

Global Visualized Analysis of Research on Sustainable Urbanization in Developing Countries

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Abstract

In this paper, a bibliometric approach is used to extract the main focus areas of the research on sustainable SUDC. The database that provided the records for this article is Scopus, and a number of 1027 records is detected and analyzed using clustering techniques of CiteSpace tool. Research that uses bibliometrics to look at investigation about sustainable cities is still very limited. Results reveal that the number of studies on sustainable urbanization in developing countries SUDC is increasing year after year, with the United States, the United Kingdom, and China currently possessing the greatest body of knowledge in the field. Results demonstrated also by burst analysis that “Sustainable development goal” SDG, “Sanitation” and “urban transportation” are the main recent keywords considered as hotspots.

Key words: Citespace, Bibliometrics, Sustainable urbanization, Developing countries, Clustering techniques.

INTRODUCTION

Almost all of the world's increasing population is believed to emerge in cities over the next 30 years (Cohen, 2006). Worldwide urban growth is expected to hit 60% by 2030, 70% by 2050, and 90% of future urban development expansion will emerge from developing countries in Asia and Africa, according to a UNDESA report. The urbanization process in several developing countries seems to have been preceded by elevated urban population density in major metropolises, for example, Korea took 20 years and Brazil 30 years to accomplish what the United States took 90 years in terms of urbanization (Henderson, 2002). The increase in personal expectations, as well as the rapid growth of the population, are the primary causes (Brutzkus, 2015).

several issues can arise as a result of this uncontrolled urbanization, including issues relating to the general health of the population (Harpham, Rapport, & 1991, n.d.; medicine & 1994, n.d.; Tabibzadeh, 287-293, & 1997, n.d.). Most people are familiar with the problems that cities face, like social problems: they are overpopulated, impacted by violent acts and corrupt practices, as well as poverty (Annez & Linn, 2010). Another important issue related to uncontrolled urbanization is the CO2 emission (Martínez-Zarzoso, 2008), but also the energy use. (Jones, 1991) found that changes in how people drive their cars are the biggest single catalyst of motivation in energy use. Traveler transportation in cities tends to be very fuel-based, especially as people's incomes rise. When considered alongside the global economy, the use of sustainable urban development to keep a good harmony between societal structure, the economic system, and the environment has gained wide acceptance around the world.

Researchers from all over the globe have densely debated structure, development plans, distribution of resources, and current urban landscape throughout urban growth. There is still a dearth of research using bibliometrics to evaluate studies on sustainable urbanization in developing countries (SUDC). Thereby, the established bibliometric research only appears to look at a few aspects of sustainable urbanization, but it doesn't look at the general topic in the field. This study looks into the data analysis situation, development course, and possible future developments of sustainable urbanization survey in developing countries. There are a variety of scientific research tools required to evaluate and envisioning morphology, dynamic, and space-time trends and patterns in research journals in a given subject area (Aria & Cuccurullo, 2017; C. Chen, 2016; Eck, NJ Van, 2010). Thus every software has its advantages and drawbacks when it comes to the types of assessment it can undertake. CiteSpace (C. Chen, 2016) was chosen as the platform for this investigation.

METHODOLOGY

Scopus is the platform from which the results of the literature search were extracted, and the derived documents were analyzed and detailed using a tool called Citespace. Scopus's breadth of coverage across multiple domains enables it to be integrated with other platforms such as the web of science WOS. Citespace's use will facilitate the analysis of the massive amount of data extracted from Scopus. CiteSpace is a free download and can be found at the following location: Citespace version 5.8R3c (<http://cluster.ischool.drexel.edu/cchen/citespace/download/>). The benefit of using CiteSpace is that it enables the creation of timeline-style graphs. CiteSpace 5.2.R2 is a citation visual analysis software designed to detect a comprehensive and holistic approach in scientific literature. This software can help scholars understand the basics of the field, locate works of literature, review relevant boundaries, and make clear the background of research evolution (C. Chen, 2016). The global framework of research methodology is shown in Figure 1. An amount of 1027 document results have been found and analyzed, with the Scopus database, and with CiteSpace tool. The followed Title key was implemented for the research: "TITLE-ABS-KEY (sustainable AND urbanization AND in AND developing AND countries)".

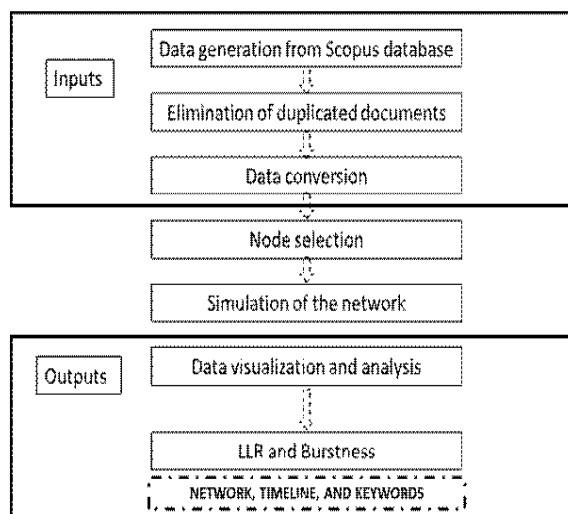


Figure 1. The global framework of research methodology

RESULTS AND DISCUSSIONS

Time Distribution and Categories

As Figure 2 indicates, the number of publications on SUDC is growing at an exponential rate, with the majority appearing in the last few years. Distributed mainly on the following categories (Figure 3): Environmental Science with 648 documents, Social Sciences with 620, Engineering with 324 documents, Energy with 221 documents, Business documents, Management and Accounting with 125 documents, Agricultural and Biological Sciences with 117 documents, Medicine 96 documents and Earth and Planetary Sciences with 78 documents. Surprisingly, Medicine exceeds in several documents in the category of earth sciences.

The number has steadily increased since 2011, leading us to presume that there are two distinct phases, before and following 2011, with a slight peak in 1996 in phase one. After 2018, the number of publications exceeded 100 per year. In 2021, there will be a maximum of 159 documents.

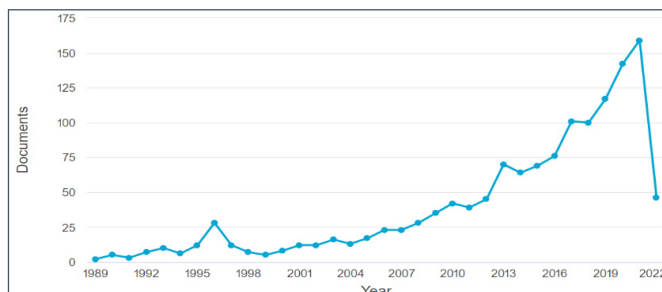


Figure 2. Time distribution of the records on SUDC in the Scopus database

Countries and Journals:

Countries:

Figure 4 details the countries that have had the greatest influence on scientific production in SUDC: the United States, the United Kingdom, China, and India are at the top of the list. Followed by Australia, South Africa, and Malaysia. Surprisingly, developing countries that are the most concerned by the article's topic are not at the top of the list that treated the subject.

Journals:

Figure 5 demonstrates that the majority of articles and documents are published in: "Sustainability Switzerland" with 63 documents, "Habitat International" with 32 documents, "Journal of Cleaner Production" with 32 documents, and "Sustainable Cities and Society" with 21 documents.

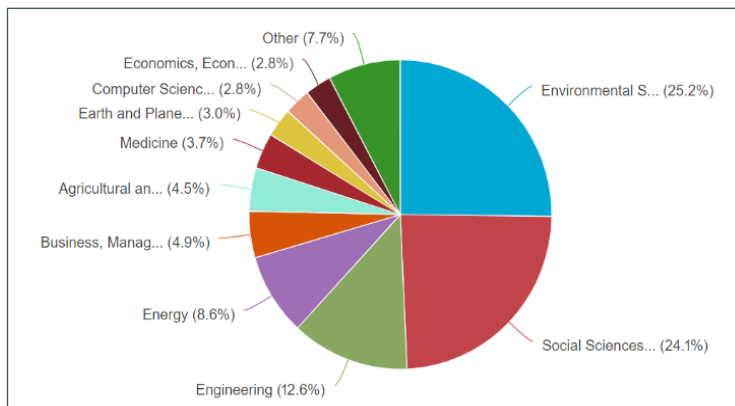


Figure 3. Main categories related to SUDC topic from Scopus database

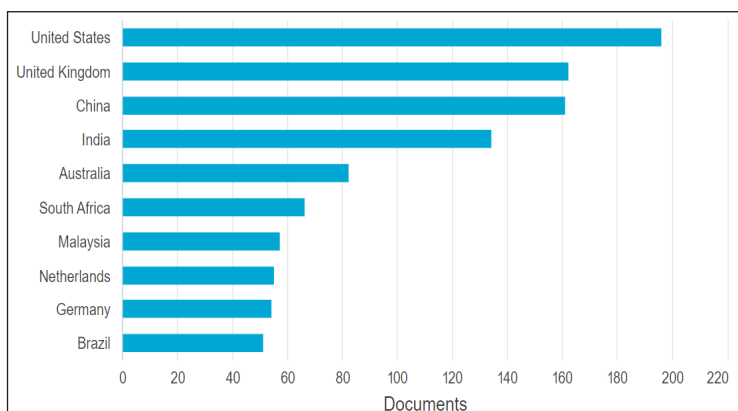


Figure 4. Most related countries and regions of records in SUDC topic from Scopus database

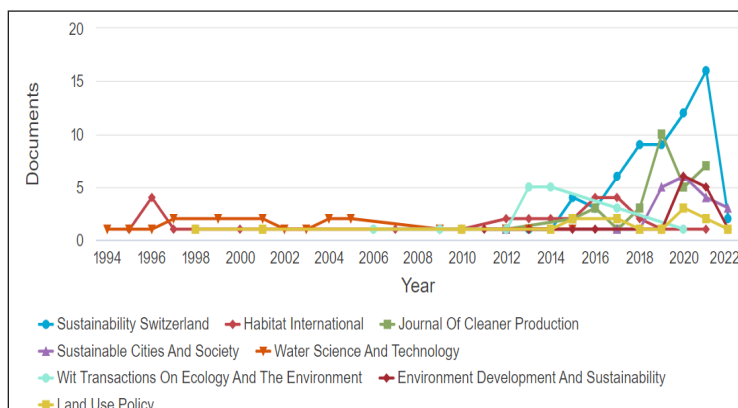


Figure 5. Most influential journals on SUDC topic

The focus of the topic

Most Influential Documents

As demonstrated in Figure 6, the highest burst is (Cohen, 2006) (Burst=4.7), which is also the most cited document as shown in Table 1, and the highest Sigma ($\Sigma=1.12$) value and also the highest centrality (Centrality=0.02). This article provided a wide-ranging summary of recent urbanization patterns and highlighted the challenging situation that Africa faces with sustainable development, especially, facing their incapacity to provide services to people living in urban areas. Followed by (Grimm, Faeth, et al., 2008), as the second-highest citation burst's article (burst= 3.57). It highlighted the impact of urbanization that increases more and more, on the environment at multiple scales, in terms of land use, ecosystems, and other aspects, and where social and natural aspects are merged to investigate the modified local environments. In (Bulkeley & Betsill, 2005), researchers reveal that the explanation and execution of sustainability are influenced by systems of authority that expand across spatial scales even beyond the limit of the city.

Also, (Bai, 2003) (burst=2), where the author confirmed that, with the evolutionary angle, urban areas can take a more environmentally friendly direction to sustainable development. Another article, (Montgomery, 2008) (burst=2.1), describes the urban demographic evolution with a focus on population statistics and future projections, this article is published in "Science" journal. In the same journal, (Kates et al., 2001) (burst=2.1), highlighted the transition from a scientific worldwide programs perspective to independent networks of scholars.

Clustering results

According to the "LLR algorithm", the generated clusters are as follows: "Complex connected diffuse"; "Diverse-social ecological systems", "District-scale assessment", "Ghana", "Rajshahi Bangladesh". This cluster's silhouettes all exceed 0.9, indicating high uniformity of the network (Figure 7 and Table 2). As demonstrated in Figure 8, the timeline proves that "Diverse-social ecological systems" Cluster is no longer a focus theme of the USDC topic.

a. Cluster # 0, Labelled by LLR as "Complex connected diffuse":

The largest cluster (#0) has a silhouette value of 0.991. The most relevant citer to the cluster is "*Data-driven smart eco-cities and sustainable integrated districts: a best-evidence synthesis approach to an extensive literature review*" by (Bibri, 2021). Where the authors' focus was on eco-cities, with an extensive literature review. Also, Many other review articles are cited in this cluster (Ameen, Mourshed, & Li, 2015; Ayambire, Amponsah, Peprah, Policy, & 2019, n.d.; Azunre, Amponsah, Peprah, Takyi, & Braimah, 2019; Roy, Byrne, & Pickering, 2012). The article with the highest burst, Sigma value, and centrality is the same document of the whole network in this cluster is "*Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability*" (Cohen, 2006) where the results are previously mentioned in 3.3.1.

b. Cluster # 2, Labelled by LLR as "Diverse-social ecological systems":

The second-largest cluster (#2), with a silhouette value equal to 0.995. The most pertinent article to the cluster is "*The new global urban realm: Complex, connected, diffuse, and diverse social-ecological systems*" by (McHale et al., 2015). The most cited article is "*Global change and the ecology of cities*" (Grimm, Faeth, et al., 2008) and also had the highest Sigma value and burst. Another important paper in this cluster is (Grimm, Grove, Pickett, & Redman, 2008), which entered on the fusion of both social and ecological sciences to understand the natural world. In the same context, (McHale et al., 2015) highlighted that accordingly, even though developing countries are experiencing massive development, developed countries were the first to study these dynamics. The authors developed a conceptual model to expand the growth of urban ecological studies and their implementation in sustainable development. Their framework defines 4 major contemporary urban characteristics which should be taken into account in any attempt to construct a coherent picture of cities that makes a significant contribution to urban sustainability initiatives.

c. Cluster # 4, Labelled by LLR as "District scale assessment"

"*City-integrated renewable energy for urban sustainability*" by (Kammen & Sunter, 2016) is the article with the highest frequency in this cluster. While the highest burst belongs to (Ameen & Mourshed, 2019) in "*Urban sustainability assessment framework development: The ranking and weighting of sustainability indicators using analytic hierarchy process*". The Highest Sigma value of 1.04, belongs to (Zezza & Tasciotti, 2010) "*Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries*". In this cluster, the main focus was on evaluating urban

sustainability. For example, a scheme for analyzing the efficiency of urban sustainability in China has been formally established by (Liu et al., 2022), and has described five major factors. It was also demonstrated that the scheme was validated in six cities in China and 129 expert interviews were used to verify it. Also, (Yang, Yang, & Wang, 2020) showed that system dynamic models are used to assess the sustainability of 13 cities in the Beijing-Tianjin-Hebei region under multiple situations. The author concluded that the method is appropriate to other areas to provide information for decision-making for urban sustainable development. Five scenarios were developed within the schema of common socioeconomic mechanisms, and it was revealed that the urban sustainability indicator within every city varies under various policy contexts.

d. Cluster # 6, Labelled by LLR as “Ghana”

Labeled from both (Owusu-Manu, Debrah, Oduro-Ofori, Edwards, & Antwi-Afari, 2020), and (Debrah, Owusu-Manu, Kissi, Oduro-Ofori, & Edwards, 2020). Most of the references in this cluster are dedicated to Green City’s development and related concepts like climate change, renewable energy, and sustainable design. For example, (Castán Broto & Bulkeley, 2013), concluded that experimentation as a vital instrument is a key implement for opening up new governmental areas for controlling climate change in cities, particularly in developing countries. While (Malik et al., 2019) investigated different obstacles faced by different politics of developing countries in the Gulf Cooperation Council (GCC) to accomplish environmental sustainability.

Green and sustainability

e. Cluster # 11, Labelled by LLR as “Rajshahi Bangladesh”

This cluster is labeled by (Abdullah-Al-Faisal et al., 2021) The most cited article is (Herold, Goldstein, & Clarke, 2003), In this article, an extended study in time and space on urban growth is conducted. The historical information is provided by satellite images, which serves with the modeling process and the topographic data to evaluate the impact of urban growth in both urban and rural area and provide information on how could be the future urbanization. Most of the cited articles in this cluster are similarly mentioned. For example, one of the most recent cited documents which are (Mohamed & Worku, 2019), spotted the out-of-control urbanization and quantified the built-up strength to rationalize and enhance appropriate decisions. In this cluster, the importance of aerial photography, remote sensing, and the use of GIS was very determinant as methods.

Table 1. Top 10 of the Most cited documents in the network on USDC.

Citation Counts	References	Cluster ID
16	(Cohen, 2006)	0
14	(Grimm, Faeth, et al., 2008)	2
6	(Ameen & Mourshed, 2019)	4
5	(Bulkeley & Betsill, 2005)	142
5	(Zezza & Tasciotti, 2010)	4
4	(Komeily & Srinivasan, 2015)	0
4	(Kaur & Garg, 2019)	4
4	(Haaland & van den Bosch, 2015)	0
4	(M. Chen, Liu, & Lu, 2016)	0
4	(Herold et al., 2003)	11

N	Year	Strength	Ref	Begin	End	1989 - 2022
1	2003	2	(Bai, 2003)	2007	2007	
2	2008	2.1	(Montgomery, 2008)	2012	2015	
3	2001	2.1	(Kates et al., 2001)	2012	2015	
4	2008	3.57	(Grimm, Faeth, et al., 2008)	2015	2022	
5	2000	1.85	(Grimm, Grove, et al., 2008)	2015	2015	
6	1999	1.85	(Newman & Kenworthy, 1999)	2015	2015	
7	2004	1.95	(Antrop, 2004)	2016	2016	
8	2004	1.95	(Mindali, Raveh, & Salomon, 2004)	2016	2016	
9	2006	4.7	(Cohen, 2006)	2017	2022	
10	2015	2.17	(Komeily & Srinivasan, 2015)	2017	2019	
11	2013	1.92	(Guerrero, Maas, & Hogland, 2013)	2017	2017	
12	2005	2.99	(Bulkeley & Betsill, 2005)	2018	2019	
13	2016	2.61	(Zezza & Tasciotti, 2010)	2018	2018	
14	2010	2.78	(Zezza & Tasciotti, 2010)	2019	2020	
15	2019	2.96	(Ameen & Mourshed, 2019)	2020	2022	
16	2019	2.44	(Kaur & Garg, 2019)	2020	2020	
17	2015	2.12	(Haaland & van den Bosch, 2015)	2020	2022	
18	2004	1.97	(Sudhira, Ramachandra, & Jagadish, 2004)	2020	2022	
19	2018	1.83	(Tan, Jiao, Shuai, Production, & 2018, n.d.)	2020	2020	
20	2017	1.83	(Klopp & Petretta, 2017)	2020	2020	
21	2016	1.83	(Jennings, Larson, & Yun, 2016)	2020	2020	
22	1997	1.83	(Cervero & Kockelman, 1997)	2020	2020	

Figure 6. Top 24 of the records with Strongest Citation Bursts (References from Scopus database)

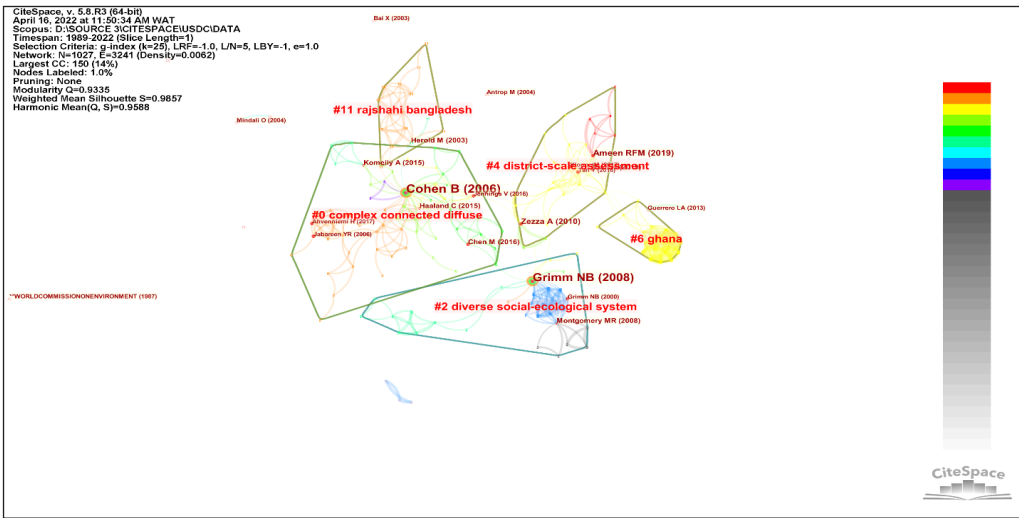


Figure 7. Network map of the SDDC Topic, colors indicates year of publication, red is the most recent.

Table 2. Main clusters of the network, with their silhouettes value and mean year publication.

ClusterID	Size	Silhouette	mean(Year)	Label (LLR)
0	60	0.991	2010	Complex connected diffuse
2	32	0.995	2005	Diverse-social ecological systems
4	25	0.969	2010	District-scale assessment
6	18	0.977	2013	Ghana
11	15	0.984	2006	Rajshahibangladesh

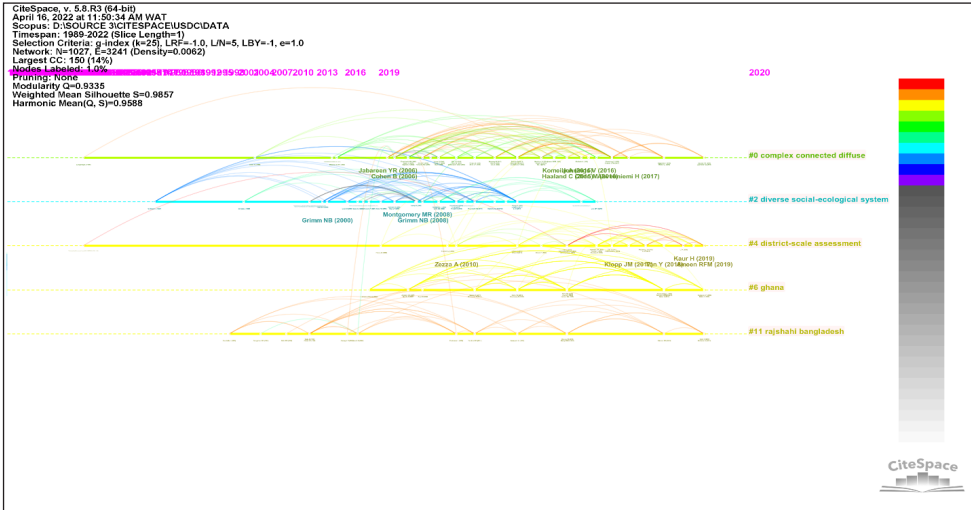


Figure 8. Timeline map of studies on SUDC

Keywords Co-Occurrence and Burst Detection

According to Figure 9, one of the most recent hotspots is “sustainable development goal”=5.9, as a result of the United Nations’ post-2015 agenda for sustainable development. Also “urban transportation” =5.94 and “sanitation”=9.55, were part of the most recent keywords detected in burst analysis in Citespace. While “Demographic factor”, “demography”, “health”, and “economic factor”, were the first to appear in the timeline of the detected burstness. It is also important to mention that Eurasia and Asia had the strongest burst with 14.48 and 13.18 consecutively. “Asia” took the highest time in terms of the duration of the burst.

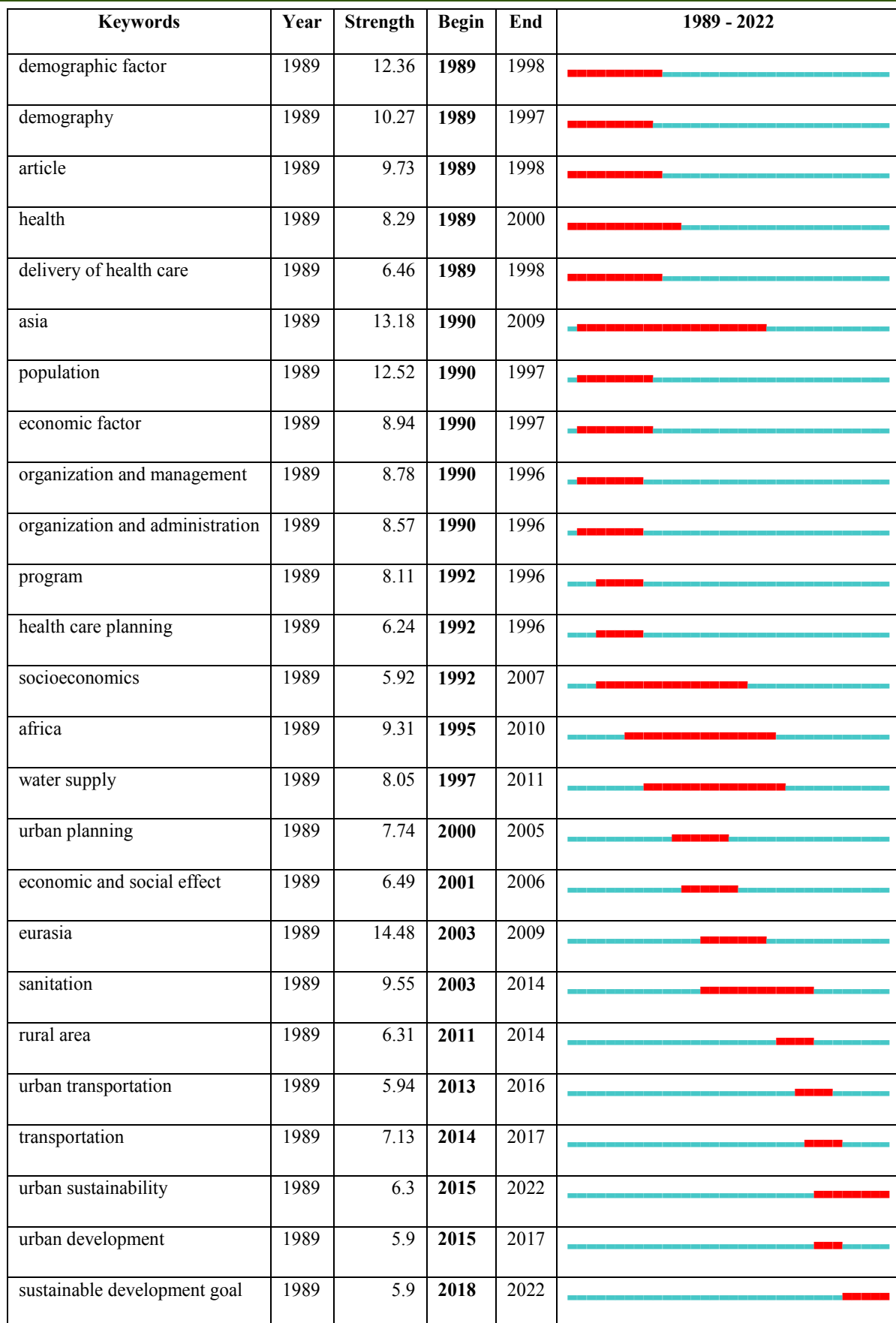


Figure 9. Top 25 Keywords with the Strongest Citation Bursts

CONCLUSION

Based on the Scopus platform, this article presents a scientific review of records about SUDC research. The CiteSpace tool is used in this study to identify current primary research topics that have received the most attention on SUDC, as well as recent research trends. The study identified pathways that have received more attention by employing co-citation clustering, co-occurrence analysis, and identifying the most prominent countries and authors, as well as keyword focus, among other methods of data analysis. Recently, there has been a significant increase in the body of knowledge on the subject of SUDC, as evidenced by the increasing number of articles that have been published in recent years, as well as the documentation of new related concepts that are being developed continuously. More attention is accorded to sustainable development goals as a related topic but also transportation and sanitation.

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