

100 Most Cited Articles in Urban Green and Open Spaces: A Bibliometric Analysis

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ABSTRACT

Researchers have contributed significantly to the development of the subject of urban green and open spaces (UGOS) in both practical and fundamental aspects. As the number of citations indicates a paper and author's competency, the online web of science (ISI) was browsed to identify the 100 most cited papers in the field of UGOS from 1980 to 2013. Papers were analyzed for authorship, journal sources, publishers, institutions, countries, year of publication, categories, and author keywords. The total number of citations was compared to the average number of citations per year. From 1105 UGOS papers returned, the maximum number of citations was 212. The top 100 most cited were published from 1988 to 2011, with the majority in 2007. A remarkable distinction was found in the comparison of total citations and average citations per year. As total linear trend indicates a significant growth in influential articles, urban green and open spaces are a developing subject in landscape and urban planning. This study gives an insight into the readership of UGOS by highlighting key papers.

Key words: Open space, Green space, Citations, Landscape, Urban planning, Bibliometric.

INTRODUCTION

In the context of urban studies, a great number of terms and definitions refer to "urban green and open space" (UGOS) such as open space, green space, public space, and urban greenery. Parks and public gardens, as the most well-known UGOS, are associated with amenity green spaces, having a high quality of landscape design and maintenance. On the other hand, experimental green spaces are often referred to as green feel, which users consciously or unconsciously experience within a certain area. Therefore, the constitution of UGOS varies among different groups of people, for example, between citizens and researchers, where human influences convert natural areas into urban areas, as UGOS is

a reflection of human demand for greenery. They can vary from a simple playing field to natural landscape or highly maintained environment and are mostly provided with open access to public, although they may be privately owned.

For the purpose of this study UGOS contains all types of public or private open spaces in urban areas which are completely or mostly covered with vegetation. Water bodies such as rivers, streams and lakes are included but not all green areas outside urban borders. Furthermore, these UGOS play a key role to improve the environment through landscape enhancement, better air quality, and noise reduction, which result in the enhancement of wellbeing and quality of citizens' life^{1,2}.

As a type of bibliometric method, citation indices trace the references in a published paper³. It exhibits how many times a specific article has been cited in other articles⁴. The avenues to evaluate citation tracking have been significantly raised in the past years^{3, 5}. The frequency of citation of the publication is assumed to display the impact of the publication, but not essentially their quality⁶. Evidently, citation count alone is not sufficient to provide a complete criteria for judging scientific paper quality, in particular when there exist numerous mechanisms to boost the citation of a paper^{7, 8}. It should be added that rather than alternative metrics, citations remain a main indicator of the importance of a research output⁹⁻¹¹.

In this study, top-cited articles¹², classic papers¹³, top publications¹⁴ or most frequently cited articles¹⁵ in different categories related to UGOS have been studied¹⁶. For a long time now, bibliometric studies have been widely applied to evaluate research papers by measuring scientific preferences (for example, Saracevi & Perk, 1973) and different aspects have been studied such as: annual publication outputs, authors, language, categories,

journals, publishers, contributing institutes, and countries, and keywords¹⁷. This study not only evaluates the publication characteristics: language, annual publications, countries, and institutional contributions, and Web of Science categories, but also evaluates researchers' trends and emphasis by analyzing author keywords in UGOS topic. The result shows the top-cited articles in the field of UGOS.

METHODS AND MATERIALS

The Institute of Scientific Information (ISI) in 1962 launched the Science Citation Index for scientific journals in a consistent and systematic manner in order to measure citation numbers. A paper quality is best recognized by citation count¹⁸. According to the number of times a paper has been cited by other authors, the scientific impact of that paper, author, or journal can be evaluated¹⁹. In this bibliometric research, we analyze citation indices to determine the key papers in urban green and open spaces.

The data utilized in this research were derived from the online Web of Science (the Tomson

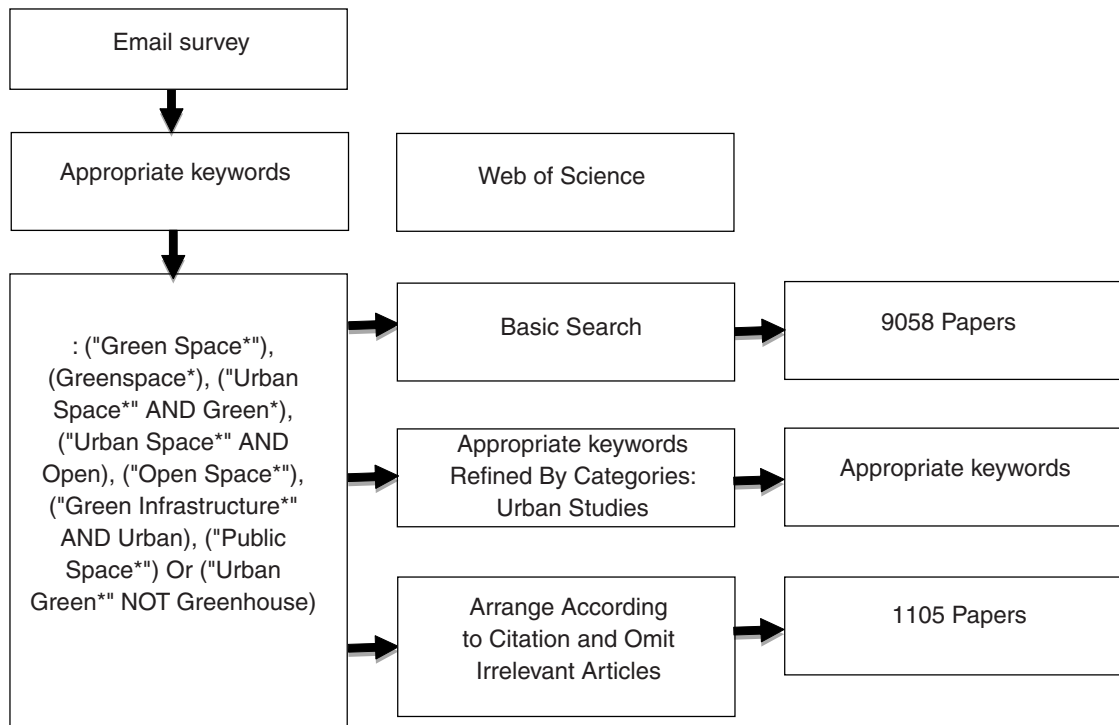


Fig. 1: Data collection process to search UGOS related researches

Reuters) on 29 August 2014. In order to find proper keywords an email survey was conducted, with 30 emails sent to experts as respondents and relevant keywords of UGOS investigated. Collected data were analyzed qualitatively and extracted keywords applied to search top articles from Web of Science core collection in terms of topic (including four sections: title, abstract, author keywords, and keyword plus) within the publication year limited to the period from 1980 to 2013, indices: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, these keywords were searched: (“green space”), (greenspace*), (“urban space” AND green*), (“urban space” AND open), (“open space”), (“green infrastructure” AND Urban), (“public space”) or (“urban green” NOT greenhouse). A total of 9,058 publications met the selection criteria. However, these publications contained some documents not closely related to UGOS, therefore the result was refined by Web of Science Categories: Urban Studies. A total of 1,105 documents were therefore determined.

Citation statistics produced for a time frame shorter than three years may not be sufficiently stable (20, 21). Therefore, the documents from 2012 to 2014 were put aside. Furthermore, since the target of the data collection is the 100 most-cited articles most relevant to UGOS and, all 1105 documents were arranged according citations, and their abstracts studied. From 139 first documents,

39 which were not specific to UGOS were excluded, to reach 100 most cited articles that were analyzed statistically by Microsoft Excel. The details of the data collection process are illustrated in Fig.1.

RESULTS AND DISCUSSION

Paper and authors’ citations

Table 1, presents the list of 100 most-cited papers in urban green and open spaces that give an idea of readership. The paper by Chiesura²², which explains the role of urban parks in a sustainable city, appears to be the most important, with a total of 212 citations. The nearest competitor is a literature review²³ about promoting the ecosystem and human health by using green infrastructure in urban areas, with a total of 183 citations. Besides that, the first and third top cited articles are review papers. These results are on the corresponding general belief that review articles had the highest number of citations^{24, 25}.

The top 100 papers were published between 1988 and 2011 (Fig 2). During this period the number of papers increased consistently from 1 to 5. This number remained unchanged between 2000 and 2002. The trend is unsteady until the two years of 2006 and 2007 which showed the highest number of top-cited papers with 11 and 13 instances. The citation rate gradually decreased over the years that followed. This reduction over the last few years

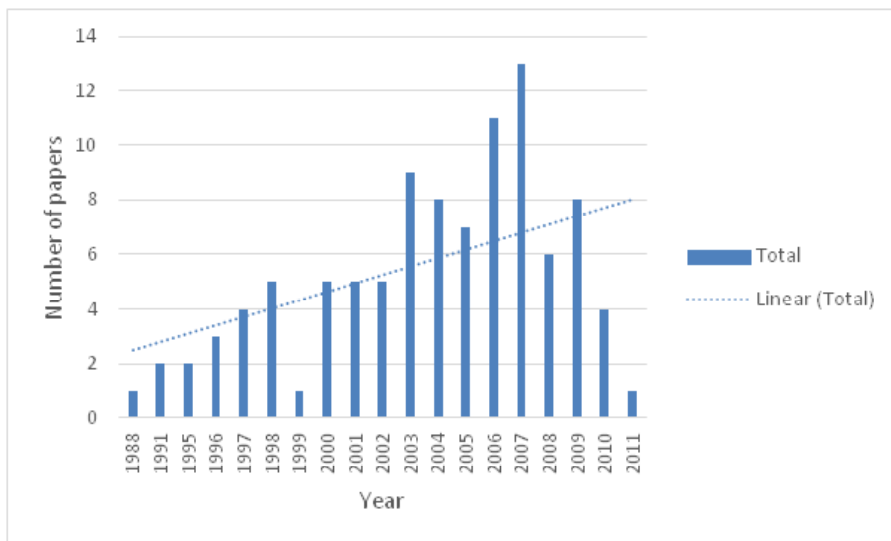


Fig. 2: Number of papers per year

would seem logical because citation of scientific papers normally starts one or two years after publication and reaches peak after about 10 years²⁶. All in all, total linear trend indicates an increasing consideration for UGOS.

Table 2 ranks the authors according the total citations they have received. It also demonstrates the two top cited articles for each author. Jim, CY with 269 citations is placed first, followed by Tyrvainen, L with 248 and after him Ennos, AR obtained with 247 citations.

While our top 100 papers have 226 authors, only 20 authors wrote more than one article (see Table 3). Jim, CY is the highest ranked with five publications and a total of 269 citations which contain one paper with single author and four papers as first author. Tyrvainen, L; Pauleit, S; Chen, WY; Ennos, R and Handley, JF each contributed three papers. According to Table 2, single authors (Jim, CY; Tyrvainen, L and Kong, FH) published only three articles.

Table 1: Top 100 article in urban green and open spaces (UGOS)

R	First Author	No.	R	First Author	No.	R	First Author	No.
1	Chiesura, 2004	212	35	Jim, 2003	61	66	Eliasson, 2007	41
2	Tzoulas, 2007	183	36	Barbosa, 2007	58	66	Fabos, 2004	41
3	Burgess, 1988	140	36	Colding, 2007	58	66	Jorgensen, 2002	41
4	Luttik, 2000	119	36	Breuste, 2004	58	71	Grahn, 2010	40
5	Valentine, 1996	118	36	Van, 2003	58	72	Sandstrom, 2006	38
6	Ruddick, 1996	108	40	Kong, 2006	57	72	Khakee, 2006	38
7	Pauleit, 2005	101	40	Cook, 2002	57	72	Breffle, 1998	38
8	Tratalos, 2007	98	42	James, 2009	55	75	Daniels, 1991	37
9	Whitford, 2001	97	42	Chang, 2007	55	76	Comber, 2008	36
10	Bengston, 2004	95	44	Carles, 1999	54	77	Troy, 2008	35
11	Tyrvainen, 2007	85	45	Gunnarsson 2007	53	77	Tajima, 2003	35
11	Tyrvainen, 1997	85	45	Walsh, 2007	53	77	Linehan, 1995	35
13	Bowler, 2010	80	45	Shafer, 2000	53	80	Balram, 2005	34
14	Thompson, 2002	79	45	Southworth, 1997	53	80	Daniels, 2005	34
15	Anderson, 2006	78	49	Sousa, 2003	52	80	Arendt, 2004	34
15	Jackson, 2003	78	50	Jim, 2004	51	80	Bondi, 1998	34
15	Tyrvainen, 1998	78	51	Jim, 2006a	50	84	Lyytimaki, 2009	32
18	Yeoh, 1998	77	52	Gill, 2008	49	84	Maruani, 2007	32
19	Atkinson, 2003	76	53	Shultz, 2001	48	86	Dobbs, 2011	31
19	Zerbe, 2003	76	54	Banerjee, 2001	47	87	Nagendra, 2010	30
21	Morancho, 2003	74	55	Flores, 1998	46	87	Gordon, 2009	30
22	Sandstrom, 2006	73	56	Allen, 2006	45	87	Nordh, 2009	30
22	Wolch, 2005	73	56	Ozguner, 2006	45	87	Haire, 2000	30
24	Mathieu, 2007	72	58	Hamin, 2009	44	91	Jorgensen, 2007	29
24	Heynen, 2006	72	58	Gobster, 2004	44	91	Zhang, 2006	29
26	Kong, 2007	70	58	Goss, 1996	44	93	Zhang & Wang, 2006	28
27	Matsuoka, 2008	68	61	(Buijs, 2009)	43	93	Walmsley, 2006	28
28	Jim, 2006b	66	61	(Lafortezza, 2009)	43	93	Kim, 2005	28
28	Acharya, 2001	66	61	(Julier, 2005)	43	93	Kuhn, 2003	28
28	Soule, 1991	66	61	(Mortberg, 2000)	43	93	Schmelzkopf, 200	28
31	Li, 2005	65	65	(Varsanyi, 2008)	42	93	Johnston, 1997	28
32	Irwin, 2004	64	66	(Jim, 2009)	41	99	Schipperijn, 2010	27
32	Hess, 2002	64	66	(Schilling, 2008)	41	99	Loukaitousideris, 1995	27
34	Gobster, 2001	62						

Journal Sources and Publishers

Results showed that these papers were published in 16 journals. The most popular journal was *Landscape and Urban Planning* with a total of 62 citations. This is more than nine times the citation number of its nearest competitor. Seven papers were published in the journal of *Urban Geography* and

six in both journals of *J AM Planning Assoc.* Total citations and also impact factor of each journal were extracted from the website of the Journal Citation Report on 5/10/2014 and presented in Table 4. The journal impact factor is one of the most important measures that indicate the journal's significance within the related fields²⁷. The impact factor was first

Table 2: The first 10 authors with the most citations

Rank	Author	Number of publications	Total citations	First article citations	Second article citations
1	Jim, CY	5	269	66	61
2	Tyrvaainen, L	3	248	85	85
3	Ennos, AR	3	247	101	97
4	Niemela, J	2	238	183	55
5	Hitchmough, J	2	238	183	55
6	Chiesura, A	1	212	212	0
7	Jorgensen, A	2	201	97	55
8	Chen, WY	3	157	66	50
9	Davies, RG	2	156	98	58
10	Fuller, RA	2	156	98	58

Table 3: Authors with 2 publications and more

Rank	Author	Number of publications	Single Author	First Author	Collaborative Authors
1	Jim, CY	5	1	4	4
2	Tyrvaainen, L	3	1	2	2
3	Pauleit, S	3	—	1	2
4	Chen, WY	3	—	—	3
4	Ennos, R	3	—	—	3
4	Handley, JF	3	—	—	3
7	Gobster, PH	2	1	1	1
8	Kong, FH	2	—	2	2
8	Jorgensen, A	2	—	2	2
8	Sandstrom, UG	2	—	2	2
11	Angelstam, P	2	—	—	2
11	Niemela, J	2	—	—	2
11	Zipperer, WC	2	—	—	2
11	Davies, RG	2	—	—	2
11	Nakagoshi, N	2	—	—	2
11	Fuller, RA	2	—	—	2
11	Gaston, KJ	2	—	—	2
11	Hitchmough, J	2	—	—	2
11	Korpela, K	2	—	—	2
11	Stigsdotter, UK	2	—	—	2

introduced by Garfield and Sher (1963) and has been widely applied to evaluate and rank journals¹⁷. According to Table 4, the average impact factor is 1.46 which indicates the majority of these papers were published in the journals with high impact factors. Therefore, in order to attain a high number

of citations, it is essential to publish papers in the English language as it appears to be a unique literary language used in UGOS and also to choose a high impact factor journal, which is advanced in science and continued development²⁸.

Table 4: Journal source

Journal Source	Number of Papers	Rank	Total Citations	Impact Factor
Landscape and urban planning	62	1	6203	2.606
Urban geography	7	2	923	1.746
Journal of the American planning association	6	3	1725	1.489
URBAN studies	6	3	4896	1.33
URBAN FORESTRY & URBAN greening	5	5	821	2.133
Journal of real estate finance and economics	2	6	1103	0.697
REGIONAL SCIENCE AND URBAN economics	2	6	1579	0.971
Cities	2	6	1296	1.836
Journal of urban economics	1	9	3094	1.888
HOUSING studies	1	9	1038	0.895
URBAN AFFAIRS review	1	9	1019	1.293
Journal of urban technology	1	9	155	0.729
HABITAT international	1	9	1051	1.577
Journal of planning education and research	1	9	815	1.383
Journal of planning literature	1	9	408	1.522
Journal of urban affairs	1	9	673	1.298

Table 5: Publishers

Rank	Publisher	Number of Papers
1	Elsevier Science Bv	64
2	V H Winston & Son Inc	6
3	Elsevier GMBH, Urban & Fischer Verlag	5
4	Amer planning Assoc	4
4	Carfax Publ Co	4
6	Routledge Journals, Taylor & Francis LTD	2
6	Routledge Taylor & Francis LTD	2
6	Sage Publications Inc	2
6	Elsevier Sci Ltd	2
6	Kluwer Academic Publ	2
6	Amer Planning Assn	2
12	Assoc Collegiate Sch Planning	1
12	Pergamon-Elsevier Science Ltd	1
12	Carfax Publishing	1
12	Academic Press Inc Elsevier Science	1
12	Blackwell Publishers	1

Table 5 shows the publishers of 100 top articles. From all of the publishers, *Elsevier Science BV* individually published 64% of papers and the other 15 publishers only contributed to 36% of papers.

Countries and Institutes

The result shows that most of the papers originated from 22 countries, with the majority originating from the USA[37] followed by UK [19].

Table 6: Number of publication of countries which have two or more publications

Country	Number of publications	Rank
USA	37	1
UK	19	2
Sweden	7	3
China	7	3
Finland	4	5
Australia	3	6
Netherlands	3	6
Denmark	2	8
Canada	2	8
Spain	2	8
Germany	2	8
Japan	2	8

Table 7: Number of publication of institute which have two or more publications

Rank	University	Number of publications
1	Univ Sheffield	5
1	Univ Hong Kong	5
3	Us Forest Serv	3
3	Univ Massachusetts	3
5	Univ Manchester	2
5	Hiroshima Univ	2
5	Univ Salford	2
5	Univ Colorado	2
5	Arizona State Univ	2
5	Univ So Calif	2
5	Univ Joensuu	2
5	Univ Wageningen & Res Ctr	2

Table 6 shows the countries that have at least two papers. Previous authors have hypothesized that American authors are biased toward locally published papers when citing references²⁹ which may possibly explain our findings. If continents are analyzed, 40 papers come from Europe, 39 from North America and 21 from Asia Pacific (Table 6).

The result also shows that from 80 universities and institutions that published top papers, 68 have merely a single paper and the others contributed two papers or more as shown in Table 7. University of Sheffield and University of Hong Kong are the most fruitful with five papers followed by US Forest Serv. and University of Massachusetts with three papers.

Document Types and Categories

The distribution of document types identified by ISI was analyzed. These papers consist of four document types, and articles are dominant with 83 documents, followed by review articles (9); Proceedings Papers [7] and editorial materials [1]. The distribution related to the language of the articles also was analyzed and all these papers are published in English (Table 7).

Regarding Web of Science categories (Table 8) all papers are categorized under urban studies because of the refinement during data collection. Environmental studies [77] and geography [69] are in the second and third ranks. This result indicates most papers are considered under two or more categories.

Table 8: Web of science categories

Rank	Web of Science categories	Number of papers
1	Urban Studies	100
2	Environmental Studies	77
3	Geography	69
4	Ecology	62
4	Geography, Physical	62
6	Planning & Development	9
7	Forestry	5
7	Economics	5
7	Plant Sciences	5
10	Business, Finance	2

Author keyword

In recent years, bibliometric analysis of author keywords has been able to provide a reasonably sophisticated picture of the papers' subjects (17). In order to illuminate research trends, frequency of author keywords should be analyzed quantitatively (table 9). Keywords according to the authors' views were used not more than 19 times (green space*) which indicated that UGOS papers have involved a wide range of research focuses and diverse scientific literature. Except the author's keywords "green space", "open space" and "urban green space" related to the searching keywords, three most frequently applied author keywords are: "urban planning"[10], "urban park"[6] and "land use"[6]. On the other hand, all of these key words are collocations of two or three words, therefore they have been separated and analyzed for the second round and this time the frequency of the first key word was urban [71].

Study limitation

It should be noted that this study has some methodological limitations. Firstly, we applied online ISI web of knowledge, so the papers not indexed in

this database are ignored. Secondly, all journals have specific approaches to reject or accept submitted manuscripts; therefore the particular journals which have stricter selection criteria may affect the quality of their publications. That is why 62% of 100 top cited articles have been found in one article. Thirdly, citation count might encounter some problems such as authors' preference for self-citation, or cite free full access articles, review papers, well known authors, papers by colleagues as well as cite papers from the journal they are going to submit their work to. Finally, publication year influences citation index and the number of citations for each paper; therefore recent papers do not have sufficient time to reach a high citation rate in comparison with older ones.

CONCLUSION

This study can be considered the first report on the top cited papers in UGOS. The priority of the papers was arranged according to the citations they have received. Total citations were extracted from *Web of Science Core Collection Times Cited Count* but analyzing merely total citation is a potential flaw as it gives a bias to the older papers because during

Table 9: The most frequently used author keywords

No	Keywords	Number of repetitions	Rank	Separated Keywords	Number of repetitions	Rank
1	green space*	19	1	urban	71	1
2	urban planning	10	2	planning	32	2
3	open space*	7	3	green	31	3
4	urban park*	6	4	space*	30	4
5	urban green space*	6	4	landscape	20	5
6	land use	6	4	City*	20	5
7	urban forest	5	7	land	17	7
8	urban ecology	4	8	environment*	16	8
9	public health	4	8	ecology*	16	8
10	compact city	3	10	value*	15	10
11	environmental psychology	3	10	nature*	11	11
12	Green Infrastructure	3	10	ecosystem*	11	11
13	urban forestry	3	10	conservation	10	13
14	Urban biodiversity	3	10	open	9	14
15	ecosystem services	3	10	hedonic	9	14
16	landscape ecology	3	10	greenway*	9	14
17	landscape metrics	3	10	public	8	17
18	Contingent valuation	3	10	Design	8	17
19		park*	8	17		

Table 10: Comparison of average number of citations per year and total citation

Document Title	Year Published	Total citations	citation per year	Rank for total citations	Rank for citation per year
Promoting ecosystem and human health in urban areas using green infrastructure: a literature review.	2007	183	26.14	2	1
The role of urban parks for a sustainable city.	2004	212	21.20	1	2
Urban greening to cool town and cities: a systematic review of the empirical evidence.	2010	80	20.00	13	3
Urban form, biodiversity potential and ecosystem services	2007	98	14.00	8	4
Tools for mapping social values of urban woodlands and green areas	2007	85	12.14	11	5
People needs in the urban landscape: Analysis of Landscape and Urban Planning contributions	2008	68	11.33	27	6
Modeling the environmental impacts of urban land use and land cover change – a study in Merseyside, UK	2005	101	11.22	7	7
Toward an integrated understanding of green space in European built environment.	2009	55	11.00	42	8
A framework for developing urban forest ecosystem services and good indicators.	2011	31	10.33	86	9
Mapping private gardens in urban areas using object-oriented techniques and very high-resolution satellite imagery.	2007	72	10.29	24	10

a longer time they would have accumulated a high number of citations which may be of less significance and influence than a more recent paper. Therefore, the average number of citations per year is used as a yardstick against which to reflect the importance of articles.

A comparison was made between the total number of citations and the average number of citations per year, of the top 10 articles (Table 10) emerging 42 and 86 ranking of total citations,

between top 10 high ranks of average citation per year indicates how different these two criteria can be. From a total of 1,105 UGOS papers returned using our methods, the paper with the maximum number of average citations per year [26.14] was written by Tzoulas (23), which has the second highest number of total citations [183]. The second highest number of average citations per year is the paper written by Chiesura (22), which achieved first rank with a total citation of 212 .

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