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The production, collaboration, and citations of high quality publications on Urban Sprawl

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Abstract

The present study explores the characteristics of the literature on urban sprawl published during the last three decades, based on the Web of Science database and its implications by using scientometric techniques. The results of this study shows that the urban sprawl has grown exponentially during this period reaching 3272 papers in total. The United States was the largest contributor in global urban sprawl research, as the USA produced most independent and collaborative papers. University of California System, USA is the largest institutional contributor publishing 3.39% of the papers. Salvati, L (Council for Agricultural Research & Economics, Italy) is the most productive author with 77 publications and 903 citations. Landscape and Urban Planning is the most publishing journals whilst, Environmental Sciences and Ecology are the most published subject areas. The total number of citations are of 62,211, with a ratio for the average citations per publication as 19.01 and “H-index” as 112. The number of cited papers is 38284 and the proportion of cited papers to the total is 1.17. This study provides researchers and practitioners with an extensive understanding of the salient research themes, trends and pattern of urban sprawl research worldwide.

Keywords: Urban sprawl, production, collaboration

1 Introduction

Urban sprawl research is very important and significant in any country especially in developing countries in the world. Urban sprawl expansion is becoming a serious problem in many urban areas in the world. Due to lack of infra-structure and basic facilities like water supply, electricity, sanitation services, excessive traffic congestion, pollution, fragmentation of housing with low density areas and increase in energy consumption that causes social segregation and environmental degradation.

The sprawl also creates serious issues like crimes, high taxes, deficiency of infrastructures and other social evil which makes many of the cities of the world are not suitable for human livings. The sprawl as of now non stoppable and much research have

also been carried out to control as well as eradications of evils of the urban sprawl. The research output on this subject is the main considerations of this research.

Thus, the purpose of the present study is to analyze the status and trends of urban sprawl research output for the last three decades (1989-2017) in order to help the researchers to understand the panorama of global urban sprawl research, and predict the dynamic directions of it.

2 Review of Literature

Scientometric applications are gaining momentum as of now but very few scientometric studies are made on the subject viz., urban sprawl, as such two are reviewed here along with few more studies which are applied scientometric applications on different disciplines:

Zeng Chen et al., (2014) carried out a bibliometric analysis on urban sprawl research from 1991 to 2011. The general publication output, the global geographical distribution of the authors, the funding and institutions involved, the research areas, and the source titles are analyzed and discussed. It was found that Scholars in the United States and China have produced most of the documents in urban sprawl and these two countries are also the largest contributors in terms of funding and institutions. Haijun Wanga et al., (2012) performed a bibliometric analysis of published urbanization research from 1991 to 2009, based on SCI and SSCI databases. This study reveals scientific outputs, subject categories and major journals, international collaboration and geographic distribution, and temporal trends in keywords usage in urbanization studies and further, discusses the relationships between urbanization papers and urbanization rate and offer a substitute demonstration of research advancements. Santha kumar, R and Kaliyaperumal, K (2015) examined the growth and development of mobile technology research in global as revealed by the publications indexed in Web of Science (WoS) for a period of 14 years from 2000 to 2013. During 2000–2013 a total of 10,638 publications were published in the field. Output of total publications, 9037 were produced by multiple authors and 1601 by single authors. Authors from USA have contributed maximum number of publications compared to the other countries and India stood 16th ranking in terms of productivity in this study period. Santha kumar and Kaliyaperumal (2014) made a scientometric study on mobile technology publications covered in the Engineering Index database during the period of 2003–2012, a total of 144,567 publications were published in the field. Authors from China have contributed maximum number of publications compared to the other countries and India stood 7th in terms of productivity in this period. Satish S Munnolli & Shamprasad M Pujar (2017) analysed the prominent institutes contributing to cancer research in India, major publication channels used and impact of highly cited papers on social media. Scopus citation database was used to extract the bibliographic data for the period 2003 to 2012.

3 Objectives of the study

The main objective of present analysis is to determine the following bibliometric indicators from quantum of publications of global researchers in the field of urban sprawl;

- Annual growth of literature output and citation impact
- Most productivity authors
- Most productive institutions
- Most productivity profile of the world's top 10 countries
- Media of communication in most productive journals
- Subject wise distribution of publications, and
- Characteristics of highly cited papers

4 Materials and Methods

For this purpose of the study, the Web of Science database of the Thomson Reuters, USA (available at [http:// www.isiknowledge.com](http://www.isiknowledge.com)) was used because it is a major source for bibliographic, citations, and other academic impact information of scientific publications in various branches of science. A total of 3272 records were downloaded and analysed by using the spreadsheet application as per the objectives of this study. The bibliographic details for each record such as year of publications and citations, document type, authors affiliations, source titles where it was published, publication details and subjects. The citations received to the publications were retrieved on 28th June, 2018 for a period of 29 years (1989 to 2017).

5 Results and Discussions

5.1 Growth of Publications and Citations

Table 1 Growth of Publications and Citations

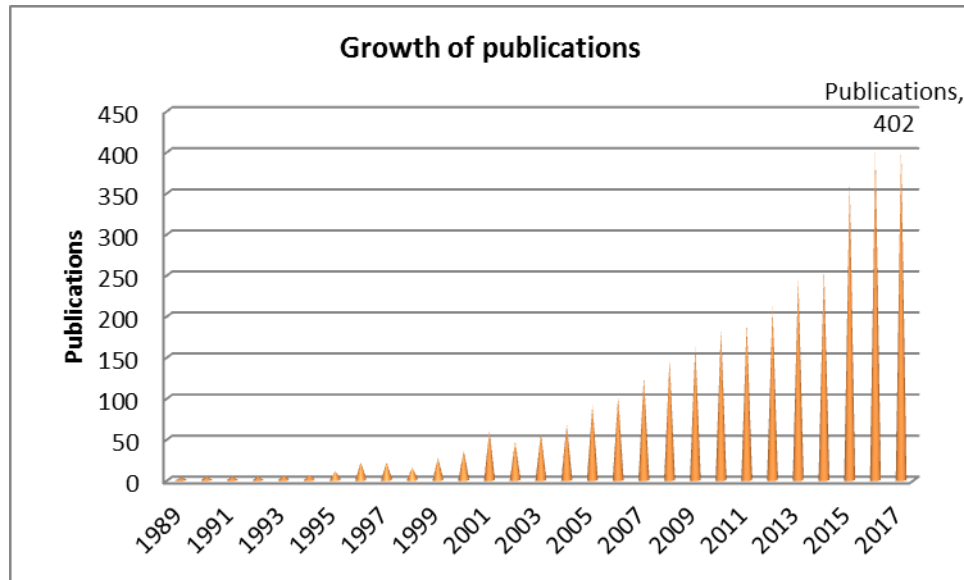
Year	TP	Percentage	TC	Percentage	ACPP
1989	3	0.09	0	0	0
1990	4	0.12	6	0	1.5
1991	4	0.12	4	0	1
1992	4	0.12	1	0	0.25
1993	5	0.15	6	0	1.2
1994	6	0.18	7	0.01	1.17
1995	11	0.34	9	0.01	0.82
1996	22	0.67	18	0.03	0.82
1997	22	0.67	31	0.05	1.41
1998	16	0.49	56	0.09	3.5
1999	27	0.83	66	0.11	2.44
2000	36	1.10	105	0.17	2.92
2001	60	1.83	153	0.25	2.55
2002	47	1.44	243	0.39	5.17

2003	57	1.74	336	0.54	5.89
2004	67	2.05	448	0.72	6.69
2005	91	2.78	751	1.21	8.25
2006	101	3.09	985	1.58	9.75
2007	125	3.82	1446	2.32	11.57
2008	146	4.46	1826	2.94	12.51
2009	163	4.98	2715	4.36	16.66
2010	184	5.62	3301	5.31	17.94
2011	191	5.84	3928	6.31	20.57
2012	211	6.45	4696	7.55	22.26
2013	247	7.55	5559	8.94	22.51
2014	258	7.89	7322	11.77	28.38
2015	362	11.06	8082	12.99	22.33
2016	400	12.22	9321	14.98	23.30
2017	402	12.29	10790	17.34	26.85
Total	3272	99.99	62211	99.99	-

TP - Total Publications, TC - Total Citations, ACPP – Average Citations per Publications

The table 1 shows that the global research output of urban sprawl consists of 3272 papers during 1989–2017, which has increased from 3 papers in 1989 to 402 papers in 2017. The highest number of publications 402 was produced in 2017, and these publications have received highest citations in 24923. The yearly output is present in Table 1 which indicates that in the initial stages the output was very less and it started increasing slowly from 1995. From 2006 onwards the publication output increased steadily and reached the peak in the year 2017. A total of 3272 publications have received 62211 citations during this period. The average citation per year was 2145. The highest number of citations (10790) was in 2017. There is an increasing trend of citations in urban sprawl research in the world during 1993-2017. The average number of publications per year was 81.79 and the number of citations per publication during the period was 19.01. The growth of article outputs has exploded since 1994, along with an increasing references and citations.

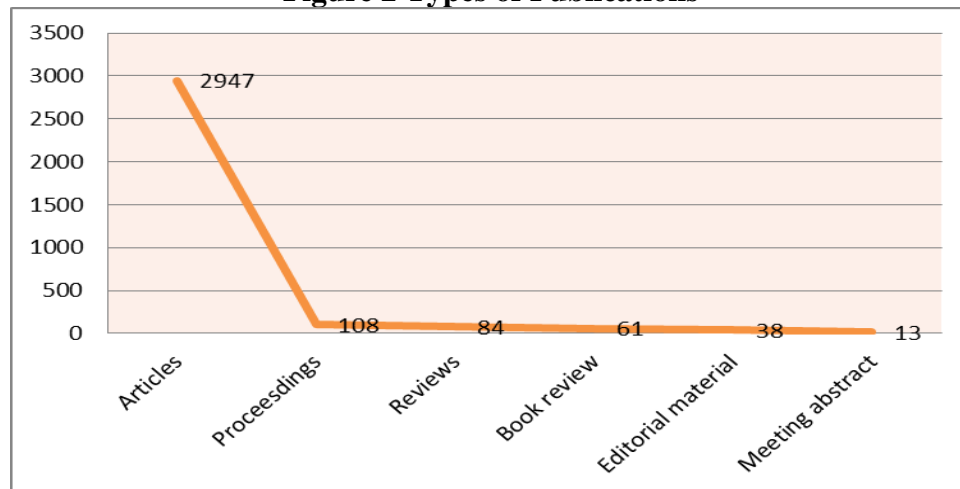
Figure 1 Growth rate of publications



5.2 Types of publications

Urban sprawl literature in world has been published in different forms of publications. Out of the 3272 published papers, 2947 (90.07%) were journal articles with 50936 citations followed by 108 (3.30%) Conference proceedings, 84 (2.57%) Reviews, 61 (1.86%) Book review and remaining 2.2% publications are of other forms.

Figure 2 Types of Publications



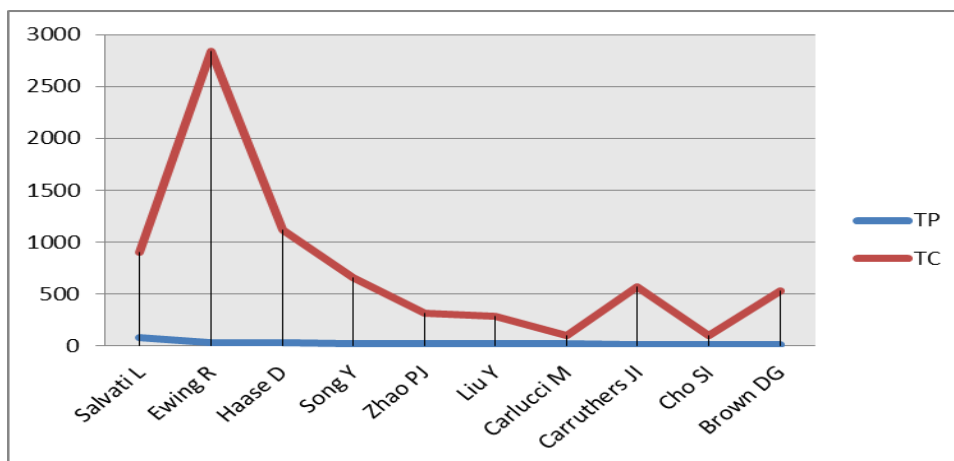
5.3 Most Prolific Authors - Contributions and their H-Index

Table 2 Most Prolific Authors

S.No.	Author	Affiliations	TP	TC	ACPP	H-Index
1	Salvati L	Council for Agricultural Research & Economics, Italy	77	903	11.73	15
2	Ewing R	University of Utah, USA	29	2837	97.83	17
3	Haase D	Humboldt University of Berlin, Germany	27	1119	41.44	20
4	Song Y	University of North Carolina at Chapel Hill, USA	21	658	31.33	11
5	Zhao PJ	Peking University , USA	20	316	15.80	21
6	Liu Y	Tianjin University, China	18	290	16.11	25
7	Carlucci M	Sapienza University of Rome, Italy	17	99	5.82	22
8	Carruthers JI	George Washington University, USA	13	569	43.77	17
9	Cho SI	University of Tennessee, USA	12	99	8.25	23
10	Brown DG	University of Michigan, USA	11	534	48.55	20

During 1989-2017, a total of 7075 authors contributed 3272 articles with an average of 2.16 authors per article. The 10 most prolific authors have together contributed a total of 245 papers, constituting 7.49% share of the total output of global research output on urban sprawl and registering an average productivity per author of 24.5. The 245 publications contributed by the top 10 authors have received 7424 citations, registering a citation impact per paper of 30.30 (varying from 5.82 to 97.83). Table 2 also indicates the list of top 10 authors who have contributed at least 11 articles along with their affiliations, h-index. Salvati, L (Council for Agricultural Research & Economics, Italy) is the most productive author with 77 publications and 903 citations followed by Ewing, R (University of Utah, USA) with 29 publications and 2837 citations, Haase, D (Humboldt University of Berlin, Germany) with 27 publications and 1119 citations, and Song, Y (University of North Carolina at Chapel Hill, USA) with 21 publications and 658 citations.

Figure 3 Most prolific authors



However, it was interesting to note that the listing of these 10 most productive authors when ranked on the basis of average citation per publication would differ substantially Ewing R, (University of Utah, USA) leads the top with first rank in ACPP and Liu, Y (Tianjin University, China) leads the top with first rank in h-index. The top 10 most productive authors have registered an average h-index of 19.1 (varying from 11 to 25). Six authors have registered higher value of h-index than the average value of h-index of all authors.

5.4 Most Productive Organizations

Table 3 Most productive organizations

S. No.	Organizations	Country	TP	TC	ACPP	H Index
1	University of California System	USA	111	4716	42.49	33
2	Chinese Academy of Sciences	China	109	2463	22.6	23
3	University of North Carolina	USA	88	2679	30.44	25
4	University System of Maryland	USA	69	3769	54.62	25
5	Consiglio per la Ricerca in Agricoltura E L Analisi Dell Economia Agraria Crea	Italy	64	473	7.39	13
6	University of Illinois System	USA	56	1685	30.09	22
7	University of Maryland College Park	USA	54	3229	59.8	23
8	University System of Georgia	USA	54	1348	24.96	19
9	State University System of Florida	USA	53	1191	22.47	14

10	Centre National De La Recherche Scientifique (CNRS)	France	51	444	8.71	12
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TP-Total Publications, TC - Total Citations, ACP- Average Citation per Publications

The top 10 most productive organizations have published from 51 to 111 papers and together contributed 21.67 % (709 papers) share in the cumulative global publications output in urban sprawl during 1989-2017. The publications profile of these 10 organizations along with their research output, citations received and h-index values are presented in table 3. There were 3257 institutions involved in the urban sprawl research.

University of California System, USA topped the list with 111 publications with 42.49 average citations per publication followed by Chinese Academy of Sciences, China with 109 publications and 22.6 average citations per publication, University of North Carolina, USA with 88 publications and average citations per publication and University System of Maryland, USA with 69 publications and 54.62 average citations per publication. Average citation per publication varied from 7.39 to 59.8, with average citation impact is 30.36. Four organizations have registered more than the average citation impact of all 10 organizations. The h-index of 10 most productive organizations in urban sprawl research varied from 12 to 33, with average h-index of 20.9 during 1989-2017. Six organizations have registered more than the average h-index of all organizations.

5.5 Most Productive Countries

Table 4 Most Productive Countries

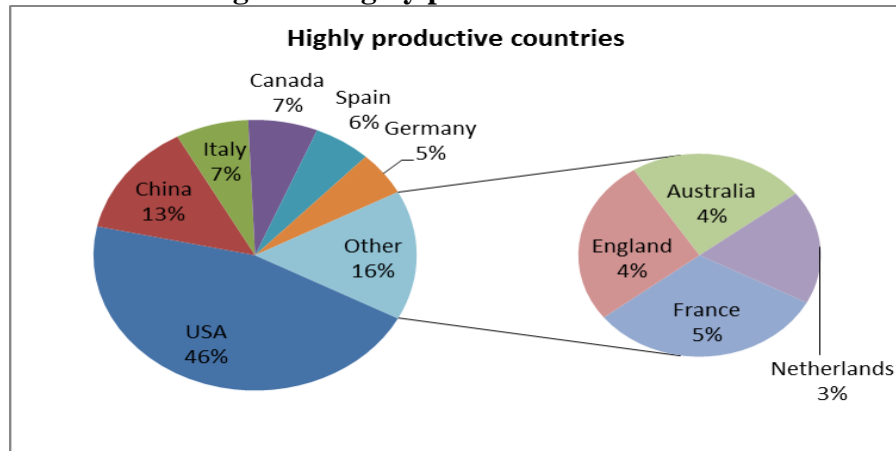
Rank	Country	Total Publications	Total Citations	CPP	RCI	H-Index	PEI
1	USA	1321	40735	30.84	1.62	99	162.19
2	China	393	7283	18.53	0.97	43	97.47
3	Italy	211	3084	14.62	0.77	28	76.87
4	Canada	201	3646	18.14	0.95	31	95.40
5	Spain	166	2514	15.14	0.80	27	79.65
6	Germany	152	3709	24.40	1.28	37	128.34
7	France	142	2166	15.25	0.80	24	80.23
8	England	118	3181	26.96	1.42	29	141.78
9	Australia	106	1991	18.78	0.99	25	98.79
10	Netherlands	81	2025	25.00	1.32	26	131.49

CPP – Citation per Publication, RCI – Relative Citation Impact, PEI – Publication Efficiency Index

The list of countries is quite long as a total of 91 countries published 3272 articles during the study period. During analysis it is observed that most of the articles are

contributed by USA authors. The country with the greatest output in terms of urban sprawl is the USA (55.69%), followed by China (12.01%), Italy (6.45%), Canada (6.14%) share of publications respectively. Subsequent positions are occupied by Spain (5.07%), Germany (4.64%), France (4.34%), England (3.61%), Australia (3.24%) and Netherlands (2.47%), the remaining countries publishing a total of 891 publications between them accounting for 11.64% of the total output. Table 4 provides distribution of publications, citations and h-index of top ten highly productive countries.

Figure 4 Highly productive countries



Research performance in USA has increased appreciably during the study period, both in regard to relative output of publications and in their citations impact on the international research productivity. Research on urban sprawl in China, Italy, Canada, Spain, Germany and France started quite late but secured positions among the top ten countries. USA again occupied the first rank with global citation share of 30.84%, followed by England (26.96%), Netherland (25%) and Germany (24.40%).

5.5.1 Relative Citation Impact

Quality and impact of research publications are being measured with two relative indicators such as Citations per Publication (CPP) and Relative Citation Impact (RCI). Citations per publication was to access the impact of a publication of years, authors, institutes and countries and relative citation impact is more robust than other indicators in the sense that it measures of research activity, irrespective of the level of evaluation either author or institutes or countries. RCI is calculating with the following formula,

$$RCI = \frac{\text{A country's share of total citations}}{\text{A country's share of total publications}}$$

RCI = 1 indicates that the country's citation value is equal to average citation rate, RCI>1 indicates that the country's citation value is higher than the average citation rate and also implies high impact of research in that country and RCI<1 indicates that the

country's citation value is lower than the average citation value and also implies that the research efforts are higher than its impact.

The relative citation impact (RCI) of top 10 most countries varied from 0.77 to 1.62 and the average value of RCI was 1.09. Four countries have scored higher value of RCI than the average value of all 10 countries. In terms of RCI, the first rank was occupied by USA with relative citation impact of 1.62, followed by England (1.42), Netherlands (1.32) and Germany (1.28).

5.5.2 Publication Efficiency Index

Publication Efficiency Index was used by Guan and Ma (2007) in their studies as a measure of research quality. It indicates whether the impact of publications in a country in a research field is compatible with the research efforts. The value of PEI > 100 for a country indicates that the impact of publications is more than the research effort devoted to it for that particular country and vice versa.

$$PEI = \frac{TNC_i / TNC_t}{TNP_i / TNP_t}$$

Where,

- TNC_i – denotes the total number of citations of country i
- TNC_t - denotes the total number of citations of all countries
- TNP_i - denotes the total number of papers of country i
- TNP_t - denotes the total number of papers of all countries

USA had the highest Publication Efficiency Index (162.19%) followed by England with (141.78%), Netherlands with (131.49%), Germany with (128.34%), Australia with (98.79%) and China with (97.47%).

5.6 Research communication in high productive journals

Table 5 High productive journals

Journal	TP	TC	CPP	H-Index	IF
Landscape and Urban Planning	140	5585	39.89	43	4.563
Land Use Policy	107	2332	21.79	28	3.194
Cities	71	1764	24.85	23	1.127
Habitat International	63	1004	15.94	18	3
Sustainability	63	345	5.48	10	1.343
Urban Studies	63	2332	37.02	23	1.934
Environment and Planning B Planning	50	1189	23.78	19	2.102

Design					
Applied Geography	46	1242	27	17	2.565
Journal of the American Planning Association	43	2186	50.84	19	2.041
Urban Geography	36	456	12.67	13	1.322

TP-Total Publications, TC - Total Citations, CPP- Citation per Publications, IF-Impact factor

The scientific literature on urban sprawl is spread over 933 different Web of Science source journals. The scientific journals and conference proceedings publications are the most important medium of communications in scientific field. The top 10 most productive journals publishing global research papers together contributed 682 papers in urban sprawl, which accounted for 20.84% of the total output of the study period. Landscape and Urban Planning is the highly productivity journals with 140 publications with 5585 citations and impact factor is 4.563 followed by Land Use Policy with 107 publications, 2332 citations and impact factor is 3.194, Cities with 71 publications, 1764 citations and impact factor is 1.127 and Habitat International with 63 publications, 345 citations and impact factor is 3. More than 20% of the top ten publications were published in the journals with impact factors ranging from 1.127 to 3.194. This indicates that the publication behavior of researchers who preferred to publish their publications in high impact factor journals. The distribution of journals publications along with their impact factors range and h-index is presented in table 5.

5.7 High Productivity Subject Areas

Table 6 High productivity subject areas

S. No.	Subject	Total Articles	Total Citations	Citation per Publication	H - Index
1	Environmental sciences ecology	1405	31988	22.77	83
2	Urban studies	792	20626	26.04	72
3	Geography	650	13040	20.06	59
4	Business economics	341	6845	20.07	45
5	Public administration	332	9107	27.43	47
6	Physical geography	248	7547	30.43	47
7	Engineering	218	3697	16.96	32
8	Public environmental occupational health	172	8547	49.69	43
9	Science technology	171	3370	19.71	21
10	Remote sensing	155	3396	21.91	31

Table 6 shows high productivity subjects which are contributing more than 100 articles. Among subjects, the highly productive subjects are: Environmental sciences ecology accounts for the largest share (42.94%, 1405 papers) of publications in the total worldwide output which received 31988 citations with 22.77 citations per publication,

followed by Urban studies (24.21%, 792 papers) and 20626 citations with 26.04 citations per publication, Geography (19.87%, 650 papers) with 20.06 citations per publication and Business economics (10.42%, 341 papers) and 6845 citations with 20.07 citations per publication respectively.

5.8 Highly cited papers

Table 7 High cited papers

S. No.	Publications	Total citations	Document Type	Country
1	Patz, JA, Campbell-Lendrum, D, Holloway, T and Foley, JA. Impact of regional climate change on human health, <i>Nature</i> , 2005, Vol. 438 (7066), pp. 310-317	966	Review	USA
2	Ewing, R, Schimd, T, Killingsworth, R, Zlot, A and Raudenbush, S. Relationship between urban sprawl and physical activity, obesity and morbidity, <i>American Journal of Health Promotion</i> , 2003, Vol. 18, (1), pp. 47-57	635	Article	USA
3	Papas, MA, Alberg, AJ, Ewing, R, Helzlsouer, KJ, Gary, TL and Klassen, AC. The built environment and obesity, <i>Epidemiologic Reviews</i> , 2007, Vol. 9, pp. 129-143	499	Article	USA
4	Radeloff, VC, Hammer, RB, Stewart, SI, Fried, JS, Holcomb, SS and McKeefry, JF. <i>Ecological Applications</i> , 2005, Vol. 15 (3), pp. 799-805	439	Communication	USA
5	Brownson, RC, Hoehner, CM, Day, K, Forsyth, A and Sallis, JF. Measuring the Built Environment for Physical Activity State of the Science, <i>American journal of preventive medicine</i> , 2009, Vol. 36 (4), pp. 99-123	435	Article	USA
6	Ewing, R. Is Los Angeles-style sprawl desirable?, <i>Journal of the American Planning Association</i> , 1997, Vol. 63 (1), pp. 107-126	435	Article	USA
7	Galster, G, Hanson, R, Ratcliffe, MR, Wolman, H, Coleman, S and Freihage, J. Wrestling sprawl to the ground: Defining and measuring an elusive concept, <i>Housing Policy Debate</i> , 2001, Vol. 12 (4), pp. 681-	396	Article	USA

	717			
8	Waddell, P. UrbanSim - Modeling urban development for land use, transportation, and environmental planning, <i>Journal of the American Planning Association</i> , 2002, Vol. 68 (3), pp. 297-314	391	Article	USA
9	Lovasi, GS, Hutson, MA, Guerra, M, Neckerman, KM. Built Environments and Obesity in Disadvantaged Populations, <i>Epidemiologic Reviews</i> , 2009, Vol. 31 (1), pp. 7-20	344	Article	USA
10	Brueckner, JK. Urban sprawl: Diagnosis and remedies, <i>International Regional Science Review</i> , 2000, Vol. 23 (2), pp. 160-171	356	Article	USA

The highly cited urban sprawl publications (which have got at least 300 citations) published by the global researchers are listed in table 7. The most frequently cited one was “Patz, JA et al., Impact of regional climate change on human health, *Nature*, 2005, Vol. 438 (7066), pp. 310-317 with 966 citations. Out of 10 highly cited publications 8 are journal articles each one is review and communication. Among the highly cited papers all were written by USA authors.

6 Summary and Conclusions

A comprehensive statistical analysis on urban sprawl research was conducted via a scientometric approach. Based on statistical analysis of the 3272 publications which were related to the topic of urban sprawl, it was found that articles are the dominating form of publications which accounted for 90.07% of the total. The Publications on urban sprawl are spread over 13 languages and the most predominant language used for communication was English. A constant increase was observed in the number of publications and citations. Specifically, from 2001 to 2017, over 3000 articles and 61000 citations were published on urban sprawl, indicating researchers great interest in this topic. Also, these articles were spread across 900 different journals, 91 countries and 2357 research institutes, revealing the importance of urban sprawl as well as the broad research interest in this field. USA institutions played a dominant role in the production, collaboration, and citation of high quality publications. As most of the major organizations are speeding up in a setting research atmosphere all over the world it is obvious, based on fact of globalization of research and also need to improve the number of publications in order to measure global research in urban sprawl. These findings will provide evidence of the current status and trends in urban sprawl all over the world and also would be helpful for researchers to conduct better researches that eventually could lead to more publications in this field.

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