

Covid-19 and Environmental Sciences: A Scientometric Assessment of India's Publications

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ABSTRACT

Background: As the Covid-19 pandemic increased exponentially across the globe, it has threatened the human lives and uprooted the economy of various cities and nations, besides having a major impact on the environment. In a matter of a few months, the world has transformed its way of living. The global disruption caused by the Covid-19 has brought about several effects on the environment and climate. Hence, a scientometric study of the India's publications in impact of Covid-19 on environment has been conducted to identify the emerging research trends in this field. **Methods:** The study downloaded India's publications on this topic from the Scopus database using a well-defined research strategy, which was based on using all keywords related to Covid-19 in "Keyword" and "Title" search tags of Scopus database. The search was subsequently restricted to "Environmental Sciences" subject, and limited to "India" yielding 805 records. **Results:** The 805 Indian publications were published on "Covid-19 and Environmental Sciences" as searched in Scopus database and these have received 8275 citations, averaging 10.28 citations per paper. The 30.19% and 36.64% share of India's publications received external funding support and involve international collaboration. Among India's foreign collaborating partner countries, USA contributed the largest share (27.80%), followed by U.K. (21.02%), China and Saudi Arabia (14.24% each) and Australia (13.9%). Among 380 participating organizations, Datta Meghe Institute of Medical Sciences, Nagpur, Indian Institute of Technology, Kharagpur and Academy of Scientific and Innovative Research, New Delhi contributed the largest number of papers (31, 26 and 26 papers) and Indian Institute of Technology, New Delhi (47.5 and 4.68), Karunya Institute of Technology and Sciences (28.29 and 2.79) and Indian Institute of Technology, Gandhinagar (19.75 and 1.95) registered the largest citation impact. Among 945 participating authors, M. Kumar,

S. Gautam and R. Kumar contributed the largest number of papers (25, 13 and 10 papers) and A. Narayanasamy (61.17 and 6.03), S. Gautam. (30.46 and 3.0) and M. Joshi (27.29 and 2.69) registered the largest citation impact. *Indian Journal of Forensic Medicine and Toxicology*, *Science of the Total Environment* and *Environmental Science and Pollution Research* contributed the largest number of papers (76, 60 and 45 papers) and *Environmental Pollution* (12.0), *Aerosol and Air Quality Research* (11.12), *Modeling Earth Systems and Environment* (10.50) registered the largest citation impact of paper. The most significant keywords associated with "Covid-19 and Environmental Science" along with their frequency are: Air Quality (124), Air Pollution (96), Particulate Matter (91), Atmospheric Pollution (65), Environmental Monitoring (52), etc. **Conclusion:** The results of the present study are focused on evaluation of the India's contribution, focusing on both national and international issues using quantitative and qualitative methods. Such a study has allowed us to visualize the research trends that emerged during the Covid-19 pandemic and will facilitate the researchers to identify significant hotspots and latest trends in the field.

Key words: Covid-19, Environmental Sciences, India's publications, Scientometrics, Bibliometric

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INTRODUCTION

Within a last few months, Covid-19 has become a medical emergency and declared pandemic by WHO. Globally as on 28 October 2021, there have been 244,897,472 confirmed cases of Covid-19, including 4,970,435 deaths in over 200 countries, reported to WHO.¹ The governments and authorities at local, national, regional, and global levels responded with various measures. The global scientific community starts investing in R&D for seeking emergent insights for tackling this crisis. Major portion of the research was devoted to the medical interventions for the prevention and treatment of this disease. However, environmental community has contributed significantly in research related the implications of this pandemic on environment and climate.

As the Covid-19 pandemic increased exponentially across the globe threatening lives and uprooting the economy of cities and nations, it also had a major impact on the environment. In a matter of a few months, the world has transformed its way of living. The global disruption caused by the Covid-19 has brought about several effects on the environment and climate. Due to movement restriction and a significant slowdown

of social and economic activities, air quality has improved in many cities with a reduction in water pollution in different parts of the world. Besides, increased use of PPE (e.g., face mask, hand gloves etc.), their haphazard disposal, and generation of a huge amount of hospital waste has negative impacts on the environment. In addition, both positive and negative environmental impacts of COVID-19 were observed globally.^{2,3}

Among the positive effects, (i) due to industries, transportation and companies closed down, there has been a sudden drop or reduction of greenhouse gases (GHGs) emissions (mainly of N₂O and CO), (ii) There is a large reduction of water pollution, a common phenomenon of a developing country like India, where domestic and industrial wastes are dumped into rivers without treatment, (iii) There was a reduction of noise pollution (the elevated levels of sound, generated from different human activities), which may lead to adverse effects in human and other living organisms; and (iv) there is a increasing efforts towards ecological restoration and assimilation of tourist spots.^{2,3}

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Among the negative effects, (i) there is a substantial increase of biomedical waste generation globally, which is a major threat to public health and environment, (ii) for protection from the viral infection, peoples are using face mask, hand gloves and other safety equipment, which increase the amount of healthcare waste; (iii) increase of municipal waste (both organic and inorganic) generation has direct and indirect effects on environment like air, water and soil pollution and (iv) other effects on environment – availability of large quantity of disinfectants on roads, commercial, and residential areas to exterminate SARS-CoV-2 virus, which may kill non-targeted beneficial species, which may create ecological imbalance. In addition, SARS-CoV-2 virus was detected in the Covid-19 patient's faces and also from municipal wastewater in many countries, which may need additional measures in wastewater treatment, particularly, where municipal wastewater is drained into nearby aquatic bodies and rivers without treatment.^{2,3}

LITERATURE REVIEW

Only a few bibliometric studies have been undertaken on this topic. Among such studies, Zyoud and Zyoud⁴ tracked the current hotspots and research trends on Covid-19 in environmental field. Bibliometric analysis and visualization mapping techniques have been utilized for revealing and evaluating the developments in Covid-2019 and its impact. The 729 documents derived from the Scopus database by limiting to environmental sources were evaluated. China has the highest share of publications (22.4%), followed by the USA (19.15%) and Italy (15.1%) with most publications in high impact journals. Chinese Academy of Sciences (with 3.3% share) was the most productive organization. The most prevalent topics are related to the impact of the pandemic on air quality, mental health, psychological, and economic aspects. Muhammad and Ho⁵ undertook a bibliometric study of environmental science publications to identify the emerging research trends in the context of Covid-19, using nine environment-related subject categories indexed in SCI-Expanded database of the WoS Core Collection. The 495 documents in above database was used to perform and identify various essential research indicators, including the type of the publication, the most prominent journals, subject categories, authors, institutions, and the countries, that contributed significantly to this theme. Casado-Aranda, Sánchez-Fernández and Viedma-del-Jesús⁶ examined 440 global publications on “Covid-19 and Environmental Sciences” during 1 December 2019 to 6 September 2020, indexed in Web of Science and Scopus database. The co-citation analysis carried out by the authors reveals the most promising themes, subtopics and outlets.

The extent of impact of Covid-19 on environment depends on the level of development of the country and the steps the government have taken to protect the country population from Covid-19. In addition, being motivated by the need to explore the commitment, and achievements of environmental sciences in the battle against Covid-19 and its impact on the environment, this study analyzed the status of research on Covid-19 published in a collection of environmental sources. The present study therefore makes a modest attempt to examine India's literature on this topic and analyses the research trends, contribution of various players and depict the subject perspective using keywords. Bibliometrics methods have been used in this study to examine, interpret, and derive indicators on the progress and dynamics of scientific knowledge on a subject in the Indian context. Therefore, present study has examined and evaluated India's research related to “Covid-19” that created impact on environmental aspects of research.

METHODOLOGY

For this study, Elsevier Scopus Database has been used and it has been chosen because of its comprehensive coverage to represent search results,

its search representation could vary as compared to other databases On the basis of a preliminary review, data was retrieved on October 24, 2021 by using the following search strategy.

TITLE (“Covid-19” or “2019 novel coronavirus” or “coronavirus 2019” or “coronavirus disease 2019” or “2019-novel CoV” or “2019 ncov” or covid 2019 or covid19 or “corona virus 2019” or ncov-2019 or ncov2019 or “nCoV 2019” or 2019-ncov or covid-19 or “Severe acute respiratory syndrome coronavirus 2” or “SARS-CoV-2”) or KEY(“Covid 19” or “2019 novel coronavirus” or “coronavirus 2019” or “coronavirus disease 2019” or “2019-novel CoV” or “2019 ncov” or covid 2019 or covid19 or “corona virus 2019” or ncov-2019 or ncov2019 or “nCoV 2019” or 2019-ncov or covid-19 or “Severe acute respiratory syndrome coronavirus 2” or “SARS-CoV-2”) AND (LIMIT-TO (SUBJAREA , “ENVI”)) AND (LIMIT-TO (AFFILCOUNTRY , “India”)).

RESULTS AND DISCUSSION

International Output

A total of 10360 publications have been published on “Covid-19 and Environmental Science” as indexed in Scopus database till 26.10.2021. These 10360 publications received 108957 citations, averaging 10.52 citations per paper. 161 participated in global research on this topic: 75 countries published 11-10 papers each, 34 countries 11-50 papers each, 13 countries 51-100 papers each, 32 countries 101-500 papers each, 4 countries 805-888 papers each and 2 countries 1412-2080 papers each.

The top 10 countries individually published 369 to 2080 papers and together contributed 8654 papers and 111911 citations, constituting 83.83% and more than 100.0% share of global publications and citations on this topic. On further analysis, it was observed that only four countries contributed more than the group average (865.4) of all 10 countries: USA (2080 papers, 20.08% share), China (1412 papers, 13.63% share), U.K. (888 papers, 8.57% share) and Italy (885 papers, 8.54% share), (ii) Five countries registered citation per paper and relative citation index more than group average (12.93 and 1.23) of all 10 countries: Australia (17.85 and 1.70), China (17.73 and 1.69), Italy (15.0 and 1.43), USA (132.32 and 1.27) and Canada (13.12 and 4.43). (Table 1, Figure 1)

India's Publications Output

Overall Output

India published 805 publications (2020=271; 2021-22=534) on “Covid-19 and Environmental Science” as indexed in Scopus database. The 805 India's publications received 8169 citations, averaging 10.15 citations per papers. India's publications constitute 7.77% share of the global output. Of the 805 India's publications, 243 (30.19%) received external funding support from more than 100 external agencies. These 243 funded papers received 3157 citations, averaging 12.99 citations per paper. The major external funding agencies supporting research in this area are: National Aeronautics Space Administration, USA (25 papers), Council of Scientific and Industrial Research, India (20 papers), Science and Engineering Research Board, India (20 papers), Ministry of Earth Sciences India (18 papers), Department of Biotechnology, India (14 papers), University Grant Commission, India (10 papers), Ministry of Human Resource Development, India (9 papers), Ministry of Environment, Forests and Climate Change, India (8 papers), etc.

Of the 805 India's publications, 602 appeared as articles, 135 as reviews, 13 each as notes and book chapters, 12 each as editorials and letters, 9 as conference papers, 5 as short surveys, 3 as erratum and 2 retracted.

Of the 805 India's papers, 295 (36.64%) involve international collaboration and these 295 international collaborative papers received 3826 citations, averaging 12.97 citations per paper. Among the foreign collaborative countries in India's output, USA contributed the largest

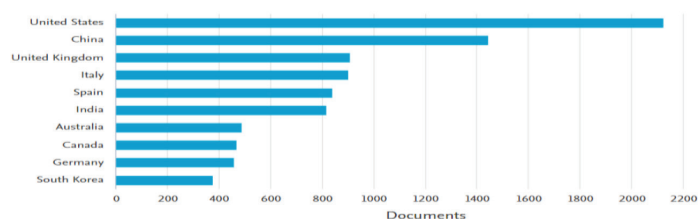
Table 1: Profile of Top 10 Countries in 'Covid-19 and Environmental Sciences'.

S.No	Name of the country	TP	TC	CPP	RCI	%TP
1	USA	2080	27710	13.32	1.27	20.08
2	China	1412	25035	17.73	1.69	13.63
3	U.K.	888	9193	10.35	0.98	8.57
4	Italy	885	13277	15.00	1.43	8.54
5	Spain	828	7433	8.98	0.85	7.99
6	India	805	8169	10.15	0.96	7.77
7	Australia	479	8550	17.85	1.70	4.62
8	Canada	459	6021	13.12	1.25	4.43
9	Germany	449	4344	9.67	0.92	4.33
10	South Korea	369	2179	5.91	0.56	3.56
	Total of top 10 countries	8654	111911	12.93	1.23	83.53
	Global total	10360	108957	10.52	1.00	
		83.53				

TP=Total papers; TC=Total citations; CPP=Citations per paper; RCI=Relative citation index.

Documents by country or territory

Compare the document counts for up to 15 countries/territories.



number of papers (82 papers and 27.8% share) followed by U.K. (62 papers and 21.02% share), China and Saudi Arabia (42 papers and 14.24% share each), Australia (41 papers and 13.9% share), Italy (32 papers and 10.85% share), South Korea (28 papers and 9.49% share), Germany (26 papers and 8.81% share), Japan (25 papers and 8.47% share), Malaysia and Spain (23 papers and 7.8% share each), Canada (22 papers and 7.46% share), etc. In terms of impact, India's collaboration with Germany registered the highest citation impact per paper (40.33), followed by India-China papers (38.86), India-USA (26.38), India—Saudi Arabia (17.20), etc.

Figure 1 shows a map that reveals the collaboration networks among countries working on "Covid-19 and Environmental Science" during pandemic. The India-USA leads with highest number of collaborative papers (297 linkages), followed by India- China (295 linkages), India-Australia (239 linkages), India-Italy (213 linkages), etc and represents the largest nodes in the map and they have also made the greatest number of collaborative research with other countries. There is a strong collaborative networks among the displaced countries, since almost all of them linked in the network.

Research hotspots and their trends

The 50 Keywords (with comparatively higher frequency of appearance varying from 11 to 663 have been identified from the literature and considered as significant as they throw some light on the trends of research on his theme. These 50 keywords are listed in Table. The largest frequency of occurrence (663) was reported by keyword "Covid-19",

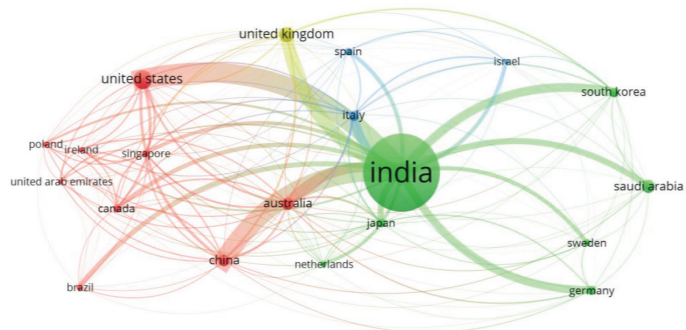


Figure 1: Collaboration Network Visualization of Indian publications.

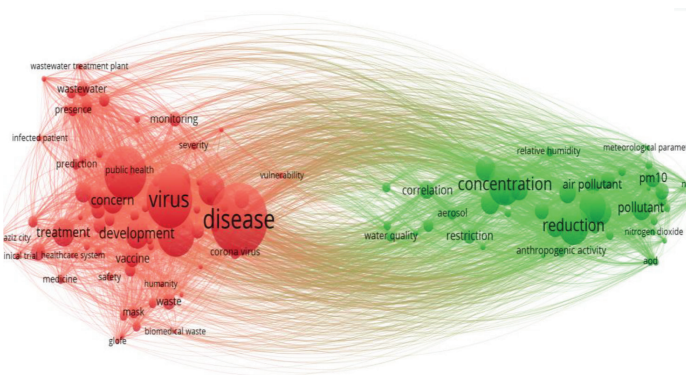


Figure 2: Network visualization of Significant Keywords.

followed by Pandemic (274), Air Quality (124), Virus Disease (112), Air Pollution (96), Particulate Matter (91), Public Health (77), Atmospheric Pollution (65), Air Pollutants (61), Virus Pneumonia (57) and Environmental Monitoring (52). The co-occurrences of keywords are depicted in Figure 2, where similar keywords are placed in same cluster.

Top 20 Organizations

In all 380 organizations participated in India's research on "Covid-19 and Environmental Science": 304 organizations published 1-5 papers each, 36 organizations 6-10 papers each, 35 organizations 11-20 papers each and 5 organizations 21-31 papers each. The top 20 organizations individually published 12 to 31 papers and together contributed 355 papers and 3844 citations, constituting 44.10% and 47.06% share of India's publications and citations on this topic. On further analysis, it was observed that only seven organizations contributed more than the group average (17.75) of all organizations: Datta Meghe Institute of Medical Sciences, Nagpur (31 papers), Indian Institute of Technology, Kharagpur (26 papers), Academy of Scientific and Innovative Research, New Delhi (26 papers), Indian Institute of Technology Gandhinagar, Gujarat (24 papers), Jawaharlal Nehru Medical College, Wardha (24 papers), National Environmental Engineering Research Institute, Nagpur (22 paper), Indian Institute of Tropical Meteorology, Pune and Amity University, Noida (18 papers each); and (ii) Eight organizations registered citation per paper and relative citation index more than group average (10.83 and 1.07) of all 10 organizations: Indian Institute of Technology, New Delhi (47.5 and 4.68), Karunya Institute of Technology and Sciences (28.29 and 2.79), Indian Institute of Technology Gandhinagar, Gujarat (19.75 and 1.95), Indian Institute of Technology, Kharagpur (18.23 and 1.8), Central University of Jharkhand (14.92 and 1.47), Jamia Millia Islamia, Delhi (14.18 and 1.4),

Table 2: Most Significant Keywords on Covid-19 and Environmental Sciences.

S.No	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency
1	Covid-19	663	20	Ozone	34	36	Mental Health	24
2	Pandemic	274	21	Risk Assessment	30	37	Social Distancing	24
3	Air Quality	124	22	Particulate Matter 2.5	34	38	Sewage	23
4	Viral Disease	113	23	Waste Management	33	39	Health Impact	22
5	Air Pollution	96	24	Environmental Impact	32	40	Anxiety	21
6	Particulate Matter	91	25	Environmental Factor	31	41	Meteorology	21
7	Public Health	77	26	Risk Assessment	30	39	Pollution	20
8	Cities	72	27	Carbon Monoxide	28	40	Air Pollution Control	19
9	Atmospheric Pollution	65	28	Wastewater Treatment	28	41	Climate Change	18
10	Air Pollutants	61	29	Ambient Air	27	42	Depression	18
11	Virus Pneumonia	57	30	Health Risk	27	43	Water Pollution	17
12	Environmental Monitoring	52	31	Pollution Control	27	44	Machine Learning	17
13	Concentration (Composition)	48	32	Sustainability	26	45	Air Quality Index	16
14	Aerosol	47	30	Health Risk	27	46	Remote Sensing	16
15	Nitrogen Oxide	36	31	Pollution Control	27	47	River Pollution	15
16	Nitrogen Dioxide	36	32	Sustainability	26	48	Prediction	15
17	Nitrogen Dioxide	36	33	Sustainable Development	27	49	Emission Control	13
18	Nitrogen Dioxide	36	34	Urban Areas	25	50	Environmental Temperature	11
19	Quarantine	34	35	Humidity	24			

Table 3: Bibliometric Profile of Top 20 Organizations.

S.No	Name of the Organization	TP	TC	CPP	RCI	%TP
1	Datta Meghe Institute of Medical Sciences, Nagpur	31	4	0.13	0.01	3.85
2	Indian Institute of Technology Kharagpur	26	474	18.23	1.80	3.23
3	Academy of Scientific and Innovative Research, New Delhi	26	311	11.96	1.18	3.23
4	Indian Institute of Technology Gandhinagar-Palaj-Gujarat	24	474	19.75	1.95	2.98
5	Jawaharlal Nehru Medical College, Wardha	24	1	0.04	0.00	2.98
6	National Environmental Engineering Research Institute India	22	201	9.14	0.90	2.73
7	Indian Institute of Tropical Meteorology, Pune	18	78	4.33	0.43	2.24
8	Amity University, Noida	18	34	1.89	0.19	2.24
9	Jamia Millia Islamia, Delhi	17	241	14.18	1.40	2.11
10	Indian Institute of Technology, Bombay	16	160	10.00	0.99	1.99
11	Jawaharlal Nehru University, New Delhi	15	140	9.33	0.92	1.86
12	University of Delhi	14	68	4.86	0.48	1.74
13	Indian Institute of Technology, New Delhi	14	665	47.50	4.68	1.74
14	Karunya Institute of Technology and Sciences	14	396	28.29	2.79	1.74
15	Symbiosis International Deemed University, Pune	14	1	0.07	0.01	1.74
16	Indian Institute of Technology, Roorkee	13	172	13.23	1.30	1.61
17	Central University of Jharkhand	13	194	14.92	1.47	1.61
18	Banaras Hindu University, Varanasi	12	79	6.58	0.65	1.49
19	Lovely Professional University, Jullandhar	12	57	4.75	0.47	1.49
20	University of Petroleum and Energy Studies	12	94	7.83	0.77	1.49
	Total of 20 organizations	355	3844	10.83	1.07	44.10
	India's total	805	8169	10.15	1.00	
	Share of top 20 organizations in India's total	44.10	47.06			

TP=Total papers; TC=Total citations; CPP=Citations per paper; RCI=Relative citation index

Table 4: Bibliometric Profile of Top 20 Authors.

S.No	Name of the author	Affiliation of the author	TP	TC	CPP	RCI	%TP
1	M. Kumar	Indian Institute of Technology, Gandhinagar, India	25	474	18.96	1.87	3.11
2	S. Gautam.	Karunya Institute of Technology and Sciences, Coimbatore, India	13	396	30.46	3.00	1.61
3	R. Kumar	National Environmental Engineering Research Institute India, Nagpur, India	10	161	16.10	1.59	1.24
4	G. Beig	Indian Institute of Tropical Meteorology, Pune, India	9	29	3.22	0.32	1.12
5	H. Bherwani	National Environmental Engineering Research Institute India, Nagpur, India	9	177	19.67	1.94	1.12
6	A. Gupta	National Environmental Engineering Research Institute India, Nagpur, India	8	165	20.63	2.03	0.99
7	P. Bhattacharya	University of Delhi, New Delhi, India	7	171	24.43	2.41	0.87
8	M. Joshi	Gujarat Biotechnology Research Centre (GBRC), Gandhinagar, India	7	191	27.29	2.69	0.87
9	A. Das	University of Gour Banga, Malda, India	6	30	5.00	0.49	0.75
10	K. Dhangar	Indian Institute of Technology Gandhinagar, Gandhinagar, India	6	96	16.00	1.58	0.75
11	V.S.N.S. Goli	Indian Institute of Technology Bombay, Mumbai, India	6	35	5.83	0.57	0.75
12	P. Mazumder	Indian Institute of Technology Guwahati, Guwahati, India	6	60	10.00	0.99	0.75
13	A. Narayanasamy	Bharathiar University, Coimbatore, 641 046, Tamil Nadu, India	6	367	61.17	6.03	0.75
14	A. Rathod	Indian Institute of Tropical Meteorology, Pune, India	6	28	4.67	0.46	0.75
15	K. Ravindra	Postgraduate Institute of Medical Education and Research, Chandigarh, Chandigarh, India	6	132	22.00	2.17	0.75
16	D.N. Singh	Indian Institute of Technology Bombay, Mumbai, India	6	35	5.83	0.57	0.75
17	B. Vellingiri	Bharathiar University, Coimbatore, India	6		0.00	0.00	0.75
18	V. Anand	Indian Institute of Tropical Meteorology, Pune, India	5	23	4.60	0.45	0.62
19	N. Aravindha Babu	Sree Balaji Dental College and Hospital (SBDCH), Chennai, India	5	0	0.00	0.00	0.62
20	N. Korhale	Indian Institute of Tropical Meteorology, Pune, India	5	22	4.40	0.43	0.62
	Total of 20 authors		157	2592	16.51	1.63	19.50
	India's total		805	8169	10.15		100.00
	Share of top 20 authors in India's total		19.50	31.73			2.42

TP=Total papers; TC=Total citations; CPP=Citations per paper; RCI=Relative citation index

Indian Institute of Technology, Roorkee (13.23 and 1.3) and Academy of Scientific and Innovative Research, New Delhi (11.96 and 1.18).

Top 20 Authors

In all 945 authors participated in research on this topic: 927 authors published 1-5 paper each, 16 authors 6-10 papers each and 2 authors 13-15 papers each. The top 20 authors individually published 5 to 25 papers and together contributed 157 papers and 2592 citations, constituting 19.50% share and more than 31.73% share of global publications and citations on this topic.

On further analysis, it was observed that only five authors contributed more than the group average (7.85) of all 20 authors: M. Kumar (25 papers), S. Gautam (13 papers), R. Kumar (10 papers), G. Beig and H. Bherwani (8 papers each), (ii) Eight authors registered citation per paper and relative citation index more than group average (16.51 and 1.63) of all 20 authors: A. Narayanasamy (61.17 and 6.03), S. Gautam. (30.46 and 3.0), M. Joshi (27.29 and 2.69), P. Bhattacharya (24.43 and 2.41), K. Ravindra (22.0 and 2.17), A. Gupta (20.63 and 2.03), H. Bherwani (19.67 and 1.94) and M.Kumar (18.96 and 1.87) (Table 4). A collaboration network of top 20 authors is presented in Figure 3.

Top 20 Journals

Of the 805 India's papers on this topic, 783 papers are published in 198 journals, 13 in book series and 9 in conference proceedings. Of the 198 journals, 173 published 1-5 papers each, 10 journals 6-10 papers each, 7 journals 11-20 papers each and 8 journals 21-76 papers each. The top 20

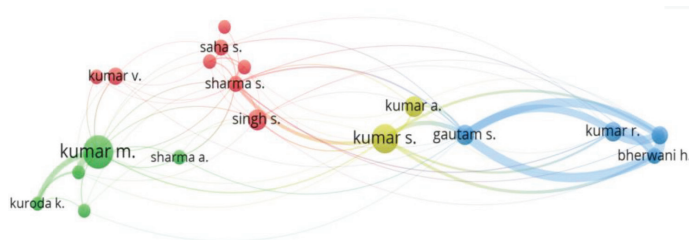


Figure 3: Collaboration Network Visualization of Authors.

journals individually published 7 to 76 papers each and together published 460 papers, constituting 59.75% share of India's journal output. The top 8 most productive journals were: *Indian Journal of Forensic Medicine and Toxicology* (76 papers), *Science of the Total Environment* (60 papers), *Environmental Science and Pollution Research* (45 papers), *International Journal of Environmental Research and Public Health* (34 papers), *Environmental Research* (28 papers), *Environment, Development and Sustainability* (26 papers), *Aerosol and Air Quality Research* (25 papers) and *Sustainability* (Switzerland) (25 papers). The top 8 most impactful journals in terms of citations per paper were: *Environmental Pollution* (12.0), *Aerosol and Air Quality Research* (11.12), *Modeling Earth Systems and Environment* (10.50), *Environment, Development and Sustainability* (10.15), *Science of the Total Environment* (56.40), *Air Quality, Atmosphere and Health* (28.54), *Environmental Research* (14.29) (Table 5). A network visualization of top 20 journals is presented in Figure 4.

Table 5: Bibliometric Profile of Top 20 Journals.

S.No	Name of the journal	TC	TP	CPP
1	Indian Journal of Forensic Medicine and Toxicology	6	76	0.08
2	Science of the Total Environment	3384	60	56.40
3	Environmental Science and Pollution Research	176	45	3.91
4	International Journal of Environmental Research and Public Health	259	34	7.62
5	Environmental Research	400	28	14.29
6	Environment, Development and Sustainability	264	26	10.15
7	Aerosol and Air Quality Research	278	25	11.12
8	Sustainability (Switzerland)	67	25	2.68
9	Urban Climate	78	20	3.90
10	3 Biotech	113	19	5.95
11	Air Quality, Atmosphere and Health	371	13	28.54
12	Indian Journal of Ecology	4	13	0.31
13	Disaster Advances	3	12	0.25
14	Journal of Cleaner Production	53	11	4.82
15	Worldwide Hospitality and Tourism Themes	24	11	2.18
16	Environmental Pollution	120	10	12.00
17	Modeling Earth Systems and Environment	105	10	10.50
18	Journal of Environmental Chemical Engineering	74	8	9.25
19	Chemosphere	106	7	15.14
20	Environmental Footprints and Eco-Design of Products and Processes	0	7	0.00
Total of 20 journals		5885	460	12.79
India's total in journals			783	0.00
Share of top 20 journals in India;s total journal papers			58.75	0.00

TP=Total papers; TC=Total citations; CPP=Citations per paper; RCI=Relative citation index

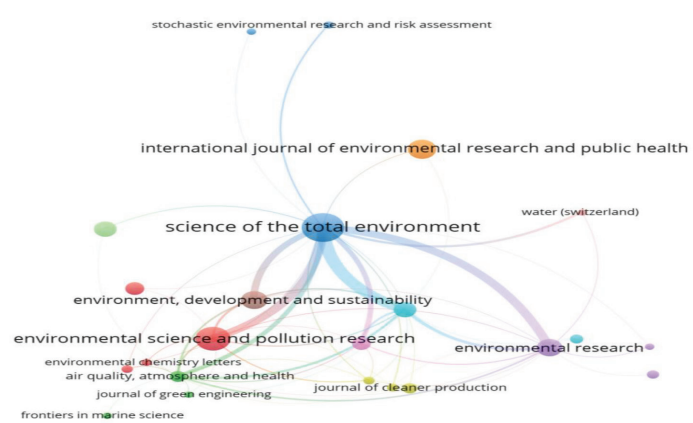


Figure 4: Network Visualization of Journals.

High Cited Papers

Out of 805 India's publications on "Covid-19 and Environmental Science", only 38 (2.08%) publications (assumed as highly cited here) received 50 to 450 citations since their publication and together received 4498 citations, averaging 648.02 citations per paper. Among 38 high-cited publications, 24 papers received 50 to 98 citations, 11 papers 100-250 citations and 3 papers 399-448 citations.

Among 38 high-cited papers, the largest number of contributions (6 papers) came from USA, followed by U.K. (4 papers), Australia, Brazil, Egypt, Italy, Saudi Arabia and Netherland (2 papers each) and 10 other countries with 1 paper each.

These 38 high-cited papers (28 articles, 9 reviews and 1 note) consisted of 11 non-collaborative papers and 27 collaborative papers (10 national collaborative and 17 international collaborative).

Among 110 high-cited papers, the largest institutional contribution (10 papers) came from Huazhong University of Science and Technology, China, followed by Tongji Medical College, China (9 papers), Harvard Medical School, USA. Brigham and Women's Hospital, USA and University of Pennsylvania, USA (7 papers each), INSERM, France (5 papers), Baylor College of Medicine, USA, Massachusetts General Hospital, USA and Universitat degli studi di Milano, Italy (4 papers each), etc.

The 38 high-cited publications on "Covid-19 and Environmental Science" are published in 18 journals, with 19 papers in *Science of the Total Environment*, 3 papers in *Air Quality, Atmosphere and Health*, 2 papers in *Environmental Research*, and 1 paper each in 16 other journals such as *Aerosol and Air Quality Research*, *Applied Energy*, *Bulletin of Environmental Contamination and Toxicology*, *Chemosphere*, *Current Opinion in Environmental Science and Health*, *Environmental Pollution*, *Environmental Science and Technology*, *International Journal of Environmental Research*, *International Journal of Environmental Research and Public Health*, *Modeling Earth Systems and Environment*, *NPJ Clean Water*, *Resources Conservation and Recycling*, *Resource Policy* and *Stochastic Environment Research and Risk Assessment*.

CONCLUSION

The present study evaluated the India's contribution on "Covid-19" impact on environmental studies, focusing on both national and international issues, based on publications indexed in Scopus database using quantitative and qualitative methods. The research undertaken looked at the performance of Indian organizations and authors and their collaborative relationship, identified the prominent sources and the most significant keywords and their co-occurrences indicating the trends of research. Here bibliometric analysis and visualization mapping were utilized to reveal and evaluate the developments in knowledge on Covid-2019 and its impacts based on a collection of environmental sources. The main focus of this bibliometric study is to illustrate the potential research hotspots emerged during this pandemic. It has been found that significant amount of research has been conducted for the assessment of environmental quality and its contribution in environmental transmission of Covid-19. Such an bibliometric exercise will also facilitate the researchers to identify significant hotspots and latest trends in the field. It will also guide the efforts in promoting global and Indian environmental strategies by various governments to control the different global risks related to air pollution, climate change and environmental degradation in the future.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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