A systematic analysis of Sustainable Urban Development research during 2002-2021

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Abstract

More than two-thirds of the world's population is likely to reside in urban areas by 2050. Rapid urbanization contributes to many contemporary challenges that confront cities. Sustainable urban development (SUD) is a widespread area of investigation that can be considered from various attitudes, such as environment, economy, society, technology, culture, and so on. This paper aimed to perform a bibliometric analysis of "sustainable urban development" research during 2002-2021, considering source types, subject areas, document types, affiliations, journals, countries, authors, and keywords. Also, Social Network Analysis was applied to recognize mapping trends, status, and hot spots in SUD research and to discover co-authorship relations and international collaborations among countries worldwide. The results of this study showed that the number of SUD-related publications has remarkably increased by more than sixteen times over the study period. Social sciences" (24.6%), "environmental science" (21.2%), and "engineering" (13.4%) were the three major subject areas. China, with 539 publications (20.3%), was the most productive country in terms of the number of publications. The most independent rate of the publications belonged to India (76.5%), while Hong Kong ranked 1st in cooperator publications (61.6%). The "Sustainability" published the most related articles, followed by "Journal of Cleaner Production" and "Sustainable Cities And Society." Among the top ten productive institutes and organizations, five affiliations were from China. "Deep learning," "circular economy," "big data," "air pollution," "spatial analysis," "urban resilience," "urban heat island," "system dynamics," and "cultural heritage" were the most increasing keywords in recent years, based on the author keywords analysis.

key words

Sustainable Urban Development

Sustainable Development

Bibliometric Analysis

Social Network Analysis

Research Trend

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1 Introduction

The ongoing urbanization and development of cities pose significant challenges in the 21st century [1]. Currently, more than half (55%) of the world's population resides in urban areas, and projections suggest that this percentage will rise to approximately 70% by the year 2050 [2-4]. Urbanization encompasses the expansion of urban populations and the scale of urban areas, accompanied by associated economic and social transformations. Managing this rapid urban growth and ensuring sustainable urban development are critical aspects of addressing the evolving needs and complexities of modern cities [5]. Cities are facing several environmental and socioeconomic challenges, such as climatic change, land use, depletion of natural resources, air pollution, reduction of biodiversity, noise pollution, waste generation and disposal, availability of potable water, etc. It is estimated that urban areas account for 3% of global land but use about 70% of the energy supply and contribute to 71%–76% of global carbon dioxide emissions [6]. Hence, the need for sustainable urban development is increasingly becoming important [7].

Urban sustainability and sustainable cities are defined in various ways. Sustainable development applied to cities can be defined as the balance between the three fundamental dimensions of sustainability including environment, economy, and society [1]. In 2015, the United Nations (UN) adopted 17 Sustainable Development Goals (SDGs) as part of the 2030 Agenda for Sustainable Development [8]. SDG 11 is "Sustainable Cities and Communities" and is defined as "make cities and human settlements inclusive, safe, resilient, and sustainable."

Sustainable urban development is an extensive area of research that can be studied from different perspectives i.e., environment, economy, society, technology, culture, and so on. To reflect the development of cities and urban areas, various categories of cities have emerged such as "sustainable cities"; "low-carbon cities"; "eco-cities"; "green cities"; "resilient cities"; "smart cities" many other terminologies [9, 10]. Mirroring this, the term 'sustainable city' has become an overarching and popular term in academia and policy [11].

According to the related literature, sustainability assessment methods of urban development including projects, frameworks, tools, and indices have become an active research area [2]. Environmental aspects such as energy efficiency, renewable energy resources, and greenhouse gas (GHG) emissions have been the major topics of the methods. Also, in recent decades, research on land use/land cover change has become an important aspect of global warming studies [12]. Urbanization has a significant impact on the land use/land cover of specific areas [13]. With global urbanization, a developing economy, and an increasing population, human activities have accelerated the exploitation and utilization of land resources [14, 15].

The purpose of this study is therefore to comprehensively summarize the existing body of knowledge on sustainable urban development through bibliometric and systematic literature review.

2 Materials And Methods

The bibliometric method and SNA were utilized to investigate trends and to specify the sustainable urban development research characteristics. The bibliometric method is based on five significant steps [16]: (1) selecting the preferred database and software package (2) considering the keywords and sorting the records (3) exporting the selected data (4) assessing and analyzing the selected publications and (5) data visualization via SNA software.

In this study, Scopus was selected as the database for searching and downloading the data. The reasoning behind the "Scopus" database selection is that it has a considerably advanced coverage of abstracts and citations compared to other databases [17, 18].

The term "sustainable urban development" was employed as the search query for titles, abstracts, and keywords spanning the years 2002 to 2021. A thorough investigation covered source type, subject area, document type, affiliation, authorship, journal, country, institution, authors, and keywords. A diverse range of document types, such as articles, conference papers, reviews, book chapters, notes, articles in press, editorial materials, short surveys, letters, conference reviews, books, editorial content, notes, and publications, were compiled during the study.

More than 94% (2750) of the publications were in English, followed by 1.9% (55) in Chinese and 1.2% (35) in Spanish. The country of each publication was determined based on the nationality of at least one of the author's affiliations. Also, the Impact factor (IF), H-index, subject area, country,

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and publisher of each journal were determined from SCImago Journal Rank (SJR) [19].

SNA has been carried out to focus on the relationship amongst different nodes as the countries or the author keywords in various clusters of the network structure [20-22]. In this study, VOSviewer 1.6.6, one of the most practical visualization tools for performing SNA, was utilized for creating bibliometric maps of cooperation analysis of countries and the analysis of author keywords.

0.6% trade journal papers (18). Notably, the annual citation count demonstrated a substantial increase from 736 in 2002 to 4240 in 2018, with two notable peaks of 4397 in 2011 and 4260 in 2015, indicating a significant interest in the discourse on SUD. However, there was a decline to 1719 citations in 2021, likely attributed to the limited widespread citation of recent publications.

3.2 Subject Categories

According to Fig. 2, the divisions of "social

Fig. 1 The trend of publications and citations by year

3 Resault and Discussion

3.1 Chronological trends, distribution, and characteristics of publications

Fig. 1 illustrates the yearly count of Sustainable Urban Development (SUD) publications across different categories, including journal articles, conference papers, books, book series, and trade journal articles, along with the corresponding citation numbers. Notably, the major share of total publications is associated with journal articles and conference papers. The publications focused on SUD experienced a substantial growth, rising from 27 in 2002 to 439 in 2021, with particularly significant increases observed in 2011 and 2019.

From 2002 to 2021, the total count of Sustainable Urban Development (SUD)-related publications reached 2924, comprising 69.6% journal articles (2035), 16.7% conference papers (489), 7.3% books (212), 5.8% book series (170), and

sciences" (24.6%) and "environmental science" (21.2%) were noticeable. The subsequent significant portions are related to "engineering" (13.4%), "energy" (9.7%), and "earth and planetary sciences" (6.5%). The following areas are "Business, Management and Accounting" (4.7%), "Computer Science" (4.6%), "Agricultural and Biological Sciences" (3.3%), and "Economics, Econometrics and Finance" (2.2%).

The remaining ("Arts and Humanities," "Mathematics," "Decision Sciences," "Materials Science," "Medicine," "Physics and Astronomy," "Chemical Engineering," "Chemistry," "Multidisciplinary," "Biochemistry, Genetics and Molecular Biology," "Psychology," "Pharmacology, Toxicology and Pharmaceutics," "Health Professions," "Neuroscience," "Immunology and Microbiology," and "Nursing,") consist the residual 9.9%.

3.3 Analysis of Journals

Table 1 displays the ten most productive jour-

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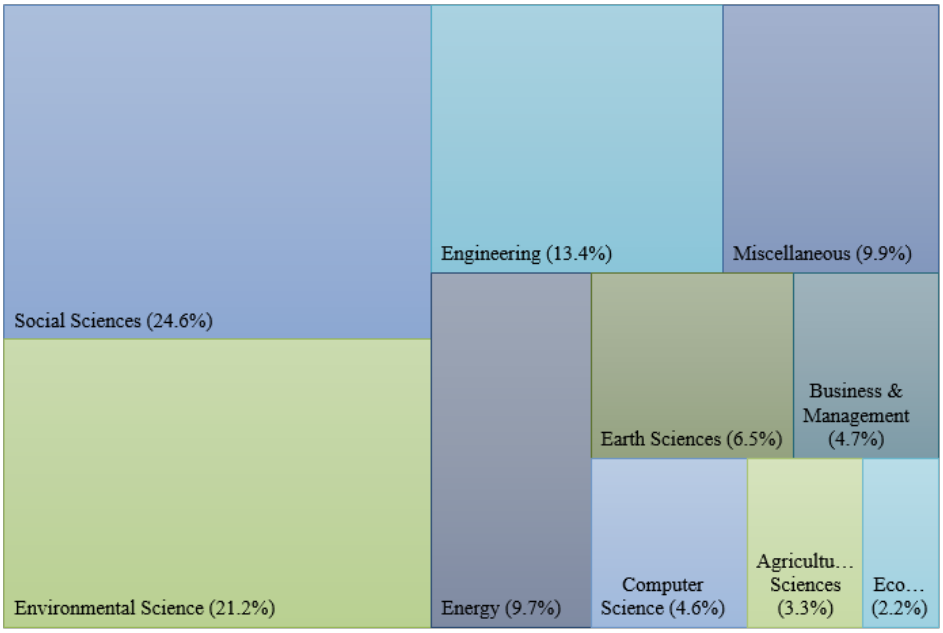

Fig. 2 The most major disciplines

nals with the highest number of published papers in SUD research within the study period, their respective impact factors, H-indexes, subject areas, countries, publishers, and the number of publications.

One of the most common indicators to consider the article's value, the researchers who wrote those articles, and even the institutes they work in is the Impact Factor [23]. The Impact Factor (IF) corresponds to the average number of citations an article published during the two preceding years receives in a given year [24, 25]. H-index is defined as the h number of articles with at least h number of citations each [26]. All the information given in Table 1 has been gathered from "Scopus" and "SJR" [19, 27].

As shown in Table 1, 552 articles (18.9% of all) are published in the ten journals. Elsevier, with seven journals, has been the most productive publisher in the field. The United Kingdom, with five journals, is the leading country, followed by Switzerland (2) and the Netherlands (2). In addition, the "Sustainability" journal published the highest number of articles (208), followed by the "Journal Of Cleaner Production" (74), and "Sustainable Cities And Society" (68). Also, "Journal Of Cleaner Production" (11.072) and "Sustainable Cities And Society" (10.696) had the highest IF. The highest h-index belonged to "Journal Of Cleaner Production" (232) and "Ecological Indicators" (145). The subject area of environmental science was seen in seven journals.

Besides, "IOP Conference Series Earth And Environmental Science" (72) and "IOP Conference Series Materials Science And Engineering" (27) were the most productive conferences and proceedings in the published SUD articles. It is worth mentioning that both of these conferences were held in the United Kingdom.

3.4 Analysis of Institutions

An analysis of the distribution of publications across countries and institutions was conducted, focusing on at least one author. Table 2 presents the top ten most prolific institutes in Sustainable Urban Development (SUD) from 2002 to 2021. The leading institute in terms of publications was the "Chinese Academy of Sciences" with 86 publications, followed by the "Hong Kong Polytechnic University" (47), the "Ministry of Education China" (45), and "The Royal Institute of Technology KTH" (45). Among these affiliations, five were based in China, while Hong Kong, Sweden, Australia, the Netherlands, and the United Kingdom each had one affiliated institute.

3.5 Analysis of Countries

The publications were from 109 countries, 24 of which had only one publication, and 83 publications had no author address information. The top ten most productive countries for total publications are shown in Table 3. More than 58.2% (1701) of the total articles are related to these countries.

Mono-national publications demonstrate the publications that all their authors are from affiliations of one country. In contrast, the multinational pub-

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Table 1 The top ten most productive journals and specifications

#	Source	TP	Impact Factor	H-index	Subject area	Country	Publisher
1	Sustainability	208	3.889	109	Energy Environment Social	Switzerland	MDPI AG
2	Journal of Cleaner Production	74	11.072	232	Business Energy Engineering Environment	United Kingdom	Elsevier Ltd.
3	Sustainable Cities And Society	68	10.696	82	Energy Engineering Social	Netherlands	Elsevier BV
4	Wit Transactions On Ecology And The Environment	43	0.18	24	Environment	United Kingdom	WITPress
5	Cities	31	6.077	102	Business Social	United Kingdom	Elsevier Ltd.
6	Ecological Indicators	29	6.263	145	Agriculture Decision Environment	Netherlands	Elsevier
7	Habitat International	27	5.205	89	Environment Social	United Kingdom	Elsevier Ltd.
8	Land Use Policy	27	6.189	125	Agriculture Environment Social	United Kingdom	Elsevier Ltd.
9	Land	23	3.905	32	Environment	Switzerland	Multidisciplinary Digital Publishing Institute (MDPI)
10	Procedia Engineering	22	discontinued as of 2021	88	Engineering	Netherlands	Elsevier BV

TP: Total Papers on SUD

lications category represents those whose authors are from different countries [24, 25]. China, with 539 articles (equal to 20.3% of all articles in this field), ranked 1st. According to Table 3, 34.4% of these articles have cooperated with other countries, while 65.6% were exclusively published in China. United Kingdom (249) ranked 2nd in publication position, followed by the United States (239) and Germany (207).

Hong Kong, with 61.6% of total SUD publications, ranked 1st in multinational publications. In contrast, with 76.5% of the total number of Indian SUD publications, India ranked 1st in independent publications.

Utilizing VOSviewer software for citation analysis, the coauthoring relationships among the 75 most productive countries in the field of Sustainable Urban Development (SUD) were explored. In Figure 3, China emerges as the largest node, boasting the highest number of citations (10659), followed by the United States (6026), the United Kingdom (5816), and Australia (5128). Additionally, the United Kingdom and Germany demonstrated notable collaboration with other countries (48), with the United States (44), Spain (41), and China (56) closely behind. Furthermore, in terms of total link strengths, China (203), the United Kingdom (131), and the United States (118) emerged as the leading contributors.

Iran occupies the 14th position on the most pro-

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Table 2 The ten most productive institutes

#	Affiliation	Country	TP
1	Chinese Academy of Sciences	China	86
2	Hong Kong Polytechnic University	Hong Kong	47
3	Ministry of Education China	China	45
4	The Royal Institute of Technology KTH	Sweden	45
5	Queensland University of Technology	Australia	43
6	Wuhan University	China	42
7	Delft University of Technology	Netherlands	40
8	Chongqing University	China	37
9	University of Chinese Academy of Sciences	China	36
10	University College London	United Kingdom	27

Table 3 Top ten most productive countries

#	Country	TP	Mono-national publications		Multinational publications	
1	China	593	389	65.6%	204	34.4%
2	United Kingdom	249	118	47.4%	131	52.6%
3	United States	239	121	50.6%	118	49.4%
4	Germany	207	125	60.4%	82	39.6%
5	Australia	163	79	48.5%	84	51.5%
6	Netherlands	129	54	41.9%	75	58.1%
7	Italy	123	76	61.8%	47	38.2%
8	Sweden	122	81	66.4%	41	33.6%
9	India	102	78	76.5%	24	23.5%
10	Hong Kong	99	38	38.4%	61	61.6%

ductive countries list, having published a total of 79 documents. The scientific documents published by Iran in this field have been published in the period from 2008 to 2021. The University of Tehran is the most productive institution with 15 publications, followed by Islamic Azad University with 14 publications. A list of the most cited documents that Iran contributed to their publication is presented in Table 4.

3.6 Analysis of Authors

Table 4 shows the top five authors who have been most active in this field, their respective countries, h-indexes, subject areas, the number of citations, and publications. Yigitcanlar, T. (40), Shen, L. (18), and Kamruzzaman, M. (14) have the most publications, while the highest citations (12981) and h-index (64) belonged to Shen, L. According to Table 4, two authors were from Australia, two were from the United States, and one was from China. It was determined that the most related subject areas were social and environmental science, respectively.

3.7 Analysis of author keywords

A total of 6320 author keywords were obtained, while cluster analysis was undertaken to ascertain principal research trends, according to the author

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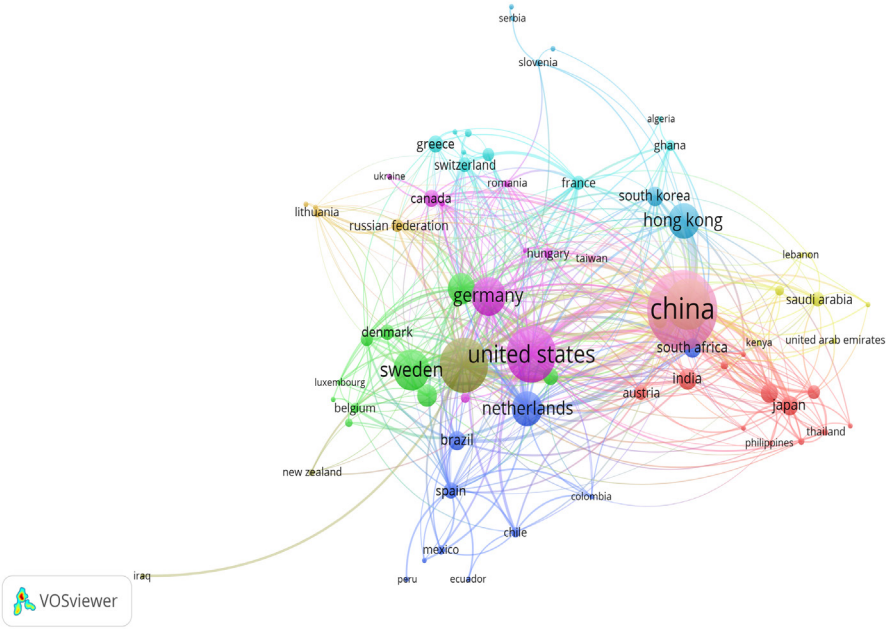

Fig. 3 Collaboration relationships between the 75 most productive countries based on citations

keywords, from 2002-2021. The nodes symbolize author keywords. So, the greater the size of the nodes, the higher the repetition of the keywords [28, 29]. The color of nodes indicates the related cluster of concentrated keywords on the bibliometric identified by VOSviewer.

As shown in Fig. 4, the top 262 keywords with at least five occurrences were distributed in four clusters. Several different components are included in the map. The most frequently used keywords such as "sustainable urban development" and "sustainable development," with 604 and 274 occurrences, have been eliminated to clarify the concentration of other keywords in the overlay visualization net-

Table 4. The top five most cited documents that Iran contributed to their publication

Rank	Authors	Title	Source Title	Cited by	Year of publication
1	Yigitcanlar et al.	Contributions and risks of artificial intelligence (AI) in building smarter cities: Insights from a systematic review of the literature	Energies	198	2020
2	Rimal et al.	Monitoring and modeling of spatio-temporal urban expansion and land-use/land-cover change using integrated Markov chain cellular automata model	ISPRS International Journal of Geo-Information	118	2017
3	Khoshnevis Yazdi et al.	The dynamic impact of renewable energy consumption and financial development on CO2 emissions: For selected African countries	Energy Sources, Part B: Economics, Planning and Policy	89	2018
4	Tonne et al.	Defining pathways to healthy sustainable urban development	Environment International	64	2021
5	Javadian et al.	Application of sustainable urban development in environmental suitability analysis of educational land use by using AHP and GIS in Tehran	Procedia Engineering	62	2011

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Table 4. XRF analysis of electrocoagulation sludge

#	Author	TP	Country	h-index	Citation	subject area
1	Yigitcanlar, T.	40	Australia	52	7856	Social Environment
2	Shen, L.	18	China	64	12981	Engineering Business
3	Kamruzzaman, M.	14	Australia	34	3386	Social Environment
4	Deakin, M.	12	United Kingdom	22	1845	Social
5	Ren, Y.	10	United Kingdom	15	476	Environment Social

work map. The largest cluster is cluster 1 with 81 keywords, and the smallest one is cluster 4 with 44.

Cluster 1 (red) is strictly related to the publications aiming at urban planning by covering keywords such as "urban planning," "smart cities," "planning," "cities," "sustainable cities," and "land use."

The keywords of cluster 2 (green) mainly belong to studies covering environmental sustainability, with keywords such as "green infrastructure," "urban regeneration," "ecosystem services," "urban agriculture," and "quality of life."

Cluster 3 (blue) mainly belongs to analytical issues. Keywords such as "GIS," "urban growth," "remote sensing," and "urban expansion" could be found obviously among the most repeated keywords of this cluster. However, other keywords are also found among these harmonious keywords, including "China" and "cellular automata."

The 4th cluster contains miscellaneous topics, including the keywords "climate change," "accessibility," "infrastructure," and "public participation."

By exploring the CSV output of VOSviewer software, the development of some particular keywords could be meaningfully significant and representative of the growth of related investigations in recent years. Amongst these keywords, "deep learning," "circular economy," "big data," "air pollution," "spatial analysis," "urban resilience," "urban heat island," "system dynamics," and "cultural heritage" could be revealed exactingly, which were not obvious at the VOSviewer maps. It is visualized that the declared keywords will also reach the phase of noteworthy appearance in VOSviewer maps in the next few years.

4 Conlusion

A comprehensive review of sustainable urban development (SUD) research spanning 2002 to 2021 was conducted using bibliometric and social network analysis. Various aspects such as document types, languages, sources, affiliations, countries/territories, authors, and author keywords were thoroughly examined. The findings revealed a substantial increase in SUD-related publications from 27 in 2002 to 439 in 2021, with a significant rise in citations from 736 in 2002 to 4397 in 2011. Over 94% (2750) of the publications were in English, predominantly comprising journal articles (69.6%) and conference papers (16.7%). More than half of the publications were categorized under social science (24.6%), environmental science (21.2%), and engineering (13.4%).

Leading journals in terms of productivity included "Sustainability," "Journal of Cleaner Production," "Sustainable Cities and Society," and "WIT Transactions on Ecology and the Environment." Among the top ten productive institutes, five were based in China, with the "Chinese Academy of Sciences" (86), "Hong Kong Polytechnic University" (47), "Ministry of Education China" (45), and "The Royal Institute of Technology KTH" (45) securing the top positions.

China exhibited the highest growth rate and emerged as the most prolific country in SUD literature, with the highest number of publications (593), followed by the United Kingdom (249) and the United States (239). Hong Kong stood out with the highest percentage of multinational publications (61.6%), while India had the highest percentage of independent publications (76.5%). The United Kingdom led in collaborative publications

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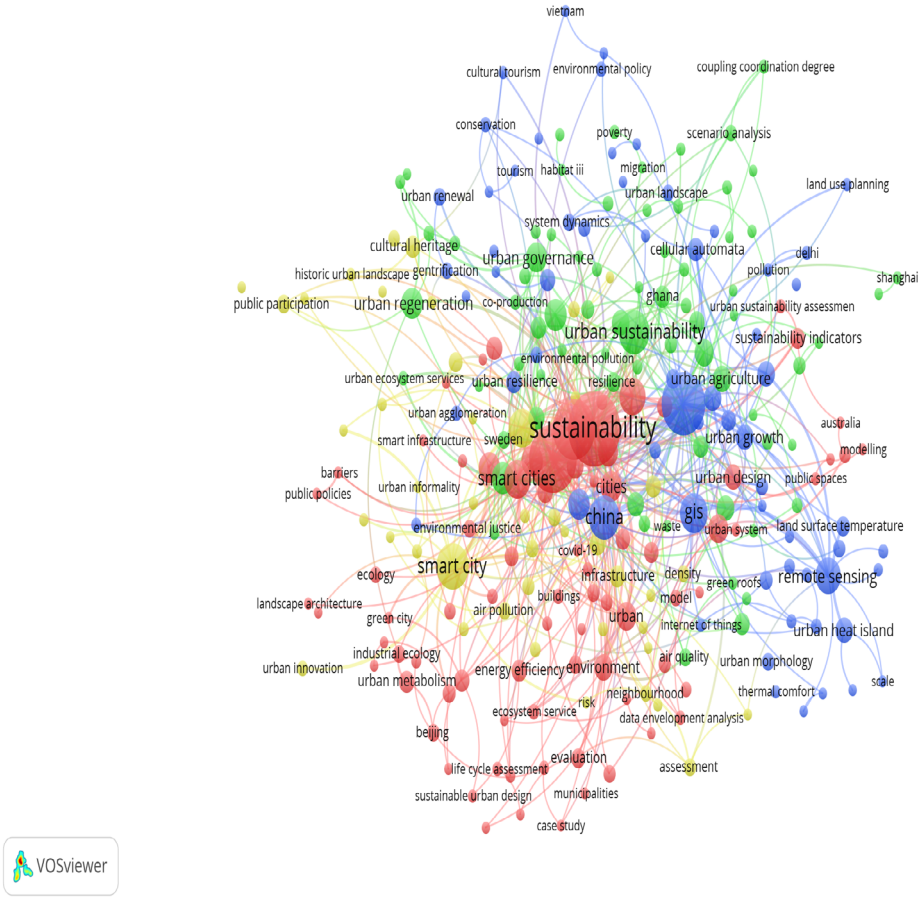

Fig. 4 The author's keywords overlay visualization network map (262 nodes)

with other countries (48), followed by the United States (44) and Spain (41).

Yigitcanlar, T. (40) from Australia, Shen, L. (18) from China and Kamruzzaman, M. (14) from Australia had the most publications, while the highest citations (12981) and h-index (64) belonged to Shen, L.

According to the analysis of the author keywords "sustainable urban development" and "sustainable development" were much more popular than other keywords.

Based on CSV output, a growing number of publications have been focused on "deep learning," "circular economy," "big data," "air pollution," "spatial analysis," and "urban resilience" areas. Besides, "urban heat island," "system dynamics," and "cultural heritage" were the most increasing keywords in recent years. These consequences could help researchers better understand the current situation, overall growth, and the trends of SUD research. The results will also prepare a base for prospective studies in the field.

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References

[1] Michalina, D., Mederly, P., Diefenbacher, H., & Held, B. (2021). Sustainable urban development: A review of urban sustainability indicator frameworks. Sustainability (Switzerland), 13(16), 1–20. https://doi.org/10.3390/su13169348

[2] Lo-Iacono-Ferreira, V. G., Garcia-Bernabeu, A., Hilario-Caballero, A., & Torregrosa-López, J. (2022). Measuring urban sustainability performance through composite indicators for Spanish cities. Journal of Cleaner Production, 359, 131982. https://doi.org/https://doi.org/10.1016/j.jclepro.2022.131982

[3] UnitedNations. (2013). Sustainable development changes. world economic and social survey 2013.

[4] UnitedNations. (2018). Revision of world urbanization prospects. United Nations: New York, NY, USA, 799.

[5] Wang, X. R., Hui, E. C. M., Choguill, C., & Jia, S. H. (2015). The new urbanization policy in China: Which way forward? Habitat International, 47, 279–284. https://doi.org/10.1016/j.habitatint.2015.02.001

[6] Athanassiadis, A., Christis, M., Bouillard, P., Vercalsteren, A., Crawford, R. H., & Khan, A. Z. (2018). Comparing a territorial-based and a consumption-based approach to assess the local and global environmental performance of cities. Journal of Cleaner Production, 173, 112–123. https://doi.org/10.1016/j.jclepro.2016.10.068

[7] Haaland, C., & van den Bosch, C. K. (2015). Challenges and strategies for urban green-space planning in cities undergoing densification: A review. Urban Forestry and Urban Greening, 14(4), 760–771. https://doi.org/10.1016/j.ufug.2015.07.009

[8] UnitedNations. (2022). UnitedNations. Sustainable Development Goals (SDGs). www.sdgs.un.org/goals.

[9] De Jong, M., Joss, S., Schraven, D., Zhan, C., & Weijnen, M. (2015). Sustainable-smart-resilient-low carbon-eco-knowledge cities; Making sense of a multitude of concepts promoting sustainable urbanization. Journal of Cleaner Production, 109, 25–38. https://doi.org/10.1016/j.jclepro.2015.02.004

[10] Mazutis, D., & Sweet, L. (2022). The business of accelerating sustainable urban development: A systematic review and synthesis. Journal of Cleaner Production, 357, 131871. https://doi.org/https://doi.org/10.1016/j.jclepro.2022.131871

[11] Schraven, D., Joss, S., & de Jong, M. (2021). Past, present, future: Engagement with sustainable urban development through 35 city labels in the scientific literature 1990–2019. Journal of Cleaner Production, 292, 125924. https://doi.org/10.1016/j.jclepro.2021.125924

[12] Xiao, J., Shen, Y., Ge, J., Tateishi, R., Tang, C., Liang, Y., & Huang, Z. (2006). Evaluating urban expansion and land use change in Shijiazhuang, China, by using GIS and remote sensing. Landscape and Urban Planning, 75(1–2), 69–80. https://doi.org/10.1016/j.landurbplan.2004.12.005

[13] Arifeen, H. M., Phoungthong, K., Mostafaeipour, A., Yuangyai, N., Yuangyai, C., Techato, K., & Jutidamrongphan, W. (2021). Determine the land-use land-cover changes, urban expansion and their driving factors for sustainable development in gazipur Bangladesh. Atmosphere, 12(10). https://doi.org/10.3390/atmos12101353

[14] Bergès, L., Avon, C., Bezombes, L., Clauzel, C., Duflot, R., Foltête, J. C., et al. (2020). Environmental mitigation hierarchy and biodiversity offsets revisited through habitat connectivity modelling. Journal of Environmental Management, 256(October 2019). https://doi.org/10.1016/j.jenvman.2019.109950

[15] Zhou, M., Ma, Y., Tu, J., & Wang, M. (2022). SDG-oriented multi-scenario sustainable land-use simulation under the background of urban expansion. Environmental Science and Pollution Research. https://doi.org/10.1007/s11356-022-20904-9

[16] Sabour, M. R., Alam, E., & Hatami, A. M. (2020). Global trends and status in landfilling research: a systematic analysis. Journal of Material Cycles and Waste Management, 22(3), 711–723. https://doi.org/10.1007/s10163-019-00968-5

[17] Borthakur, A., & Govind, M. (2018). Public understandings of E-waste and its disposal in

[DOI: 10.22034/jaert.1.3.45]

urban India: From a review towards a conceptual framework. Journal of Cleaner Production, 172, 1053–1066. https://doi.org/10.1016/j.jclepro.2017.10.218

[18] Sabour, M. R., Zarrabi, H., & Hajbabaie, M. (2023). A systematic analysis of research trends on the utilization of life cycle assessment in pharmaceutical applications. International Journal of Environmental Science and Technology, 20(10), 10921-10942. https://doi.org/10.1007/s13762-023-05103-4

[19] SCImago Journal Rank. (2022). www.scimagojr.com

[20] Hatami, A. M., & Nikravan, M. R. S. M. (2020). A systematic analysis of research trends on incineration during 2000 – 2019. International Journal of Environmental Science and Technology, (0123456789). https://doi.org/10.1007/s13762-020-02794-x

[21] Mostafa Hatami, Amir, Sabour, M. R., & Nikravan, M. (2022). A bibliometric analysis on incineration ash during 2000 to 2020. Amirkabir Journal of Civil Engineering, (Article in Press). https://doi.org/10.22060/CEEJ.2022.20084.7339

[22] Wang, D., Bischof, L., Lagerstrom, R., Hilsenstein, V., Hornabrook, A., & Hornabrook, G. (2016). Automated Opal Grading by Imaging and Statistical Learning. IEEE Transactions on Systems, Man, and Cybernetics: Systems, 46(2), 185–201. https://doi.org/10.1109/TSMC.2015.2427776

[23] Amin, M., & Mabe, M. (2000). Impact factors: use and abuse. Perspectives in Publishing. http://www.elsevier.com/framework_editors/pdfs/Perspectives1.pdf

[24] Mostafa Hatami, A., Sabour, M. R., & Nikravan, M. (2021). A systematic analysis of research trends on incineration during 2000–2019. International Journal of Environmental Science and Technology, 18(2), 353–364. https://doi.org/10.1007/s13762-020-02794-x

[25] Sabour, M. R., Alam, E., & Mostafa Hatami, A. (2020). Environmental and economic assessment of Enhanced Landfill Mining in Tehran. Environmental Science and Pollution Research, 27(27), 34469–34483. https://doi.org/10.1007/s11356-020-09458-w

[26] Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. Proceedings of the National Academy of Sciences, 102(46), 16569–16572. https://doi.org/10.1073/pnas.0507655102

27] Scopus.com. (2022). www.Scopus.com

[28] Sabour, M. R., Babaei, S., & Anasori, S. M. (2021). Global trends of landfill leachate treatment research : A bibliometric analysis during 2000-2020, 5(4). https://doi.org/10.22097/eeer.2021.296061.1210

[29] Wang, Y., Lai, N., Zuo, J., Chen, G., & Du, H. (2016). Characteristics and trends of research on waste-to-energy incineration: A bibliometric analysis, 1999–2015. Renewable and Sustainable Energy Reviews. https://doi.org/10.1016/j.rser.2016.07.006

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