International Journal of Innovative Studies in Sociology and Humanities
ISSN 2456-4931 | Open Access | Volume 7, Issue 6, 2022
DOI: https://doi.org/10.20431/2456-4931.0706020

GIS-Based Studies on Urban Sprawl, Some Literature Statistics

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Abstarct

The SCOPUS database was searched for papers published between 1997 and 2021. Using clustering techniques and log-likelihood ratios (LLR) algorithm in Cite space visualization tool, researchers were able to track the progress of urban sprawl GIS-based studies. In the period from 1997 to 2014, researchers were still investigating the subject. Throughout 2014 and the present, there has been an increase in research. Besides geographical related keywords, technical keywords have been the most frequently used in this field since 2000, according to a review of the literature. It was common to conduct research via some key words such as "Satellite"and "Spatiotemporal analysis" With a disparate fields when clustering documents.

INTRODUCTION

An enormous amount of space is needed to accommodate the increase of the urban population, as well as alterations and transitions in the citizenry's requirements, which constitute a danger to farmland and the ecosystem(Hasse & Lathrop 2003). As shown in a report published by the European Environment Agency in November 2006, this growth establishes a major expression of the city's enlargement, manifested by the formation of quasi neighborhoods with sparse population in the farmlands around the city. Urban sprawl as a research theme, became a major interest in several countries due to a lack of infrastructure and basic equipment such as water resources, energy, basic sanitation, inordinate road congestion, environmental damage, incoherence of accommodation, all of which cause social discrimination and ecological pollution. Many researchers focused on collecting and analyzing urban sprawl studies related studies (Kumar & Kaliyaperumal 2018).

The focus on evidence based achievements is generating vast, disparate, and debatable research themes, attempting to make bibliometric ideal for scientific research modeling. Bibliometrics are based on the idea that interpretation method enables the retrieval of helpful data and information and its representation and via instinctive charts and graphs or maps and timeline as network, which performs a statistical study over maps generated to demonstrate various metrics of the existing network or the connection or intersect of the different clusters identified.

In the literature few bibliometric analysis were performed on Urban Sprawl and none of them related the research focusing only on GIS based methods. This work starts by identifying major statistics and the discovering the focus of the studies on the Urban Sprawl topic in relation to GIS. The study was conducted with clustering techniques and log-likelihood ratios (LLR) algorithm to visualize and analyze studies from SCOPUS database

METHODOLOGY

Science and scientific research literature and bibliometric techniques are more acquainted to scholars and researchers than technology and patents are to bibliometricians. The base of the methodology used in this paper is the bibliometric analysis of extracted documents from SCOPUS platform (http://www.scopus.com). The analysis was conducted by a software called CITESPACE(Zhou et al. 2019), as a free software from (http://cluster.ischool.drexel.edu/~cchen/citespace/download/).

The major steps of the present study were as follows: First, the set of protocols; second, the information gathering; third, the data processing; and fourth, the data modeling and visualizations.

RESULTS AND DISCUSSIONS

Publications Statistics

Figure 1 clearly shows the number of publications that deals with Urban sprawl related to GIS that has been increasing in recent years since 1997. With 2021, as a top of 77 publications. The figure also shows that a period between 1997 and 2014 was characterized by ups and downs in the publication of papers on the subject. But after 2014 an unrelenting increase in the number of papers began to emerge until 2021, when the research is still in progress, and papers from 2022 are also included.

Chinese academy of sciences were the most related affiliation of these documents followed by the national authority of remote sensing, ministry of education of China and Universiti putra Malaysia (Figure 2). Most of articles provided in the extracted documents were published by Sustainaility Journal followed by the international archive of photogrammetry remote sensing and spatial information science ISRPS archives and then Landscape and urban planning and Egyptian journal of remote sensing and space science. Most of journals deals with Remote science and geographic information systems studies.

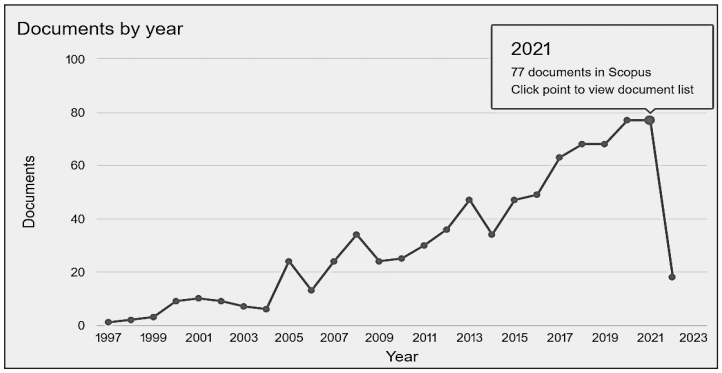

Figure 1. Number of documents published per year according to SCOPUS records in the topic

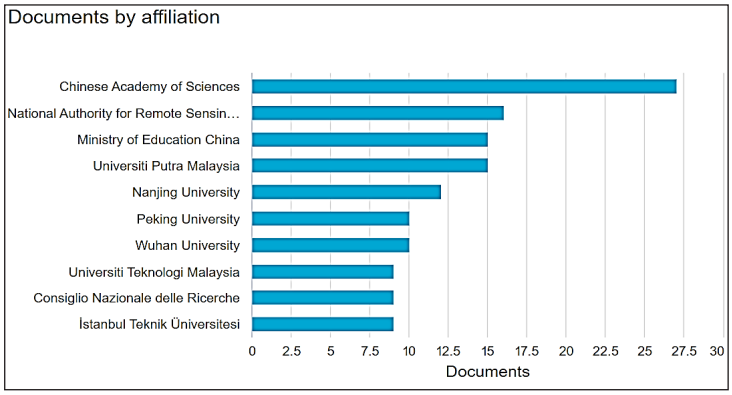

Figure 2. Affiliations of extracted documents

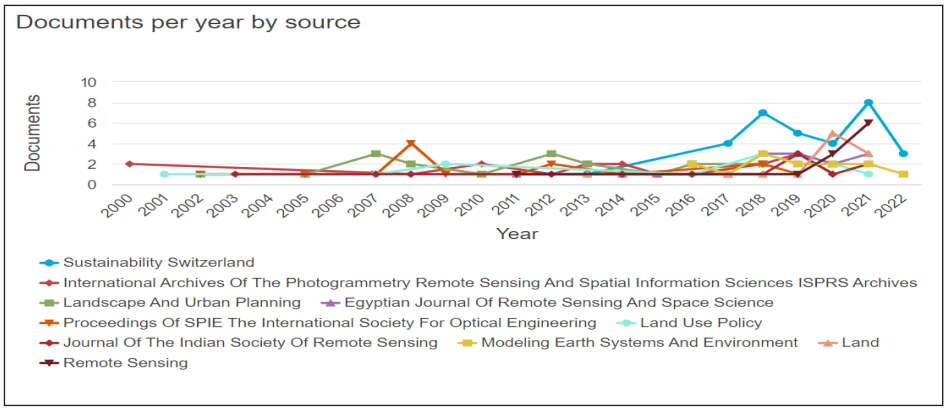

Figure 3. Sources of the extracted documents from SCOPUS

Focus of the Topic

The Figure 3 shows the diversity of clusters that have characterized the network of studies around urban sprawl and its study via GIS. The clusters are as follows: "land-cover change", "residential development", "sprawl management", "city jaipurindia", "geo-spatial indice", "markov-chain model", "assessment", "metropolitan city yemen", "land use", "modelling", "multi-criteria analysis", "Zanzibar Tanzania". And related terms are shown in the Table 1.

The Figure 3 also shows that despite this disparity in the ranking of the clusters according to LLR, the pattern remains compact which means the dependent relationship of the clusters; this is also proved by the repetition of some terms in the Table 2 under each cluster.

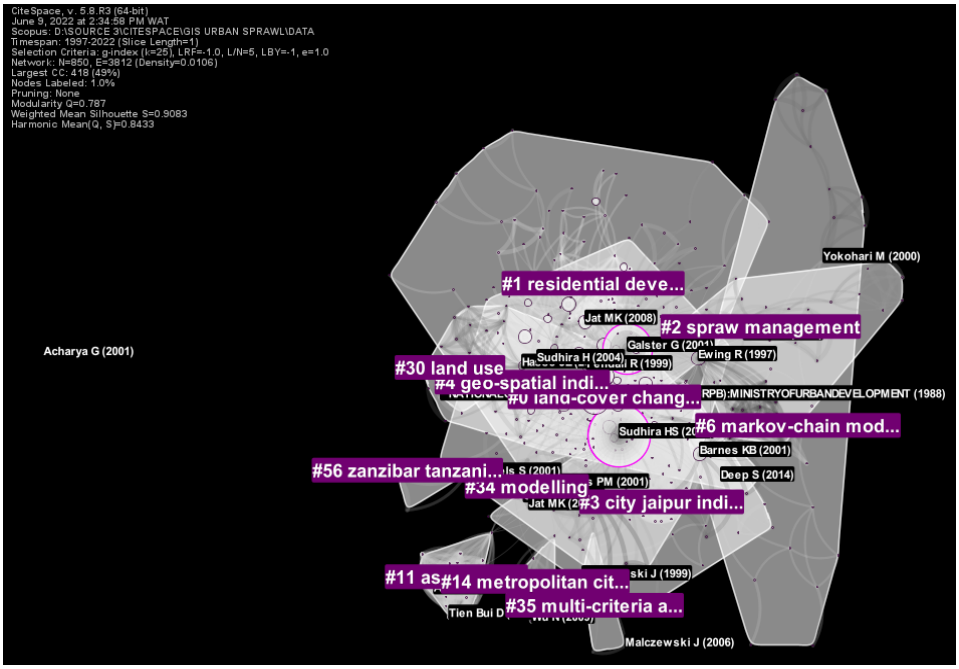

Figure 4. Clusters of the network

Table 1. Labels of clusters and their related terms according to LLR algorithm

Cluster ID	Size	Silhouette	mean(Year)	Label (LLR) and related thesmes
0	117	0.865	2006	land-cover change; built-up area; residential development; using r; mid-sized indian cities
1	107	0.849	2006	Residential development; using r; mid-sized indian cities; landscape protection planning; using remote sensing ann-mlp.
2	41	0.974	1999	spraw management; assessment approach; gis-based measurement; geographic information system; comprehensive brownfield database
3	40	0.945	1998	city jaipurindia; urban sprawl monitoring (130.87, 1.0E-4); fast growing urban centreindia; modelling using gis; metrics dynamics
4	40	0.936	2000	geo-spatial indice; measuring urban sprawl; regional plans-an effective growth management; spatial approach; spanish urban area
6	29	0.988	2000	markov-chain model; geospatial environmental modeling-; past agricultural landuse pattern; deltaic asian mega-city; urban fringe
11	19	0.998	2009	assessment; evidential belief function; using bivariate statistical model; frequency ratio model; spatio-temporal prediction
14	9	0.996	2004	metropolitan city yemen; sanaa; modelling urban growth evolution ; case ; sleuth model
30	5	0.989	2005	land use; delhi metropolitan area; fragmented governance; sprawl ; control
34	4	0.991	2003	modelling; ajmercit; using spatial analysis technique ; urban growth ; case study

35	4	0.992	2002	multi-criteria analysis; korea; sustainable land use management; assessment system ; land suitability assessment
56	3	0.998	2005	Zanzibar Tanzania; forest change; contrasting land use ; spatio-temporal analysis; case study

Documents with High Effect in the Research Progress of the Topic: GIS-BASED URBAN SPRAWL STUDIES

Most of documents in Table 2 are published in high ranked journals. The highest citation burst goes to (Mahesh Kumar Jat et al. 2008) with 4.24 as strength of citation burst, in which authors considered the urban sprawl of Ajmer, India from 1977 to 2002, to extract data about spatial and temporal changeability, and it was established that statistical classification approaches served for the classification of remotely sensed images. Another document with high citation burst is (Bhatta et al. 2010)with 3.72 as strength of citation burst, which was dedicated to study measurements techniques of urban sprawl phenomena. (Hasse & Lathrop 2003)Presented a set of five indicators to analyze the per total consumption of major expansion area in connection to numerous major land capacity problems linked with sprawl. Other documents related urban sprawl to land use (Mahesh Kumar Jat et al. 2008; Dewan & Yamaguchi 2009; Hegazy & Kaloop 2015).

Most recent documents with highest citation burst were (Punia & Singh 2012)(Zha et al. 2003)(Bhatta 2009)

Table 2. Top 20 References with the Strongest Citation Bursts

Ref	Published in	Year	Strength	Begin	End
(Mahesh Kumar Jat et al. 2008)	Int J Appl Earth ObsGeoinf,	2008	**4.24**	2019	2022
(Bhatta et al. 2010)	ApplGeogr,	2010	**3.72**	2019	2020
(Hasse & Lathrop 2003)	Applied Geography	2003	**3.41**	2007	2009
(Bhatta et al. 2010)	Applied Geography	2010	**3.38**	2019	2022
(Galster et al. 2006)	Housing policy debate	2001	**3.36**	2012	2016
(Barnes et al. 2015)	Towson University	2001	**3.26**	2014	2018
(Rawat & Kumar 2015)	The Egypt J of RemSensing and Space Science	2015	**3.21**	2018	2019
(Bhatta 2009)	I.J of Remote Sensing	2009	**3.18**	2018	2022
(M. K. Jat et al. 2008)	I.J of Remote Sensing	2008	**3.06**	2019	2020
(Hegazy & Kaloop 2015)	Int J Sustain Built Environ	2015	**3.06**	2019	2020
(Ewing 1997)	APA Journal	1997	**3.05**	2010	2012
(Herold et al. 2003)	Remote sensing of Environment	2003	**3.01**	2009	2016
(McGarigal et al. 2002)	University of Massachusetts, Amherst	1995	**2.97**	2013	2018
(Punia & Singh 2012)	Journal of the Indian Society of R.S	2012	**2.96**	2019	2022
(Zha et al. 2003)	International Journal of Remote Sensing	2003	**2.79**	2018	2022
(Dewan & Yamaguchi 2009)	Applied geography	2009	**2.72**	2015	2020
(Johnson 2001)	Environmental and planning A	2001	**2.72**	2007	2013
(Luck & Wu 2002)	Landscape Ecology	2002	**2.68**	2011	2019
(Schneider & Woodcock 2008)	Urban studies	2008	**2.62**	2018	2020
(Angel et al. 2011)	Progress in planning	2011	**2.62**	2018	2020

Keyword Analysis

According to Table 1 "Eurasia", "United states", "North America" and "Asia" were the top of citation bursts. Those words refers to geographic location that are the most debated in the studied topic. Followed by "Satellite", "spatiotemporal analysis" and "database system". Most of keywords are related to analytical and technical relations like data, sources of data and related techniques to study urban Sprawl.

"United States", "Urban population" and "India" had the longest time of bursts. And the most recent ones were Urban sprawl, India and agricultural robot. As we can see in the Table 1, disparate themes are detected when studying burst analysis of keywords.

Table 3. Top 25 Keywords with the Strongest Bursts according to Citespace analysis

Keywords	Year	Strength	Begin	End
eurasia	1997	**15.05**	2005	2009
united states	1997	**10.08**	2001	2010
north america	1997	**9.49**	2003	2009
asia	1997	**8.77**	2005	2008
satellite	1997	**6.2**	2002	2005
spatiotemporal analysis	1997	**6.07**	2018	2019
database system	1997	**5.99**	2000	2005
geophysics	1997	**5.2**	2005	2005
radar	1997	**5.2**	2005	2005
wavelet transform	1997	**5.2**	2005	2005
water wave	1997	**5.2**	2005	2005
sar image classification	1997	**5.2**	2005	2005
wave	1997	**5.2**	2005	2005
numerical model	1997	**5.18**	2013	2015
deforestation	1997	**5.12**	2005	2005
economics	1997	**4.99**	2008	2013
urban population	1997	**4.86**	2009	2016
study area	1997	**4.83**	2008	2012
urban sprawl	1997	**4.63**	2021	2022
satellite communication system	1997	**4.55**	2005	2005
image compression	1997	**4.55**	2005	2005
cryospheric monitoring	1997	**4.55**	2005	2005
radar system	1997	**4.55**	2005	2005
india	1997	**4.42**	2016	2022
agricultural robot	1997	**4.41**	2020	2022

CONCLUSION

Papers published between 1997 and 2021 were retrieved from the SCOPUS database. Researchers were able to monitor the development of GIS-based studies on urban sprawl. Between the years 1997 and 2014, academics continued their investigation on the topic. Researchers were able to monitor the development of urban sprawl GIS-based studies by utilizing different GIS based techniques. According to an examination of the relevant literature, the most common types of keywords utilized in this topic have been related to geographic locations,and technical keywords. The use of broad terms like “Satellite” and “Spatiotemporal analysis” database system, radar, were the major caracstic derived from a keyword mapping. Also it is important to mention that till present studies number is growing at an exponential rate.

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Citation: *Amina Merakchi, Djamel Alkama, et al. GIS-Based Studies on Urban Sprawl, Some Literature Statistics. Int J Innov Stud Sociol Humanities. 2022;7(6):216-221. DOI: https://doi.org/10.20431/2456-4931.0706020.*