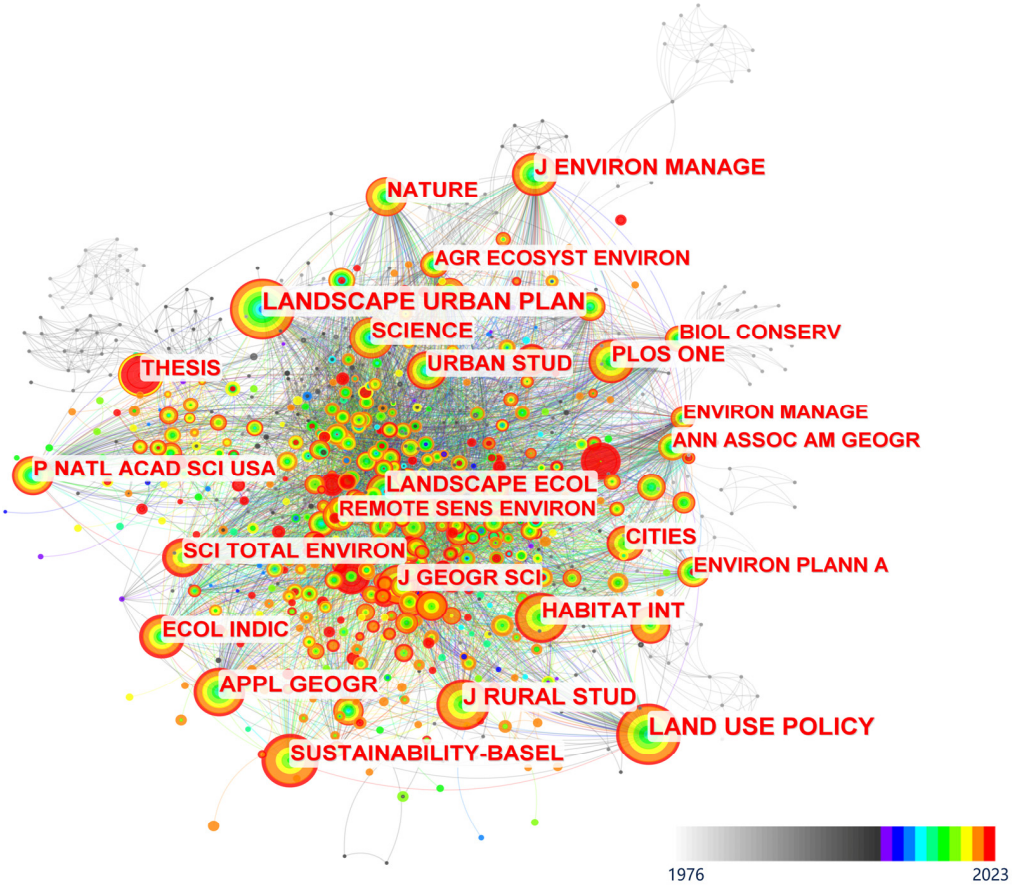

Figure 6. Co-citation analysis of journals in RFCRS. The colors in the graph represent the year in which the RFCRS journals were co-cited, with the more the color skewed toward red, the more recent the journals were co-cited.

Table 2 highlights the journals with more than 150 citations. The Landscape Urban Plan and Land Use journals are the most cited, suggesting that they publish very high-quality research in RFCRS, focusing on rural land spatial utilization [34], and are often cited by the relevant scientific community as core journals in the RFCRS field. Overall, the links between the various journals of RFCRS are relatively strong. This paper lists the 20 most influential journals (ranked by citations) in RFCRS-related research. It can be found that the types of journals in RFCRS cover a wide range of fields, such as land use policy, rural studies, applied geography, sustainable development, landscape ecology, environmental management, with multidisciplinary attributes.

Table 2. The top 20 co-cited journals in RFCRS.

Count	Centrality *	Year	Journals
498	0.03	2001	Landscape Urban Plan
457	0.03	2007	Land Use Policy
350	0.05	1998	J Rural Stud
331	0.02	2007	Appl Geogr
312	0.02	2006	Habitat Int
293	0	2015	Sustainability-Basel
270	0.06	2003	Science
265	0.04	2001	Landscape Ecol
262	0.03	2004	J Environ Manage
240	0.04	2004	Nature
230	0.02	2011	Plos One
212	0.06	2008	P Natl Acad Sci Usa
212	0.02	2011	Ecol Indic
201	0.01	2008	Cities
199	0	2013	Thesis
197	0.02	2012	Sci Total Environ
196	0.02	1992	Urban Stud
192	0.02	2010	J Geogr Sci
173	0.02	2004	Remote Sens Environ
171	0.03	2001	Agr Ecosyst Environ

* Centrality is a metric employed to assess the significance of the literature or nodes within a literary network. The centrality derived from the cumulative citations of a journal allows for the identification of pivotal journals within the entirety of the literary network.

3.2.2. Co-Citation Literature

Literature co-citation analyses can highlight the key literature at a particular research stage [35]. The higher the number of co-citations an article receives, the more the article may be fundamental or innovative in research, reflecting the core of the research field. In this paper, we use CiteSpace to visualize and analyze the core database of 1994 documents to generate a co-citation network based on the documents that have been co-cited more than 13 times in the RFCRS study and their primary authors and year of publication. Numerous nodes in Figure 7 represent the RFCRS research literature in the WOS core database. Among them, the node size is proportional to the importance and novelty of the literature, i.e., the larger the node, the more critical it is in RFCRS research; the node connecting lines represent the co-citation relationship between the RFCRS literature [36], i.e., the more the connecting lines are, the stronger the degree of co-citation is. Based on Figure 7, Table 3 further lists the top 20 most influential and highly cited articles in the field of RFCRS. It can be found that the most cited document is published by Liu, Y. et al. in 2017 [37], with a citation count of 49; the highly cited document with the earliest publication year is published by Long, H. et al. in 2012 [38], with a citation count of 14. The research contents of the top 20 highly cited documents are mainly related to rural revitalization [37,39], spatial optimization [34,40–44], sustainable development [45,46], rapid urbanization [34,47], and land use [38,48].

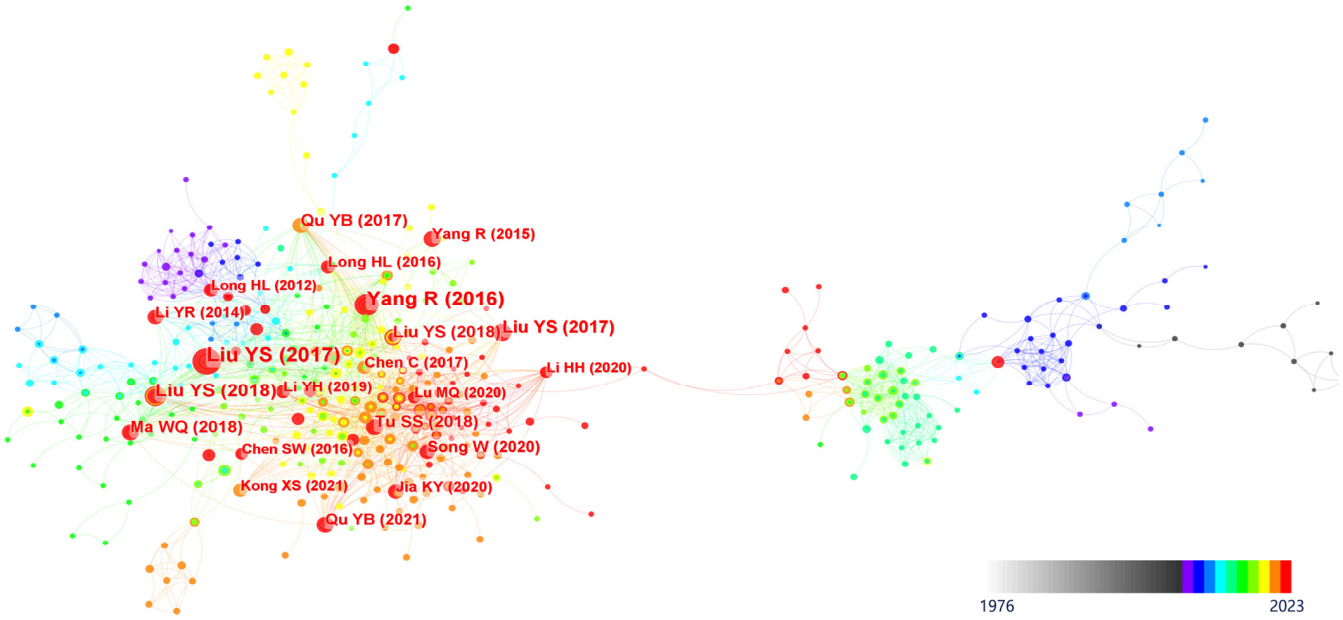

Figure 7. Co-citation analysis of the literature in RFCRS. The colors in the graph represent the year of publication of the RFCRS literature; the more reddish the color, the more recent the literature was published. For all literature in Figure 7, see references [34,37–55].

Table 3. The top 20 highly cited pieces of literature in RFCRS.

Number	Title	Citations	Year
1	Revitalize the world's countryside [37]	49	2017
2	R: A Language and Environment for Statistical Computing [49]	46	2020
3	Spatial distribution characteristics and optimized reconstruction analysis of China's rural settlements during the process of rapid urbanization [34]	39	2016
4	Introduction to land use and rural sustainability in China [45]	31	2018
5	Conversion from rural settlements and arable land under rapid urbanization in Beijing during 1985–2010 [47]	24	2017
6	Geographic identification, spatial differentiation, and formation mechanism of multifunction of rural settlements: A case study of 804 typical villages in Shandong Province, China [40]	21	2017
7	Rural restructuring at the village level under rapid urbanization in metropolitan suburbs of China and its implications for innovations in land use policy [50]	21	2018
8	Strategic adjustment of land use policy under the economic transformation [51]	20	2018
9	Rural settlements transition (RST) in a suburban area of metropolis: Internal structure perspectives [52]	19	2018
10	How does the rural settlement transition contribute to shaping sustainable rural development? Evidence from Shandong, China [46]	18	2021
11	Spatial pattern evolution of rural settlements from 1961 to 2030 in Tongzhou District, China [41]	18	2020
12	Community-based rural residential land consolidation and allocation can help to revitalize hollowed villages in traditional agricultural areas of China: Evidence from Dancheng County, Henan Province [39]	16	2014
13	Spatio-temporal characteristics of rural settlements and land use in the Bohai Rim of China [53]	16	2015
14	Rural restructuring in China [54]	15	2016
15	Spatial distribution characteristics of rural settlements under diversified rural production functions: A case of Taizhou, China [42]	15	2020
16	Why some rural areas decline while some others not: An overview of rural evolution in the world [55]	15	2019

Table 3. *Cont.*

Number	Title	Citations	Year
17	Institutional changes, land use dynamics, and the transition of rural settlements in suburban China: A case study of Huishan District in Wuxi city [48]	15	2017
18	Accelerated restructuring in rural China fueled by 'increasing vs. decreasing balance' land-use policy for dealing with hollowed villages [38]	14	2012
19	Spatial optimization of rural settlements based on the perspective of appropriateness–domination: A case of Xinyi City [43]	13	2020
20	Pattern of spatial evolution of rural settlements in the Jizhou District of China during 1962–2030 [44]	13	2020

3.2.3. Co-Citation Authors

This paper uses Citespace's author co-citation analysis feature [56] to identify the most influential and active authors in the RFCRS field. Each node in Figure 8 represents an author, and the links between nodes represent the strength of co-citation. The citation frequency is proportional to the node's size; the more significant the node and the more citations, the more critical the author's research is. Red circles in the nodes indicate authors with high emergent citations, which means that the authors have a sudden increase in citation frequency within a certain period [57]. In this paper, we set the minimum threshold for the visual analysis to 50 to highlight authors with more than 50 citations. Long, H. was cited 175 times, making him the most cited author and the most centrally cited author. Liu, Y. was the second most prolific author in the RFCRS, with a citation count 192. It is worth noting that several associations and organizations also have a very high co-citation frequency, such as the United Nations (47 citations), R Core Team (63 citations) and FAO (39 citations). Table 4 counts the top 20 highly cited authors whose research is mainly related to rural revitalization [37], spatial differences [34], and land use [51]. These statistics show that the space, land, and policy of rural settlements are an essential part of the research in RFCRS.

Table 4. The top 20 highly cited authors in RFCRS.

Count	Centrality *	Year	Authors
175	0.06	2008	Long H.L.
129	0.03	2010	Liu Y.S.
92	0.06	2010	Antrop M.
89	0.02	2017	Yang R.
69	0.02	2016	Li Y.R.
67	0.04	2009	Woods M.
63	0.02	2011	R Core Team
59	0.01	2018	Qu Y.B.
54	0.02	2015	Liu Y.
53	0.02	2017	Song W.
53	0.02	2016	Tian G.J.
52	0.01	2008	Tan M.H.
52	0.16	2007	Lambin E.F.
49	0.07	2008	Seto K.C.
47	0.02	2016	United Nations
46	0	2019	Li Y.H.
45	0.02	2014	Banski J.
44	0	2016	Zhang L.
43	0.04	2014	Salvati L.
40	0.01	2009	Chen C.

* Centrality is a measure of the importance of a document or node in a literature network, and the centrality of authors in co-citations identifies the principal co-authors in the overall literature network.

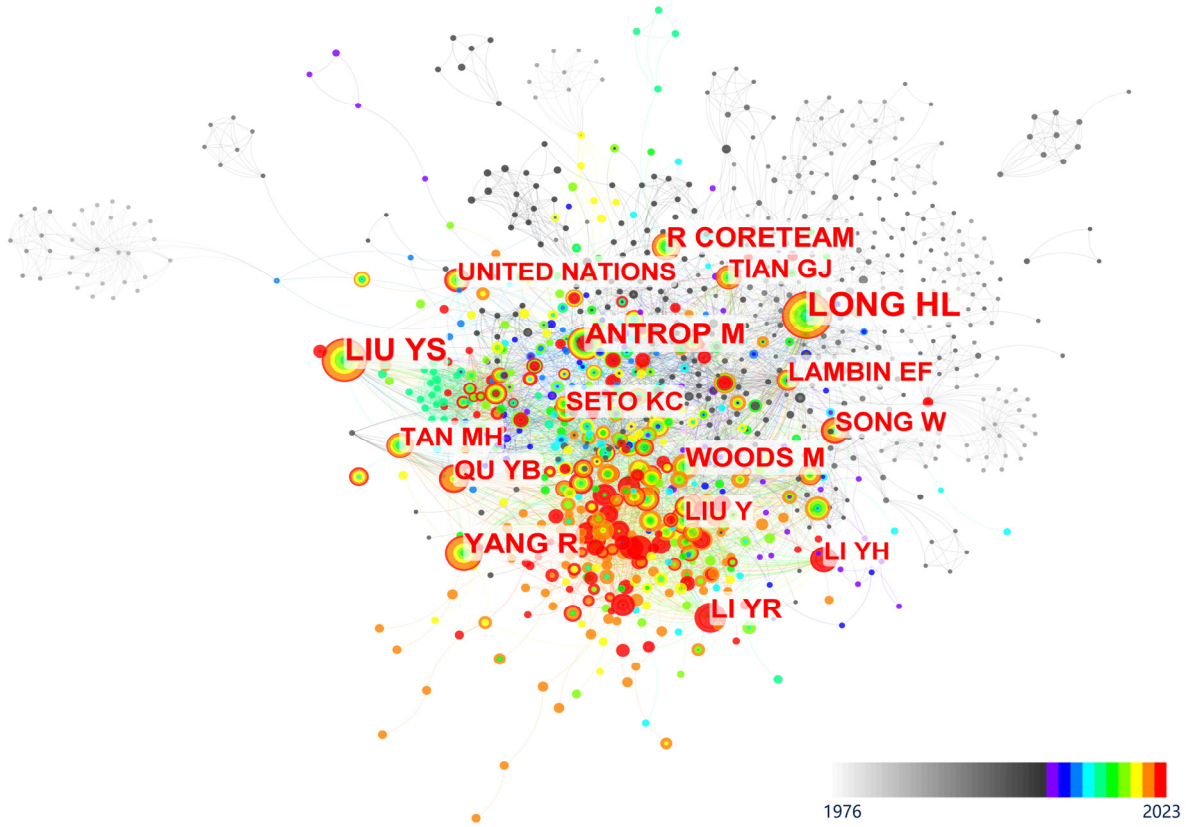

Figure 8. Co-citation analysis of authors in RFCRS. The colors in the figure correspond to the publication years when the works of RFCRS authors were collectively cited. A shift towards the red spectrum indicates a more recent timeframe in which the literature by these authors has been co-referenced.

3.3. Analysis of the Collaborative Characteristics in RFCRS

3.3.1. Collaborating Authors

Collaboration analysis is an effective method to investigate the level of collaboration between different authors in any scientific research field worldwide. In this study, three levels of scientific research collaboration network analyses were conducted using CiteSpace at the micro (authors), meso (institutions), and macro (countries) levels to demonstrate the level of collaboration at different levels. Figure 9 illustrates the degree of collaboration between RFCRS authors at the individual level, where the size of the nodes represents the number of publications the authors have collaborated on, while the distance between the different nodes and the thickness of the links represent the strength of the collaboration.

As can be seen in Figure 9, RFCRS has only one larger collaborative group in author collaboration, led by Salvati, L., which has the highest number of publications (23) and citations (21), with a total of 12 nodes and the other prominent members of this group are Salvia, R., et al. None of the authors are cited authors, and the second-largest research group is led by Li, Y., and has 2 nodes, including Liu, Y. and Chen, Z., both of which are highly cited authors in RFCRS. Combined with the top 20 most productive authors in RFCRS based on the number of publications listed in Table 5, there is not much collaboration between the two authors with more publications. A large proportion of the top 20 authors are still individual authors, and overall, RFCRS has a deplorable tendency to co-operate with each other at the micro-author level. Most RFCRS researchers tend to carry out their research as individuals or in small groups, and in the future, RFCRS could encourage researchers to collaborate to produce more and better quality research.

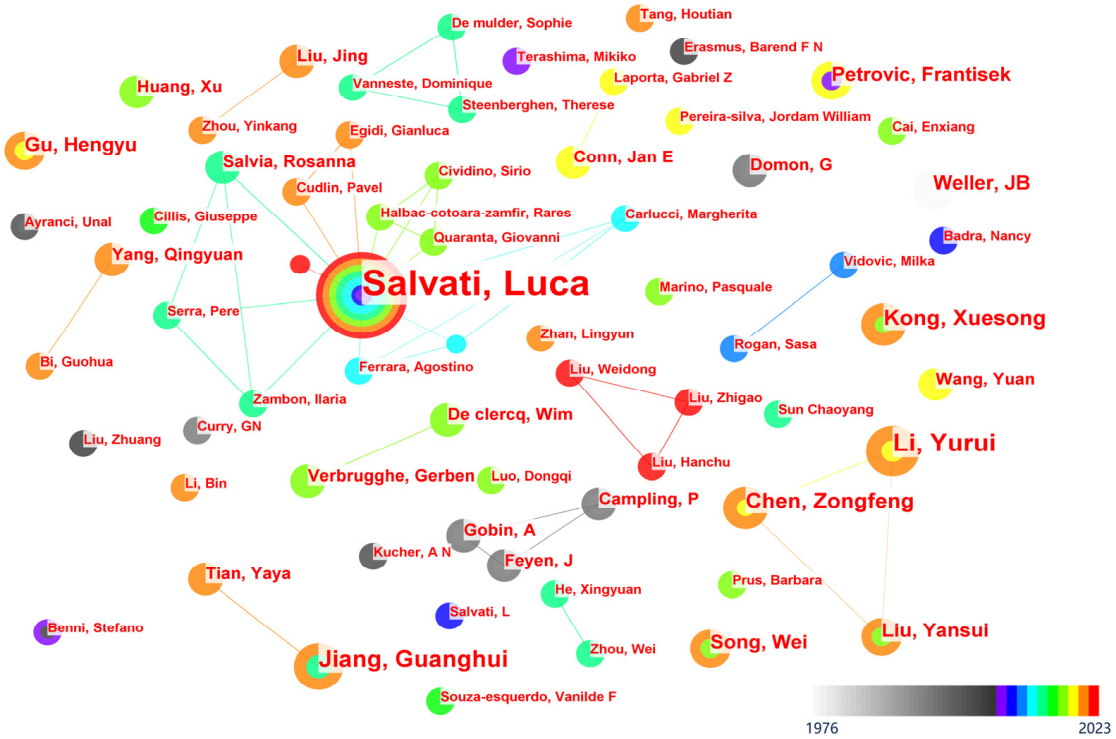

Figure 9. Co-operation analysis of RFCRS authors. The color spectrum in the figure signifies the temporal dimension of author collaborations within RFCRS. A shift towards the red hue indicates more recent collaborative efforts among authors, implying a more recent timeframe of collaborative engagements.

Table 5. The top 20 collaborating authors in RFCRS.

Count	Year	Authors
21	2014	Salvati, Luca
7	2021	Li, Yurui
6	2018	Jiang, Guanghui
5	2020	Kong, Xuesong
5	2021	Chen, Zongfeng
4	1976	Weller, JB
4	2020	Song, Wei
4	2020	Liu, Yansui
4	2021	Gu, Hengyu
4	2014	Petrovic, Frantisek
3	2001	Gobin, A
3	2001	Feyen, J
3	2001	Domon, G
3	2022	Tian, Yaya
3	2022	Liu, Jing
3	2001	Campling, P
3	2020	Huang, Xu
3	2022	Yang, Qingyuan
3	2020	De clercq, Wim
3	2021	Conn, Jan E

3.3.2. Collaborating Institutions

Literature cooperation analysis can reflect the cooperation of different academic institutions in RFCRS. This paper uses CiteSpace to calculate the cooperation analysis of different institutions. The node size in Figure 10 represents the number of articles published by the institution, and the connection between the node and the node represents the coordination and cooperation between different organizations. The more connections, the closer the organization cooperates with other organizations. It can be seen that the number of cooperations of RFCRS organizations is high, and the connections between the organizations are potent. As can be seen from Table 6, the Chinese Academy of Sciences (Chinese Academy of Sciences, Beijing, China) tops the list with 99 research papers, followed by Institute of Geographic Sciences & Natural Resources Research (Institute of Geographic Sciences & Natural Resources Research, Tianjin, China) and University of Chinese Academy of Sciences (University of Chinese Academy of Sciences, Beijing, China). The Institute of Geographic Sciences & Natural Resources Research of the Chinese Academy of Sciences and the University of Chinese Academy of Sciences led the list with 99 research papers, followed by 63 and 326 papers. The leading publishers of the study were from China, the UK and Russia. Among the top ten collaborating institutions, Chinese research institutions accounted for 60% of the publications, indicating that China attaches importance to RFCRS and has outstanding research contributions to RFCRS.

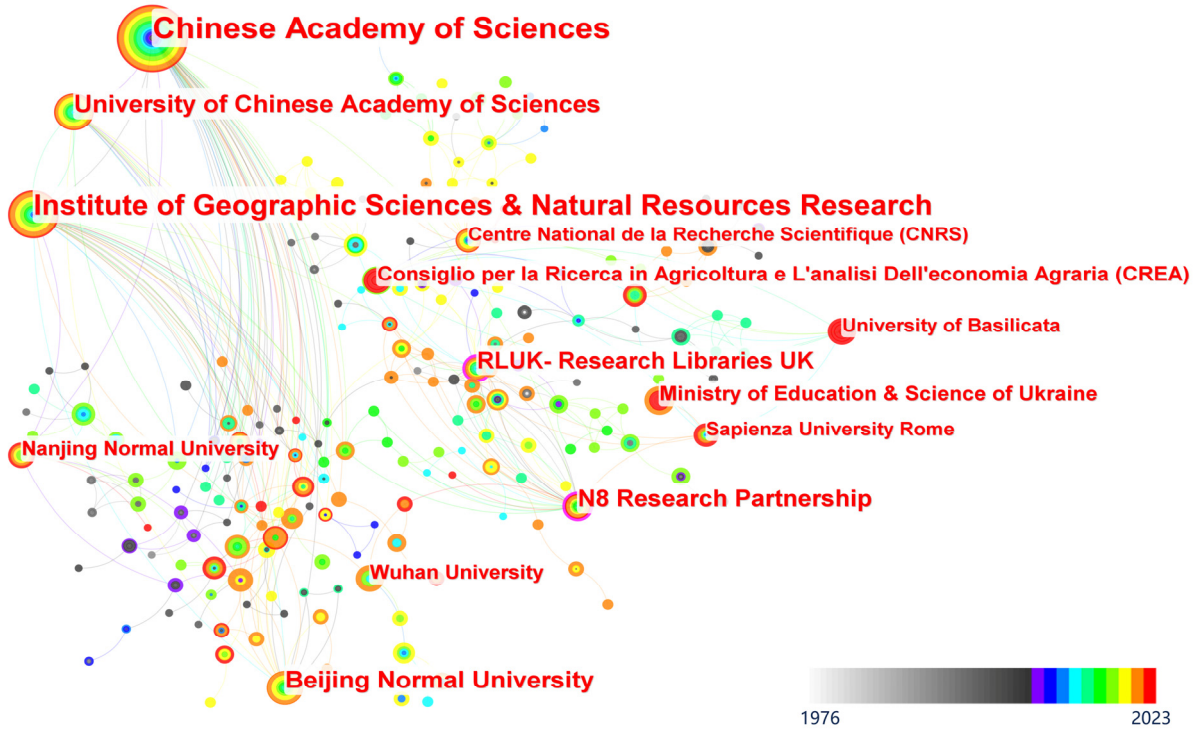

Figure 10. Collaborating analysis of institutions in RFCRS. The colors in the figure denote the collaborative years among RFCRS institutions, wherein a shift towards the red spectrum indicates more recent periods of institutional collaboration.

Table 6. The top 20 collaborating institutions in RFCRS.

Count	Centrality *	Year	Institutions
99	0.09	2007	Chinese Academy of Sciences
63	0.05	2007	Institute of Geographic Sciences & Natural Resources Research
36	0	2014	University of Chinese Academy of Sciences
34	0.02	2010	Beijing Normal University
30	0.13	1998	N8 Research Partnership
28	0.1	1976	RLUK-Research Libraries UK
24	0	2004	Russian Academy of Sciences
19	0.01	2013	Consiglio per la Ricerca in Agricoltura e L'analisi Dell'economia Agraria (CREA)
19	0	2018	Ministry of Education & Science of Ukraine
16	0.02	2014	Nanjing Normal University
16	0.01	2016	Wuhan University
15	0.06	2011	Centre National de la Recherche Scientifique (CNRS)
14	0.03	2005	Sapienza University Rome
14	0	2017	University of Basilicata
13	0.02	2008	Peking University
13	0.02	2004	Helmholtz Association
13	0.03	1993	University of London
13	0.02	2017	Tuscia University
13	0	2007	Nanjing University
12	0.01	2019	Ministry of Natural Resources of the People's Republic of China

* Centrality measures the importance of a document or node in a network of documents, and centrality in institutional collaborations identifies essential collaborating institutions throughout the network.

3.3.3. Collaborating Nations

Figure 11 represents the cooperation between countries, where the radius size corresponds to the number of published papers, with China publishing the most papers (498), followed by the United States (257). The purple circles in the figure represent centrality. The stronger the centrality, the stronger the influence of the stage, and the higher the citation rate of the published papers, which may be crucial knowledge-based literature. The centrality is a measure of the node's importance in the network. There is a significant gap in the number of publications between different institutions. The United States is the strongest country in terms of centrality, with a centrality of 0.33 and the highest overall citation rate. The UK was the first (1976) country to conduct RFCRS (Table 7). The top 5 countries accounted for 59% of the total number of publications globally, suggesting that these countries have paid more attention to RFCRS research than the rest of the countries, proposed a variety of policies and measures for rural settlements, set goals for rural preservation and development in order to safeguard their historical and cultural heritage, enhance the rural economy, promote sustainable tourism development, and actively participated in international cooperation.

Table 7. The top 20 collaborating countries in RFCRS.

Count	Centrality *	Year	Countries
498	0.09	1999	Peoples R China
257	0.33	1991	USA
150	0.08	1998	Italy
140	0.23	1976	England
98	0.29	2002	Germany
78	0	2004	Turkey
71	0.07	2006	Spain
71	0.04	1977	Australia
67	0.06	2004	Russia
64	0.02	2004	Brazil
54	0.07	1998	Canada

Table 7. *Cont.*

Count	Centrality *	Year	Countries
53	0.03	1999	Poland
52	0.04	1992	South africa
46	0.05	2007	Romania
43	0.03	1999	Netherlands
39	0.01	2001	India
37	0	2001	Slovakia
34	0.01	2003	Czech Republic
32	0.06	2009	France
27	0.02	2006	Scotland

* Centrality measures the importance of a document or node in a literature network. The centrality of country cooperation allows for identifying important cooperating countries across the literature network.

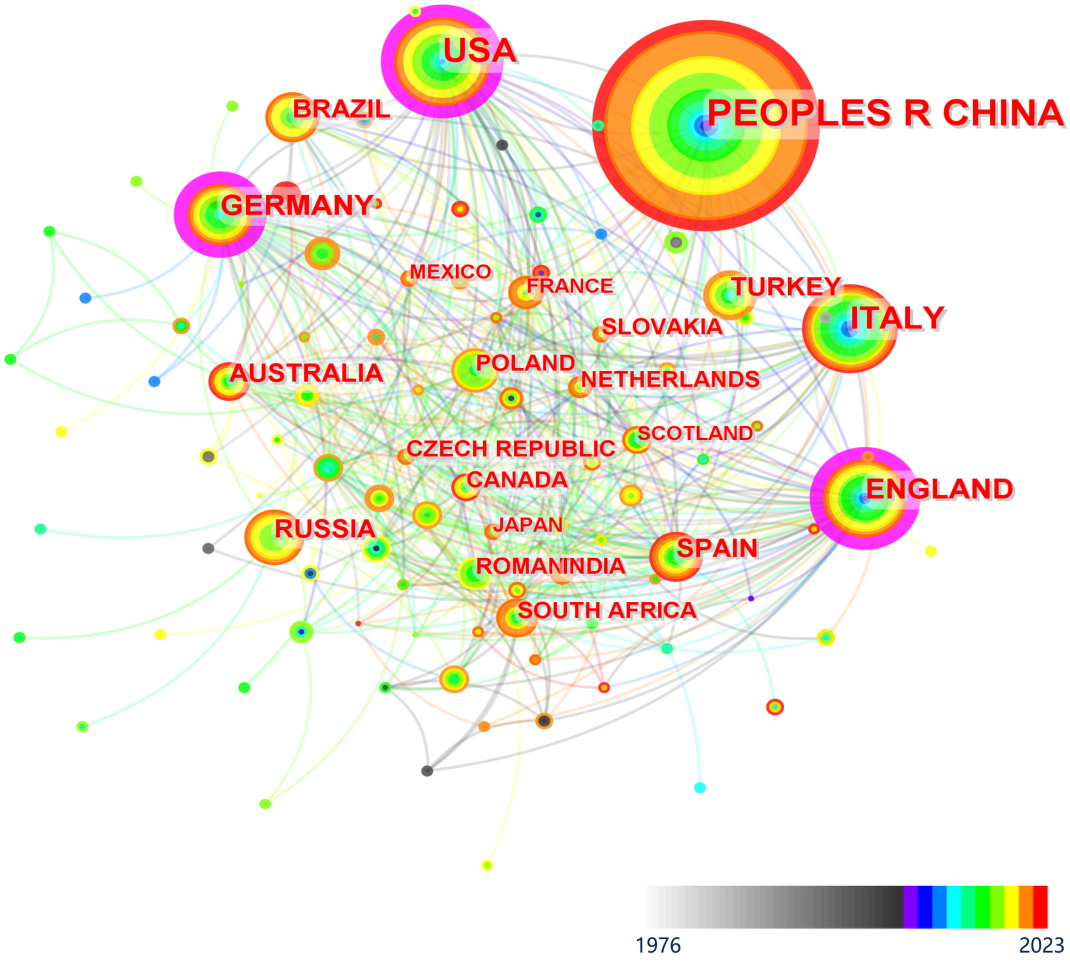

Figure 11. Collaborating analysis of countries in RFCRS. The colors in the figure represent the publication year of documents from collaborating countries in the RFCRS. The more the color of a node tends towards red, the later the collaboration in publishing documents occurred for that country.

3.4. Analysis of RFCRS Key Issues

3.4.1. Analysis of Keyword Clusters

Keyword cluster analysis can enhance the conciseness of the co-occurrence network of RFCRS keywords, condensing a substantial number of linked keywords into a relatively minor set of clustered research topics. It aids in identifying pivotal issues within a particular field of study [58,59]. In this process, CiteSpace employs the log-likelihood ratio algorithm to label each research topic cluster. The assessment of cluster mapping effectiveness

primarily relies on two metrics: modularity value (Q) and average silhouette value (S). The modularity value (Q), ranging from 0 to 1, indicates significant structural coherence within a cluster module when Q exceeds 0.3, signifying a certain level of tight interrelation among the keywords within the cluster. The average silhouette value (S), measuring content similarity within the same cluster, ranges from −1 to 1. By calculating the similarity among different keywords, the average silhouette value reveals the consistency and compactness within the cluster.

Based on the results of keyword clustering analysis, RFCRS can be divided into 11 main research clusters (as shown in Figure 12 and Table 8). The modularity value (Q value) of RFCRS clusters is 0.4, and the average silhouette value (S value) is 0.7, indicating that most clusters are relatively cohesive and encompass a substantial number of research papers. The 11 research clusters in RFCRS are as follows: "0. Ecosystem services", "1. Rural settlement", "2. Sustainable development", "3. Urban sprawl", "4. Remote sensing", "5. Mortality", "6. Settlement intention", "7. Abundance", "8. Optimal threshold", "9. Land use", and "10. Moshav". Among these clusters, the one with the most keywords (95) is "Ecosystem services", consisting of 227 papers. The keywords in this cluster include services, landscape, conservation, biodiversity, and sharing. The cluster with the highest silhouette value (0.939) is "Moshav" (a type of Israeli town or settlement) [60], with keywords such as Israel, space, renewable energy, spatial statistics.

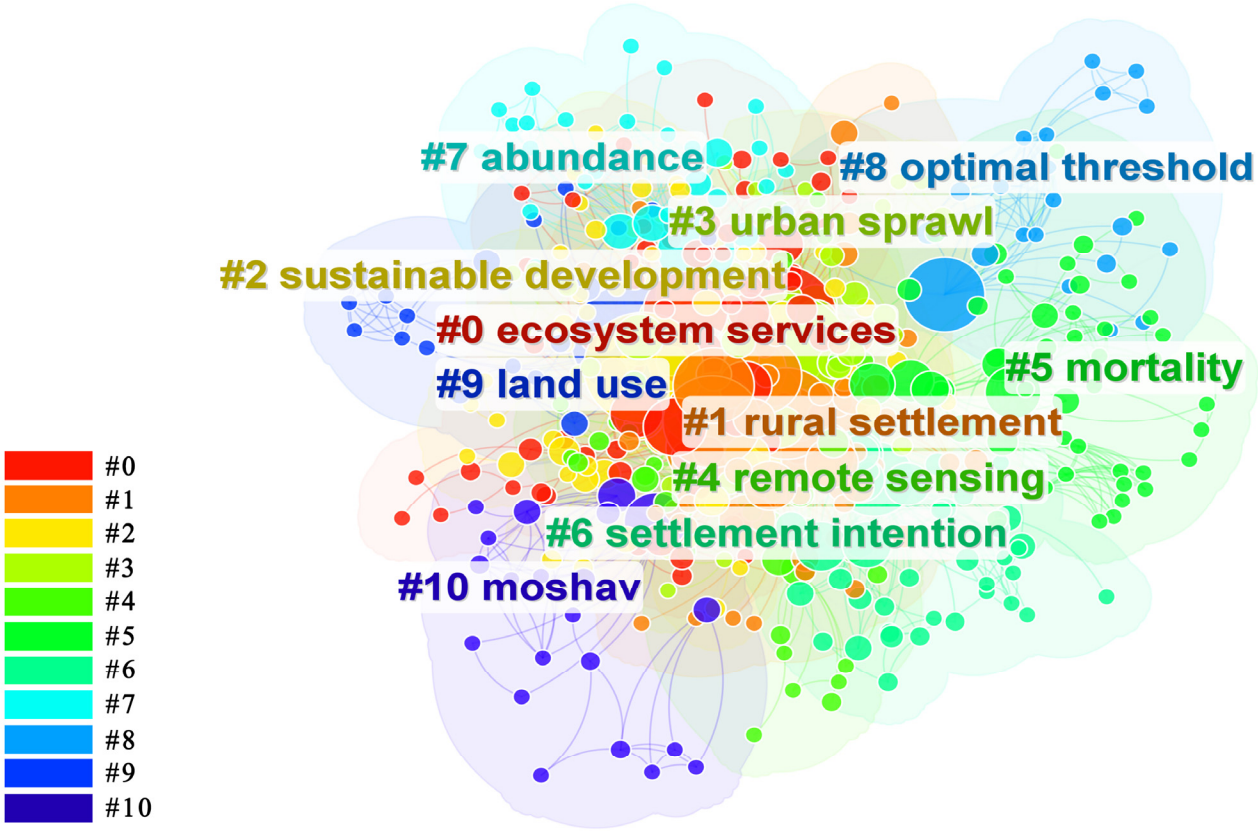

Figure 12. Analysis of keyword clustering in RFCRS.

Table 8. The 11 clusters of keywords in RFCRS.

Cluster Name	Size	Score *	Year	Main Keywords
0. Ecosystem services	95	0.484	2011	services; landscape; conservation; biodiversity; sharing
1. Rural settlement	86	0.666	2015	settlement; factors; settlements; residential land; differentiation
2. Sustainable development	79	0.571	2010	development; architecture; area; depopulation; Environment
3. Urban sprawl	61	0.704	2010	sprawl; indicators; growth; Italy; Rome
4. Remote sensing	56	0.713	2010	sensing; analysis; age; forest; Russia
5. Mortality	53	0.808	2006	health; rural health; prevalence; cover change
6. Settlement intention	43	0.857	2012	intention; migrants; floating population; China; workers
7. Abundance	30	0.9	2004	South Africa; riparian buffer; ottocoded basins; Romania
8. Optimal threshold	23	0.853	2005	threshold; nighttime light; vulpes bengalensis; cross-sectional study; fox
9. Land use	23	0.899	2003	use; tourism; Brazilian Amazon; CCA; separation
10. Moshav	21	0.939	2000	Israel; space; renewable energy; spatial statistics

* The higher the score, the better the quality of the cluster, the more similar the keywords within the cluster, and the greater the difference from other clusters. Size refers to the number of keywords contained within a cluster.

3.4.2. Summary of Key Issues

Classifying and merging RFCRS keyword clusters and analyzing the relevant literature shows that there are currently three main research topics within RFCRS. These topics include rural ecosystem services and environmental conservation, sustainable development and architectural design of rural settlements, and rural health services and population mobility.

(1) The Issue of Rural Ecosystem Services and Environmental Conservation in Rural Settlements. This topic is reflected in clusters 0, 7, 8, and 9. As rural development expands and socio-economic growth accelerates, the fundamental landscape of rural areas is undergoing significant changes. Due to delayed construction, ecological degradation, and inadequate management, rural settlements face challenges such as lacking local distinctiveness and environmental degradation during development [61]. The question of protecting the rural ecological environment while promoting sustainable development through ecosystem services has garnered widespread attention within academia [62]. Scholars have employed various methods such as assessment models [63], public opinion [64], and network analysis [61] to analyze the key factors influencing the features and characteristics of rural settlements landscape. Rogge, E. and others have considered the gap between expert and public perceptions in rural settlement landscape planning, emphasizing the need to account for divergent landscape preferences among different target groups in future landscape planning [64]. Xia, L. used the Analytic Network Process (ANP) method to explore the critical factors for sustainable rural landscape in the decision-making process of rural planning, highlighting settlement layout as the most significant factor and proposing strategies for sustainable rural landscape development [61]. Azari Dehkordi, F. developed a Landscape Degradation Model (LDM) for rural areas in Japan, providing a quantitative framework for preserving characteristic rural landscapes [63]. Future discussions within rural ecosystem services and environmental conservation will likely focus more on establishing models that balance the supply and demand of rural ecosystem services, determining the value of ecosystem services, and encouraging active

farmer participation in ecosystem services. It will contribute to forming features and characteristics of the rural settlement landscape.

(2) The Issue of Sustainable Rural Settlement Planning and Architectural Design. This topic encompasses the core content of clusters 1, 2, 3, 4, and 10, involving a complex interplay of factors related to architecture, space, and the environment. In recent years, rural settlements have been facing challenges of population loss and environmental changes, making sustainable development an urgent concern. Sustainable development of rural settlements primarily focuses on exploring the relationship between rural architecture and the environment. Effective planning and architectural design play crucial roles in achieving the sustainable development of rural settlements, including spatial planning [65], architectural aesthetics [66], and landscape design [67]. Kavas, K.R. and others introduced a novel approach in their comprehensive study of rural architecture by incorporating rural cultural landscapes into architectural design standards. They analyzed, interpreted, and evaluated traditional green rural residential areas [68]. Kuczman, G. and colleagues utilized principles of landscape architecture to transform public spaces in rural settlements, considering aspects such as vegetation forms, natural elements, and socio-cultural factors in an integrated manner [69]. Yıldırım, M. and others used the example of the traditional village of Sanıuva in Turkey to establish sustainable architectural heritage conservation standards and reuse methods by analyzing the relationship between traditional houses and local historical environmental changes [70]. Future discussions within the domain of sustainable rural settlement planning and architectural design will explore innovative planning methods and architectural designs that promote the sustainable development of rural settlements. It will contribute to creating distinct features and characteristics of rural settlement architecture.

(3) The Issue of Construction of Living Environments and Service Facilities in Rural Settlements. This topic includes clusters 5 and 6. Human habitat and the development of service facilities are fundamental guarantees for achieving the sustainable development of features and characteristics of rural settlements. Aspects such as the quality of the human habitat, municipal infrastructure, medical service establishment, and challenges arising from population loss and ageing have significant implications for the formation and maintenance of features and characteristics of rural settlements. Currently, rural areas are confronted with population structure changes caused by population loss and ageing, giving rise to new demands for service facilities and foundational infrastructure in rural settlements.

In the issue of human settlement development, scholars have assessed the role of landscape factors in the construction of human settlements in rural areas from the perspectives of value assessment [71], social interactions [72], and settlement evolution [73]. For example, Zheng, Q. et al. incorporated green space area characteristics into evaluating public facilities construction in rural villages, utilizing multidimensional data such as geographic spatial data, big data, and socioeconomic data to assess their value [71]. Zhang, H. et al. examined the transition from nomadism to settlement in rural settlements in the Nagqu Town of Tibet Autonomous Region as a case study, exploring its impact on the rural structure and providing specific strategies and recommendations for the sustainable revitalization of rural areas and the ongoing optimization of human settlements in highland pastoral regions [73]. Svoradova, L. et al., from the perspective of social interactions, analyzed the balance between the development of rural tourism and the ecological landscape functions of human settlements in Slovak rural areas, suggesting that improving human settlements and service facility development in rural settlements can enhance the attractiveness of rural tourism [74].

In the issue of service facility construction, it is essential to identify the specific needs of rural settlements in crucial areas such as housing, production, healthcare, and education. Long-term strategies should be formulated to ensure that rural settlements can access necessary services and resources. Rai, V.K. and others utilized geographic information

system platforms to analyze the spatial changes in healthcare facilities in Gajapati District, India and provided recommendations for rural infrastructure planning [75]. Wołoszyn, R. and colleagues conducted a multidimensional assessment of the quality of living conditions in rural settlements across different provinces in the United States and Poland, encompassing housing, sanitation, environment, and primary service facilities [76]. Kaiser, N. and team discovered that the maintenance and technological innovation of rural transportation infrastructure such as roads and bridges play a vital role in enhancing the well-being of rural residents [77]. Given the challenges posed by the shortage of rural healthcare services and population mobility, future research should continue to explore policies aimed at improving the rural living environment and enhancing infrastructure to foster the healthy development of features and characteristics of rural settlements.

3.5. Analysis of RFCRS Hotspots

3.5.1. Evolution Analysis of RFCRS Hotspots Based on Keyword Timezone

Keywords, serving as a means of refining and summarizing the primary content of an article authored by an individual, find joint employment within bibliometrics to conduct keyword frequency analyses. These analyses serve to unveil the distribution of research hotspots. This paper uses CiteSpace for keyword analysis of the RFCRS, resulting in a total of 700 nodes, with a selected frequency of 90 times more than the keywords of landscape, pattern, city, conservation, and other keywords for display; the keywords generated by the co-occurrence of the network is shown in Figure 13.

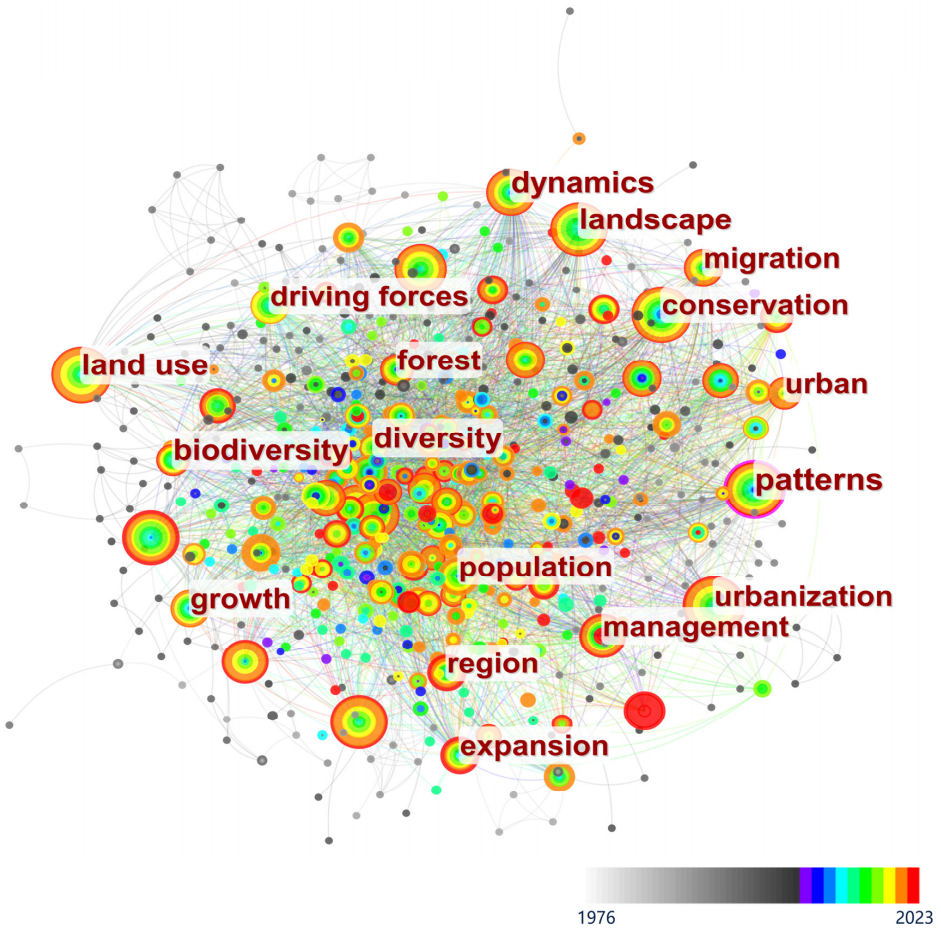

Figure 13. Analysis of keyword co-occurrence of RFCRS. The colors represent the timeline of keyword appearances, with shades of red indicating later appearances of keywords.

Each node in the graph represents a keyword, the keyword frequency is proportional to the size of the node, and the connecting line between the nodes represents the co-occurrence network of the keywords, and the number of times the keywords co-occur in multiple articles constitutes the weight of the co-occurrence network [78]. According to the co-occurrence frequency, the main keywords are urbanization (122 times), land use (120 times), and landscape (114 times).

Table 9 shows the top 20 most frequent and influential keywords in the RFCRS field. In addition to the core keywords "urbanization", "countryside", and "landscape", which directly reflect the content of RFCRS research, other keywords such as "pattern" and "land use change" appear frequently with high frequency and centrality. "Patterns" and "land use change" are other keywords with high frequency and centrality. The prevalence of these keywords indicates the future development trend and hot areas of rural clustered landscape character research. In particular, the keyword "land use change" has become increasingly important in modern RFCRS, implying that the land resource allocation and utilization problems faced by rural settlements will be one of the future research directions.

Table 9. The top 20 co-occurring keywords in RFCRS.

Count	Centrality *	Year	Keywords
122	0.04	2004	urbanization
120	0.08	2001	land use
114	0.07	1994	landscape
98	0.11	2001	patterns
97	0.06	1992	city
96	0.07	2004	conservation
84	0.03	2007	rural settlements
75	0.02	2009	policy
69	0.04	2001	management
67	0.08	2001	dynamics
57	0.01	2015	settlements
57	0.06	2005	urban
54	0.08	2005	biodiversity
51	0.08	1998	migration
51	0.08	1996	population
49	0.04	2013	region
49	0.02	1997	rural settlement
48	0.03	2009	land use change
47	0.08	2003	diversity

* Centrality is a metric employed to gauge the significance of the literature or nodes within a scholarly network. Centrality within keyword co-occurrence enables the identification of pivotal keywords throughout the entire scholarly network.

By analyzing the keyword temporal distribution chart (Figure 14), we have observed significant variations in the research focus and hotspots of RFCRS across different developmental stages.

(1) In the early stages of RFCRS, the focus was primarily on exploring the fundamental features of features and characteristics of rural settlements, such as cultural landscapes [79], landscape patterns [80], and diversity [81]. Researchers attempted to characterize the rural settlements' physical and non-physical elements to represent regional cultures and adapt to the ecological environment. Subsequently, the research focus gradually expanded to broader areas, with concepts of land use, management, and environment becoming significant. During this period, studies emerged that established land use change models to dynamically analyze land use situations and formulate policies [82]. Studies also analyzed the impact of urban fringe growth management on rural settlements, identifying low-density residential construction as a primary driving factor [83]. This phase of RFCRS primarily concentrated on the ecological and cultural dimensions of features and characteristics of rural settlements.

Exploration into the spatial allocation of rural settlements, climate change, and other topics had not yet appeared, marking the initial phase of RFCRS.

(2) After 2008, new research focal points emerged, including land use change, urbanization, and ecological diversity. During this stage, RFCRS shifted its attention towards understanding the impact of spatial allocation on the features and characteristics of rural settlements, for instance, optimizing land use to enhance the environmental quality and ecological benefits of rural settlements [84]. Firstly, researchers recognized the significance of rural ecosystems and began exploring the functions and services of agricultural ecosystems [85], investigating the relationship between agricultural landscape diversity, ecological diversity [86], and the ecological functions of agricultural fields [87]. Secondly, research on climate adaptation gained traction, exploring the effects of climate change on agricultural production and rural communities while seeking adaptation strategies and mitigation measures [28]. Thirdly, progress was made in studying rural communities' climate resilience and community engagement [88]. During this stage, RFCRS primarily focused on maintaining and developing features and characteristics of rural settlements amidst urbanization. The volume of the research literature notably increased during this phase, with further expansion of research topics and methodologies, marking a steady advancement phase for RFCRS.

(3) Since 2016, RFCRS has focused on several primary research areas, including sustainable development, rural revitalization, climate change, and urban growth. The academic community has shown significant interest in the role of features and characteristics of rural settlements in sustainable development and harmonious rural–urban development. Efforts have been made to integrate and preserve the distinctive features of rural settlements [89] within the framework of rural revitalization strategies [90] while also incorporating sustainable development principles and practices into rural planning and management [91]. Simultaneously, research has explored how to achieve coordinated development between rural and urban areas through innovative rural revitalization strategies [92]. During this period, RFCRS has experienced explosive growth in publication volume, expanding its scope and methods. Research has delved into the socioeconomic elements of rural settlement characteristics, sustainable development, and planning and management, marking a diverse developmental stage for RFCRS.

Overall, the evolution of RFCRS keywords reflects the continuous deepening of scientists' understanding regarding the spatial structure of rural settlements [43], ecological environment conservation in rural settlements [93], rural community development [94], and rural revitalization [95]. The development of RFCRS has undergone stages of initial establishment, steady advancement, and diverse expansion.

3.5.2. Identification of Research Hotspots Based on Keyword Burst

Keyword burst is a methodology used to analyze the frequency changes in keywords within a specific research domain over a defined time frame. This analysis captures shifts in research focus during that period, and keywords that exhibit bursts are considered to hold developmental potential and research value within that particular timeframe [96]. CiteSpace's keyword burst detection feature can identify keywords that undergo high-frequency changes within a specified time interval. In the study of "features and characteristics of Rural Settlements" from 1988 to 2023, 334 bursting keywords were identified. The top 30 keywords with the highest frequencies were selected for analysis.

The burst keyword map of RFCRS (Figure 15) demonstrates an in-depth exploration of rural qualities. From these keywords, we can observe that RFCRS has the following four research hotspots.

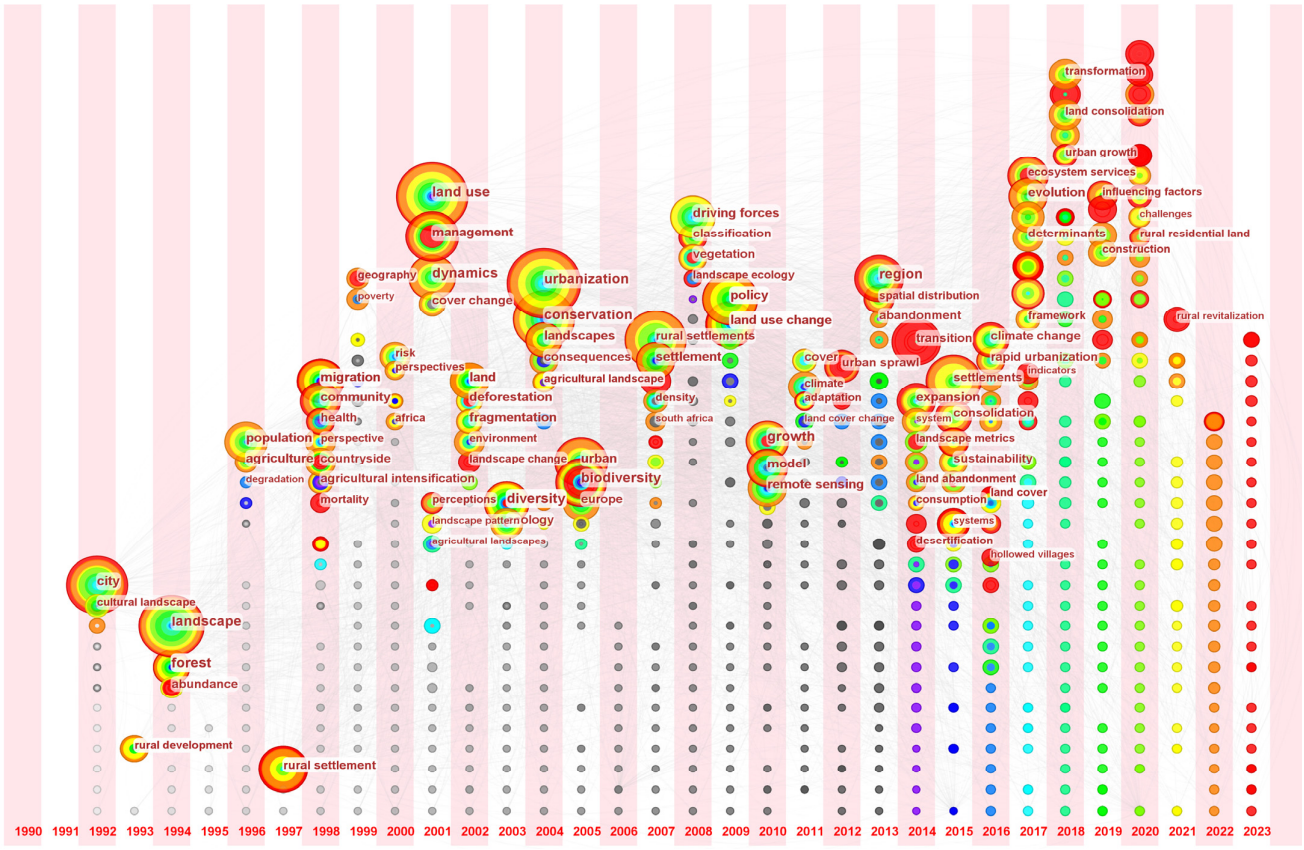

Figure 14. Analysis of temporal partitioning of RFCRS keywords. The colors in the figure correspond to the initial and final instances of appearance for RFCRS keywords. Nodes shifting towards the red end of the color spectrum indicate keywords that emerged later. The horizontal axis's timeline represents the initial appearance time of keywords.

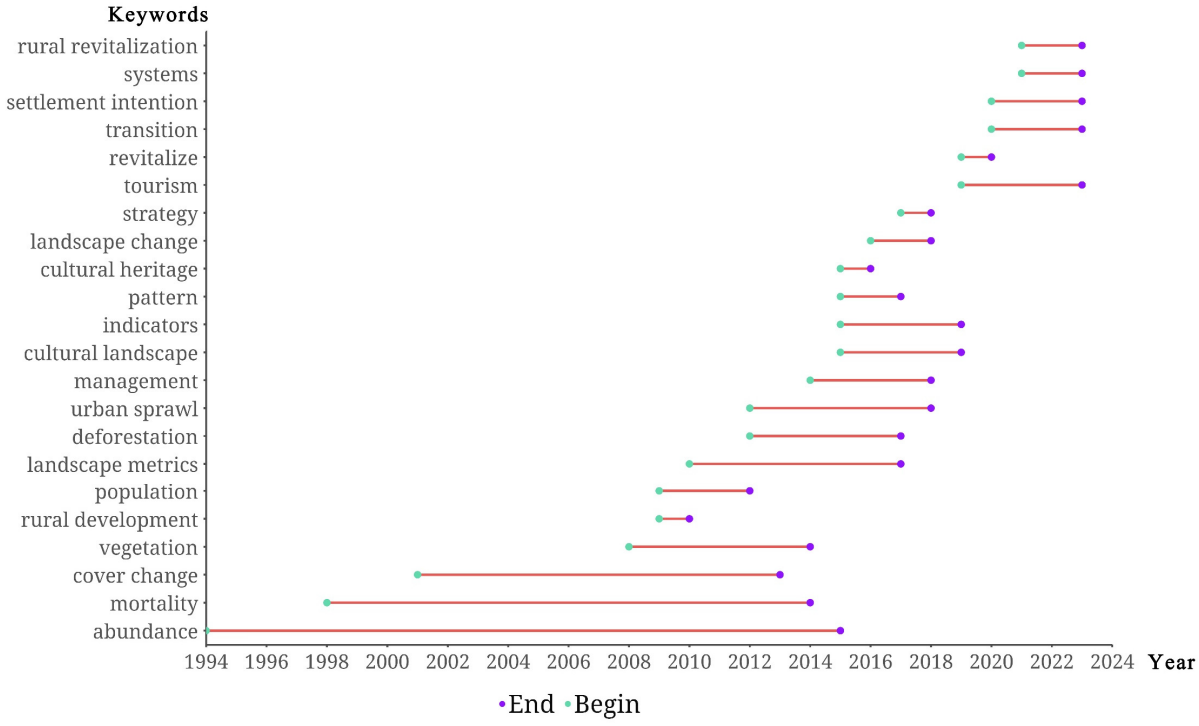

Figure 15. Analysis of burst keywords of RFCRS from 1994 to 2023 (first 6 months).

(1) Ecology and environmental protection

The terms "abundance", "mortality", "cover change", and "vegetation" are all related to the ecological environment of the countryside. It indicates that the natural environment and ecosystem of the countryside is an essential direction of research and directly connects with the countryside's spatial layout, land use and ecology. In addition, the appearance of "population" also reflects the exploration of the relationship between rural population change and the ecological environment.

(2) Interaction between urban and rural areas

With the acceleration of urbanization, keywords such as "rural development", "urban sprawl", and "deforestation" demonstrate the interaction and influence between rural and urban areas. It also shows that the features and characteristics of rural settlements need to be adapted to the natural environment and are also constrained by economic and social factors, especially the impact of urbanization.

(3) Cultural inheritance and heritage protection

The terms "cultural landscape", "cultural heritage", and "landscape change" show that RFCRS pays excellent attention to the cultural heritage and traditions of the countryside, with architectural styles, regional cultures, and religious practices. It is the focus of the study.

(4) Rural revitalization and transformation

The words "tourism", "revitalize", "transition", and "rural revitalization" illustrate RFCRS's emphasis on rural revitalization and transition development. Features and characteristics of rural settlements are closely related to the spatial forms, landscape patterns and architectural features of rural settlements, which promote a sustainable transformation of the rural economy and society while respecting traditional rural values.

Overall, the keywords of RFCRS reflect the researcher's comprehensive thinking on the spatial, ecological, cultural, and developmental aspects of rural settlements and are also a complete embodiment of the definition of features and characteristics of rural settlements in this paper.

3.6. Prediction of RFCRS Research Trends

In the above section, we analyzed keyword clustering, temporal partitioning, and keyword emergence on the RFCRS bibliometric data for 1976–2023. In Section 3.4.1, it is found that current RFCRS research has three main research topics: ecological services and natural environmental protection of rural settlements, sustainable planning and architectural design of rural settlements, and construction of human settlements and service facilities in rural settlements. In Section 3.5.1, it is found that research hotspots related to cultural landscape and development strategies, such as sustainable development, rural revitalization, climate change and urban growth, have emerged from 2016 to the present. In Section 3.5.2, four types of research hotspots were found to have emerged in recent years, namely, ecology and environmental protection, urban–rural relationship interaction, cultural heritage and heritage preservation, and rural revitalization and transformation. Combined with the conclusions above, this paper predicts that future RFCRS research has the following three research trends.

3.6.1. Study on Features and Characteristics of Landscape Based on Ecology, Climate, and Aesthetics

From the analysis in Section 3.5, it can be seen that the keywords Landscape change (2016), tourism (2019), Rural landscape (2020), and Influencing factor (2021), which appeared after 2016, have a high degree of prominence, demonstrating a trend of research on landscape features and characteristics of rural settlements research trend.

The features and characteristics of rural settlements landscape result from nonlinear interactions among ecological environment, spatial patterns, and landscape aesthetics.

With increasing global attention to ecological, environmental protection, climate change adaptation, and carbon neutrality issues, scholars have started researching the features and characteristics of rural settlements landscape from perspectives such as landscape genetics, ecological environment, climate adaptation, and landscape aesthetics. Landscape genetics refers to the inherent cultural factors that differentiate a landscape from others. It serves as a landscape's "genetic" fundamental unit, acting as a dual expression and abstraction of the material carrier and cultural connotation of landscape features and characteristics [97]. Ecological environment and climate adaptation are the major driving factors influencing landscape features and characteristics. For instance, Turner, M.G. emphasized the central role of the ecological environment in shaping landscape aesthetics [98], and Galan, J. et al. pointed out that landscapes are complex and dynamic socio-ecological systems. Climate change can catalyze the holistic management of various dimensions (ecological, cultural, social, political, and economic) of landscapes and can address current adaptive planning issues [99]. Compared to the features and characteristics of urban landscapes, the features and characteristics of rural settlements landscapes are characterized by their integration with nature, utilization of regional resources, and evoke memories of the harmonious coexistence of primitive humans and nature and a longing for peaceful and poetic living. Incorporating research on landscape aesthetics can provide a more comprehensive understanding of how protecting and maintaining landscape features can be achieved through understanding landscape patterns [100]. Due to this concept, the emergence of rural tourism has played an essential role in promoting local economic development and showcasing and inheriting rural culture based on the aesthetic foundation of rural settlements.

Future researchers should pay attention to identifying and quantifying landscape features and characteristics of rural settlements, evaluation indexes and methods, and optimization strategies based on evaluation results. The development of artificial intelligence technology, such as machine learning and the improvement of rural data, can provide better technical support for this research topic.

3.6.2. Study of Architectural Features and Characteristics Based on Characteristic Factors and Hierarchical Structure

From the analysis in Section 3.5, it can be seen that the keywords form (2013), strategy (2017), construction (2019), and cultural heritage (2021), which appeared after 2013, have a high degree of prominence and are attributed to the topic of research on characteristic architectural features of rural settlements, which is one of the future RFCR is one of the research trends of the future RFCR.

The features and characteristics of rural settlement architecture refer to the interrelationships between individual architectural entities within a settlement, influenced by natural topographical conditions and other factors. These relationships create a particular order and texture in space, ultimately giving rise to the overall characteristics of the settlement. This concept comprises both intrinsic meaning and external representations. The intrinsic meaning encompasses various features of rural settlements, including their economic, historical, cultural, and political contexts and their significance in different eras, artistic value, local distinctiveness, and ethnic customs [101]. The external representations are evident at a macro level through settlement texture, architectural layout, rural skyline and at a micro level through architectural styles, forms, materials, structures, colors, and more [102]. In the RFCRS (Rural Fabrics of Chinese Rural Settlements) research, intrinsic meaning involves investigating architectural characteristic factors such as regional culture, cultural landscapes, regional genes, and architectural memes. Exploring external representations involves studying architectural features across different systemic levels within rural settlements.

In terms of the study of intrinsic meaning, as discussed by Bourdier, J.-P., architecture is not merely a physical structure but closely intertwined with the local society and culture [103]. Regional culture and cultural landscapes find expression in architecture, while landscape and regional genes provide a unique foundation for these architectural

features and characteristics [104]. Wei, Q. suggests that research on the theory and methods of "regional genes" can help researchers uncover the regulatory mechanisms behind the generation and growth of regional construction systems. This understanding can lead to the identification of settlement combinations, spatial forms, material choices, and construction methods that align with the principles of sustainable development [105]. Yao, Q. and others propose that the study of architectural memes has evolved from early identification and analysis of inheritable features of settlements and architecture to the reduction in, abstraction, and adaptive evolution of fundamental characteristic factors. Approaching the complex system of rural settlements from an architectural meme perspective helps decode their mechanisms of feature inheritance [106]. In rural settlement hierarchical characteristics research, elements such as village layouts, dwellings and public buildings, streets and alleys, public spaces, agricultural landscapes, and traditional farming and craftsmanship techniques all reflect the local rural culture [107]. Zhang, D. and others take the example of Henan province, combining spatial imagery and grammar to explore traditional rural settlements' internal spatial order characteristics [108]. Farnian, S. analyzes traditional Iranian rural architecture, dissecting strategies such as orientation, materials, and natural forms to reveal their close connection within internal spatial layouts. This analysis provides valuable insights for modern sustainable design [109]. Future researchers can continue to delve into the identification of intrinsic meaning and evolutionary simulation analysis of fundamental characteristic factors of rural settlements. Furthermore, they can deepen the study of measurement indicators and evaluation weights for architectural elements across different levels within rural settlements.

3.6.3. Research on Rural Revitalization Based on Sustainable Development Principles

Based on the analysis from Section 3.5, the emergence of keywords such as "urban sprawl" (2012), "sustainable development" (2015), "floating population" (2017), "ecosystem services" (2017), and "rural revitalization" (2021) indicates a high level of attention to the issues of sustainable development and rural revitalization. These keywords represent essential research trends in the future of RFCR. In the face of global climate change and environmental degradation, sustainable development has become a shared pursuit of governments and the academic community worldwide. Based on sustainable development goals, revitalizing rural industries, improving living quality, and constructing the features and characteristics of rural settlements are crucial strategies for achieving effective cycles of rural development and alleviating social issues in rural areas.

In sustainable development research, Xia, L. et al. employ the Multiple-Criteria Decision-Making (MCDM) analysis method, using the Analytic Network Process (ANP) framework to explore the features and characteristics of sustainable rural settlements. They emphasize the importance of terrain-adapted settlement layouts, continuity of traditional architectural styles, restoration of natural landscapes, and rural vitality [61]. Górka, A. uses the case of rural development in Poland to underscore the close relationship between rural settlement landscapes and sustainable development, emphasizing the need for a clear rural vision to promote sustainable spatial development [25]. Regarding rural revitalization research, Turner, B.L. [110] and Liu, Y. et al. [111] indicate that rural revitalization should occur within sustainable development, ensuring a balance between ecological, economic, and social development in rural areas. Berkes, F. et al. explore the role of traditional ecological knowledge in adaptive management [112]. Nocca, F. argues that to ensure the ongoing prosperity of rural settlements, emphasis must be placed on protecting the features and characteristics of rural settlements and cultural heritage [24]. As an increasingly prominent topic, rural revitalization represents a revival and innovation of rural space, economy, and social life. Revitalization plans focus not only on economic growth in rural areas but also on cultural heritage, local characteristics, and community involvement [113]. In the future, rural revitalization research based on sustainable development should advocate for green and low-carbon architecture and infrastructure, strengthen the preservation and inheritance of rural culture, and encourage the development of rural tourism and creative industries.

4. Discussion

Based on the analysis of the RFCRS literature distribution characteristics, co-citation characteristics, key issues, research hotspots and trends, this paper suggests that researchers from different disciplines can prioritize the following four types of RFCRS topics in the future.

(1) Establishing and Enhancing a Diverse Theoretical Framework for RFCRS. Through analyzing the distribution of the literature, co-citation of the literature, and research collaborations, it is evident that although research in the field of RFCRS began to emerge as early as 1976, the average annual publication rate before 2010 was relatively low, with research primarily concentrated in the fields of Environmental Sciences and Geography. After 2016, disciplines such as Urban Planning, Ecology, Architecture, and Economics also showed increased interest in RFCRS, resulting in a significant growth in the number of publications. Currently, the research topics within RFCRS encompass a wide range of interdisciplinary subjects, including sustainable development [61,114], adaptive evolution to disasters [115], cultural and landscape assessment [116], land-use policies [117], and human habitation environments [118]. The scope of research is highly diverse. For instance, within the realm of Landscape Architecture, there is a research framework that covers topics such as ecosystem services [26], cultural landscapes [119], and landscape genes [120]. In Architecture, a research framework includes subjects such as architectural heritage [121], regional culture [122], and vernacular building materials [5]. Urban and Rural Planning, as well as Rural Geography, comprise research frameworks that encompass urbanization [123], spatial patterns [22], land use [124], and tourism development [125], among other topics. Given the interdisciplinary nature of RFCRS, its primary research topics are expected to involve theories, perspectives, and methods from various related disciplines. Establishing a diverse interdisciplinary theoretical framework for RFCRS is crucial. This framework would facilitate collaborative research on the commonalities of features and characteristics of rural settlements among researchers from diverse disciplinary backgrounds. Creating and enhancing such a theoretical framework for RFCRS would improve research efficiency, clarify specialization, diversify research methods, and effectively address the increasingly complex issues related to features and characteristics of rural settlements. In the future, developing and refining a diverse theoretical framework for RFCRS will be essential to provide a platform for researchers to collaborate and contribute their unique insights, thus advancing our understanding and strategies for addressing the multifaceted challenges of rural settlements.

(2) Exploring the Evolution Mechanisms of Features and Characteristics for Rural Settlements. Analyzing the evolution mechanisms of features and characteristics of rural settlements is a fundamental question in RFCRS research. These features and characteristics comprise six categories: village layout, architecture and courtyards, streets and alleys, agricultural landscapes, traditional farming and craftsmanship techniques, and rural culture [126]. The research within RFCRS needs to evolve from qualitative to quantitative methods and from static (morphological indices and spatial visualization) to dynamic (influential factors and evolution mechanisms) approaches. Studying the evolution mechanisms of features and characteristics of rural settlements involves a dynamic investigation of the six component elements from a systemic perspective, primarily focusing on the morphological changes and pattern evolution of rural settlements. Dynamic quantification research on rural settlements is still in its nascent stages, and the methods employed often borrow from urban research. These methods require adjustment and refinement for application in RFCRS research. In recent years, with the further development of relevant theoretical models and computer analysis techniques, accurate and quantitative analysis of the evolution of ancient rural settlements has become feasible. Among the available approaches, System Dynamics (SD) models, suitable for scenario planning in rural settlements [127], and Cellular Automata (CA) models, appropriate for morphological planning [128],

have been applied to various issues within rural settlements, such as energy structure improvement decisions [129], disaster prevention measures [130], land use [131], and land use changes [132]. These models show promising research prospects for exploring the evolution mechanisms of features and characteristics of rural settlements. As these models continue to develop and adapt to rural contexts, they offer the potential for precise and quantitative analyses of rural settlement dynamics.

(3) Deepening the Implementation Strategies of Features and Characteristics of Rural Settlements. The research on implementation strategies for rural settlement features and characteristics encompasses design and policy aspects.

Firstly, design research represents the evolution mechanisms of features and characteristics of rural settlements and contributes to a renewed understanding of urban–rural relationships and values. The design of features and characteristics of rural settlements should be guided by the principles of "comprehensiveness, authenticity, and continuity". It involves formulating design schemes or control guidelines at three hierarchical levels: macro-level spatial layout, meso-level street patterns and landscape nodes, and micro-level architectural forms, colors, and materials. Design considerations should encompass explicit factors such as geographical conditions, ecological environment, and local building materials, as well as implicit factors such as economic development, regional culture, farming practices, religious beliefs, and architectural aesthetics.

Secondly, policy research ensures the implementation of design schemes for features and characteristics of rural settlements. Policy content includes land use, industrial planning, population policies, healthcare, educational facilities, municipal facilities, and providing government guidance and financial support to protect and update features and characteristics of rural settlements. Researchers have approached the study of implementation strategies for features and characteristics of rural settlements from various perspectives. For example, research on "new cultural landscapes" based on sustainable development principles [133], "Standards of architectural design for the ecological certification of the rural settlements" [68], sustainable architectural design features [15], rural revitalization action plans [134], and the impact of "China's government proposed a linked urban-rural construction land policy" on rural landscape patterns [117].

In future RFCRS research, with the deepening of knowledge on the mechanism of the evolution of the characteristic landscape of rural settlements, comparative research on different types of rural settlements should be strengthened, and it is recommended that researchers use emerging intelligent technology tools to carry out specialized design research and policy research, exploring the differences in the impact of various factors on the RFCRS, with a view to providing more targeted recommendations and strategies for the development of the countryside in different regions.

(4) Emphasizing the Application of Emerging Intelligent Technologies in RFCRS. To achieve various research objectives, researchers from different countries increasingly incorporate emerging research methods from foundational disciplines such as mathematics, physics, and artificial intelligence in their studies of RFCRS. Currently, some researchers are utilizing models and methods such as Cellular Automata, spatial autocorrelation, and blocked quadrat variance analysis to investigate features and characteristics of rural settlements. For instance, Deadman, P. and others used Cellular Automata models to analyze rural settlements' distribution and pattern development trends in an 80 km^2 area around Toronto [135]. Winter-Livneh, R. et al. employed Ripley's K-function and General Linear Models to analyze the spatial distribution patterns of primitive settlements from the Stone to Bronze Ages in southern Israel's Negev [136]. Su, G. et al. utilized the Grey Relational Analysis model to study the driving mechanisms behind the expansion and evolution of rural residential land in Beijing's Changping District between 2001 and 2006 [137]. Prus, B. et al. used the Pearson correlation coefficient to study the cross-compliance between building concentration indexes and the qualitative nature of socioeconomic development in rural settlements of Malopolska province in Poland [138]. As research data become increas-

ingly diverse, the research methods within RFCRS need continuous improvement and upgrading. Emerging technologies such as Artificial Intelligence (AI), Machine Learning, Network Big Data, and Virtual Reality (VR) are also being applied to RFCRS research. For example, machine learning methods are being used to mine the correlation between geographical variables of rural settlements and land-use development potential from historical spatial data [139]. Deep learning techniques analyze the geospatial distribution patterns in traditional Chinese settlements to identify environmental patterns [140] and dominant factors [141]. Among other applications, deep learning is also used to extract rural settlement areas from high-resolution aerial images [142]. In future RFCRS research, integrating emerging technologies such as AI, machine learning, Internet of Things (IoT), mobile communications, and new geospatial econometric models with traditional methods will likely become mainstream. This integration will help researchers efficiently study the formation mechanisms, development patterns, design methods, and policy regulations related to the features and characteristics of rural settlements.

5. Conclusions

This paper utilized CiteSpace software as a research tool to conduct bibliometric analysis and knowledge map analysis of the RFCRS literature within the WOS core dataset, aiming to clarify the research landscape and development trends of RFCRS. The paper sequentially analyzed the literature distribution, co-citation of references, Key Issues, research hotspots, and research trends within RFCRS, ultimately resulting in five re-search conclusions.

(1) Literature Distribution, Co-citation, and Research Collaboration:

Literature Distribution: The number of RFCRS publications exhibited fluctuating growth trends, with variations in annual publication counts, subject distribution, source publications, and country origins. Notably, environmental science and geography accounted for the highest proportion, with sustainability and land-related journals being prominent.

Co-citation: "Landscape Urban Planning" and "Land Use" journals emerged as core publications in RFCRS. High co-citation articles and authors were centered around topics such as rural revitalization, spatial optimization, sustainable development, rapid urbanization, and land use.

Research Collaboration: Researchers tended to work individually or in small groups. Major contributing institutions were from China, the UK, and Russia. China accounted for 60% of RFCRS publications among the top ten collaborating institutions. The US had the highest citation rate, and the UK was an early contributor to RFCRS research. The top five countries accounted for 59% of the total RFCRS publications.

(2) Research Clusters and Key Issues:

Based on keyword cluster analysis, RFCRS was grouped into 11 main research clusters, which were categorized into three key issues: "Ecological Services and Natural Environment Protection", "Sustainable Rural Settlement Planning and Architectural Design", and "Construction of living environments and service facilities in rural settlements".

(3) Research Hotspots:

Keyword time zone analysis revealed evolving research hotspots in different periods. Initial RFCRS research approached the topic from cultural, spatial, ecological, and demographic perspectives. Post 2008, focus shifted to residential environments, land use, and urbanization. From 2017 onward, RFCRS research delved into policies, strategies, and practices related to sustainable development, rural revitalization, climate change, and urban growth. In the past five years, research hotspots included "ecology and environmental protection", "urban–rural interaction", "cultural heritage conservation", and "rural revitalization and transformation".

(4) Research Trends:

The analysis of research clusters, key issues, and hotspots suggests three emerging research trends in RFCRS: "study on features and characteristics of landscape based on ecology, climate, and aesthetics", "study of architectural features and characteristics based on characteristic factors and hierarchical structure", and "research on rural re-vitalization based on sustainable development principles".

(5) Future Priority Research Recommendations:

Future research should prioritize four topics: "establishing and enhancing a diverse theoretical framework for RFCRS", "exploring the evolution mechanisms of features and characteristics for Rural Settlements", "deepening the implementation strategies of features and characteristics of rural settlements", and "emphasizing the application of emerging intelligent technologies in RFCRS".

In conclusion, the depletion of features and characteristics of rural settlements has gained widespread attention due to rapid urbanization, rural–industrial adjustments, and ecological degradation. To address these challenges, multidisciplinary research is needed to investigate the formation mechanisms, evolutionary patterns, design methods, and policy implementations of features and characteristics of rural settlements. The present study's five conclusions provide valuable insights for researchers with diverse backgrounds to understand the development trajectory, key issues, and research trends in RFCRS, offering reference and guidance for future investigations.

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Nomenclature

ANP	Analytic Network Process
CNRS	Centre National de la Recherche Scientifique
CREA	Consiglio per la Ricerca in Agricoltura e L'analisi Dell'economia Agraria
MCDM	Multiple-Criteria Decision Making
RFCRS	Research on Features and Characteristics of Rural Settlements

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