

Research Article

RESEARCH PUBLICATIONS ON ENVIRONMENTAL POLLUTION: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

This paper examines research publications on environmental pollution, the data have been accessed from the Scopus database; during the study period 2006-2020, totally of 3895 records were retrieved for the study. Objectives of the study, to find out year wise publications on environmental research, to examine authorship pattern, to find out top twenty authors contributions, to find out top twenty institutions contributed on environmental research, to find top twenty sources contributions, to identify top twenty countries on environmental research. The study reveals that, the year-wise publications on environmental pollution research in the last five years shows on an increasing trend, overall shows that the year wise increased and decreased trend. Majority of the records were published in the form of articles, the sources type wise research publications on environmental pollution, 78.2 per cent papers were published in journal. The top twenty authors contributed to environmental pollution research. Among the 20 authors MÃ¼nzler, T. has occupies first place, followed by Daiber, A. has second place, in the authorship pattern multi authors' contributions are more high compare with single author contributions. The language wise research publications on environmental pollution, out of 3895 papers, 90.91 percent of papers have been published in English, the top twenty countries contributed on environmental pollution research, out of 3895 environmental pollution research publications, China has occupied first place with 27.06 per cent contributions, followed by United States of America has second place with 12.55 per cent contributions, India has third place with 5.96 per cent.

Keywords: Environmental pollution, Air pollution, Biodiversity, Ecosystems, Earth's surface.

INTRODUCTION

Environmental pollution is a global problem and is common to both developed as well as developing countries. Holdgate, M.W, (1979). Define Environmental pollution as the introduction by man, into the environment, of substances or energy liable to cause interference with legitimate uses of environment. Environmental pollution is the unfavorable alteration of our surroundings, wholly or largely as a byproduct of man's actions, through direct or indirect effects of the changes in the energy pattern, radiation levels, and chemical and physical constitution and abundance of organisms (Rai. P K, 2016). Environmental pollution is the buildup and accumulation of toxic heavy metals in the air, water, and land that reduce the ability of the contaminated sites to support life. The rise in human population density and anthropogenic activity has led to degradation of the Earth's surface through misuse of environmental resources and improper disposal of wastes (Pushpanathan. M, *et al.*, 2014). Environmental pollution is one the major problems that affects biodiversity, ecosystems, and human health worldwide by contaminating soil and water (Jan. S, *et al.*, 2016). Environmental pollutants have various adverse health effects from early life some of the most important harmful effects are perinatal disorders, infant mortality, respiratory disorders, allergy, malignancies, cardiovascular disorders, increase in stress oxidative, endothelial dysfunction, mental disorders, and various other harmful effects (Kelishadi, R *et al.*, 2009, Kelishadi, R and Poursafa, P. 2010). Climate change-related health impacts, which currently are responsible for an estimated 150,000 deaths annually, can be expected to increase in the future. Other global environmental changes, such as loss of biodiversity, can have health consequences by increasing instability in disease transmission in animal populations, which are the source

of most of the pathogens affecting humans (Taylor, L H, Latham, S M & Woolhouse, M E., 2001).

METHODOLOGY

In the present study, the data have accessed from the Scopus database; the keyword was used in search documents 'Environmental pollution' selected the search within field 'article title', and the time span field has been selected published from 2006 to 2020. A total of 3895 records were retrieved, the data downloaded and analyzed using MS office-Excel as per objectives of the present study.

Relative Growth Rate (RGT) and Doubling Time (DT)

The relative growth rate is the increase in the number of publications/pages per unit of time. Here, one year is taken as the unit of time. The mean relative growth rate R (1-2) over a specified period of interval can be calculated from the following equation suggested by Mahapatra (1985).

$$R(1-2) = \frac{W2 - W1}{T2 - T1}$$

Where,

R = Mean relative growth rate over the specific period of interval;
W1 = log w1 (Natural log of initial number of publications/ pages);
W2 = log w2 (Natural log of initial number of publications/pages);
T2-T1 = Unit difference between the initial time and final time.

Therefore,

R (a) = Relative growth rate per unit of publications per unit of time (year)

R (p) = Relative growth rate per unit of pages per unit of time (year)

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Doubling Time (DT)

A direct equivalence exists between the relative growth rate and doubling time. If the number of publications/pages of a subject doubles during a given period, then the difference between the logarithms of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. This difference has a value of 0.693. Thus, the corresponding doubling time for publication and pages can be calculated by the following formula:

$$\text{Doubling time (Dt)} = \frac{0.693}{R}$$

Therefore,

$$\text{Doubling time for publications Dt (a)} = \frac{0.693}{R(a)}$$

Objectives

The following objectives are framed for the present study;

- To find out year wise publications on environmental pollution research
- To identify document types wise research on environmental pollution
- To find out top twenty authors contributed on environmental pollution research
- To examine authorship pattern
- To find out top twenty institutions contributed on environmental pollution
- To find top twenty sources contributions on environmental pollution research
- To identify top twenty countries contributed on environmental pollution research

ANALYSIS AND INTERPRETATION

Table 1 year wise publications on environmental pollution research

Sl. No.	Publication Years	No. of Records	Percentages
1	2006	109	2.80
2	2007	126	3.23
3	2008	134	3.44
4	2009	163	4.18
5	2010	175	4.49
6	2011	260	6.68
7	2012	212	5.44
8	2013	220	5.65
9	2014	224	5.75
10	2015	215	5.52
11	2016	241	6.19
12	2017	306	7.86
13	2018	385	9.88
14	2019	513	13.17
15	2020	612	15.71
Total		3895	100.00

Table 1 show that year wise publications on environmental pollution research, totally 3895 publications on environmental pollution research, out of 3895 records in the year 2020 has occupied first place with 11.75 percent, followed by in the year 2019 have 13.17 per cent publications, in the year 2018 have published 9.88 per cent, in 2017 have 7.86 per cent, in the year 2011 has 6.68 per cent, in the year 2016 has 6.19 per cent, in the year 2014 has 5.75 per cent, 2013 has 5.65 per cent, in the year 2015 has 5.52 per cent, in the year 2012 5.44 per cent, in the year 2010 has 4.49 per cent, in the year 2009 has 4.18 per cent, in the year 2008 has 3.44 per cent, in the year 2007 has 3.23 per cent, and the starting year of the study period 2006 has started with least number. It found year-wise publications on environmental pollution research in the last five years shows on an increasing trend, overall shows that the year wise increased and decreased trend.

Table 2 Relative Growth Rate and Doubling Time of environmental pollution research

Sl. No.	Years	No. of Records	Cumulative	W1	W2	W2 - W1(Ra)	Mean (Ra)	W2-W1	Doubling Time	Mean Dt (a)
1	2006	109	109		4.69		0.11			7.47
2	2007	126	235	4.69	4.83	0.14			4.95	
3	2008	134	369	4.83	4.89	0.06			11.55	
4	2009	163	532	4.89	5.09	0.2			3.47	
5	2010	175	707	5.09	5.16	0.07			9.90	
6	2011	260	967	5.16	5.56	0.4	0.04		1.73	6.62
7	2012	212	1179	5.56	5.35	-0.21			-3.30	
8	2013	220	1399	5.35	5.39	0.04			17.33	
9	2014	224	1623	5.39	5.41	0.02			34.65	
10	2015	215	1838	5.41	5.37	-0.04			-17.33	
11	2016	241	2079	5.37	5.48	0.11	0.2		6.30	3.73
12	2017	306	2385	5.48	5.72	0.24			2.89	
13	2018	385	2770	5.72	5.95	0.23			3.01	
14	2019	513	3283	5.95	6.24	0.29			2.39	
15	2020	612	3895	6.24	6.41	0.17			4.08	
Total		3895					0.11			5.94

Table 2 shows that Relative Growth Rate and Doubling Time of environmental pollution research, the publications Doubling Time mean value is 5.94. In 2006, the environmental pollution research publications were 109; the research publications were raised to 612 in the year 2020, the relative growth rate mean value is 0.11. The environmental pollution research publications are increasing more than five times from starting year to end of the study period year.

Table 3 Document type wise research publications on environmental pollution

Sl. No.	Document types	No. of Records	Percentages
1	Article	2417	62.05
2	Conference Paper	516	13.25
3	Book Chapter	256	6.57
4	Review	253	6.50
5	Erratum	250	6.42
6	Editorial	61	1.57
7	Note	38	0.98
8	Book	36	0.92
9	Letter	28	0.72
10	Conference Review	23	0.59
11	Short Survey	7	0.18
12	Retracted	7	0.18
13	Abstract Report	2	0.05
14	Data Paper	1	0.03
Total		3895	100.00

Table 3 shows that document type wise research publications on environmental pollution, fourteen document types were contributed 3895 research papers. Among the fourteen document types, 62.05 percent records were published in the form of articles, followed by in Conference Paper 13.25 percent, 6.57 per cent published in Book Chapter, in Review 6.50 per cent, in Erratum 6.42 per cent, in Editorial 1.57 per cent, in Note 1.57 per cent, Book 0.92 per cent, Letter 0.72 per cent, Conference Review 0.59 per cent, Short Survey, Retracted 0.18 per cent respectively, Abstract Report 0.05 per cent, in the Data Paper 0.03 per cent means only one papers have published.

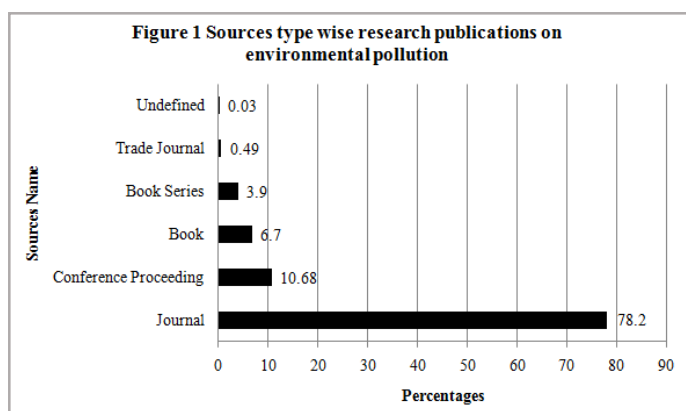


Figure 1 shows that the sources type wise research publications on environmental pollution, among the six sources, 78.2 per cent papers were published in journal, followed by conference proceeding have published 10.68 per cent, book has 6.7 per cent contributions, book series has 3.9 per cent contributions, trade journal has published 0.49 per cent publications, and undefined sources were contributed 0.03 per cent papers published on environmental pollution.

Table 4 top twenty authors contributed on environmental pollution research

Sl. No.	Authors	No. of Records	% of 3895
1	MÄ¼nzel, T.	10	0.26
2	Daiber, A.	8	0.21
3	GarcÄa-Barrera, T.	7	0.18
4	Hao, Y.	7	0.18
5	GÄmez-Ariza, J.L.	6	0.15
6	Liu, R.	6	0.15
7	Managi, S.	6	0.15
8	Tokmechi, Z.	6	0.15
9	Zhang, M.	6	0.15
10	Zhang, Y.	6	0.15
11	Chakraborty, J.	5	0.13
12	Landrigan, P.J.	5	0.13
13	Mukhacheva, S.V.	5	0.13
14	Oke, I.A.	5	0.13
15	Ozturk, I.	5	0.13
16	Samecka-Cymerman, A.	5	0.13
17	Vaseashta, A.	5	0.13
18	Yang, Y.	5	0.13
19	Zhou, D.	5	0.13
20	Amza, G.	4	0.10

Table 4 shows that the top twenty authors contributed to environmental pollution research. Among the 20 authors MÄ¼nzel, T. has occupies first place with 0.26 percent, followed by Daiber, A. has second place with 0.21 per cent, GarcÄa-Barrera T., Hao, Y. has third and fourth place with 0.18 percent respectively, GÄmez-Ariza, J.L., Liu, R., Managi, S., Tokmechi, Z., Zhang, M. Zhang, Y. have occupied fifth, sixth, seventh, eighth, ninth and tenth place respectively, Chakraborty, J. Landrigan, P.J. Mukhacheva, S.V. Oke, I.A. Samecka-Cymerman, A. Vaseashta, A. Yang, Y., Zhou, D. have occupies eleventh, twelfth, thirteenth, fourteenth, fifteenth, sixteenth, seventeenth, and nineteenth place with 0.13 per cent respectively, Amza, G. has a twentieth place with 0.10 per cent contributions on environmental pollution research.

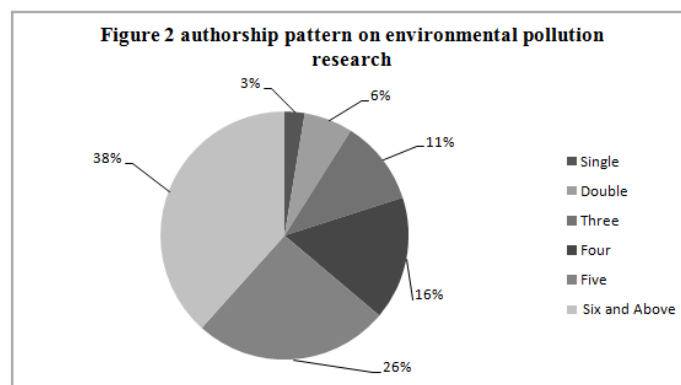


Figure 2 shows that the authorship pattern on environmental pollution research publications, out of 3895 publications on environmental pollution research, Six and above authors' contributions are 38 per cent, followed by five authors contributions are 26 per cent, four authors contributions are 16 per cent, three authors are 11 per cent contributions, double authors' contributions are 6 per cent, single authors' contributions are very least at 3 per cent. It is shown that the

multi authors' contributions are more high compare with single author contributions.

Table 5 language wise research performance on environmental pollution

Sl. No.	Languages	No. of papers	Percentages
1	English	3541	90.91
2	Chinese	132	3.39
3	Russian	50	1.28
4	German	42	1.08
5	Spanish	35	0.90
6	French	23	0.59
7	Italian	18	0.46
8	Portuguese	9	0.23
9	Persian	8	0.21
10	Polish	7	0.18
11	Japanese	5	0.13
12	Turkish	5	0.13
13	Ukrainian	4	0.10
14	Croatian	3	0.08
15	Bosnian	2	0.05
16	Hungarian	2	0.05
17	Korean	2	0.05
18	Slovak	2	0.05
19	Bulgarian	1	0.03
20	Czech	1	0.03
21	Malay	1	0.03
22	Romanian	1	0.03
23	Serbian	1	0.03
Total		3895	100.00

Table 5 shows that the language wise research publications on environmental pollution, out of 3895 papers, 90.91 percent of papers have been published in English, in Chinese 3.39 per cent, in Russian 1.28 per cent, in German 1.08 per cent, in Spanish 0.90 per cent, in French 0.59 per cent, in Italian 0.46 per cent, in Portuguese 0.23 per cent, in Persian 0.21 per cent, in Polish 0.18 per cent, in Japanese, and in Turkish 0.13 per cent respectively, in Ukrainian 0.10 per cent, in Croatian 0.08 per cent, in Bosnian, Hungarian, Korean, Slovak, 0.05 per cent respectively, in Bulgarian, in Czech, in Malay, in Romanian, in Serbian 0.03 per cent respectively.

Table 6 top twenty sources contributed on environmental pollution research

Sl. No.	Sources	No. of papers	% of 3895
1	Environmental Science and Pollution Research	253	6.50
2	Environmental Pollution	86	2.21
3	Science of the Total Environment	68	1.75
4	IOP Conference Series Earth and Environmental Science	65	1.67
5	International Journal of Environmental Research and Public Health	63	1.62
6	Advanced Materials Research	57	1.46

7	Journal of Cleaner Production	52	1.34
8	Nature Environment and Pollution Technology	49	1.26
9	Encyclopedia of Environmental Health	34	0.87
10	Sustainability Switzerland	31	0.80
11	Marine Pollution Bulletin	28	0.72
12	Journal of Environmental Management	27	0.69
13	Environmental Monitoring And Assessment	26	0.67
14	E3s Web of Conferences	24	0.62
15	Journal of Physics Conference Series	24	0.62
16	Environmental Research	23	0.59
17	Journal of Environmental Protection And Ecology	23	0.59
18	Applied Mechanics and Materials	20	0.51
19	Fresenius Environmental Bulletin	20	0.51
20	Chemosphere	19	0.49

Table 6 shows that the top twenty sources contributed to environmental pollution research, out of 3895 publications, Environmental Science and Pollution Research occupies the first position with 6.50 per cent of papers published, followed by Environmental Pollution has second place with 2.21 per cent, Science of the Total Environment has third position with 1.75 per cent, IOP Conference Series Earth and Environmental Science has fourth place with 1.67 per cent, International Journal of Environmental Research and Public Health has sixth place with 1.62 per cent, Advanced Materials Research has sixth place with 1.46 per cent, Journal of Cleaner Production has seventh place with 1.34 per cent, Nature Environment and Pollution Technology has eighth place with 1.26 per cent, Encyclopedia of Environmental Health has ninth place with 0.87 per cent, Sustainability Switzerland has ninth place with 0.80 per cent, Marine Pollution Bulletin has eleventh place with 0.72 per cent, Journal of Environmental Management has twelfth place with 0.69 per cent, Environmental Monitoring and Assessment has thirteenth place with 0.67 per cent, E3s Web of Conferences has fourteenth place with 0.2 per cent, Journal of Physics Conference Series, Journal of Environmental Protection and Ecology has fifteenth place with 0.62 per cent, Environmental Research, Journal of Environmental Protection and Ecology has sixteenth and seventeenth place with 0.59 per cent respectively, Applied Mechanics and Materials, Fresenius Environmental Bulletin has eighteenth and nineteenth place with .051 per cent respectively, Chemosphere has twentieth place with 0.49 per cent.

Table 7 top twenty countries contributed on environmental pollution research

Sl. No.	Countries/Regions	No. of papers	% of 3895
1	China	1054	27.06
2	United States of America	489	12.55
3	India	232	5.96
4	United Kingdom	203	5.21
5	Italy	196	5.03
6	Germany	147	3.77
7	Russian Federation	121	3.11
8	Spain	119	3.06
9	Iran	109	2.80
10	Poland	105	2.70

11	France	103	2.64
12	Canada	93	2.39
13	Australia	92	2.36
14	Turkey	91	2.34
15	Japan	88	2.26
16	Romania	76	1.95
17	Brazil	66	1.69
18	Nigeria	61	1.57
19	Egypt	59	1.51
20	Indonesia	55	1.41

Table 7 shows that the top twenty countries contributed on environmental pollution research, out of 3895 environmental pollution research publications, China has occupied first place with 27.06 per cent contributions, followed by United States of America has second place with 12.55 per cent contributions, India has third place with 5.96 per cent, United Kingdom has fourth place with 5.21 per cent, Italy has fifth place with 5.03 per cent, Germany has sixth place with 3.77 per cent, Russian Federation has seventh place with 3.11, Spain has eighth place 3.06 per cent, Iran has ninth place with 2.80 per cent, Poland has tenth place with 2.70 per cent, France has eleventh place with 2.64 per cent, Canada has twelfth place with 2.39 per cent, Australia has thirteenth place with 2.36 per cent, Japan has fifteenth place with 2.26 per cent, Romania has sixteenth place with 1.95 per cent, Brazil has seventeenth place with 1.69 per cent, Nigeria has eighteenth place with 1.57 per cent, Egypt has nineteenth place with 1.51 per cent, Indonesia has twentieth place with 1.41 per cent. It found that the country wise contributed on environmental pollution research, China has occupied first place, United States of America has second place, India has third place.

CONCLUSION

Conclude from the study, the year-wise publications on environmental pollution research in the last five years shows on an increasing trend, overall shows that the year wise increased and decreased trend. Fourteen document types were contributed on environmental pollution. Among the fourteen document types, 62.05 percent records were published in the form of articles, 78.2 per cent papers were published in journal, MÄ¼nzler, T. has occupies first place, followed by Daiber, A. has second place, GarcÄ±a-Barrera T., Hao, Y. has third and fourth place respectively. The authorship pattern on environmental pollution research, multi authors' contributions are more high compare with single author contributions. Out of 3895 papers, 90.91 percent of papers have been published in English, in Chinese 3.39 per cent, in Russian 1.28 per cent. The country wise contributed on environmental pollution research, China has occupied first place, United States of America has second place, India has third place.

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