Integrated Framework of Rural Landscape Research: Based on the Global Perspective

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Abstract

Context In recent years, the important value of rural landscape has been highlighted in tourism, cultural heritage, ecology and other fields, rural landscape research (RLR) has been paid more and more attention by researchers, with the deepening of research, RLR has the characteristics of diversity and complexity.

Objectives To understand the development trend of RLR in the past 20 years, the distribution of research power, research hotspots and frontal research, to comb through the relevant results of RLR, to analyze the progress of RLR, and finally to integrate the main contents of RLR in a framework.

Methods 735 related literatures were selected from the WoS Core Collection Database, and the papers on RLR from 1992 to 2020 were quantitatively data mined and qualitatively summarized by using Bibliometrics and VOSviewer software for mapping and analysis.

Results (1) The number of papers on RLR increased from 1992 to 2020, during which it gradually became a hotspot research field that attracted increasing global attention. (2) From the research strength, Europe has a great influence in RLR, and has issued a series of conventions and protection policies, making its rural landscape become a model of modern rural development. There is little international cooperation and exchange in RLR, which is not conducive to the development of disciplines. *Landscape & Urban Planning* journals fit the theme of RLR. (3) The five hotspots of RLR are: rural cultural landscape and rural development; rural tourism landscape, the matching of landscape value and landscape perception; urban-rural interaction, land use change and landscape pattern conflict; change of ecosystem service value; rural landscape planning, protection and management.

Conclusions RLR has developed from a study based on geography and ecology to a comprehensive research direction combining multidisciplinary and multi-methods of social and economic development, culture and other elements. At present, RLR covers the ecological landscape, production landscape, tourism landscape and cultural landscape of rural landscape system, changes from static pattern of rural landscape to dynamic evolution process, urban-rural interaction, ecosystem service and multifunctional landscape trade-off, and changes from single dimension to multi-dimensional in research paradigm, and combines "3S" technology and various landscape ecological model software. From the perspective of multidisciplinary research, from the perspective of rural landscape system, the correlation and mechanism between rural landscape multifunctionality, and dynamic monitoring and trend simulation, help to clarify the rural landscape multi-functional trade-off ideas and paths to guide the sustainable development of rural areas.

Introduction

Rural landscape is a composite system composed of human-social-natural (Yang et al. 2018a), which has the characteristics of both urban landscape and natural landscape, both settlements, commercial centers formed by the rural settlements, but also farmland, orchards, waters formed by the natural scenery, natural mixed distribution with residential, local culture and natural scenery, the formation of a unique landscape culture. Initially, geographers began to study the cultural landscape systematically, but later, the study of the rural landscape gradually expanded to different disciplines and fields such as landscape ecology, environmental resources, and rural tourism (Deconchat et al. 2007; Howley 2011). Rural landscapes are fully, diverse and closely linked to local natural resources, political and economic policies, social structures and cultural awareness, which contribute to changes in the rural landscape and lead to the diversity and complexity of RLR (Wu et al. 2020). The diversity of RLR is reflected in the rich content of RLR, which is generally considered to be of economic value, social value, ecological value and aesthetic value (García-Moruno 2010; Arriaza 2004; Laterra et al. 2012). Complexity is reflected in the cross-discipline and multifunctional landscape of RLR, which is particularly evident in rural landscape planning studies (Hart et al. 2016; Israel and Wynberg 2018).

However, modern rural landscapes are at risk of abandonment and degradation, and the erosion of rural land by urbanization has led to the use of rural land in modern times, such as Agricultural intensification and land abandonment (Strbele and Hunziker 2017; Dolejš et al. 2019; Li et al. 2021). Urbanization has not only changed the traditional rural low-intensity land use (Banerjee and Srivastava 2013; Lieskovský et al. 2015; Pedrolí et al. 2016) has also revolutionized rural landscape vision, ecological diversity, and biocultural heterogeneity (Hartel et al. 2010; Gottero and Cassatella 2017). In addition to environmental and land use changes, rural cultural landscapes have also been affected by urbanization, many of which have been added to the UNESCO World Heritage List (Gullino and Larcher 2013; Ridding et al. 2018). With the migration of population to the city, the phenomenon of the abandonment of the historical and cultural heritage of the countryside is very serious. For example, terraced landscapes—an ancient best practice that puts it at potential risk of soil degradation due to wasteland (Tarolli et al. 2014; Tucci et al. 2019). All these problems cause losses to the social value, ecological value and aesthetic value of rural landscape. Rural areas not only provide food and cash crops, but also are losing a treasure trove of traditional land knowledge.

In recent years, we are aware of the crisis facing the rural landscape, more and more research on the rural landscape, but through the past literature summary found that the RLR review articles are few. According to a search of the WoS Database, there are only a few review papers on RLR. Most of the traditional methods of literature analysis rely on the efforts of scholars to consult and select articles. An article by Sitzia et al. (2010) reviewed 52 papers on the impact of woodland on rural landscapes based on landscape indicators or index analysis. Kizos et al. (2010), with the theme "Rural Landscape", bring together papers presented at the European Society of Rural Sociology (ESRS) to present the exchange of theories, concepts and methods in defining, describing, analyzing, understanding and revealing today's complex rural landscape realities (with a European focus). Zasada et al. (2017) reviewed the evidence from eight European case studies and established a comprehensive understanding and illustration of the linkages between policy, landscape, ecosystem services and value streams. With the progress made so far in this area, it is also important to identify and analyse the overall state of the rural landscape. Document measurement tool is a new method of literature review, which is used by scholars in the field of RLR to determine the literature that needs to be read carefully through software automatic screening, and to reflect the general and basic situation of a research field by drawing knowledge maps. Wu et al. (2020) used CiteSpace to visualize and quantify 7,581 existing RLR articles on the WoS. However, many of the literature analyzed in this literature is about the study of agricultural landscape, lack of relevance to RLR.

Data Sources And Research Methods

Data sources

This paper uses the WoS Core Collection Database as the literature database. The retrieval words were “Rural landscape” or “Countryside landscape” or “Village landscape”. The retrieval method was title retrieval, the restriction document type was “Article” and “Review”, and the restriction language was “English”. Considering the small amount of literature related to early rural landscapes, the period was set as 1992–2020. A total of 1,090 publications were obtained (data retrieval time: 5 March 2021). After manually eliminating the articles not in the field of RLR, a total of 735 relevant studies were finally obtained. This paper conducts a bibliometric analysis of RLR based on these 735 retrieved articles.

Research methods

This paper uses the bibliometric tools Bibliometrix and VOSviewer (Aria and Cuccurullo 2017; Eck and Waltman 2010). From qualitative and quantitative perspectives, this paper analyses the annual number of published articles, research strength (authors, institutions, countries), research keywords and topics. The trend of RLR is analysed from multiple perspectives (cooccurrence analysis, cluster analysis and thematic evolution analysis), and the future development trend of RLR is discussed at the end of the paper. The specific research steps of this paper are shown in Fig. 1.

A Review Of Quantitative Research

Analysis of article publication and citation

Figure 2 shows the time change curve of the number of published articles and cited articles in each year of RLR. It can be found from the figure that relevant studies can be roughly divided into three periods, representing the three stages of RLR. The first stage was from 1992 to 2006, which was the embryonic stage of related research. The number of articles in this period was relatively small, with an average annual publication of 6.5 articles and an average annual citation of 313.07. The second stage is from 2007 to 2014, with an average annual publication of 30.62 papers and an average annual citation of 857.25. Since the second stage, RLR has entered a stage of rapid development. The third stage is from 2015 to 2020, with an average annual publication of 65 papers and an average annual citation of 10.83. In terms of the number of published articles and citations, the third stage had the highest annual average number of published articles, and the second stage had the highest annual average number of citations. The curve of the number of articles changing with time is an increasing function, and the second stage of RLR has made a great contribution to RLR.

According to the line chart of the average citation frequency of articles, the average citation frequency of articles in 2002 and 2004 was higher, indicating that there were highly cited articles in these two periods. Moser et al. (2002) published an article in *Landscape Ecology*, “*Landscape Patch Shape Complexity as an Effective Measure for Plant Species Richness in Rural Landscapes*”. The number of citations of this paper was 157, a new robust shape complexity measurement method is proposed to explore the relationship between plant species richness and landscape shape complexity in rural landscapes based on aerial photographs. Arriaza et al. (2004) published an article in *Landscape & Urban Planning*, “*Assessing the Visual Quality of Rural Landscapes*”. As of this paper, the number of citations is 363, which is much higher than other articles. The contribution of this article is to propose a methodology for evaluating agricultural landscape quality through direct and indirect techniques of landscape value. These two articles applied studies of methods and techniques, indicating that technical articles are easily cited by other articles and that the research progress of rural landscapes depends on the progress of technology and tools.

Analysis of academic journals

The continuous development of RLR cannot be separated from the support of some important academic journals that have made great contributions to RLR. Table 1 lists the top 10 journals in terms of the number of articles on rural landscapes. These journals published 235 articles on rural landscapes, accounting for 32.37% of the total literature in this field, which means that a series of academic journals focusing on rural landscapes are concentrated in this research field. The journals listed are all SCI and SSCI journals of high quality, with an average impact factor of 3.462, indicating that international mainstream academic circles are paying increasing attention to the field of RLR.

Table 1
Top 10 academic journals in the field of rural landscape research

Journal	Articles	Percentage occupied	Impact Factor (2019)
<i>Landscape & Urban Planning</i>	73	10.06%	5.441
<i>Sustainability</i>	34	4.68%	2.576
<i>Land Use Policy</i>	29	3.99%	3.682
<i>Landscape Research</i>	25	3.44%	1.806
<i>Landscape Ecology</i>	23	3.17%	3.385
<i>Journal of Rural Studies</i>	14	1.93%	3.544
<i>Journal of Environmental Management</i>	12	1.65%	5.647
<i>Biodiversity and Conservation</i>	9	1.24%	2.935
<i>Applied Geography</i>	8	1.10%	3.508
<i>Journal of Environmental Planning and Management</i>	8	1.10%	2.093

Analysis of relevant authors

Figure 3 is the bubble diagram of the author's publication, which directly reflects the number of articles published and cited by authors in different years. The size of the circle indicates how much the author has published, and the shade of the colour indicates how many times the author's article has been cited. Table 2 shows the H index of the top 10 authors, the total number of publications, the total number of citations, publication time and country of origin.

Table 2
Top 10 authors in the field of rural landscape research

Author	H_index	NP	TC	PY_start	Country
Cousins SAO	8	8	559	2001	Sweden
Picuno P	7	8	129	2015	Italy
Statuto D	7	8	129	2015	Italy
Hartel T	6	6	200	2009	Italy
Primdahl J	6	6	91	2010	Denmark
Busck AG	4	5	62	2010	Denmark
Domon G	4	5	148	2001	Canada
Eriksson O	5	5	454	2001	Sweden
Garcia-Moruno L	5	5	144	2010	Canada
Kristensen SBP	4	5	69	2009	Denmark
Notes: NP: number of papers; TC: total article citations; PY_start: starting year of the papers.					

Judging from the H index in Table 2, Professor Cousins has the greatest influence, with an H index of 8. From the point of view of their respective countries, these scholars are European scholars, it can be seen that the European scholars in the circle has formed a good atmosphere for RLR. The representative works and major contributions of influential scholars are shown in Table 3.

Table 3
TOP scholar's most representative literature

Author (year)	Focus	Keywords
Cousins and Eriksson 2002	A model of plant species abundance on different spatial scales in 14 habitats in the Swedish rural landscape was explored. Using historical cadastral maps and aerial photographs, the effects of physical conditions, as well as the relationship between species richness and management history, were examined.	Alpha diversity Beta diversity Habitat history Land use Physical properties Plant species richness
Statuto and Picuno 2017	From the historical map, we can better understand the current characteristics of the country landscape. Using Geographic Information System (GIS) to analyze geographic information on historical maps can help to make better informed decisions and manage rural landscapes.	GIS Historical maps Landscape changes Rural land
Hartel et al. 2010	Changes in land use have led to a large-scale decline in biodiversity. Efforts must therefore be made to better understand the factors governing organizational distribution, particularly in countries where traditional management was about to be strengthened, such as Romania. In addition, the spatial distribution of amphibians in the rural landscape is recorded.	Breeding pond use Conservation Landscape ecology Spatial models Romania
Primdahl et al. 2013	Analyze the way farmers perceive landscape and how their views on landscape changes correspond to actual changes.	Landscape Rural Policy Spatial strategy
Domon 2011	The economy of rural areas has been heavily dependent on the exploitation of natural resources, but with the increasing demand for natural area facilities, the functional image of rural landscape has been changed, and improving the visual quality of rural landscape has become a new goal of rural development.	Rural landscapes Rural changes Landscape as resources Landscape dynamics Landscape perceptions Landscape valuation
García-Moruno 2010	The increase in rural tourism and farm buildings in many developed countries has seriously undermined the attractiveness of natural and traditional landscapes. The visual and aesthetic aspects of any object are defined by their color, shape, line, texture, scale, and spatial features. There are three aspects to consider in landscape-related buildings: landscape value, location of new projects, and visual features of existing landscapes (e.g. colors, textures, lines, etc.).	Building design Public survey Visual integration.

Author (year)	Focus	Keywords
Kristensen et al. 2016	The analysis of land-use change patterns in different landscapes in Europe highlights the great diversity of land-use changes, processes and drivers in Europe.	Land use change Landowner diversity Drivers Case study Europe

Analysis of research institutions

This paper also analyses the top ten scientific research institutions that publish the most papers in the field of rural landscapes in the world (Table 4). Wageningen University & Research is the largest research institution in the field of RLR, followed by Stockholm University and the University of Copenhagen, which have published the same number of papers. The ten institutions published 125 papers in total, accounting for 17.22% of the total published papers, which is relatively small. The top ten research institutions are located in different countries; generally, a university only carries out research on the villages that are typical of its country. This shows that RLR in different scientific research institutions and countries presents a flowering situation, not concentrated in a single scientific research force. This also means that the cooperation of RLR is not strong, which may lead to the diversity of RLR content, is not conducive to the clear definition of rural landscape connotation. Most of the institutions are in Europe, which also shows that the strength of the institutions studying the rural landscape is mainly in Europe.

Table 4
Top 10 research institutions in the field of rural landscape research

Institution	Articles	Country
Wageningen UR	22	Netherlands
Stockholm University	17	Sweden
University of Copenhagen	16	Denmark
University of Wisconsin System	13	US
University of Extremadura	12	Spain
Ghent University	11	Belgium
University of Basilicata	9	Australia
The University of Melbourne	9	Australia
University of Leuven	8	Belgium
Pontifical Catholic University of Chile	8	Chile

Analysis of representative country

Countryside is available all over the world, including Japan (Takeuchi 2010) and India (Ranganathan et al. 2008), China (Ellis et al. 2009; Liu et al. 2013; Yu et al. 2016) and Europe (Plieninger 2006; Walker and Ryan 2008; Solymosi 2011; Kupidura 2014). In order to analyze the degree of investment in RLR, this paper draws a map of the number of articles in RLR (Fig. 4). Due to international cooperation in RLR, when counting the volume of national articles, an article was published as long as the country participated in the relevant studies, and the final total was 946. Europe has the largest number of articles, far more than any other continent. This was followed by North America, followed by Asia and Latin America, with Africa among the least studied rural landscapes. On a national scale, the United Kingdom conducted the relevant research earlier, while the United States slowly became the country with the largest number of studies on rural landscapes, followed by the United Kingdom, Italy, China, Spain and so on.

There is a large amount of research literature on rural landscape in Europe because of its social background. 95% of the landscape in the EU territory is in rural areas, and 66% of the European population lives in rural areas. In addition, the European countryside creates 45% of the total value of the EU and provides 53% of the employment opportunities (Agnoletti, 2014). Since 1957, the analysis of the function, change and development of the European rural landscape has been an important part of the study of the rural landscape (Palang et al. 2005). The European countryside is characterized by a rich and diverse cultural landscape (Antrop, 1997; Plieninger 2006; Palang et al. 2006; Kristensen et al. 2016; Soler-Estrela 2018). The European countryside is dominated by agricultural production landscape, and in the past few decades, the large-scale modernization of economy and technology in agriculture has made agriculture intensive or land abandoned, and the rural landscape has changed dramatically (Vos and Meekes 1999; Kuemmerle et al. 2009; Sutcliffe et al. 2013; Vliet et al. 2015), the EU's Common Agricultural Policy (CAP) accelerated this process (Pedroli et al. 2016). But the European rural landscape has become a model for modern rural development and is widely used for reference, thanks to European countries' alliances and organizations in RLR, as well as the formulation and promulgation of conventions and policies (Estel et al. 2015; Pedroli et al. 2015; Agnoletti 2014). These include the European Landscape Convention of the Council of Europe, which aims to promote the protection, management and planning of landscapes and to organize international cooperation on landscape issues (Pinto-Correia et al. 2006; Pedroli et al. 2016; Górká 2018).

Cooperation between countries can promote the exchange and development of RLR (Ledda et al. 2020), and this paper obtains the intensity of cooperation between two countries based on the number of articles of cooperation between the two countries divided by the total number of articles from the two countries. Observations of the Fig. 5 show that RLR is generally less cooperative among countries. The United States, Britain, Australia, China, Spain and other countries have the highest level of cooperation, of which the United States and China are the most cooperative.

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Keywords cooccurrence network analysis

Because keywords are the core summary of a paper, there must be some correlation between the keywords in the same paper, and this correlation can be expressed by the frequency of cooccurrence. It is generally believed that the more frequently two keywords appear in the same literature, the closer the relationship between these two topics is. This paper uses the Co-occurrence function in VOSviewer to create a keyword cooccurrence network. We set a threshold to eliminate the occurrence of low-frequency keywords. The threshold set in this paper is 8, which means that at least 8 author keywords can enter the common word network. Finally, 29 keywords can enter the threshold to obtain the keyword cooccurrence network (Fig. 6). Each node represents the corresponding keyword, and the size of the node reflects the frequency of keyword occurrence. The two keywords of the line represent that they are related, and the thickness of the line reflects whether the theme content is closely related or distant.

High-frequency keyword cluster analysis

Clustering high-frequency keywords, closely linked keywords will form clustering. After VOSviewer software, the formation of 5 clusters (Fig. 7), the darker the color of the Chinese block, the longer the keyword appears more frequently. The five clusters formed by keyword clustering represent five hotspots of RLR. The most frequently used keywords in the five clusters are Rural Landscape, Landscape, Landscape, Landscape Change, and Landscape planning.

There are 5 hotspots in RLR, and the core scientific problems in these five research fields are analyzed below.

Cluster 1 mainly studied rural cultural landscape and rural development. The main keywords are: Rural landscape, Cultural landscape, Rural development, Sustainable development, Cultural heritage, Place. Centuries of farming, forestry, fishing, and pastoral management have shaped the rich and diverse cultural landscapes of rural areas (Antrop 2005; Fischer et al. 2012; Sutcliffe et al. 2013; Dorresteijn et al. 2017), including internationally protected species, habitats (Halada et al. 2011) or specific landscape elements such as forest farms, pastures (Plieninger and Schaar 2008) and Corridors (Oteros-Rozas et al. 2013). These cultural heritage landscapes and traditional agricultural landscapes have important natural, cultural and aesthetic values (Antrop 1997; Vliet et al. 2015; Yu et al. 2016), and how to protect these important historical and cultural heritages is an important issue (Ridding et al. 2018; Di Fazio et al. 2018; Gullino et al. 2018). In addition, some traditional ancient villages, local culture and other historical and cultural heritage has been abandoned, and even dragged the back of rural development (Eetvelde and Antrop 2004; Agnoletti 2007; Loos et al. 2015; Cillis et al. 2020). In the rural landscape, where historical values and traditional crops conflict with recent commercial and social needs, farming civilization is facing unprecedented challenges, and the study of the combination of cultural and historical values and socio-economic trends is a core scientific issue in this field for sustainable development.

Cluster 2 mainly studied rural tourism landscape, the matching of landscape value and landscape perception. The main keywords are: Landscape, Agriculture, Rural, Sustainability, Tourism, and Heritage. The development of rural tourism is based on the emergence of new consumption patterns (Xi et al. 2014; Mastronardi et al. 2017; Kristensen et al. 2019). This is partly due to a shift in tourist preferences to more direct contact with nature and increased interest in local customs, folklore and resources (Chen et al. 2017; Christou et al. 2018; Guan et al. 2019; Zhang et al. 2021). For city dwellers, on the other hand, the rural landscape represents peace and tranquility - an escape from the negative impact of urban life (Ryan 2002; Vogt and Marans 2004). The value of rural landscape comes from people's landscape perception (Daugstad 2008), and in recent years, the study of the perception and evaluation of rural landscape has shown a strong trend (Abram et al. 2014). Therefore, it is an important problem to study the match between landscape value and landscape perception.

Cluster 3 mainly studied urban-rural interaction, land use change and landscape pattern conflict. The main keywords are: Landscape metrics, Land use, Land-use change, Biodiversity, Urbanization, China, and Landscape structure. At a time when urbanization and industrialization are in a rapid development phase, the imbalance between urban and rural development has led to a large number of "one-way" flows of rural populations, capital, land and other factors of production to cities (Chen and Zhou 2018). Uncontrolled urban development continues to consume agricultural land and occupy rural residential communities, leading to an increasing number of urban and rural land-use conflicts (Yang et al. 2018b; Zou et al. 2019). Urban-rural conflicts also affect rural ecosystems, leading to the complexity, heterogeneity and discontinuity of natural plaques, resulting in degradation of ecological functions and reduction of biodiversity (Groot et al. 2012; Meffert et al. 2012; Larson et al. 2016), which directly affect the stability of urban and rural landscape patterns and regional ecological sustainability. Although urbanization has a negative impact on rural areas, it is not advisable to cut off the interaction between urban and rural areas directly, because the development of rural industries depends on the interaction between urban and rural markets and industries. Urbanization can solve the problems of labor circulation, land circulation, financing and technology and low management level in rural market. The revitalization of rural areas through the integration and development of urban and rural areas cannot be separated from the two-way interaction between urban and rural areas. Conflicts and interactions between cities and rural areas are becoming a hot topic of research among experts as inequality increases in urban and rural societies and urban-rural boundaries disappear (Darly and Torre 2013; Zhou et al. 2013; Yang et al. 2018c).

Cluster 4 mainly studied the change of the value of rural landscape ecosystem services, and the primary research method is to study landscape spatial pattern and landscape versatility through GIS mapping. The main keywords are: Landscape change, Ecosystem services, GIS, Landscape Ecology, Multifunctionality, and Agriculture Landscape. As technology continues to advance, historical cartography has allowed for the expansion of visualization into rural landscapes (Appleton and Lovett 2003). In the past, when studying the ecological function of rural landscape, we often faced two difficult problems, one is to analyze the

environment and landscape change of rural land needs to collect long-term landscape change information (Sandker et al. 2010; Statuto et al. 2018); These problems can be solved successfully through new technologies in geography (RS and GIS). First, satellite remote sensing can provide ecologically relevant data for long-term data sets to analyze changes in ecosystem area, structure and function on time and spatial scales (Murray et al. 2018). Aerial photography provides high-quality images and has been widely used as a basic tool for RLR (Moser et al. 2002; Martin-Martin et al. 2013). Second, visual communication, as a “common currency”, is an effective bridge between policy makers and experts (Appleton and Lovett 2003). Using geographic information from historical maps, combined with modern digital mapping and remote sensing imagery, can be used in GIS for more informed analysis and targeted environmental management decisions on rural landscapes (Iosifescu-Enescu et al. 2010; Casado-Arzuaga et al. 2014; Tortora et al. 2015; Statuto et al. 2018).

Cluster 5 mainly studied rural landscape planning, conservation and management. The main keywords are: Landscape Planning, Conservation, Landscape Management, and Rural Areas. The natural and cultural characteristics of the rural landscape are essential resources for shaping the rural character, but the expansion of the landscape function of modern rural production has resulted in a great loss of natural resources and historical sites (Pedroli et al. 2016), and the conflict between different types of landscape functions of the rural landscape on the border has intensified (Schlesinger et al. 2016). How to resolve the conflict between landscapes has become an important issue in this field. Pacione (2013) and Tudor et al. (2014) point out that landscape planning is critical to successfully resolving various types of landscape conflicts and protecting specific landscapes. Systematic landscape conservation planning achieves a balance between food security, landscape development and biodiversity (Pino et al. 2000; Jackson et al. 2012). Israel and Wynberg (2018) suggest that multi-functional countryside landscapes are becoming a new solution. Multifunctional landscapes are defined as landscapes that provide a variety of different ecological, economic and social functions, meaning enhanced synergies and reduced trade-offs between landscape objectives (Reyers et al. 2012; Hart et al. 2016; Ren et al. 2021). RLR planning is an important basis for rural construction and rural management, and the purpose of rural landscape planning and design is to create a healthy and comfortable living environment for rural residents and achieve sustainable development of rural landscape.

Frontal analysis

Through the cooccurrence network and cluster analysis of keywords, this paper has a general understanding of the hotspots of RLR, but the development trend and thematic evolution of research content is still unclear, and then, this paper uses R to map the heat map of the annual distribution of keywords (Fig. 8), and Bibiloshiny's Thematic evolution module to visualize the Thematic evolution path of RLR (Fig. 9).

Observing the frequency changes in keywords, Rural landscape has been around for nearly five years, and it's getting more and more frequent. Landscape metrics, Cultural landscape, Landscape planning, Urbanization, Land use have also seen high frequency in recent years. Three time slices were set in the Thematic evolution module, which automatically formed three evolution nodes in 2010, 2015, and 2018. the Thematic evolution path has a single path and differentiation path, and the single path indicates that the research topic has not changed. Compared with a single path, differentiation path is of greater significance to related research. Rural landscape (1992–2020), Landscape (1992–2020), Landscape planning (1992–2020) are three single research paths. There are three clear frontier paths to research in the Thematic evolution path map: Landscape ecology (1992–2010) — Landscape (2015–2018) — Agriculture/Heritage/Biodiversity (2018–2020); Landscape change(1992–2010) — Ecosystem services (2010–2015) — Cultural landscape (2018–2020); Land use change (1992–2018) — Landscape planning (2018–2020).

Landscape ecology (1992–2010) — Landscape (2015–2018) — Agriculture/ Heritage/ Biodiversity (2018–2020)

Between 1992 and 2010, urbanization was considered one of the main drivers of ecological degradation of rural landscapes (Zhou et al. 2013). Between 2015 and 2018, as landscape-related values are being eroded, there is an increase in landscape research. Between 2018 and 2020, the concept of biocultural diversity has attracted the attention of a large number of scholars. Biocultural diversity contains and integrates the cultural and biological (and non-biological) aspects of the landscape, referring to the specific link between biodiversity and cultural diversity (Gavin et al. 2015; Rotherham 2015; Bridgewater 2017; Eriksson 2018). Agnoletti and Rotherham (2015) believe that considering biological and cultural diversity and recognizing the need to protect key habitats that interact with nature may help to resolve some of the contradictions between landscape and conservation.

Landscape change (1992–2010) — Ecosystem services (2010–2015) — Cultural landscape (2018–2020)

Between 1992 and 2010, scholars mainly solved the problem of long-term landscape change or its specific components. For example, Paquette and Domon (2001) used land-use aerial footage from 1968 to 1997 to analyze rural landscape changes in southern Quebec, Canada, revealing a complex link between the process of social restructuring and large-scale agricultural land-use transformation. Branislav et al. (2009) studied current trends and long-term developments in the cultural landscape of Slovakia. Between 2010 and 2015, scholars conducted research on the impact of landscape change on ecosystem services. For example, Wang et al. (2016) analyzed land-use changes related to invasive species in 1996–2006 and predicted land use and land cover changes through 2018. Van der Sluis (2019) explores the significant impact of rural landscape transformation (determined by land use and land cover changes) on biodiversity, cultural identity and landscape identity. Between 2018 and 2020, many scholars are turning their attention to the cultural landscape and analyzing heritage conservation strategies and policies. For example, Di Fazio et al. (2018) consider agriculture and farmers to be the main actors in the conservation and transformation of rural landscapes, and heritage strategies and policies must be integrated with agricultural sector policies. Dolejš et al. (2019) identified the principal contradictions in rural landscape conservation, including (i) conservation based on cultural and environmental/ecological values, (ii) conservation based on spatial landscape patterns and individual landscape characteristics, and (iii) conservation based on the preservation of the past landscape while simultaneously addressing the process of change. Chrastina (2020) believes that long-term stable cultural landscapes have the potential to develop ecotourism similar to natural landscapes (wilds).

Land use change (1992–2018) — Landscape planning (2018–2020)

Between 1992 and 2018, rural land use changed from extensive to intensive (Jackson et al. 2012; Nowakowski et al. 2015; Kristensen et al. 2016). Therefore, promoting the balance between agricultural production in agricultural systems and biodiversity conservation in rural landscapes is a key issue. Starting in

2018, many scholars will focus on landscape planning, conservation and management. Gorka (2018) believes that incorporating the visual dimension of landscape into spatial planning is a necessary condition for sustainable spatial management. Research by Onitsuka et al. (2018) focuses on the potential of 3D visualization in rural landscape planning and concludes that integrating the knowledge of various actors into discussions and increasing diversity should improve rural governance and contribute to the goal of rural sustainability.

An integrated framework for rural landscape research

Through cluster analysis, it is found that the different functions of rural landscape can be divided into four different landscape types: cultural landscapes, tourism landscapes, ecological landscapes and production landscapes, and there are complex tradeoffs and synergies between different landscape types. The function of cultural landscape is related not only to the protection of historical heritage, but also to the sense of locality at the local, regional and national levels; the function of tourism landscape is to provide a place of leisure and tranquillity for human beings, and at the same time to bring considerable tourism benefits to the local area, and there is a synergy between cultural landscape and tourism landscape; the function of ecological landscape is to protect ecosystem services and provide human welfare, ecological landscape and production landscape have obvious tradeoffs, but also with tourism landscape has a synergy; the function of production landscape is to live and accumulate production materials for farmers, and a key function of the production landscape is related to food security, food sovereignty and foreign exchange, as well as to increasing agricultural income, rural employment and value-added in rural areas to slow the outflow of people. Because of the tradeoff and synergy between different landscape types, landscape planning in order to develop the high-intensity multifunctionality of rural landscape, need to have a tradeoff of thinking, and adopt an integrated landscape management approach, in a favorable way to strengthen the efficiency of rural landscape planning (Badiani et al. 2017; Israel and Wynberg 2018). Through reasonable and comprehensive landscape planning, the rural landscape develops towards multifunctional and sustainable landscape. Based on the research contents of rural landscapes, an integrated framework diagram of RLR is drawn (Fig. 10).

Discussion

The rural landscape is the main resource of agricultural production, providing food, materials and energy to the market. The rural landscape also supports biodiversity and has a unique ecosystem. However, in recent years, the outflow of rural population, the aging of the population and the abandonment of cultivated land have led to the decline of cultivated land production and biodiversity, and the abandonment of cultural heritage. In order to analyze the trade-off of multi-functional rural landscape and promote the sustainable development of the harmonious relationship between rural landscape people and environment, the concept of sustainable development should be integrated into RLR in the future. Swaffield et al. (2019) summarize the sustainability of rural landscapes as the occupation and management of areas other than those directly affected by cities without reducing ecosystem services to meet current and future social needs. There are still some problems in RLR sustainability and multi-functional rural landscape: First, there are more practical studies on multifunctional landscape recognition, planning and management in rural areas, and less theoretical research; Second, there are more evaluations and studies on the main functions of rural landscape, and less evaluation and research on the versatility of landscapes; Third, the relationship between the function of rural landscape and the versatility of landscape is less involved.

From the perspective of social-natural coupling system, the internal structure and internal correlation and mechanism between the multi-functional system of rural landscape are more complex, and the relationship types of landscape functions in specific rural areas are different, and their functional effects on the region are different. Therefore, from the perspective of multidisciplinary research, from the perspective of rural landscape system, the correlation and mechanism between rural landscape multifunctionality, and dynamic monitoring and trend simulation, help to clarify the rural landscape multi-functional trade-off ideas and paths to guide the sustainable development of rural areas.

Conclusions

This paper collects and organizes 735 related articles on rural landscape in the WoS Core Collection Database from 1992 to 2020 as research objects, and systematically combs and analyzes the hotspots, development trends and characteristics of RLR in the world using the bibliometric method, and concludes as follows through quantitative and qualitative analysis:

(1) Through quantitative analysis and research, the number and citation of RLR papers, relevant authors, research institutions and the basic situation of the country are obtained. The trend of RLR with the change of writing volume over time is a function of increase, which has aroused wide concern of the international community. European scholars have been influential in this field, with Cousins, Picuno and Statuto making outstanding contributions to RLR patterns using historical maps. European research institutions also play an important role in RLR. The United States, China and most European countries pay great attention to RLR, the United States, Britain, Italy and China are currently the most written RLR countries, it can be seen that developed countries pay more attention to RLR. In addition, cooperation between countries is weak, and research is dominated mainly by developed countries, which may pay less attention to rural development and construction. In rural development, developing countries must learn from the development plans of European countries on rural landscapes and avoid the loss of value of rural landscapes.

(2) Through the qualitative research and analysis of the keyword cooccurrence network and the thematic evolution path map, the five hotspots and three clear research frontier paths of RLR are extracted. The five hotspots are: rural cultural landscape and rural development; matching landscape value and landscape perception of rural tourism landscape; urban-rural interaction, conflict between land use change and landscape pattern; change of the value of rural landscape ecosystem service; and rural landscape planning, protection and management. The three frontal paths are: Landscape ecology (1992–2010) — Landscape (2015–2018) — Agriculture/Heritage/Biodiversity (2018–2020); Landscape Change (1992–2010) — Ecosystem services (2010–2015) — Cultural landscape (2018–2020); Land use change (1992–2018) — Landscape planning (2018–2020). In recent years, RLR has paid more attention to the protection of cultural landscape, bio-cultural diversity and landscape planning. RLR, from qualitative landscape narrative analysis to the extensive use of GIS and RS and

other techniques for quantitative measurement, to qualitative and quantitative analysis methods for rural landscape multi-dimensional, dynamic and comprehensive research, so that modern RLR presents a complex, multi-dimensional characteristics.

In general, the number of RLR has been increasing year by year, and from the study based on geography and ecology to the multidisciplinary and multi-method combination of social and economic development, culture and other elements of comprehensive research direction. At present, RLR takes cultural landscape, tourism landscape, ecological landscape, agricultural production landscape and rural landscape planning as its main research objects, and changes from the static pattern of rural landscape to dynamic evolution process, urban-rural interaction, ecosystem service and multifunctional landscape trade-off. In the research paradigm from a single dimension to a multi-dimensional, and combined with “3S” technology, a variety of landscape ecological model software research.

Declarations

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Figures

Figure 1

Bibliometric and the recommended science mapping workflow

Figure 2

The number of articles and the average citations per paper on rural landscape research from 1992 to 2020

Figure 3

Authors' production over time in the field of rural landscape

Figure 4

Country scientific production in the field of rural landscapes (N=946), Source: Make it yourself (The shades of colour indicate the number of articles published in the country, grey indicating that no rural landscape research has been conducted; the bar chart shows the change in the number of articles published by the 10 countries with the largest number of articles from 1992 to 2020, while the pie chart shows the proportion of articles published by 6 continents.)

Figure 5

Intensity of research cooperation between countries

Figure 6

Cooccurrence network for rural landscape keywords

Figure 7

High-frequency keyword cluster map of rural landscape research

Figure 8

Heat maps of the annual distribution of keywords in rural landscape research from 1992 to 2020

Figure 9
Thematic evolution path of rural landscape research from 1992 to 2020

Figure 10
An integrated framework for rural landscape research