Research Paper

Knowledge Mapping of Urban Shrinkage Studies based on Published Journal Papers

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Abstract

Studies of urban shrinkage are important to the understanding of the essence of cities, industries, and people. It is a counterpart research area related to boom and growth. The concept of "shrinkage" is addressed by scholars from a wide range of disciplines, which aims at helping shrinking cities to achieve better urban efficiency, quality of life, and the goals of sustainable development. To clarify the research paths and current status of progress in this field, a knowledge mapping approach for urban shrinkage studies is proposed in this paper, which is a bibliometrics method based on published journal papers from the database of Web of Science (WOS). The visual representation of the progress paths, current status, and future trends make an easy understanding of the research field. Based on a total of 496 published papers since 1993, knowledge mapping based on keyword frequency summarizing, timeline and burstness analysis, research hotspot tracing, and research trend concluding is performed. The results indicate that the current theoretical research on urban shrinkage has formed a certain system, and there are some studies on the phenomenological level, the method level, and the strategic level. The research topics mainly focus on a series of socio-economic effects caused by population change, and the researches on the shrinkage strategy also include economic recovery to resource adaptation. In future trends, more attention may be paid to the exploration of urban localization, the construction of methods and models, and some specific perspectives of the human living environment.

Keywords

Urban shrinkage, bibliometrics, knowledge mapping, visualization

1. Introduction

Urban shrinkage has gradually become a global concern of urban planners and scholars. Under influence of suburbanization, de-industrialization, local financial crisis, and social transformation, urban shrinkage gradually becomes a new way of urban transformation (Turok and Mykhnenko, 2007). The phenomenon

of urban shrinkage appeared earlier, and its concept originated from a German scholar, Schrumpfende Städte, who was the first to address the problem of population loss in Germany (A. Haase et al., 2014). Since the late 20th century, the impact of suburbanization, de-industrialization, and social transformation led to obvious economic recession and population reduction in some of the developed industrial cities (Haase et al., 2021). For developing countries, improvement of urbanization levels also brings the phenomenon of urban growth and shrinkage in some regions. Urban shrinkage is sweeping the world in a new way of development. Urban shrinkage has a huge impact on the urban economy. The shrinkage of young people, labor forces, and employment are one of the important reasons for urban economic shrinkage. The outflow of a large number of talents causes a certain impact on the healthy development of the urban economy. The reasonable flow of population is an important topic of concern in the field of shrinkage (Bernt, 2016; Deng et al., 2019; Liu and Liu, 2022; Steinführer and Grossmann, 2021). To clarify the research context and development trends of urban shrinkage, it is necessary to map concurrent knowledge from existing literature. Through visual analysis of the literature, some complex relationships between research topics can be revealed. The method of combining bibliometrics and visualization analysis has not been fully applied in the field of urban shrinkage research.

2. Methodology

2.1. Data source and filtering

Research papers published in journals in the Web of Science (WOS) core database from 1993 to 2022 are selected in this research. Search terms are divided into three levels displayed in Table 1, with a total of 23 keywords. By reading titles and abstracts, and removing the irrelevant, finally 496 papers are selected. The papers are derived in “Refworks” file format for subsequent literature statistical analysis. The logical framework of this study is shown in Figure 1.

Table 1. Keyword Search Conditions

Levels	Search Terms
First-level	shrinking city, urban shrinkage, urban decline, declining city, smart shrinkage, shrinkage planning
Second-level	shrinkage development, shrinkage transformation, shrinkage renewal, shrinkage regeneration, shrinkage trend, shrinkage policy, shrinkage response, shrinkage governance, shrinkage simulation, shrinkage industrial transformation
Third-level	population shrinkage, economic shrinkage, social shrinkage, spatial shrinkage, population decline, economic decline, industrial decline

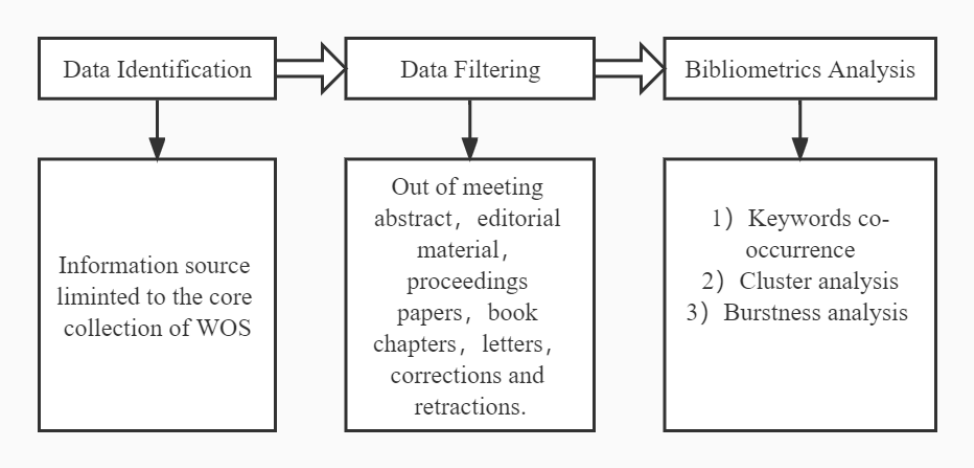

Figure 1. Logical Framework.

1.2. Data analysis

Bibliometric methods and CiteSpace software are used to visually analyze and summarize the papers on urban shrinkage, mainly using keywords frequency, clustering, and burstness analysis. The following parameters are used in CiteSpace: "Time slicing = 1993-2022"; "Years per slice = 1"; "Node types = keyword". The main research methods adopted in this paper include:

(1) Keywords co-occurrence analysis of literature

Keywords co-occurrence is used to analyse the co-occurrence relationship and co-occurrence intensity between keywords in the literature. In the keyword co-occurrence analysis, frequency statistics of keywords and centrality is essential. The higher the frequency of keywords, the higher the attention to topics, which can be used to measure the research hotspots in the field (Li et al., 2017; Meng et al., 2021). Centrality measures the degree of "centrality" of a node in the other "nodes" in the graph. When centrality is greater than 0.1, keywords have an important influence in the field.

(2) Clustering analysis of literature

Clustering analysis can objectively reflect the research status of a large number of literature group content. This study uses a custom method to create clusters (USR). The selection of clustering labels comes from the LLR (Likelihood Rate) algorithm, which can better reflect the state of the study.

Modularity (Q) and Silhouette (S) are used to evaluate the rationality of clustering. In general, the Q value is in the interval [0,1), Q>0.3, indicating that the clustering label structure is obvious, Q>0.5 is considered to be reasonable clustering results, S=0.7, clustering is convincing(Xiang et al., 2021; You et al., 2022). In this paper, control Q and S in Q>0.5, and S>0.7, to get effective clustering results.

(3) Burstness analysis of literature

Burstness analysis can show keywords that have received special attention in the field for a certain period and can represent rapid growth themes and emerging research directions. The burst peak is represented by the "strength". The burst analysis can reflect the period of the keyword burst. The greater the strength is, the higher the attention can be.

3. Results and Discussion

3.1. General characteristics of urban shrinkage literature

The top 10 countries ranking by a paper count of urban shrinkage research are shown in Table 1, covering developed and developing countries. Scholars in the USA and China published more than 100 articles, which are the main countries in the international research in this field. The USA, England and Germany are the first countries to focus on urban shrinkage, among which Germany has the strongest centrality. China's publications in this rank the second. China also has an important influence in this field caused of its publications (which include Hong Kong, Macao and Taiwan).

The yearly published paper quantity on urban shrinkage is shown in Figure 2. The first was published in 1993. Since the incomplete publication records in 2022 now, the time frame in Figure 2 was 1993-2021. According to the growth trends of the literature in Figure 2, the development of urban shrinkage is divided into three stages: before 2008, from 2008 to 2015, and after 2015. Before 2008, it is the germination period. At this time, there is little literature on urban shrinkage and the development was slow. 2008-2015 is the initial stage of development. In this stage, the phenomenon of urban shrinkage in various countries is intensified, and there are many studies on such problems. After 2015, it is a rapid growth stage. The amount of literature increased steadily year by year, which indicates that the field itself and some related research fields are attractive to more and more scholars, globally.

Table 2.Top 10 Countries of Concern

Country	Centrality	Count	Begin
USA	0.27	117	2000
China	0.27	105	2008
Germany	0.42	85	2005
England	0.28	44	2001
Italy	0.12	31	2009
Japan	0.01	29	2012
Netherlands	0.29	25	2008
South Korea	0.01	24	2015
Poland	0.00	23	2010
France	0.04	17	2012

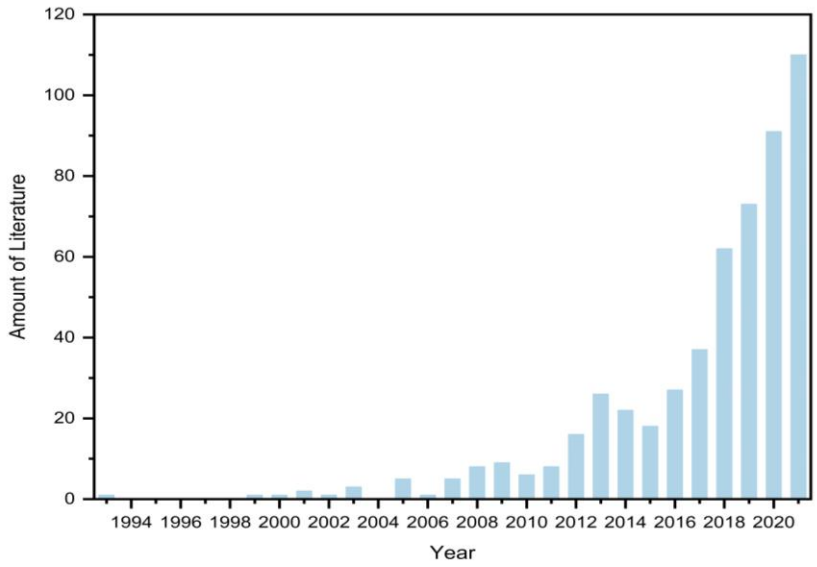

Figure 2. Amount of Literature

3.2. Research topics of urban shrinkage literature

3.2.1. The hot topics

The higher frequency and centrality of co-occurrence, the higher degree of attention. In this paper, a total of 534 keywords are obtained, and the top 10 keywords with a screening frequency of more than 25 are listed in Table 3.

In the context of urban shrinkage, researchers focus on keywords such as “shrinking pattern”, “urban regeneration”, “urban governance” and “land use”. According to the ranking of research keywords in Table 2, the research hotspots include: (1) the macro representation and influence of urban shrinkage, (2) the development direction and governance, and (3) the research on influencing factors. The longest concerned topic is “urban regeneration”. Since the problem of urban shrinkage has been explored, how to re-develop the city is the first problem to be discussed by scholars. The impact of shrinkage should not be underestimated. It not only has an impact on urban fiscal revenue, but also on population change and housing vacancy. The impact of reduction of living environment quality on the neighbourhood level is obviously more closely related to the internal development of a city.

Table 3. Frequency ranking of keywords

Keyword	Total	1993-2007 (count/centrality)	2008-2015 (count/centrality)	2016-2022 (count/centrality)
Shrinking City	154		28 (0.21)	126 (0.10)
Urban Shrinkage	125		9 (0.04)	116 (0.15)
Shrinking Pattern	45		3 (0.02)	42 (0.10)
Urban Regeneration	35	1 (0.00)	6 (0.05)	28 (0.10)
Urban Government	33		8 (0.02)	25 (0.07)
Land Use	30		9 (0.16)	21 (0.06)
Urbanization	26			26 (0.08)

Urban Transformation	26			26 (0.09)
Urban Decline	26		3 (0.07)	23 (0.03)
Impact	26	1 (0.00)		25 (0.15)

3.2.2. The research themes and evolution in urban shrinkage literature

The timeline established based on literature analysis is shown in Figure 3. There are a totally 11 clusters, according to the actual meaning of clustering. The literature is divided into three categories as follows.

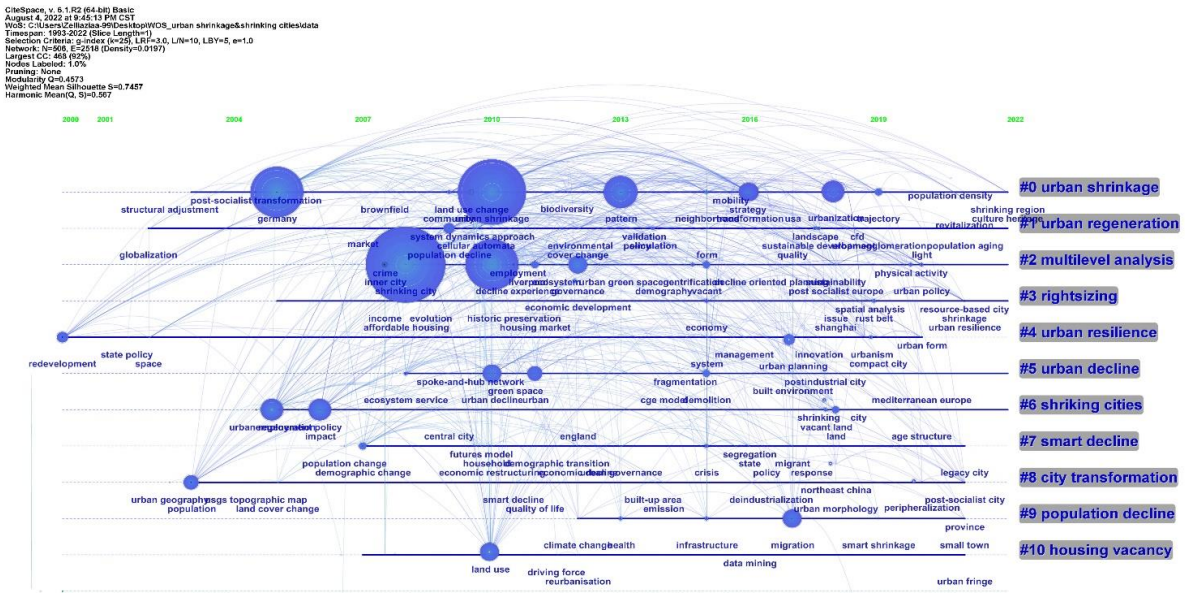

Figure 3. Keywords Clustering Timeline

(1) Phenomenon of urban shrinkage: the representative clusters are # 5 urban decline, # 9 population decline, and # 10 housing vacancy.

Urban recession is the result of the negative contraction state, which is mainly manifested in a large outflow of population from the city and the decline of the urban economy caused by labor structure changes. The urban recession does not mean the gradual decline of the urban economy, but relative to a certain area, the vitality of urban economy decreases or the growth rate slows down, and there is a trend behind other cities (MARTINEZ-FERNANDEZ et al., 2012). In addition to demographic and economic downturns, “urban decline” is also manifested in spatial degradation, namely housing and land vacancies resulting from demographic changes, lack of maintenance of infrastructure, which leads to a decline in community vitality.

(2) Urban shrinkage research methods: representative clustering has # 2 multilevel analysis.

In the related research on urban shrinkage, in addition to using spatial data for analysis and visualization, a multi-dimensional index construction method was used as well for influencing factors and comprehensive measurement of urban shrinkage. From the perspective of the research process of urban shrinkage, the population is the key, and it is also the first factor being noticed. With the deepening of research, methods developed from univariate exploration to multi-level variables comprehensive analysis, including population, economy, society, and space (Kim et al., 2020; Liu et al., 2020).

(3) Research on urban shrinkage development strategy: the representative clusters are # 3 rightsizing, # 4 urban resilience, # 7 smart decline, and # 8 urban transformation.

Smart shrinkage emphasizes streamlining the existing size of cities to match the current or projected urban population (Rhodes and John Russo, 2013). Alberti defines resilient cities as the ability and extent to defuse and utilize changes before restructuring a range of structural and functional changes in cities (Tabibian and Movahed, 2016). Core concepts of a resilient city include coordination of social space and material space and enhancement of the ability to deal with urban and regional risk. The process of shaping of urban elasticity will lead to more sustainable urban construction and find a balance between people and cities.

3.2.3. The research topic trends in urban shrinkage literature

The intensity of keywords and the appearing and ending of keywords can be visualized by a keyword burstness map. The red dotted line represents the appearance and end. The keywords were screened according to the mutation intensity, and a total of 10 burst words with high intensity were obtained, and listed in Table 4.

Except for “urban planning”, the emergent intensity of other keywords are all above 2.00. The mutation intensity of “neighborhood” was the highest, followed by “shrinking city” and “vacant land”. Shrinkage city is the result of urban shrinkage. Shrinkage has a great impact on urban population migration, economic development and spatial quality improvement. The vacant land involves not only the vacant house, but also the old vacant land, land use change and so on. However, the vacancy of urban land is not completely negative, and the vacant land also provides new development space for human living quality and ecosystem services (Asl, 2022; D. Haase et al., 2014). Community shrinkage is a new topic of concern in international research. Community is an important unit in urban development. Scholars have explored the design and revitalization of the shrinking neighborhood in the context of reasonable adjustment of urban shrinkage. Population decline has been the focus of discussion in the field of contraction. With increasing attention to urban shrinkage in recent years, the issue of population loss becomes a topic of common concern, as well.

Table 4. Keywords burstness

Keyword	Strength	Begin	End	1993-2022
Land Cover Change	2.05	2005	2014	
Urban Governance	2.11	2013	2016	
Neighborhood	2.66	2015	2016	
Urban Transformation	2.46	2016	2018	
Urban Planning	1.85	2017	2018	
Shrinking City	2.58	2018	2019	
Vacant Land	2.58	2018	2019	
Demolition	2.11	2018	2019	
Shrinkage Trajectory	2.05	2019	2020	
Population Decline	2.16	2020	2022	

4. Conclusion

It is necessary to research the existing urban shrinkage and the possible future shrinkage as an inevitable urban phenomenon in urban development. At the same time, it can be seen from this study that urban shrinkage has a considerable impact on the economy, population, society and space of the city. Its negative aspect also has an important impact on the sustainable development of cities.

CiteSpace is a software of research focus and trend in the field of visualization, which helps to understand the research process and research hotspots since the emergence of urban shrinkage. This paper carries out keyword co-occurrence, keyword clustering and keyword burstness. The advantages of CiteSpace literature analysis are as follows. (1) The research hotspots in the field can be displayed through keyword frequency sorting, revealing the research direction of hotspots. (2) CiteSpace can visualize the evolution of keywords through the timeline, and automatically cluster, so as to understand small research problems in large research directions. (3) Through the analysis of emergent keywords, research hotspots and future research trends of each stage can be understood.

This paper combs and summarizes the research progress by CiteSpace, so that relevant scholars can realize the current research progress in this field, and how to promote future research in this field. This study also has certain limitations, which is also the direction that can be broken through in the future. In this study, although the selection of database is based on the global important literature platform, the literature is not comprehensive, and more platform data integration may be needed. Moreover, only journal articles are selected for the study, because of the limitations of the software. The research on the future development of urban shrinkage needs more in-depth thinking, which is also an important part of future research on global economic change and urban sustainable development.

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