



GROWTH OF POLLUTION CONTROL RESEARCH PUBLICATIONS IN INDIA FROM SCOPUS DATABASE (1991-2015): A SCIENTOMETRIC STUDY

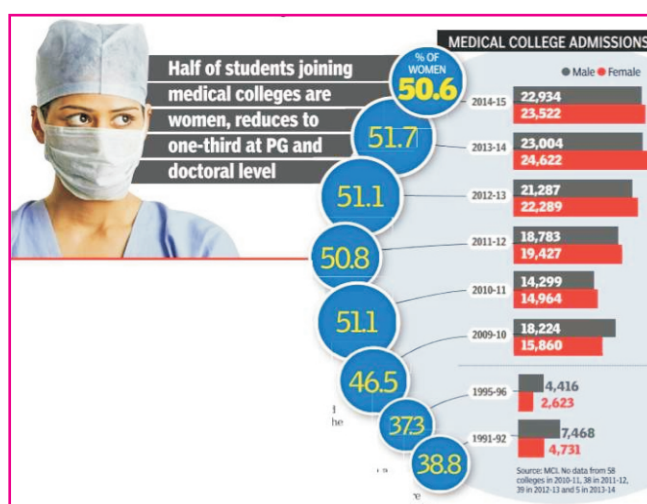
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ABSTRACT

This study evaluates the Indian Pollution Control research publications output during 1991–2015 are using for different scientometric indicators. Data have been downloaded from SCOPUS international multidisciplinary online database using the search keywords Indian and Pollution Control. During the study period, a total number of 52575 publications have been identified. Out of which, 2210 publications are contributed in India and the research output was increasing gradually. From the study, analysis the statistical tools such as growth of publications in Globe and India, percentage of sharing in Indian authors publications, ranking of top 20 authors, institutions, journals contribution and scientometric techniques such as Relative Growth Rate, Doubling Time, Authorship patterns are analyzed for the study.



KEYWORDS- Scientometrics analysis, relative growth rate and doubling time, activity index, pollution control, India.

SCIENTOMETRIC

Scientometric is the study of measuring and analysing of science, technology and innovation. Major research issues are include the measurement of impact, reference sets of articles to investigate the impact of journals and institutes, understanding the scientific citations, mapping of scientific fields and the production of indicators for use in policy and management contexts. Methods of scientometric research include qualitative, quantitative and computational approaches. The main focus of the scientometric studies have been on institutional productivity comparisons, institutional research rankings, journal rankings establishing faculty productivity and permanent status, assessing the influence of top scholarly articles, and developing profiles of top authors and institutions in terms of research performance.(1,2)

POLLUTION CONTROL

Pollution is a problem of recent origin of our planet. Prior to industrial revolution, people lived in perfect harmony with their environment [3]. With large scale industrialization, the problem of pollution also spread around the globe. Pollution is the direct or indirect changes in one or more components of environment that are harmful to the living beings. The early year of the previous century saw the no concerted effort in the direction of

pollution control. Global warming and climate change have led to untold miseries in many part of the globe. There has been massive displacement of people due to environmental changes, caused by developmental activities. Undoubtedly it is the scientific and industrial revaluations that marked the beginning of exponential rate of natural resource consumption. . In India, Maharashtra state was the front runner to enact Water Pollution and Control Act in 1962. This was followed by passing of Comprehensive Environmental Protection Bill for prevention of air pollution in 1983. Maharashtra, Gujarat, Madhya Pradesh were the first states in India to have pollution control board with analytical laboratory [4]. In the present study, Indian authors research publications in the field of pollution control indexed in the SCOPUS database have been analyzed for the period of 25 years from 1991 to 2015.

REVIEW OF LITERATURE

Meena M and Nagarajan M (2013) (5) has been analyzed Indian malaria research output for 40 years from Scopus database. The study examined the growth of the Indian output, its collaboration with other countries. The study conform the Malaria vaccine research output was gradually increasing. The Indian authors collaboration with USA, followed by the UK and Australia has the highest number of papers. The majority of the prolific institutions are located North India.

C. Ranganathan & R. Balasubramani (2014) (6) has identified Green Energy Research in India as revealed by the scholarly publication indexed in web of science for a period of fifteen years. It was seen that the analyses included research growth, author productivity, authorship pattern, Geographical distribution of the literature, citation analysis rank, global publications' share, citation impact, share of international collaborative papers and major collaborative partner countries and patterns of research communication in most productive journals. It also analyses the characteristics of most productive institutions, authors and high-cited papers.

Gupta B M et al., (2014) (7) has analyses were the Indian publication outputs on liver disorder research during 2003-2012, on several parameters, including contribution and citation impact of the most productive countries, India's overall contribution, its growth pattern, citation impact, the share of international collaboration, identification of the significant participating countries in India's international collaboration, contribution and impact of different types of liver disorders, productivity and impact of leading Indian institutions and authors, and pattern of communication of Indian output in most productive journals.

MAIN OBJECTIVES OF THE STUDY

- to identify the growth of pollution control research publications in Globe and India
- to analysis the Activity Index
- to find out the relative growth rate and doubling time of Indian publications
- to identify the document type of Indian publications
- to determine the authorship pattern of Indian authors publications
- to analysis the ranking of top 20 authors, Institutions, Journals

METHODOLOGY

From this study, the Indian authors research on pollution control research publications has been downloaded from 'SCOPUS', multidisciplinary online database during 25 years from 1991 to 2015. For this study, using the search term TITLE-ABS-KEY "Pollution Control" AND AFFILCOUNTRY "India" AND PUBYEAR > 1990 AND PUBYEAR < 2016". A total no of 52575 publications have been identified in global level. Out of which, 2210 publications are contributed in India. The research publications data have been classified by using Microsoft Excel for the purpose of analysis.

LIMITATIONS

The following are the limitations to the study:

1. This study is confined to the SCOPUS database only.
2. Indian authors research publications in pollution control data have been used for the study from 1991 to 2015.

Growth of Pollution Control Research Publications in Globe and Indian

Table 1: Growth of Publications in Globe and Indian

S.No	Year	Globe	%	India	%	India Share	AI
1	1991	807	1.53	17	0.77	0.03	50.11
2	1992	1152	2.19	7	0.32	0.01	14.46
3	1993	1581	3.01	16	0.72	0.03	24.08
4	1994	1958	3.72	28	1.27	0.05	34.02
5	1995	1784	3.39	13	0.59	0.02	17.34
6	1996	2098	3.99	36	1.63	0.07	40.82
7	1997	2321	4.41	29	1.31	0.06	29.72
8	1998	2659	5.06	33	1.49	0.06	29.52
9	1999	1976	3.76	54	2.44	0.10	65.01
10	2000	2018	3.84	72	3.26	0.14	84.88
11	2001	1465	2.79	72	3.26	0.14	116.92
12	2002	1617	3.08	85	3.85	0.16	125.05
13	2003	1819	3.46	91	4.12	0.17	119.01
14	2004	2190	4.17	117	5.29	0.22	127.10
15	2005	2365	4.50	89	4.03	0.17	89.53
16	2006	2007	3.82	129	5.84	0.25	152.91
17	2007	2250	4.28	115	5.20	0.22	121.59
18	2008	1854	3.53	94	4.25	0.18	120.62
19	2009	2196	4.18	105	4.75	0.20	113.75
20	2010	2630	5.00	161	7.29	0.31	145.63
21	2011	3803	7.23	184	8.33	0.35	115.10
22	2012	2569	4.89	167	7.56	0.32	154.65
23	2013	2359	4.49	145	6.56	0.28	146.23
24	2014	2483	4.72	175	7.92	0.33	167.67
25	2015	2614	4.97	176	7.96	0.33	160.17
Total		52575	100.00	2210	100.00	4.20	100.00
Average		2103	4.00	88.4	4.00		94.64

Table 1 shows that the growth of pollution control publications in Global and India, share of Indian author's contributions, activity index. A total no of 52575 in publications are published in global level. Out of which, 2210(4.20%) publications are contributed in India. From the study in global level the highest no of 3803(7.23%) publications in the year 2011, lowest no of 807(1.53%) publications are contributed in the year 1991 and the average no of 2103(4%) publications are contributed. On the same time, in India the highest no of 184(8.33%) publications contributed are in the year 2011, lowest no of 7(0.32%) publications in the year 1992 and average no of 88.4 (4%) publications are contributed during the study period.

Activity Index

The Comparison of India's contributions with the global contributions was carried out using the Relative Activity Index, first suggested by Frame [8]. The relative activity index indicates weather a unit is more or less activity in India than the rest of the world.

$$AI = (n_{ij}/n_{io}) / (n_{oj}/n_{oo}) \times 100$$

Where, n_{ij} is the Indian output of paper in a particular field; n_{io} is the total Indian output in all fields; n_{oj} is the World output of paper in a particular field; n_{oo} is the total World output in all fields.

RAI = 100 indicates that the country research effort is the world average; RAI > 100 reflects higher activity than the world average; RAI < 100 reflects lower than average effort dedicated to the field under study. From the table 1 indicates that Indian's research effort in pollution control was less than the world average from 1991 to 2000. Then the year 2001 onwards Indian's research effort is increased the world average year by year. The average RAI for India was 94.64 during 1991 – 2015.

Relative Growth Rate and Doubling time of Pollution Control Publications in India

Relative Growth Rate: The relative growth rate is the increase in number of articles per unit of time. The mean Relative Growth Rate over the specific period of interval can be calculated for the following formula[9]

Table 2: Relative Growth Rate and Doubling Time

S.No	Year	Pub.	Cum.	W1	W2	RGR= (W ₂ -W ₁)	Avg.	Dt = 0.693/RGR	Avg.
1	1991	17	17		2.83				
2	1992	7	24	2.83	3.18	0.34		2.01	
3	1993	16	40	3.18	3.69	0.51		1.36	
4	1994	28	68	3.69	4.22	0.53		1.31	
5	1995	13	81	4.22	4.39	0.17		3.96	
6	1996	36	117	4.39	4.76	0.37		1.88	
7	1997	29	146	4.76	4.98	0.22		3.13	
8	1998	33	179	4.98	5.19	0.20		3.40	
9	1999	54	233	5.19	5.45	0.26		2.63	
10	2000	72	305	5.45	5.72	0.27		2.57	
11	2001	72	377	5.72	5.93	0.21		3.27	
12	2002	85	462	5.93	6.14	0.20		3.41	
13	2003	91	553	6.14	6.32	0.18	0.29	3.85	2.73
14	2004	117	670	6.32	6.51	0.19		3.61	
15	2005	89	759	6.51	6.63	0.12		5.56	
16	2006	129	888	6.63	6.79	0.16		4.41	
17	2007	115	1003	6.79	6.91	0.12		5.69	
18	2008	94	1097	6.91	7.00	0.09		7.74	
19	2009	105	1202	7.00	7.09	0.09		7.58	
20	2010	161	1363	7.09	7.22	0.13		5.51	
21	2011	184	1547	7.22	7.34	0.13		5.47	
22	2012	167	1714	7.34	7.45	0.10		6.76	
23	2013	145	1859	7.45	7.53	0.08		8.53	
24	2014	175	2034	7.53	7.62	0.09		7.70	
25	2015	176	2210	7.62	7.70	0.08	0.12	8.35	6.41
Total		2210							

$$01. R(a) = \frac{(W_2 - W_1)}{(T_2 - T_1)}$$

W1 = log of initial number of articles/ pages, W2 = log of final number of article / pages after a specific period of interval, T2-T1 = the unit different between the initial time and the final time. Doubling Time: There exists a direct equivalence between the relative growth rate and the doubling time. If the number of articles/pages of a subject doubles during a given period was calculated by using the formula

$$Dt = \frac{0.693}{R(a)}$$

Table 2 shows that, relative growth rate and doubling time of Indian author's pollution control research publications during the study period of 25 years. Relative growth rates are between 0.08 in the year 2013 and 2015, 0.53 in the year 1994. The same time doubling times are 1.31 in the year 1994 and 8.53 in the year 2013. The study period was divided in two blocks, from the block period RGR values are decreasing from first block to second block (0.29 to 0.12). The same time doubling times are increasing trend from first block to second block. (2.73 to 6.41)

Document Type

Document type for the Indian authors publications are shown in the table 3. During the study period a maximum of 1757(79.50%) publications are contributed in article, followed by

Table 3: Document Type

S.No	Document Type	Publications	%	Cum.	Cum.%
1	Article	1757	79.50	1757	79.50
2	Conference Paper	272	12.31	2029	91.81
3	Review	128	5.79	2157	97.60
4	Editorial	16	0.72	2173	98.33
5	Book Chapter	15	0.68	2188	99.00
6	Short Survey	9	0.41	2197	99.41
7	Letter	7	0.32	2204	99.73
8	Book	4	0.18	2208	99.91
9	Erratum	1	0.05	2209	99.95
10	Note	1	0.05	2210	100.00
Total		2210	100.00		

conference papers are 272(12.31%), review 128(5.79%) and remaining 2.48% are contributed in editorial, book chapter, short survey, letter, book, erratum and note.

AUTHORSHIP PATTERN

During the study period table 4 shows that the authorship pattern of Indian author's pollution control research publications. From the study, the highest no of 697(31.54%) publications are contributed in two authors, followed by 543(24.57%) publications are contributed in three authors, 334 (15.11%) publications are single authors and etc. From the study a highest no of 24 authors are contributed one paper, followed by 21 authors are also contributed one paper and etc.

Table 4: Authorship Pattern

S. No	No of Authorship	No of Publications	%	No of Authors	%
1	1	334	15.11	334	5.03
2	2	697	31.54	1394	21.01
3	3	543	24.57	1629	24.55
4	4	326	14.75	1304	19.65
5	5	149	6.74	745	11.23
6	6	70	3.17	420	6.33
7	7	47	2.13	329	4.96
8	8	14	0.63	112	1.69
9	9	11	0.50	99	1.49
10	10	8	0.36	80	1.21
11	11	1	0.05	11	0.17
12	12	1	0.05	12	0.18
13	13	1	0.05	13	0.20
14	16	2	0.09	32	0.48
15	18	2	0.09	36	0.54
16	20	2	0.09	40	0.60
17	21	1	0.05	21	0.32
18	24	1	0.05	24	0.36
Total		2210	100.00	6635	100.00

Ranking of top 20 authors from India in Pollution Control Research Publications

Table 5 shows that, the ranking of top 20 Indian authors are contributed 218 publications in the fields of pollution control research. From the study, the highest no of 19 (8.72%) publications are contributed in Biswas, M.N. and Meikap, B.C., Indian Institute of Technology, Kharagpur with ranked one. Followed by Bandyopadhyay, A., University of Calcutta, Kolkata had 18(8.26%) publications with 2nd ranked, Khare, M., Indian Institute of Delhi, New Delhi had 17(7.80%) publications with 3rd ranked.

Table 5: Ranking of top 20 Indian Authors

S.No	Authors	Name of Institution and Place	Publications	%	Rank
1	Biswas, M.N.	Indian Institute of Technology, Kharagpur	19	8.72	1
2	Meikap, B.C.	Indian Institute of Technology, Kharagpur	19	8.72	1
3	Bandyopadhyay, A.	University of Calcutta, Kolkata	18	8.26	2
4	Khare, M.	Indian Institute of Delhi, New Delhi	17	7.80	3
5	Ghose, M.K.	West Bengal University of Technology, Kolkatta	15	6.88	4
6	Ravindhranath, K.	K L University, Guntur	14	6.42	5
7	Abbasi, S.A.	Pondichery University, Pondichery	12	5.50	6
8	Philip, L.	Indian Institute of Technology, Madras	10	4.59	7
9	Devotta, S.	Chemical and Environmental Engineering Consultant, Chennai	9	4.13	8
10	Gajghate, D.G.	National Environmental Engineering Research Institute India, Nagpur	9	4.13	8
11	Mujumdar, P.P.	Indian Institute of Science, Bangalore	9	4.13	8
12	Singh, N.	National Botanical Research Institute India, Lucknow	9	4.13	8

13	Hasan, M.Z.	MSG College, Nasik	8	3.67	9
14	Prasad, M.N.V.	University of Hyderabad, Hyderabad	8	3.67	9
15	Kathuria, V.	Indian Institute of Technology, Mumbai	7	3.21	10
16	Khan, F.I.	Memorial University of New foundland, Canada	7	3.21	10
17	Kundu, G.	Indian Institute of Kharagpur, Kharragpur	7	3.21	10
18	Sharma, P.	The Energy and Resources Institute India, New Delhi	7	3.21	10
19	Sinha, S.	National Botanical Research Institute India, Lucknow	7	3.21	10
20	Tripathi, B.D.	Banaras Hindu University, Varanasi	7	3.21	10
Total			218	100	

Ranking of top 20 Institution in India from Pollution Control Publications

Table no 6 shows that top 20 Indian Institutions are contributed 731 publications with his rank. Out of top 20 Indian institutions, the highest no 4 institutes are contributed in New Delhi. Out of which, National Environmental Engineering Research Institute of India, Nagpur has contributed

Table 6: Ranking of top 20 Institution in India

S. No	Institution and Place	City	Pub.	%	Rank
1	National Environmental Engineering Research Institute India	Nagpur	100	13.68	1
2	Indian Institute of Technology Delhi	New Delhi	85	11.63	2
3	Indian Institute of Technology, Roorkee	Uttarakhand	53	7.25	3
4	Indian Institute of Technology, Kharagpur	West Bengal	52	7.11	4
5	The Energy and Resources Institute India	New Delhi	38	5.20	5
6	Indian Institute of Technology, Madras	Tamilnadu	34	4.65	6
7	Anna University, Chennai	Tamilnadu	33	4.51	7
8	Banaras Hindu University, Varanasi	Uthra Pradesh	32	4.38	8
9	Indian Institute of Technology, Kanpur	Uthra Pradesh	31	4.24	9
10	Indian School of Mines University, Dhanbad	Jharkhand	28	3.83	10
11	Central Leather Research Institute India, Chennai	Tamilnadu	28	3.83	10
12	Indian Institute of Science, Bangalore	Kharnataka	27	3.69	11
13	Jadavpur University, Kolkata	West Bengal	27	3.69	11
14	Bhabha Atomic Research Centre, Mumbai	Maharastra	26	3.56	12
15	National Botanical Research Institute India, Lucknow	Uthra Pradesh	25	3.42	12
16	Indian Institute of Technology, Guwahati	Assam	23	3.15	13
17	Central Pollution Control Board India	New Delhi	23	3.15	13
18	Indian Institute of Technology, Bombay	Maharastra	22	3.01	14
19	University of Calcutta	West Bengal	22	3.01	14
20	Jawaharlal Nehru University	New Delhi	22	3.01	14
Total			731		

in highest no of 100 (13.68%) publications with 1st ranked, followed by Indian Institute of Technology, New Delhi 85(11.63%) with 2nd ranked, Indian Institute of Technology, Roorkee, Uttarakhand 53(7.25%) with 3rd rank and etc.

Ranking of top 20 journals in Pollution Control Research Publications in India

Table 7 shows that a total no of 765 publications are contributed a top 20 journals. Out of which, Indian Journal of Experimental Biology contributed 107(13.99%) publications with 1st ranked. Followed by, Environmental Policy and Law 102 (13.33%) publications with 2nd ranked, Environmental Policy and Law 77(10.07%) publications with 3rd ranked.

Table: 7 Ranking of top 20 Journals in India

S. No	Journals	No of Publications	%	Rank
1	Indian Journal of Experimental Biology	107	13.99	1
2	Environmental Policy and Law	102	13.33	2
3	Journal of Intelligent and Fuzzy Systems	77	10.07	3
4	Polymer - Plastics Technology and Engineering	65	8.50	4
5	Journal of Hazardous, Toxic, and Radioactive Waste	49	6.41	5
6	ISEC 2013 - 7th International Structural Engineering and Construction Conference: New Developments in Structural Engineering and Construction	44	5.75	6
7	Atmospheric Pollution Research	37	4.84	7
8	Chemical Geology	26	3.40	8
9	Asian Journal of Water, Environment and Pollution	25	3.27	9
10	BioResources	25	3.27	9
11	Communications in Computer and Information Science	25	3.27	9
12	Noise and Health	25	3.27	9
13	Journal of Environmental Planning and Management	24	3.14	10
14	Journal of Solid Waste Technology and Management	22	2.88	11
15	Water Science and Technology: Water Supply	22	2.88	11
16	Ecotoxicology and Environmental Safety	21	2.75	12
17	International Journal of Earth Sciences and Engineering	19	2.48	13
18	Chemtech	17	2.22	14
19	Journal of Computer Science and Technology	17	2.22	14
20	Industrial Bioprocessing	16	2.09	15
Total		765		

MAJOR FINDINGS AND CONCLUSIONS

- During the Indian authors pollution control research publications study, a total no of 52575 publications are published in global level. Out of which, 2210(4.20%) publications are contributed in India. From the study, in global level the highest no of 3803(7.23%) publications in the year 2011, the same time in India the highest no of 184(8.33%) publications in the year 2011.
- Activity Index is identified from the year 2001 onwards Indian's research effort is increased the world average. The average AI for India is 94.64 during the study period.
- Relative Growth Rates are between 0.08 in the year 2013 and 2015, 0.53 in the year 1994. The same time doubling times are 1.31 in the year 1994 and 8.53 in the year 2013.
- During the study period a maximum of 1757(79.50%) publications are contributed in article. For the authorship Pattern of the study period, the highest no of 697(31.54%) publications are contributed in two authors
- For the study period, highest no of 19 (8.72%) publications are contributed in Biswas, M.N. and Meikap, B.C., Indian Institute of Technology, Kharagpur with no 1 ranked authors.
- National Environmental Engineering Research Institute of India, Nagpur has contributed in highest no of 100 (13.68%) publications with 1st rank. Indian Journal of Experimental Biology contributed 107(13.99%) publications with 1st ranked

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