Asian Journal of Information Science and Technology
ISSN: 2231-6108 (P) Vol.2 No.2, 2012, pp.16-21

DOI: https://doi.org/10.51983/ajist-2012.2.2.2584

Global Warming: A Bibliometric Study

Iyyakadan Manigandan[1] and S. Jayaraman[2]
[1]JSS College of Pharmacy, Udhagamandalam, The Nilgiris
Research Scholar, Karpagam University, Coimbatore - 641 021, Tamil Nadu, India
[2]Department of Library and Information Science, Karpagam University, Coimbatore - 641 021, Tamil Nadu, India
E-mail: mani_jsscp@rediffmail.com
(Received on 28 August 2012 and accepted on 25 October 2012)

Abstract – **The main object of this study is to investigate the research trend in global warming for the past 18 years. Data are based on an online database which offers journal articles and books. Articles referring to global warming were assessed by many aspects during the period 1992-2010. The analysis cover mainly the number, journal and subject-wise distribution, periodic growth of the literature, authorship pattern, length of the articles and year-wise distribution of journals etc. Journal form of documents is the main source of information with 44,795 articles referring to global warming was published up to the year 2010. The maximum number of articles (6206) appeared in the year 2010. Among the journal-wise publication "Energy policy" (impact factor 2.614) is in the top of the list with 1485 articles out of which 837 articles were selected and analysed. Majority of articles 285 (34.05%) have the length between 6 to 9 pages and maximum number of articles 277 (33.09%) were contributed by two authors.**

Keywords: **Bibliometrics, Energy Policy, Global Warming, Science Direct**

I. Introduction

The study of publication output in a field is a good indicator of status of research work in that field. Bibliographic databases are representative samples of publication activity in any field of knowledge. The analysis of the publication records gives some idea about the direction of research, pitfalls, and current trends in a micro field. The results are very much useful for academicians, young scientists, policy makers, professional bodies who confer awards and prizes etc. The handy outputs of such bibliometric and scientometric studies in a given field are very important information sources on some occasions. The present era has evolved with many scientometric techniques and studies not limited to traditional sources of information but digital and web resources.

Global warming is a topic on many people's minds right now. From elementary school students to advanced researchers, politicians to business leaders, questions abound regarding what global warming is (or is not), why it is happening (or is not), and what can and should be done about it. This study is designed to help librarians in public, school, and academic libraries help their patrons find basic information from respected sources. Since the industrial revolution, humans have been emitting greenhouse gases that the Intergovernmental Panel on Climate Change (IPCC) believes are responsible for global warming. While the majority of climatologists agree with the IPCC's conclusions, skeptics suggest that the IPCC's climate models are flawed and that recent climate changes should be attributed to natural causes. Many questions arises in the minds of the common man and the scientists, is global warming caused primarily by humans? are the causes of climate change well understood? does atmospheric CO_2 cause significant global warming? have solar cycles significantly affected earth's recent climate? etc. The scientific consensus is that global warming is occurring and is mostly the result of human activity than to natural causes. The Kyoto Protocol is aimed at stabilizing greenhouse gas concentration to prevent a "dangerous anthropogenic interference". Global temperatures are already higher than they have ever been scientists had the past millennium [1], and the increase in accelerating even faster than scientists had predicted [2]. The effects of global warming will substantially increase as the temperature of the planet rises [3 &4].

In the recent years, there has been an explosive growth in human knowledge about global warming. The number of scientists working on this issue increases. So obviously does the volume of literature generated by the scientific community. The periodicals are the indicators of literature growth in any filed of knowledge. They emerge as the main channel for transmitting knowledge. The main aim of this study is to find out the research trend in the global warming throughout the world. A search in the literature about the bibliometric study on global warming revealed that very few reports [5] were available.

According to Lancaster (1991) [6], Info metric research provides an opportunity for research diversification and for the support of global warming research because it presents

up-to-date research and publication indicators using multiple variables that include international, regional, national, disciplinary and individual issues, trends and challenges.

Info metric techniques were used by Dennis Ocholla and Lyudmila Ocholla (2009) [7] to analyze Global warming research using the published literature as indexed and reflected in three key bibliographic databases of Web of Science, namely Science Citation Index, Social Sciences Citation Index and Arts and Humanities Citation Index in addition to South African Bibliographical Network (SABINET) databases that represents local/national research productivity in South Africa between the period 1980 to 2007. The paper provided useful information for research policy and evaluation on global warming and comparative data between national/local and international databases. The study found that a total of 116 countries produced one or more publications on global warming, with the USA (2572; 35. 7%), England (834; 11. 6%) and Japan (546; 7. 6%) leading the pack with 3952 (54. 85%) publications. In contrast, the contribution of African countries is insignificant, as noted by the participation of 18 (of 53) countries, with South Africa (46), Kenya (14) and Egypt (7) being among the contributors. It is further noted that an overwhelming number of journals originate from English speaking countries such as the USA and the UK. The top five journals, out of a total 1558, were Nature (199; 2. 8%), that also accounts for the highest impact factor in the domain, Geophysical Research Letters (175; 2. 4%), Climatic Change (161; 2. 2%), Science (137; 1. 9%) and New Scientist (116; 1. 6%).

In the report by Beverly Campbell (2008) a bibliometric analysis of the papers was prepared by intramural and extramural researchers of the U.S. Environmental Protection Agency's (EPA) Global Change Research Program. For their analysis, 432 journal publications and 12 non-journal publications made during from 1998 to 2007 were reviewed. The journal publications were cited 5,925 times in the journals covered by Thomson Scientifics' Web of Science and Elsevier's Scopus. The non-journal publications were cited 720 times in journals and books. Of the 444 publications global change publications, 397 (89.4%) have been cited at least once in a journal or book. One-fourth of the global change publications are highly cited papers. One-fourth of the global change papers are published in high impact journals, eleven of the global change papers qualify as hot papers.

The film An Inconvenient Truth, directed by Davis Guggenheim, won the 2006 Academy Award for best documentary feature, it focused people's attention on the climate crisis [8]. How effective was An Inconvenient Truth in spreading the word about global warming? A look at newspaper coverage of the topics related to global warming and climate change, based on searches in InfoTrac Custom Newspapers, provided an answer.

In this present study, we attempted to do the bibliometric study based on the research articles referring to global warming published for the past eighteen years from 1992 to 2010 from a popular data base and from 2001 to 2010 in one of the leading journal with respect to energy policy which has published more number of articles in this aspect. Accordingly the objectives of the present study were: to analyse the total number, subject and journal wise distribution, periodic growth of the articles, authorship pattern, total number of pages, length of articles and to study the subject coverage of the articles.

II. Materials And Method

Documents used in this study were based on the online database the Science Direct. Science Direct is a leading full-text scientific database offering journal articles and book chapters from more than 2,500 peer-reviewed journals and more than 11,000 books. There are currently more than 9.5 million articles/chapters, a content base that is growing at a rate of almost 0.5 million additions per year. Science Direct is a part of Elsevier. Headquartered in Amsterdam, The Netherlands, the company is the world's largest scientific, technical and medical information provider and publishes over 2,000 journals as well as books and secondary databases.

The journal "Energy Policy" is established worldwide as the authoritative journal addressing those issues of energy supply, demand and utilization that confront decision makers, managers, consultants, politicians, planners and researchers. Major articles cover a comprehensive range of topics from national energy pricing to energy efficiency potential in the domestic sector; from the politics of US energy policy to the economic evaluation of nuclear power; from the environmental impacts of fossil fuel use to energy demand management in developing countries.

Types of contributions made by the journal "Energy policy" is Full Length Articles, short items (leaders (approximately 1000 to 2000 words), viewpoints (1000

to 3000 words), short communications(up to 3000 words), book reviews (800-1200 words), conference reports (1000-1500 words), calendar events and notification of recent publications and reports) and contributions to Forum section like rejoinders, comments and insights, relating to published papers, on-going differences of opinion, or letters to the Editor. The articles less than five pages may be mostly of short items.

The bibliometric study is based on the research articles referring global warming published up to 2010 in the Science Direct data base. Further selected articles referring to global warming from the journal "Energy Policy" was also analysed. Document information included names of authors, title, and year of publication, number of pages, subject categories and names of the journal publishing the articles. The records were downloaded and assessed by the following aspects characteristic of publication outputs during 2001-2010, distribution of articles, source title.

III. Discussion

Total number of articles published and distribution in the Science Direct data base with the key word "global warming" is presented in Table I. Distribution of various forms of cited documents were shown. They include journals, books, reference books. It showed that majority of the contributors preferred journals as the source of information which occupied the top position with the highest number of 44,795 articles. The literature on Global warming, due to its multi-disciplinary nature, is scattered in a variety of journals (Table II). Out of the 44,795 publications, nearly 11,864 articles that come from 16 journals originating from a variety of disciplines. The journals which has published more than 500 papers are presented. Among the published articles 1,485 articles appeared in the journal "Energy policy", leads the list with an impact factor of 2.614 followed by the journal "Palaeogeography" with an impact factor of 2.39 consists of 1421 articles. Even articles has been published in high impact factored journals like Quaternary Science Reviews (4.657), Earth and Planetary Science Letters (4.279), and International Journal of Hydrogen Energy (4.053).

Table I Forms of Documents Published

S.No.	Content type	Number of Publications
1	Journal	44,795
2	Book	5,502
3	Reference Work	1,213

Table II Journal-Wise Distribution of The Articles And Their Impact Factor

S.No.	Journal/Book title	Number of Publications	Impact Factor*
1	Energy Policy	1,485	2.614
2	Palaeogeography	1,421	2.390
3	Quaternary Science Reviews	1,033	4.657
4	Global and Planetary Change	840	3.351
5	Atmospheric Environment	679	3.226
6	Earth and Planetary Science Letters	675	4.279
7	New Scientist	662	
8	Fuel and Energy Abstracts	650	3.602
9	Ecological Economics	605	2.754
10	Forest Ecology and Management	599	1.992
11	Deep Sea Research Part II: Topical Studies	594	1.670
12	International Journal of Hydrogen Energy	567	4.053
13	Energy	531	3.565
14	Agricultural and Forest Meteorology	520	3.228
15	Soil Biology and Biochemistry	503	3.424
16	Quaternary International	500	1.768

* Based on the information from the journal websites during November 2011.

Table III Year-Wise Distribution of Articles

S.No.	Year	Number of Publications	%
1	2010	6,206	12.9
2	2009	5,458	11.4
3	2008	4,676	9.7
4	2007	4,205	8.7
5	2006	3,225	6.7
6	2005	2,769	5.7
7	2004	2,283	4.7
8	2003	2,302	4.8
9	2002	1,887	3.9
10	2001	1,702	3.5
11	2000	1,372	2.9
12	1999	1,044	2.1
13	1998	1,079	2.2
14	1997	1,132	2.3
15	1996	1,402	2.9
16	1995	1,103	2.3
17	1994	962	2.0
18	1993	975	2.0
20	1992 and earlier	4,241	8.8

The data on periodic growth of literature on Global warming are presented in Table III. The number and the percentage of the articles published year-wise from the year 1993 is presented. A very limited research interest has been shown in this area up to the year 2000. The volume of literature starts increasing from 2001 onwards, declined in between 2004 and 2005 and once again increased continueously growing on a steady rate up to 2010. The number of articles increased more than 6 times i.e. 975 in 1993 to 6206 in 2010. There is a phenomenal jump in the publication output in the last four years from 2007 onwards. This growth is partly due to the IPCC meeting followed by the Kyoto Protocol during 2007. Global warming is of interest to researchers from many disciplines including Energy, Enviornment, Agriculture, Fuel etc. Therefore, topical coverage of this body of literature is so diverse and sometimes so specific in nature that makes it very hard to organize it under subjects of equivalent status. The different topic under which "Global Warming" was distributed and discussed was given in the Table IV.

Table IV Different Subject Under Which Global Warming was Discussed

S.No.	Subject	Number of Publications
1	Climate change	1,794
2	CO_2 emission	814
3	North atlantic	672
4	Global warming	516
5	Ghg emission	475
6	Earth	388
7	Renewable energy	385
8	Life cycle	370
9	China	356
10	Carbon dioxide	344
11	Greenhouse gas	316
12	Southern ocean	274
13	N_2O emission	270
14	Fuel cell	246
15	Ice sheet	241
16	CO_2 concentration	230
17	Sustainable Development	230
18	Energy policy	223
19	Environmental impact	219
20	North pacific	218

The distribution of publications presented in Table IV reveals the top twenty topics under which the "global warming" was discussed. The topic with Climate change leads the list with 1794 publications followed by CO_2 emission and North Atlantic with 814 and 672 articles respectively.

It reveals that the global warming may be one of the causes which lead to the climate change in the earth. Like wise it indicates that the CO_2 emission may lead to the global warming. Analysis of the entire topic indicates that there is a significant overlap between the topics like climate, energy, fuels, power and agriculture. The global warming are often discussed in terms of improvement of energy efficiency. It indicates pollution and low levels of energy efficiency and productivity are more widely perceived as real problems for global warming. This overlap bears out the inter-disciplinary nature of the literature of global warming.

For a complete bibliometric analysis the articles published in the journals indicated in Table II are to be considered. To start with as a representative journal, "Energy policy" being top in the list with respect to the number of the articles published (1485) was analysed. The year-wise publications are presented in the Table V. Similar to the observation made from the Table II, there is more number of publications in the last four years. On an average the number of articles increased more than six times i.e. on an average 40 between 1992 to 2000 to 238 in 2010. The Table VI indicates the distribution of the top ten topics under which the global warming was discussed and it accounts to nearly 60% of the total number of articles (883). The topic with CO_2 emission is in the top of the list with 206 articles followed by the topics energy policy and climate change with 151 and 91 articles. It indicates that mostly the global warming is attributed to the carbon-di-oxide present in the atmosphere. The carbon-

Table V Year-Wise Publications in The Journal Energy Policy

S.No.	Year	Number of Publications
1	2010	238
2	2009	162
3	2008	130
4	2007	137
5	2006	85
6	2005	38
7	2004	40
8	2003	30
9	2002	29
10	2001	25
11	2000	24
12	1999	18
13	1998	33
14	1997	38
15	1996	40
16	1995	43
17	1994	29
18	1993	39
19	1992	62
20	1991 & earlier	157

Table VI Subject-Wise Distribution of Articles in The Journal Energy Policy

S.No.	Topics	No. of Articles
1	CO_2 Eission	206
2	Energy Policy	151
3	Climate Change	91
4	GHG Emission	86
5	Renewable Energy	69
6	Energy Efficiency	66
7	China	60
8	Global Warming	41
9	Kyoto Protocol	37
10	Greenhouse Gas	36

Table VII Authorship Pattern, Pages and The Average Length of The Articles

S.No.	year	1	2	3	4	5	a	b	c	d	e	f	g	P/A	h
1	2010	45	73	63	23	7	19	99	72	19	3	1939	530	3.68	9.18
2	2009	37	55	30	16	16	20	57	54	19	1	1395	304	4.58	9.05
3	2008	34	37	27	10	9	20	35	36	24	3	1124	275	4.08	9.60
4	2007	29	31	25	18	6	10	41	28	30	2	1130	268	4.21	10.3
5	2006	28	28	21	4	3	9	16	36	23	3	903	178	5.07	10.7
6	2005	15	12	5	6	2	7	8	9	16	1	452	88	5.13	11.8
7	2004	8	16	4	3	1	5	6	11	8	1	330	64	5.15	10.6
8	2003	18	8	6	2	2	4	6	12	17	2	419	71	5.90	11.6
9	2002	17	10	-	1	1	2	11	10	7	1	303	55	5.50	10.4
10	2001	8	7	5	4	1	3	6	7	7	2	285	58	4.91	11.4
Total		239	277	186	87	48	101	285	262	170	19				

Note: 1-single author; 2- two authors, 3- three authors; 4- four authors; 5- more than four authors; a- 1 to 5 pages; b- 6-9 pages; c- 10-12 pages; d- 13-20 pages; e- more than twenty pages. f – total number of pages, g-total number of authors, P/A average number of pages per author. h- average length of the article.

di-oxide may come from the inefficient burning of fuels. The effect of global warming may be the climate change.

The top ten area under which the global warming was discussed was presented in Table VI. It shows that measures to mitigate the problem of global warming are being studied. Nevertheless, emissions of greenhouse gases (GHG's) are expected to increase owing to the influence of developing countries which have huge populations and are projected to achieve considerable economic growth.

After going through the 1485 titles about 837 (56.35%) more relevant titles has been selected (based on the appearance of the words like global warming, climate change, energy, carbon-di-oxide and green house gases) for further study. The number of authors involved in each and every article, the total number of authors in an year, number of pages of each and every article article, the total number of pages, average number of pages per author and the average length of the article has been analysed and presented in Table VII. It indicates about of the 9% (97) of the articles are of

short article type and the remaining 91% (754) are of full length articles. The average length of an article oscillates between 9.05 to 11.8 pages. Further the number of pages has increased by seven fold from 285 pages in 2001 to 1939 in 2010. Further Table VII reveals that the majority of articles 285 (34.05%) have the length between 6 to 9 pages, followed by 264 (31.54%) articles with 10-12 pages, 170 (20.32%) articles with 13-20 pages, 19 (2.27%) articles with more than 20 pages and the remaining , 99 (11.82%) articles have the length of 1-5 pages. Likewise the number of authors publishing the articles has increased by 10 fold from 58 in 2001 to 530 in 2010. Table VII reveals the authorship pattern of the articles published during the period of study. Maximum number of articles was contributed by two authors with 277 articles (33.09%). This is followed by single author were contributed 239 articles (28.67%), 186 (22.22%) articles have been contributed by three authors, 87 (10.37), articles have been contributed by four authors and more than four authors with 48 articles (5.65 %) of the total articles. It also showed that out of 837 articles single authors contributed 239 (28.67%) while the rest 598 (71.33%) articles were contributed by joint authors. In spite of increase in number of authors and number of pages of the articles, the P/A the number of pages per author has marginally decreased from an average of 5.0 to 3.68 indicating the interdisciplinary nature of the research work carried out.

Measures to prevent global warming could presumably make steady progress in the future along with a further rise in public awareness and skillful use of foreign energies. Pollution and low levels of energy efficiency and productivity are more widely perceived as real problems which lead to global warming.

IV. Conclusion

In the study period journals are the source of information with the highest number of 44,795 articles. The maximum number of articles (6206) is in the year 2010. The subject under which global warming was discussed is Climate change leads with 1794 publications. With respect to journal wise publication “Energy policy” (impact factor 2.614) is top in the list with 1485 articles. In the selected 837 articles from the journal “Energy policy” single authors contributed 239 (28.67%) while the rest 598 (71.33%) articles were contributed by joint authors. Majority of articles 285 (34.05%) have the length between 6 to 9 pages and maximum number of articles were contributed by two authors with 277 articles (33.09%). The average length of an article oscillates between 9.05 to 11.8 pages.

References

[1] E. Mann, Michael, et al., “Northern Hemisphere Temperatures During the past Millennium: Inferences, Uncertainties, and Limitations”, *Geophysical Research Letters,* Vol. 26, No.6, pp.759-762, 1999. http://www.ngdc.noaa.gov/paleo/pubs/ mann_99.html.

[2] “Global warming may be accelerating”, USA Today, 17 Mar. 2000, http://www.usatoday.com/weather/ news/2000/wgblwrm.htm.

[3] Intergovernmental Panel on Climate Change. Climate change 2007. Impacts, adaptation, and vulnerability, Contribution of working group II to the fourth assessment report of the Intergovernmental Panel on Climate Change. Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, eds. Cambridge University Press, 2007.

[4] M. Parry, J. Paluyokof, C. Hanson, and J. Lowe, “Squaring up to Reality”, *Nature Reports Climate Change,* Vol. 2, No. 68-70, 2008.

[5] Beverly Campbell, Bibliometric Analysis for the U.S. Environmental Protection Agency/Office of Research and Development’s Global Change Research Program, EPA Contract No. EP-C-05-015, 2008.

[6] F.W. Lancaster, “Bibliometric Methods in Assessing Productivity and Impact of Research”, *Sarada Ranganathan Endowment for Library Science,* Bangalore, 1999.

[7] Dennis Ocholla, Lyudmila Ocholla, “Research Output and Scientific Impact of Global Warming Research Productivity and Literature from 1980–2007”, An Informetrics Analysis, 2009. http://www. lis. uzulu. ac. Za.

[8] Kaeti Stoss and Frederick W. Stoss, “ Heating Up for Global Warming”, *Research and Policy,* Vol.32, No.1, 2008.

[9] M. Amudha and C. Muthusamy, “Mapping of Computer Communication Research Output among Indian Scientists (1976-2009): A Scientometric Study”, *Asian Journal of Information Science and Technology,* Vol.1 No.1, pp. 13-18,2011.