frontiers | Frontiers in Environmental Science

TYPE Mini Review
PUBLISHED 20 October 2022
DOI 10.3389/fenvs.2022.1029510

OPEN ACCESS

EDITED BY
Hu Li,
Guizhou University, China

REVIEWED BY
Yutao Zhang,
Anshun University, China
Rongguo Sun,
Guizhou Normal University, China

*CORRESPONDENCE
Yuchi Yang,
yangyuchi@tongji.edu.cn

SPECIALTY SECTION
This article was submitted to Land Use Dynamics,
a section of the journal
Frontiers in Environmental Science

RECEIVED 27 August 2022
ACCEPTED 03 October 2022
PUBLISHED 20 October 2022

CITATION
Yang Y (2022), Research hotspots and evolution trends of rural resilience in the perspective of biodiversity—Based on citeSpace's visual analysis of bibliometrics.
Front. Environ. Sci. 10:1029510.
doi: 10.3389/fenvs.2022.1029510

Research hotspots and evolution trends of rural resilience in the perspective of biodiversity —Based on citeSpace's visual analysis of bibliometrics

Yuchi Yang*

College of Architecture and Urban Planning, Tongji University, Shanghai, China

Strengthening the construction of rural resilience and improving the rural ecotope and biodiversity are of great significance to improving the governance's abilities of rural areas to resist external disturbances and various crises. Based on the 1786 documents which are associated with the research topics collected in the "Web of Science" database from 1992 to 2022, this study uses the visualization analysis method of the "CiteSpace document" to focus on the rural resilience from the ecosystem perspective, sort out the hotspots of rural resilience construction research, and study and judge the future development tendencies. It pertinently put forward the research evolution trends of "bottom–up ecological restoration" and "top–down planning improvement." The research results are beneficial to provide useful references and direction enlightenment for the sustainable research of rural resilience and the formulation of planning strategies from the perspectives of biodiversity.

KEYWORDS

rural resilience, biodiversity, ecosystem biomass, CiteSpace, sustainable development

1 Introduction

The continuous advancement of industrialization and urbanization has led to the overall reconstruction of rural areas and has been facing a series of problems such as industrial decline, population decline, and ecological decline. The instability and fragility of rural areas have become increasingly prominent and inhibited the sustainable development of rural areas (McManus P et al., 2012; Modica M et al., 2015; Pandey R et al., 2017). How to strengthen the rural resilience construction, improve the governance abilities of rural areas to resist natural disasters, instability, and various crises caused by external disturbances, improve the quality of the rural ecological environment (Qiu et al., 2021), and promote the high-quality development of rural areas remains unclear. It has been highly valued by the countries over the world and has also attracted extensive attention from the academic communities (Center and Garden,2009; Chaigneau, T et al., 2022; Ekblom et al., 2020; Li et al.,

2022). Regarding the cognition of resilience theory, Western scholars have two perspectives: one is the equilibrium theory based on engineering resilience and ecological resilience (Rigg et al., 2015; Roberts et al., 2017), and the other is the evolution theory based on evolutionary resilience (Chen, 2007;Chen et al., 2017; Hennebry, 2020; Huang, et al., 2020; Li et al., 2014; Li et al., 2020). Following this logic, the academic research has been deepened gradually, and the concept and connotation of resilience have been evolving and developing from focusing on the resilience of research objects to focusing on biological and ecological sustainability (Wang et al., 2021; Li Y,2022) and then to long-term adaptability; it has been constantly evolving and developing.

Wilson took the lead in introducing resilience theory into the research on rural multi-functional transformation, which has better explained many problems faced in rural transformation and development (Wilson, 2012; Li, 2020). Scholars have found that rural resilience is mainly reflected in the rural disturbance and instability caused by natural disasters (Cutter et al., 2016), climate change, sustainable utilization of biomass energy (Emmanuel et al., 2012), and social–economic changes (Tebboth et al., 2019; Yang, et al., 2020). At present, the research on rural resilience mainly focuses on the prevention and control of rural natural disasters (M.F.MFirdhous et al., 2018; Mohamed et al., 2014; Babulo et al., 2008), community construction and governance (Philp, 2008; Bjorna and Aarseether., 2009; Marsden and Sonnino., 2008), farmers' livelihood (M.F. MFirdhous et al., 2018), infrastructure construction (Elisabeth et al., 2017; Nguyen et al., 2017), and resilience evaluation (Mazur et al., 2018; Wilson et al., 2018; Scott, 2013). With the connotation of resilience becoming an important aspect of biological sustainability, rural resilience is widely understood as the ability of rural systems to cope with changes (Kilkenny, et al., 2008; Koning, et al., 2021), adapt, and continue to develop in the uncertain environment of unexpected shocks and challenges (Folke et al., 2010; Pain and Levine, 2012; Brown, 2017; Folke, et al., 2016). The concept and connotation of rural resilience have also gradually shifted from the equilibrium theory to evolution theory (Scott, 2013; Qiu et al., 2021; Wang et al., 2021).

Over the years, the research on resilience theory mainly focuses on urban areas, while the research on rural biodiversity (especially rural biodiversity) is not enough and systematic. The unbalanced development between urban and rural areas has made the rural infrastructure backward and the flood control and drought relief facilities weak, thus reducing the ability of disaster prevention (Cutter et al., 2010) and risk resistance in rural areas (Mazur et al., 2018), and the living environment in rural areas has become increasingly worse. In this research, resilience is defined as the ability of the rural regional system to maintain relative stability through comprehensive means such as social, economic, and ecological relative stability (Holladay and Power., 2013). It realizes the transition from the original equilibrium state to a new equilibrium state and emphasizes the characteristics of the system by actively adapting and maintaining sustainable development (Heijman Hagelaar, 2007; Li et al., 2021). Therefore, it is significant and necessary to gradually analyze the research results of rural resilience, promote the construction of rural resilience, improve the ability of rural areas to cope with various crises (Al-Zubaidy.,2015), and promote the construction of the beautiful ecological environment (Huang X, et al., 2019), biodiversity, and sustainable development in rural areas (McManus et al., 2012; Dai Qi., 2015). Based on the "Web of Science" database and utilizing CiteSpace document visualization analysis software, this study focuses on the research on rural resilience from the ecosystem perspective, discusses and analyzes the hotspots of rural resilience construction research, and studies and judges the future development and evolution trend, thus guiding the direction for further research on it. The innovation lies in focusing on the rural resilience research from the perspective of the ecosystem, discussing and analyzing the hotspots of rural resilience construction research, with judging the future development trend from the perspective of biodiversity, so as to guide the direction for further research on rural resilience. Literature visualization software helps sort out the salience time, salience intensity, and the important literature of various keywords and is more beneficial to understand the research progress.

2 Research data and analysis methods

2.1 Research data

The research data are obtained from the "Web of Science" literature database. Here, "rural resilience" and "rural resilience" are selected as the main topic words, respectively, and they are set as TS = ("rural resilience") or TS = ("rural-resilience") through the advanced search of the WOS database; time expand = "1992–2022." The conference contributions, the opening remarks of the volume, and introduction of personal academic achievements in the search results were deleted completely, and the duplicate literature was eliminated, and 1786 relevant literature reports were finally determined. Through the function of year per slices *via* "CiteSpace," all the literature studies are departed to a cycle of 3 years. Among them, the number of relevant literature has increased significantly year by year, with only two literature studies from 1992 to 1994, 72 literature studies from 2007 to 2009, and 249 literature studies from 2019 to 2021.

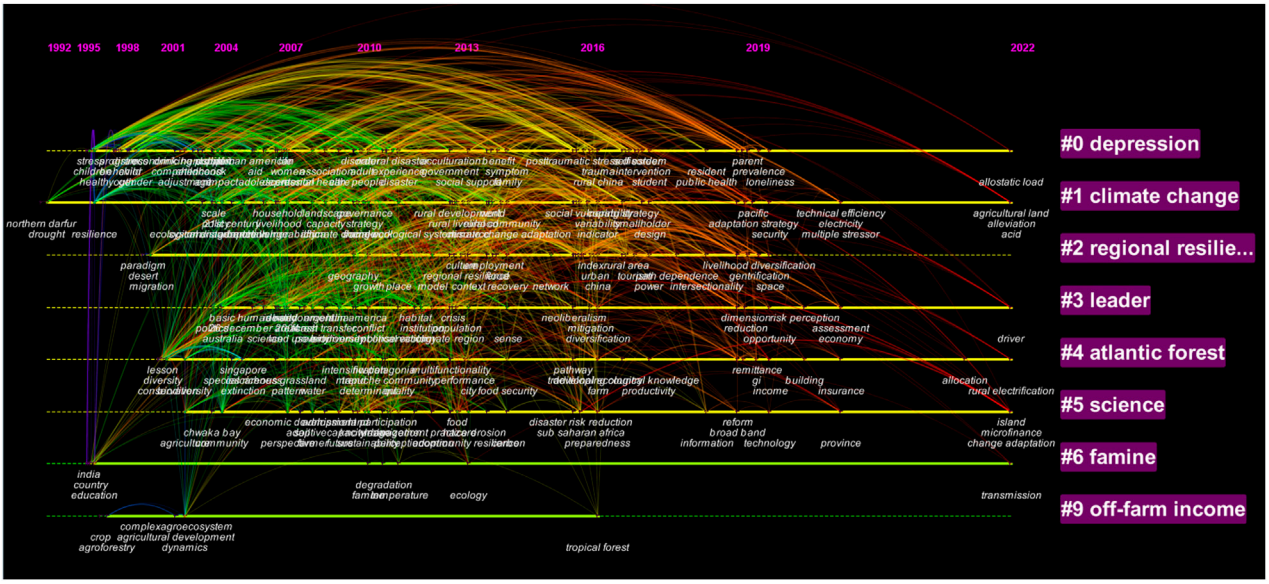

FIGURE 1
Evolution analysis of theme words of rural resilience in the Wos database.

2.2 Analysis method

"CiteSpace bibliometric visualization analysis" describes the main content of the literature, analyzes, and builds the correlation relationship between knowledge with the help of statistical methods, which can effectively provide important technical support for mining-related research progress (Chen et al., 2009; Hu et al., 2018). It is extensively used in the research and analysis of the existing literature (LI Jie et al., 2016; Yue, 2009). Therefore, this research adopted CiteSpace software analysis, combined with association analysis and cluster analysis, to import the literature data retrieved and sorted out from 1992 to 2022 into "CiteSpace 6.1." Through debugging the setting of relevant parameters, the keyword co-occurrence network graph and subject salient word graph are drawn completely.

3 Research hotspots and evolution analysis

The research is based on the time zone function of the CiteSpace 6.1 software platform to search for mutant words and analyze mutant words through literature keywords, aiming to explore the current top keywords with the strongest citation bursts. A burstness model was used to calculate words and sudden mutation in the rural resilience–related literature. The burstness model is used to calculate the mutant words and literature in the related research of rural resilience. The mutant detection algorithm of the computing party thinks that the emerging and rising mutant literature are frontier and timely in revealing the new tendency in the scientific field. In order to ensure the number of mutant words in the calculation, the threshold value was adjusted from 1 to 0.8, and 20 mutant words were detected with the help of software, among which the highest intensity was "Africa, biodiversity, environment, support," etc.

3.1 Research on mutation words and their evolution

The academic research on rural resilience has a wide range of perspectives and methods. The evolution analysis graph of rural resilience subject words in the Wos database (Figure 1) reveals that 20 mutant words have appeared in the past 30 years. In terms of the mutant words' intensity, the highest value is "Africa," and the frequency intensity is 4.4869, which appeared in 2007 and ended in 2015 with a moderate occurrence cycle. The second is "biodiversity" with a frequency intensity of 4.3301, which appeared in 2001 and ended in 2015, and the occurrence cycle was relatively long. From the point of view of the intensity of the mutant word, the highest value was "Africa" and the frequency intensity was 4.4869, which appeared in 2007 and ended in 2015, and the occurrence cycle was moderate. The high-frequency literature mainly researches the persistence and resistance to human

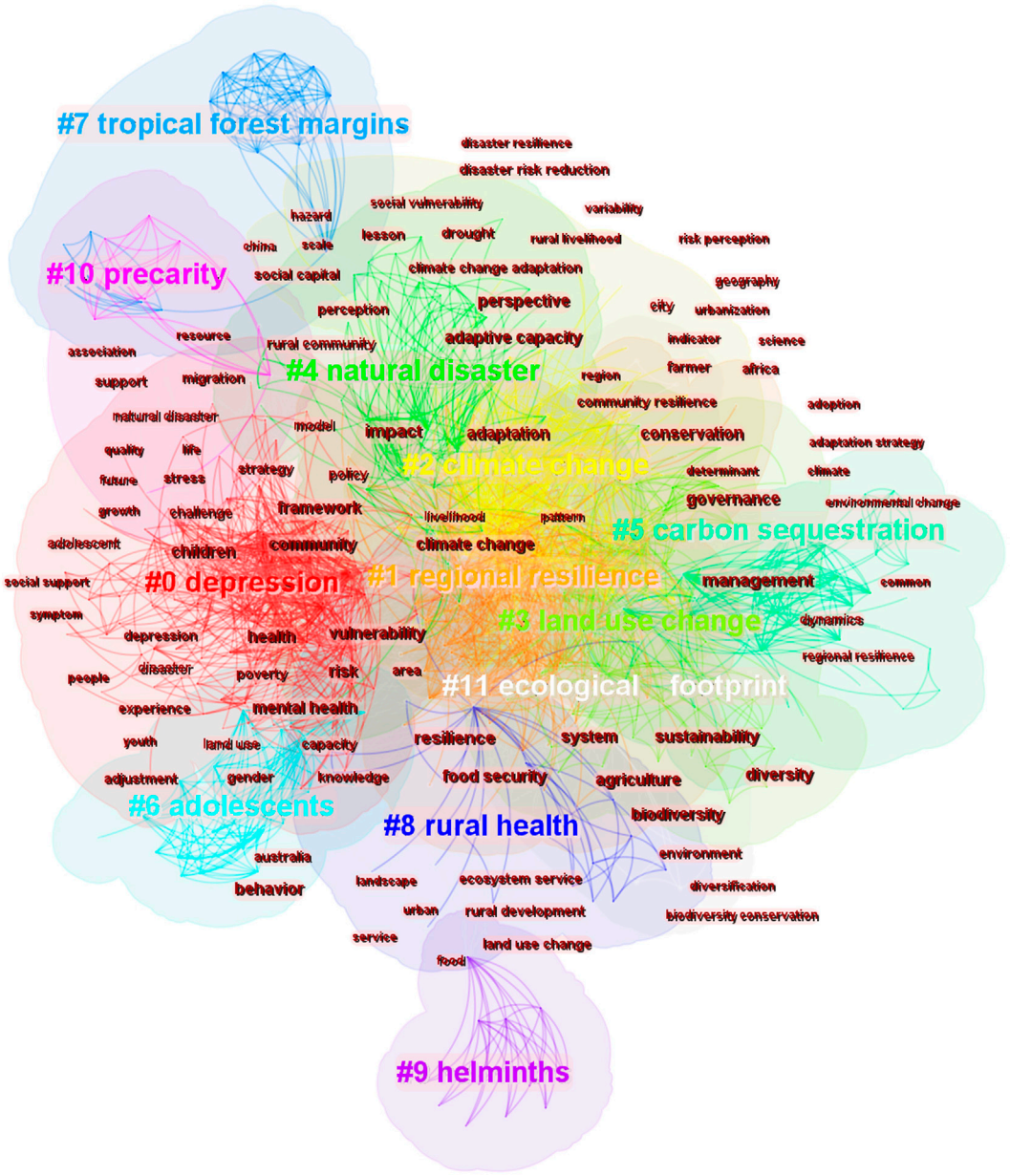

FIGURE 2
Clustering diagram of rural resilience keywords in the Wos database.

disturbance of rainforest birds in plantations and primary forests of Peninsular Malaysia (Kelvin, 2005).

The high-frequency word from 2010 to 2015 was the social ecological system (SES), with a frequency intensity of 3.6702. It mainly includes a social ecological system framework proposed by Ostrom, which is mainly used in ecological restoration projects, biomass energy, ecological vulnerability assessment, etc. From 2010 to 2015, the high-frequency word was "Social Ecological System (SES)" with a frequency intensity of 3.6702. It mainly includes a social ecological system framework proposed by Ostrom, which is mainly used in ecological restoration projects, biomass energy, ecological vulnerability assessment, etc. The high-frequency literature mainly researches the resilience and vulnerability of remote rural communities to global climate and ecological environment changes (Scott et al., 2013; Bailey et al., 2016; Douglas et al., 2019; Peng et al., 2017). The frequency intensity of the mutant word "adaptivity" was 3.0606, which appeared in 2013 and ended in

2018. It is mostly used for resilience and adaptability to cope with biomass and biodiversity changes. The high-frequency literature mainly researches the adaptability and resilience of rural households to cope with climate changes and carbon dioxide emission reduction (Angeler et al., 2018).

The mutant words mainly indicate the concern about biomass energy, biodiversity, climate change, and ecological environment in the research topics of rural resilience. In part, vulnerability assessment, optimal utilization of resources, ecological planning, and other methods are widely used to improve the level of rural resilience. For the resilience measurement in the ecosystem, the quantitative measurement and diversity characteristics are reflected in the landscape heterogeneity (Liu et al., 2015), landscape diversity (Yang et al., 2021), and biodiversity (Schwarz et al., 2011).

The biomass content can further reflect the threshold level of numerous elements of the rural ecosystem and can explain the motivations and influencing factors in the evolution of the ecosystem.

3.2 Research keywords and evolution

The clustering nodes are set as keywords by CiteSpace 5.8 software, and the keyword co-occurrence relationship graph based on the Wos database is obtained after eliminating the words with low relevance and low frequency to the subject words (Figure 2). It reveals that the research topics of "rural resilience" are relatively concentrated, and the keywords are closely connected. Among them, the keywords with high frequency are "region resilience," "climate change," "land use change," "natural disaster," "carbon sequestration," "traditional forest margins," "rural health," "precarity," and "ecological footprint." The analysis shows that the impact of climate change is being felt globally. To a large extent, climate change is regarded as the greatest threat to people's lives. It is expected that the impact of climate change will be greater in the future (IPCC, 2014). According to the World Bank (2010), the total loss caused by all disasters during 1970–2008 was about $230 billion. Some highly cited keywords revealed in the figure indicate the concern about climate changes, natural disasters, biological sustainability, carbon storage, etc., emphasizing the ability level of the rural social–ecological system to maintain a relatively stable state and sustainable development.

The results obtained by keyword cluster analysis show that the research topic pays attention to external factors such as "climate change," "natural disaster," and "ecological footprint" that affect the resilience and stability of rural ecosystems. Meanwhile, it combines the internal elements of the system such as "land use change," "carbon sequestration," and "rural health." Numerous research studies have been conducted on the external and internal factors that affect the stability of the system and cope with changes. From the research on internal and external systems, influencing factors to the rural human settlement environment, we pay attention to the living conditions, environmental quality, and climate conditions of rural residents. The biomass content not only affects the stability and diversity of the rural social–ecological system but also directly or indirectly affects various physiological and psychological states of people in the system and the threshold level and evolution trend of some elements.

4 Main research contents

The theory of rural resilience has a pluralistic essence, highlighting the interaction between elements, the form, coupling structure, and the non-equilibrium evolution path of rural material elements (Li et al., 2019). Rural transformation in the new period often adopts a new development mode to improve its ability to resist the impact and maintain a stable state. Combined with the sorting and quantitative analysis of the high-frequency mutation words and keywords in the research on rural resilience, it is found that the research content of rural resilience based on the perspective of biodiversity focuses on the biodiversity and external climate change in the rural ecosystem and their interaction modes and conditions on rural resilience. Scholars believe that the spatial promotion of rural resilience through social spatial reproduction (Westlund H, 2006) can improve the biomass content in rural ecosystems and enrich the organizational structure to maintain relative stability.

4.1 Resilience and biodiversity

Biodiversity can reflect the multiple characteristics of rural resilience, and the influencing factors are relatively complex and comprehensive. Scholars at home and abroad have carried out a series of studies on this issue. For example, Nivaldo Peroni et al. (2002) put forward a theoretical model focusing on biodiversity and resource resilience to explain the impact factors of biodiversity decline: the rural population outflow, increase in tourism, and changes in production and lifestyle, aiming at the interspecific and intraspecific diversity of cultivated crops. Kelvin S.H (2005) studied the composition and structure of virgin forests, artificial forests, and birds in rural areas, proposed that the abundance of material resources and factors closely related to forest disturbance affect biodiversity, and explored resilience of rural areas from the perspective of ecosystem stability and sustainability. Peng et al. (2017) quantitatively analyzed the internal relationship between regional ecosystem health assessment, biodiversity, and rural land use and land cover change through quantitative indicators and explored the mutual relationship between the model and process and rural resilience. Marleen Schouten (2013) explained the interrelation between biodiversity and rural resilience at the landscape level through the

theoretical construction and scheme experiment of the rural environmental agency model and proposed that the top–down government investment aimed at improving the public value of the rural society ecosystem and improving rural resilience. M.G.Sorice (2012) studied the land ownership patterns in three counties in central Texas. Through interviews with 767 owners and questionnaire data, he found that changes in land owners and their ideas may bring about changes in the land cover, thus affecting ecological diversity and resilience.

Biodiversity assessment is the ecological basis for assessing the resilience level of rural areas. How to conduct rural scale assessment requires comprehensive consideration of the land cover, landscape vegetation, biological composition and structure, and other factors. As for the rural "social–ecology–economic" system, existing research mainly focuses on landscape diversity, landscape fragmentation degree, coverage, etc., without comprehensive and systematic consideration of rural social–ecology–economic factors. In recent years, with the rise of spatial quantitative analysis and the improvement of the availability of remote sensing data in villages, many scholars have paid attention to the quantitative measurement of biodiversity and ecosystem assessment. Future research needs to pay attention to the soil carbon content, biomass carbon dioxide, etc., and effectively link up with the double carbon targets of carbon neutralization and carbon peak.

4.2 Resilience and climate change

Climate changes affect various elements of the rural ecosystem and their relationships at the macro scale. For example, drought can easily lead to the loss of rural crops and the reduction of biomass in soil. Soil and water loss affect the content of soil biomass and the spatial pattern of soil and water. The research by Elisabeth Simelton (2009) shows that the size of rural population and the amount of agricultural input are negatively correlated with drought vulnerability, and the vulnerability is negatively correlated with land abundance. Loring and Gerlach (2009) addressed the complex ecological environment and climate change by studying rural food security and sustainable development of food resources. Nguyen et al., (2017) researched the rural land-use decision-making factors represented by land-use selection decisions and crop diversity. He found that they are closely associated with the ability to cope with the impact of climate change, economic life expectations, and living environment characteristics and discussed the rural resilience shown by coping with climate change and measures on how to improve rural resilience.

In the background of urban sprawl, population expansion, and climate change, Kristine Lien Skog (2016) researched the conversion of the rural arable land and the protection of the arable land by quantitative measures. Taking Norway as an example, he discussed the influence mode and mechanism of soil attachments on rural resilience from the perspective of conversion of the arable land to a construction land. Barrett, C (2015) researched the correlation between rural economic conditions and soil quality and proposed the importance of soil fertility for rural resilience and resistance to climate change. As the spatial carrier of biomass coverage and bearing, the land provides material conditions for rural adaptation to climate change, and the level of the land itself has a positive impact on resilience. In his speech on the International Year of Soil in 2015, the UN Secretary-General Ban Ki Moon believed that "A healthy life is not possible without healthy soils."

In summary, the richness and quality of the land, the rationality of spatial distribution, the content of soil biomass, artificial agricultural production, and non-agricultural behavior play a decisive role in rural resilience under the background of climate change. Climate changes have a direct impact on the rural ecological environment, affect the stability of the rural social–economic system, and play a role in its ability to cope with occasional shocks and complex risk changes.

5 Development trend of rural resilience research

5.1 Research results

Based on the perspective of biodiversity, this study adopted the CiteSpace document visualization analysis method to analyze the mutation words, keywords, and evolution trend of rural resilience research from 1992 to 2022 using the knowledge map. The main conclusions are as follows: first, more and more attention is paid to rural resilience; second, the high-frequency mutation words in rural resilience research mainly include "Africa, biodiversity, social ecological system and adaptability," which reflect that biomass energy, biodiversity, climate change, and ecological environment have received high attention in the study of rural resilience. The high-frequency keywords mainly include "region resilience, climate change, land use change, natural disaster, carbon sequestration," etc., indicating the concern about climate change, natural disasters, biological sustainability, carbon storage, etc. Third, the research content mainly focuses on resilience and biodiversity, and resilience and climate change; the fourth conclusion is made to analyze and judge the development trend of promoting the research and construction of rural resilience from the aspects of ecological restoration and rural planning.

5.2 Development trend

In combination with the main research contents, relevant research progress, and the two main research hotspots

mentioned earlier, the author made the following prediction and conclusion on the development trend of the interdisciplinary research on the combination of rural resilience and biodiversity: 1) with the in-depth implementation of the strategies such as "beautiful countryside, carbon peak, and carbon neutralization," the importance of rural ecological environment protection and biomass diversity protection will become more and more prominent in rural resilience construction and research. 2) Carrying out bottom–up ecological restoration and top–down planning improvement will be an important development trend and research direction for the future development of rural resilience construction. This point will be emphatically discussed later.

5.2.1 Bottom–up ecological restoration

In response to biodiversity changes, rural resilience emphasizes the mode, extent, and direction of adaptation formed by resisting external environmental changes, which are affected by natural, economic, social, and other factors. Rural resilience from the perspective of biodiversity needs to consider the rural regional ecosystem and its evolution process from the perspective of spatial–temporal changes and factor transmission, and accurately recognize and evaluate the resilience level and capacity of the rural system from a dynamic perspective. It is proposed that the bottom–up ecological restoration mode is a path of self-restoration and improvement based on the evolution and coordination perspective with rural space as the carrier and the land as the cell under the existing framework of rural resilience identification, measurement, and research. It can effectively promote the richness of land biomass, sustainable development of the rural spatial system, realize the goal of individual cognition, network social association, human–earth system co-existence, and improve biodiversity in practice. In further research, we should pay attention to the combination of theory and empirical cases.

5.2.2 Top–down planning improvement

In response to global climate change, rural resilience emphasizes on coping with complex change scenarios and optimizing sustainable development paths. Based on the perspective of climate adaptation and climate change, it is necessary to emphasize the top–down planning promotion path. From the perspective of a more macroscopic spatial scale and time evolution, it is necessary to systematically sort out and think about the whole elements of the land space in the village and propose planning strategies, planning paths, and spatial layout optimization methods. Starting from the complex relationship and interaction between various related elements of rural resilience, it is considered to dock territorial space planning, construct village territorial space planning, optimize the layout of the village territorial space from the top to the bottom, and promote the integration and improvement of biological resources. Dynamic monitoring and follow-up are carried out according to the evolution trend of rural resilience, and new spatial adjustments are constantly made to optimize the rural social–economic–ecological system so as to better improve the biomass content of land resources and carry rural production and life. Scholars should pay attention to the applicability of planning improvement in different spatial scales and time conditions in further research studies.

Author contributions

YY was in charge of designing the experiments and writing the manuscript; YY was in charge of revising the manuscript; YY was in charge of project administration.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Al-Zubaidy, M. S. K. (2015). A literature evaluation of the energy efficiency of leadership in energy and environmental design (LEED)—certified buildings[J]. *Am. J. Civ. Eng. Archit.* 3 (1), 1–7. doi:10.12691/ajcea-3-1-1

Angeler, D. G., Allen, C. R., Garmestani, A., Pope, K. L., Twidwell, D., and Bundschuh, M. (2018). Resilience in environmental risk and impact assessment: Concepts and measurement. *Bull. Environ. Contam. Toxicol.* 101, 543–548. doi:10.1007/s00128-018-2467-5

Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., Deckers, J., et al. (2008). Household livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia. *Agric. Syst.* 98 (2), 147–155. doi:10.1016/j.agsy.2008.06.001

Bailey, I., and Buck, L. E. (2016). Managing for resilience: A landscape framework for food and livelihood security and ecosystem services. *Food Secur.* 8, 477–490. doi:10.1007/s12571-016-0575-9

Barrett, C., and Bevis, L. (2015). The self-reinforcing feedback between low soil fertility and chronic poverty. *Nat. Geosci.* 8, 907–912. doi:10.1038/ngeo2591

Bjorna, H., and Aarsæther, N. (2009). Combating depopulation in the northern periphery: Local leadership strategies in two Norwegian municipalities. *Local Gov. Stud.* 35 (2), 213–233. doi:10.1080/03003930902742997

Brown, K. (2017). Book review: Brown, katrina. 2016: Resilience, development and global change. *Prog. Dev. Stud.* 17 (1), 90–92. doi:10.1177/1464993416672302

Center, L. B. J. W., and Garden, U. S. B. (2009). The sustainable sites initiative: Guidelines and performance benchmarks[J]. *Environ. Policy Collect.*

Chaigneau, T., Coulthard, S., Daw, T. M., Szaboova, L., Camfield, L., Chapin, F. S., et al. (2022). Reconciling well-being and resilience for sustainable development. *Nat. Sustain.* 5, 287–293. doi:10.1038/s41893-021-00790-8

Chen, C. M., Chen, Y., and Hou, J. (2009). CiteSpace II: Identification and visualization emerging trends and transient patterns in scientific literature[J]. *J. China Soc. Sci. Inf.* 28 (3), 401–21. doi:10.1002/asi.20317

Chen, C. M. (2009). Citespace II:detecting and visualizing emerging trends and transient patterns in scientific literature. *J. China Soc. Sci. Tech. Inf.* doi:10.1002/asi.20317

Chen, M., and Mengyuan, C. (2017). Aninternational literature review of regional economic resilience:Theories and practices based on the evolutionary perspective. *Progress. Geogr.* 36 (11), 1435–1444. doi:10.18306/dlkxjz.2017.11.012

Cutter, S. L., Burton, C. G., and Emrich, C. T. (2010). Disaster resilience indicators for benchmarking baseline conditions. *J. Homel. Secur. Emerg. Manag.* 7 (1). doi:10.2202/1547-7355.1732

Cutter, S. L., Ash, K. D., and Emrich, C. T. (2016). Urban–rural differences in disaster resilience[J]. *Ann. Am. Assoc. Geogr.* 106 (6), 1236–1252. doi:10.1080/24694452.2016.1194740

Dai, D., and Qi, C. (2015). Cases and enlightenments of sustainable landscape architecture in the United States[J]. *China Urban For.* 13 (1), 33–37.

Ekblom, A. (2020). Livelihood security, vulnerability and resilience: A historical analysis of chibuene, southern Mozambique. *AMBIO* 41, 479–489. doi:10.1007/s13280-012-0286-1

Emmanuel, R., and Krüger, E. (2012). Urban heat island and its impact on climate change resilience in a shrinking city: The case of Glasgow, UK. *Build. Environ.* 53, 137–149. doi:10.1016/j.buildenv.2012.01.020

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., and Rockstr€om, J. (2010). Resilience thinking:integrating resilience, adaptability and transformability. *Ecol. Soc.* 15 (4), 20. available at:. doi:10.5751/es-03610-150420http://www.ecologyandsociety.org/vol15/iss4/art20/

Folke, C. (2016). Resilience (republished). *Ecol. Soc.* 21 (4), 44. doi:10.5751/ES-09088-210444

Heijman, W. J. M., and Hagelaar, J. L. F. (2007). Rural resilience as a new development concept[C]//DENILO T,MILANDIN M. 100th seminar of the EAAE: Development of agriculture and rural areas in central and eastern europe. *NoviSad, Serbia Montenegro Eur. Assoc. Agric. Econ.*, 383–396.

Hennebry, B. (2020). The determinants of economic resilience in rural regions. An examination of the Portuguese case. *Misc. Geogr.* 24 (1), 24–29. doi:10.2478/mgrsd-2020-0001

Holladay, P. J., and Powell, R. B. (2013). Resident perceptions of social–ecological resilience and the sustainability of community-based tourism development in the Commonwealth of Dominica[J]. *J. Sustain. Tour.* 21, 1188–1211. doi:10.1080/09669582.2013.776059

Hu, K. F., and Zheng, X. (2018). Literature review of key areas and frontier trends in landscape performance research based on citespace bibliometric analysis[J]. *Landsc. Archit.* 25 (11), 84–89. doi:10.14085/j.fjyl.2018.11.0084.06

Huang, J., and Waibel, H. (2021). Location and economic resilience in rubber farming communities in southwest China. *China Agric. Econ. Rev.* 13 (2), 367–396. doi:10.1108/CAER-06-2020-0153

Huang, X., Li, H., Zhang, X., Hu, K. F., and Zheng, X. (2018). Land use policy as an instrument of rural resilience – the case of land withdrawal mechanism for rural homesteads in China. *Ecol. Indic.* 87, 47–55. doi:10.1016/j.ecolind.2017.12.043

IPCC (2014). *Climate change 2014: Impacts, adaptation, and vulnerability.Part A: Global and sectoral aspects. Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate*. Cambridge, United Kingdom and New York, USA: Cambridge University Press.

Júnior, W. S. F., Ladio, A. H., and Albuquerque, U. P. D. (2011). Resilience and adaptation in the use of medicinal plants with suspected anti-inflammatory activity in the Brazilian Northeast. *J. Ethnopharmacol.* 138 (1), 238–252. doi:10.1016/j.jep.2011.09.018

Kelvin, S. H. P., Johnny, D. J., Navjot, S. S., Susan, L. H. L., Yap, C. A. M., Lim, S. L. H., et al. (2005). Lowland rainforest avifauna and human disturbance: Persistence of primary forest birds in selectively logged forests and mixed-rural habitats of southern peninsular Malaysia. *Biol. Conserv.* 123 (4), 489–505. doi:10.1016/j.biocon.2005.01.010

Kilkenny, M. (2008). Social capital in the knowledge economy: Theory and empirics – by hans westlund. *Pap. Reg. Sci.* 87 (1), 149–152. doi:10.1111/j.1435-5957.2007.00157.x

Koning, J. D., Hobbis, S. K., Mcneill, J., and Prinsen, G. (2021). Vacating place, vacated space? A research agenda for places where people leave. *J. Rural Stud.* 82 (1), 271–278. doi:10.1016/j.jrurstud.2021.01.026

Li, H., Jin, X., Liu, J., Feng, D., Xu, W., and Zhou, Y. (2022). Analytical framework for integrating resources, morphology, and function of rural system resilience—an empirical study of 386 villages. *J. Clean. Prod.* 365, 132738. doi:10.1016/j.jclepro.2022.132738

Li, H., Li, Y., Huang, H., and Song, C. (2020). Rural settlements research from the perspective of resilience theory. *Sci. Geogr. Sin.* 40 (4), 556–562. doi:10.13249/j.cnki.sgs.2020.04.007

Li, J., and Chen, C. (2016). *Citespace: Scientific text mining and visualization[M]*. Beijing: Capital University of Economics and Business Press.

Li, T., Niu, P., and Gu, C. (2014). Research on framework of resilient cities. *Urban Plan. Forum* (5), 23–31. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2015&filename=CXGH201405008&uniplatform=NZKPT&v=8v9R6NbfdyWOFA6jUiTczhrVqFcFpbqDCNdJOFpEK4doLawN3y9bzyJ1TZcdVJzj.

Li, Y., Huang, H., Song, C., et al. (2020). The spatiotemporal evolution ofChina's rural resilience and the key factors detection. *Actageogr. Sin.* 2020-06-15. [2020-09-28] http://kns.cnki.net/kcms/detail/11.1856.P.20200615.0835.002.html.

Li, Y. (2022). A systematic review of rural resilience. *China Agric. Econ. Rev.* ahead-of-print No. ahead-of-print. doi:10.1108/CAER-03-2022-0048

Li, Y., Westlund, H., and Liu, Y. (2019). Why some rural areas decline while some others not: An overview of rural evolution in the world. *J. Rural Stud.* 68, 135–143. doi:10.1016/j.jrurstud.2019.03.003

Li, Y., Wu, W., and Wang, Y. (2021). Global poverty dynamics and resilience building for sustainable poverty reduction. *J. Geogr. Sci.* 31 (8), 1159–1170. doi:10.1007/s11442-021-1890-4

Lien Skog, K., and Steinnes, M. (2016). How do centrality, population growth and urban sprawl impact farmland conversion in Norway? *Land Use Policy* 59, 185–196. doi:10.1016/j.landusepol.2016.08.035

Liu, Y. X., Peng, J., Wang, A., Xie, P., and Han, Y. N. (2015). New research progress and trends in ecosystem health. *Acta Ecol. Sin.* 35 (18), 5920–5930. doi:10.5846/stxb201401060032

Loring, P. A., and Gerlach, S. C. (2009). Food, culture, and human health in Alaska: An integrative health approach to food security. *Environ. Sci. Policy* 12, 466–478. doi:10.1016/j.envsci.2008.10.006

Marsden, T., and Sonnino, R. (2008). Rural development and the regional state: Denying multifunctional agriculture in the UK. *J. Rural. Stud.* 24 (4), 422–431. doi:10.1016/j.jrurstud.2008.04.001

Mazur, C., Hoegerle, Y., Brucoli, M., van Dam, K., Guo, M., Markides, C. N., et al. (2018). A holistic resilience framework development for rural power systems in emerging economies. *Appl. Energy* 235. doi:10.1016/j.apenergy.2018.10.129

McManus, P., Walmsley, J., Argent, N., Baum, S., Bourke, L., Martin, J., et al. (2012). Rural Community and Rural Resilience: What is important to farmers in keeping their country towns alive?[J]. *J. Rural Stud.* Vol. 28, 20–29. doi:10.1016/j.jrurstud.2011.09.003

Mfirdhous, M. F., and Mkaruratane, P. (2018). A model for enhancing the roleof information and communication technologies for improving the resilience of rural communities to disasters. *Procedia Eng.* 212, 707–714. doi:10.1016/j.proeng.2018.01.091

Modica, M., and Reggiani, A. (2015). Spatial economic resilience: Overview and perspectives. *Netw. Spat. Econ.* 15 (2), 211–233. doi:10.1007/s11067-014-9261-7

Mohamed, A., Nguyen, C., and Ben Youssef, A. (2015). Natural disasters, household welfare, and resilience:evidence from rural vietnam. *World Dev.* 70, 59–77. doi:10.1016/j.worlddev.2014.12.017

Nguyen, T. T., Nguyen, L. D., Lippe, R. S., and Grote, U. (2017). Determinants of farmers' land use decision-making: Comparative evidence from Thailand and vietnam. *World Dev.* 89, 199–213. doi:10.1016/j.worlddev.2016.08.010

On first World Soil Day (2014). *Secretary-General says in message, sustainable management should be universal priority, as healthy planet requires healthy soils*. Tokyo: United Nations Press Release. doi:10.1016/S0167-8809(01)00298-5

Pain, A., and Levine, S. (2012). A conceptual analysis of livelihoods and resilience: Addressing. *Theinsecurity agency*.

Pandey, R., Jha, S. K., Alatalo, J. M., Archie, K. M., and Gupta, A. K. (2017). Sustainable livelihood framework-based indicators for assessing climate change vulnerability and adaptation for Himalayan communities[J]. *Ecol. Indic.* 79, 338–346. doi:10.1016/j.ecolind.2017.03.047

Peng, J., Liu, Y., Li, T., and Wu, J. (2017). Regional ecosystem health response to rural land use change: A case study in lijiang city, China. *Ecol. Indic.* 72, 399–410. doi:10.1016/j.ecolind.2016.08.024

Peroni, N., and Hanazaki, N. (2002). Current and lost diversity of cultivated varieties, especially cassava, under swidden cultivation systems in the Brazilian Atlantic Forest. *Agric. Ecosyst. Environ.* 92 (2–3), 171–183. doi:10.1016/S0167-8809(01)00298-5

Qiu, M. L., Liu, D. F., and Liu, Y. L. (2021). Review on theoretical framework and evaluation system of rural resilience[J]. *China Land Sci.* 35 (8), 107–114. doi:10.11994/zgtdkx.20210812.094413

Rigg, J., and Oven, K. (2015). Building liberal resilience? A critical review from developing rural asia[J]. *Glob. Environ. Change* 32, 175–186. doi:10.1016/j.gloenvcha.2015.03.007

Roberts, E., Beel, D., Philip, L., and Townsend, L. (2017). Rural resilience in a digital society: Editorial. *J. Rural Stud.* 54, 355–359. doi:10.1016/j.jrurstud.2017.06.010

Schouten, M., Paul, O., Polman, N., and Westerhof, E. (2013). Resilience-based governance in rural landscapes: Experiments with agri-environment schemes using a spatially explicit agent-based model. *Land Use Policy* 30, 934–943. doi:10.1016/j.landusepol.2012.06.008

Schwarz, A-M., Bene, C., Bennett, G., Boso, D., Hilly, Z., Paul, C., et al. (2011). Vulnerability and resilience of remote rural communities to shocks and global changes: Empirical analysis from Solomon Islands[J]. *Glob. Environ. Change* 21, 1128–1140. doi:10.1016/j.gloenvcha.2011.04.011

Scott, M. (2013). Resilience: A conceptual lens for rural studies? *Geogr. Compass. Geogr. Compass* 7, 597–610. doi:10.1111/gec3.12066

Shoemaker, D. A., BenDor, T. K., and Meentemeyer, R. K. (2019). Anticipating trade-offs between urban patterns and ecosystem service production: Scenario analyses of sprawl alternatives for a rapidly urbanizing region. *Comput. Environ. Urban Syst.* 74, 114–125. doi:10.1016/j.compenvurbsys.2018.10.003

Simelton, E., Evan, D., Fraser, G., Termansen, M., Piers, M., and Andrew, J. (2009). Dougill(2008).Typologies of crop-drought vulnerability: An empirical analysis of the socio-economic factors that influence the sensitivity and resilience to drought of three major food crops in China (1961–2001). *Environ. Sci. Policy* 12, 438–452. doi:10.1016/j.envsci.2008.11.005

Sorice, M. G., Kreuter, U. P., Wilcox, B. P., and Fox, W. E. (2012). Classifying land-ownership motivations in central, Texas, USA: A first step in understanding drivers of large-scale land cover change. *J. Arid Environ.* 80, 56–64. doi:10.1016/j.jaridenv.2012.01.004

Tebboth, M. G. L., Conway, D., and Adger, W. N. (2019). Mobility endowment and entitlements mediate resilience in rural livelihood systems. *Glob. Environ. Change* 54, 172–183. doi:10.1016/j.gloenvcha.2018.12.002

Wang, C., Ren, M., Hu, Q., and Li, Q. (2021). Rural production space system resilience and its research domains. *Prog. Geogr.* 40 (1), 85–94. doi:10.18306/dlkxjz.2021.01.008

Wang, J., and Zigang, C. (2021). Resilient rural construction: Conceptual connotation and logical approach [J]. *Acad. Exch.*, 140–151.

Westlund, H. (2006). *Social capital in the knowledge economy: Theory and empirics*. Cheltenham: Edward Elgar.

Wilson, G. A. (2012). Community resilience, globalization, and transitional pathways of decision-making. *Geoforum* 43 (6), 1218–1231. doi:10.1016/j.geoforum.2012.03.008

Wilson, G. A., Hu, Z., and Rahman, S. (2018). Community resilience in rural China: The case of Hu village, sichuan province. *J. Rural Stud.* 60, 130–140. doi:10.1016/j.jrurstud.2018.03.016

Wilson, G. (2010). Multifunctional 'quality' and rural community resilience. *Trans. Inst. Br. Geogr.* 35 (3), 364–381. doi:10.1111/j.1475-5661.2010.00391.x

World Bank (2010). *Natural hazards, unnatural disasters, the economics of effective prevention*. Washington, DC, USA: The World Bank.

Yang, B., Feldman, M. W., and Li, S. (2020). The status of perceived community resilience in transitional rural society: An empirical study from central China. *J. Rural Stud.* 80, 427–438. doi:10.1016/j.jrurstud.2020.10.020

Yang, T., Chen, H., Liu, D., Zhang, H., and Shi, Q. (2021). Spatiotemporal change of rural community resilience in loess hilly-gully region and influencing factors: A case study of gaoqu township in mizhi county, shannxi province. *Prog. Geogr.* 40 (2), 245–256. doi:10.18306/dlkxjz.2021.02.006