

# **Citations and Publications on Zero Pollution Research during 2012-2021. A Scientometric Study**

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## **ABSTRACT**

*The present study has analyzed nearly 50637 publications in the field of citations and publications on Zero Pollution research during 2012-2021. A scientometric study. Of the 342076 citations, a maximum of 8491(16.77%) research publications are contributed in the year 2021, followed by 7593(14.99%) publications in the year 2020, and 7059(13.94%) publications in the year 2019. Singh, B. India has made the highest contribution by publishing 497(40.28% research publications. The RGR is 0.77 in the year 2013 and 0.18 in the year 2021. This study confirmed that the RGR is decreasing trend. At the same time doubling time was found that 0.90 in the year 2013 and .3.78 in the year 2021 and it is confirmed that doubling time is an increasing trend. The subject maximum of 18054(60.04%) research publications are contributed by computer science, The time series analysis statistical application will be expected in the year 2025 is around equal to 73243 and in the year 2030 is around equal to 107333, So the time series analysis research publication is increasing trend. The Majority of the research output is being published in the form of research articles (24224(47.84%) and conference papers (22562(44.56%). The journals have a maximum of 1860(26.98%) research publications that are contributed by the SAE Technical Papers. The Institute of a maximum of 1185(14.26%) contributions are Vellore Institute of Technology. In the country, a maximum of 50637(89.82%) research publications are contributed by India. The highly cited paper a maximum of 3462 citations are received for the publication of Vos, T., et.al (2017) Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016, The Lancet, 390(10100): 1211-1259.*

**KEYWORDS:** Scientometrics, relative citation index, relative growth rate and doubling time, degree of collaboration, collaborative co-efficient, collaborative index, modified collaborative co-efficient, time series, co-authorship index.

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## **INTRODUCTION**

Mankind's negative impact on the planet – and its health and environmental consequences – can be summed up in one word: pollution. Environmental and health policies seek to reduce pollution, often on a case-by-case basis, such as by banning or restricting a specific activity or substance. To tackle such problems in a coherent way in the context of the European Green Deal and the goal of a net-zero, truly sustainable economy by 2050, the European Commission in May published a strategy, the Zero Pollution Action Plan (ZPAP). Jointly with the Chemicals Strategy for Sustainability adopted last year, the ZPAP sets out measures that will be taken to end pollution. Zero pollution is defined as reducing discharges to air, soil, and water to levels “no longer considered harmful to health and natural ecosystems.” It is an ambitious goal that will need high levels of eco-innovation to succeed.

The Commission wants the zero-pollution aim to be achieved by 2050. In the meantime, a number of goals have been defined for 2030: air-pollution-related premature deaths cut by 55% and ecosystems threatened by air pollution cut by 25%; a halving of municipal waste and plastic litter at sea, and a 30% cut in the number of microplastics entering the environment; a halving of the use of chemical pesticides and of soil-nutrient losses. Doing all of this will require “investments in clean and sustainable design, circular economy business models, cleaner transport and mobility, low-emission technologies, nature-based solutions, and sustainable digitalization,” according to the strategy. There are thus multiple opportunities for eco-innovation. The zero-pollution strategy notes that innovation will be needed to make production cleaner, and there are specific needs for innovation in areas including reduction of pollution indoors, cutting pollution in the oceans, reducing pesticide use, limiting industrial emissions, and dealing with issues such as light pollution and nanoparticles.

To help think about these and other challenges, the zero-pollution strategy includes a handy hierarchy of action. The priority should be preventing pollution in the first place, followed by efforts to minimize and control it, and only then by cleaning up and remediating. As EU countries are working hard to develop their recovery plans and actions, the Commission urges them to seize this opportunity to fight pollution, embracing eco-innovation across the board and reaping the benefits. Green technologies can help Europe reduce pollution and offer business opportunities. Just think of better air pollution monitoring systems, new decontamination techniques, or state-of-the-art solutions to remove microplastics from water. The challenges are huge but fortunately, there are already numerous efforts underway, and a solid basis of experience from EU-backed projects dealing with pollution reduction or elimination. Often these projects go unheralded – they may take place in unglamorous industrial sectors, for example. Nevertheless, the knowledge is there to be built on.<sup>1</sup>

## **Scientometric Study**

Scientometric is a study to measure the performance of researchers as well as research publications. The research activities contain major changes over the last few decades and emerged as established research in the discipline of “Library and Information Science”. The study of scientific literature has a long history dating back to the early decades of the past century. However, despite in the number of research literature in this area, it was not until 1969, that the term bibliometrics first appeared in print (**Pritchard 1969**)<sup>2</sup>. The definition of bibliometric was the ‘application of mathematical and statistical methods to books and other media of communication’, particularly in North America, the term was quickly adopted and used (**Wilson, 1999**)<sup>3</sup>. At the same time, **Nalimov and**

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**Mulchenko (1969)**<sup>4</sup> coined the term scientometrics to refer to ‘the application of quantitative methods which are dealing with the analysis of science viewed as an information processing contrast, this term was widely used in Europe (**Wolfram, 2003**)<sup>5</sup>. Initially, therefore, scientometrics was restricted to the measurement of science communication, whereas bibliometrics was designed to deal with more general information processes, **Andres A (2009)**<sup>6</sup> **Van Raan (1997)**<sup>7</sup> According to scientometric research is devoted to Quantitative studies of science and technology. So that this paper aims to analyze the contribution of wastewater management research publications published in the Scopus database from 2010 to 2019. According to **Beck (1978)**<sup>8</sup> “Scientometrics is defined as the quantitative evaluation and inter-comparison of scientific activity, productivity, and progress”. **Bookstein (1995)**<sup>9</sup> defined “scientometrics as the science of measuring science. Scientometrics is also considered as a bibliometric measurement for evaluation of scientific development, social relevance, and impact of the application of science and technology”. **Ingwerson and Christensen (1997)**<sup>10</sup> defined the term “informatics designates a recent extension of the traditional bibliometric analysis, also to cover non-scholarly communities in which information is produced, communicated and used”.

### **LITERATURE REVIEW**

**P. Rajendran et.al (2013)**<sup>11</sup> examine the Scientometric Analysis of India’s Research Output on Wireless Communication (2001 – 2012). Indian scientists published 1128 research papers with an average of 94 papers per year and the most preferred type is a conference paper. Analysis of the authorship pattern reveals that Indian scientists prefer to do research with a co-author than solo. A Co-authorship pattern also indicates that Indian scientists are willing to work with a co-author (two authors). The degree of collaboration is 0.95 for the study period which reveals that there exists a high level of collaboration among the authors. Anna University is the leading institution in this research field and IITs also contributed a significant number of papers. Communications in Computer and Information Science is the top journal preferred by Indian scientists to publish their research findings.

**V. Viswanathan et.al (2017)**<sup>12</sup> mapping of Andrology Research Productivity: A Scientometric Study Based on Scopus Database for the period 2007-2016. A total number of 2619 research outputs were published in the field between 2007 and 2016 and collaborated research work dominates throughout the study period. In the overall productivity, 80.45% of publications received citations with an average of 11.98 citations per paper. The average value of the uncited/cited ratio is 0.24. An article written by Cooper T.G., et al., in the Human Reproduction Update published in the year 2009 on “World Health Organization reference values for human semen characteristics” received a maximum of 646 citations. The United States of America has contributed 23.37% of the total productivity and ranked top in terms of publications. “Andrology” is the most preferred journal among the researchers and the organization “Rigs Hospitale” has contributed the maximum number of publications.

**N.Amsaveni & Hari Krishnan C.A (2018)**<sup>13</sup> a scientometric analysis of environmental management research output from 1989 to 2014. The main objective of this article is to find out the most prolific authors and journals in the environmental management research output from 1989 to 2014. This area is an interdisciplinary subject and developed dramatically over the last few decades. Scientometrics offers assess the quantitative analytical techniques with the development and growth of research in Environmental management. The total sample data retrieved from the database of Web of Knowledge, includes, SCI, SSCI, and A&HCI. Total records of 61877 research articles were

retrieved from 22 types of different sources. The applicability of Bradford's law and Lotka's law methods was tested.

**S. Ravichandran et.al (2022)<sup>14</sup>** Covid-19 and Infertility: A Scientometric Assessment of Global Publications. A scientometric analysis of the publications data for the study was sourced from the Scopus database during 2019 and 2021 with 10700 research publications and 210744 citations. The maximum growth of 9168(85.68%) research publications contributed in the year 2021. Countries a maximum of 3367(38.45%) contributions are from the United States. The study subjects a maximum of 1605(63.06%) contributions are Biochemistry, Genetics, and Molecular Biology. The author's maximum of 70(17.41%) contributions is Baden, L.R., and the United States. In the document type, a maximum of 5971(55.80%) research publications are contributed by articles. The study Institution with a maximum of 221(15.04%) contributions is the Harvard Medical School.

**E. Nishavathi and R. Jeysankar (2020)<sup>15</sup>** A Scientometric Social Network Analysis of International Collaborative Publications of All India Institute of Medical Sciences, India. Scientometrics and social network analysis (SNA) measures were used to analyze the international scientific collaboration (ISC) of the All India Institute of Medical Sciences (AIIMS) for a period of 10 years (2009-2018). The dataset consists of 19,622 records retrieved from the Scopus database. The mean degree of collaboration of 0.95 implied that researchers of AIIMS tend to collaborate domestically (80.29%) and internationally (14.67%). The data exhibits a hyper-authorship pattern, and a medium-size research team consists of 4 to 10 authors who contributed a maximum of 62.08% (12,182) publications. 71.97% of research findings are scattered in journal articles. The most preferred journals published 58.55% of medical literature.

**B. Elango and B.M.Gupta (2022)<sup>16</sup>** Application of Artificial Intelligence to Covid-19: A Scientometric Analysis of Global Publications during 2020-21. The paper examines global 1142 research publications in the field of "Application of Artificial Intelligence to Covid-19" during 2020-21, using publication data indexed in the Scopus database. It assesses and evaluates the research performance of this theme based on quantitative and qualitative indicators. 1142 global papers have been cited 7673 times, articles involving 87 countries, organizations, and 5069 authors. Global research comes from 542 different sources. Research has observed that the United States and India lead the world, accounting for 21.54% and 19.53% share in global publications and citations respectively. The study tracks key research organizations, authors, research areas, and most significant keywords, cited papers, and productive sources. The study also presents a visual map of a collaborative network involving key countries, institutions, authors, and important keywords in this domain.

**N. Siva et.al (2019)<sup>17</sup>** Global Research Publications on Hepatitis C from SCOPUS Database (2009-2018): A Scientometric Study. This study aims to analyze the hepatitis c research publications, carried out by using the Scopus online database during the period of ten years from 2009 to 2018. This study find out the year-wise growth of publications, country, author, organization, document type, language-wise publications, and citation analysis and identified the impact factor (IF) of the journal productivity in the field of hepatitis C research. During the ten-year study period, it identified that 59926 publications contributed to the field of hepatitis C research. During the period, RGR is 0.71 to 0.10 and correspondingly the doubling time (Dt) is 0.98 to 7.28. A maximum of 41141 (68.65%)

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research publications are articles, and 55746 research publications are in the English Language. A maximum of 18160 (23.10%) publications are contributed by the United States and the relative citation index is varied from 0.95 to 3.3.

**R. Jeysankar and A. Vellaichamy (2016)<sup>18</sup>** Scientometric Analysis of Autism Research Output during 2007-2011. In the present study, we attempt to analyze 13079 global literature on Autism, indexed in the Scopus database during 2007- 11. Totally 70 countries contributed to the literature, with the majority of the papers coming from the USA (49.24%). The study analyzed that Indian scientists together published 134 papers on Autism research during 2007-11. India ranks 17th among the other countries in Autism research with a global publications share of 1.01% during 2007-11. In-depth, this study analyzed that majority of the publications are published in the form of articles (64.76%) and the majority (79%) of the scientists preferred to publish their research papers in joint authorship. The study also analyzed that majority of the autism research appeared in the Journal of Autism and Developmental Disorders (7.19%).

**S. Ravichandran and S. Vivekanandhan (2022)<sup>19</sup>** Scientometric Analysis of Soil Pollution Research Publications from SCOPUS Database during 2011 – 2020. With a total number of 35,572 research publications. A compound annual growth rate of 1.61. The relative growth rate is 0.69 in the year 2012 and 0.15 in the year 2020. At the same time, doubling time is found that 1.00 in the year 2012 and 4.72 in the year 2020. The majority of the authors in the field are preferred to publish their research works in four authorship modes with 6,359 publications. The average degree of collaboration is 0.96, the average collaborative coefficient is 0.72 ties and the average collaborative index value is 4.38 and the average modified CC value is 4.38. A maximum of 142 (14.68%) research publications are contributed by Ok Y-S, India. This study identified that time series analysis will be expected in the soil pollution research publications in the year 2025 around are equal to 4,657 and in the year 2030 around are equal to 5,207.

### **OBJECTIVES THE STUDY**

The main objective of this study was to use Scientometrics to analyze the zero pollution Research Output covered in the Scopus database during 2012 - 2021:

- ❖ To identify and analyze the growth rate of world research in yoga research output publications
- ❖ To analyze the author's, relative growth rate and doubling time research output publications
- ❖ To analyze the subject of research output publications
- ❖ To analyze the time series research output publications
- ❖ To know the global research output of document-wise distribution of publications
- ❖ To assess the institution-wise and journals research concentration;
- ❖ To examine the country-wise distribution of publications;
- ❖ To analyze the Funding Agencies supported Yoga research
- ❖ To analyze highly cited papers of research publications

### **METHODOLOGY**

The study retrieved and downloaded 10 years of publications data on the global output in Zero pollution research output from the Scopus database covering the period of 2012-2021. The present study aims to analyze the research

output of Researchers in the field of Zero pollution Research Output. The growth rates of output in terms of research productivity were analyzed during the study period. The data have been extracted and tabulated in the form of tables and figures and it is also analytical in nature strengthening the empirical validity due to the application of suitable statistical tools. The data was collected on 23.05.2022 and the Micro Soft excel format was downloaded.

## **DATA ANALYSIS AND INTERPRETATIONS**

### **Relative Citation Index (RCI)**

The relative citation index (RCI) was developed by the institute of scientific information and examined the impact of different countries, institutions, authors, and journals research publications. The scientific impact of leading countries was examined by using two relative indicators, namely citations per paper (CPP) and relative citations index (RCI). Citations per paper (CPP) is a relative indicator computed as the average number of citations per paper. To measure both influence and visibility of country research, the following formula has been used by Bharvi Dutt and Khaiser Nikam (2016)<sup>20</sup>

$$RCI = \frac{\text{A Country share of the World Citations}}{\text{A Country share of the World Publications}}$$

RCI = 1 indicates that a country's citation rate is equal to the world citation rate

RCI > 1 indicates that a country's citation rate is greater than the world citation rate

RCI < 1 indicates that a country's citation rate is lower than the world citation rate

### **Year-wise growth of Zero pollution research publications**

**Table 1** Year-wise growth of Zero pollution research publications

S. No	Year	Publication	%	Citations	%	h-index	CPP	RCI
1	2012	2274	4.49	30833	9.01	78	13.56	2.01
2	2013	2650	5.23	33380	9.76	69	12.60	1.86
3	2014	3206	6.33	40093	11.72	76	12.51	1.85
4	2015	3784	7.47	35364	10.34	69	9.35	1.38
5	2016	4355	8.60	43165	12.62	71	9.91	1.47
6	2017	4760	9.40	51342	15.01	73	10.79	1.60
7	2018	6465	12.77	39750	11.62	88	6.15	0.91
8	2019	7059	13.94	36464	10.66	57	5.17	0.76
9	2020	7593	14.99	30205	8.83	52	3.98	0.59
10	2021	8491	16.77	1480	0.43	32	0.17	0.03
	Total	50637	100.00	342076	100.00			
	CAGR	14.08						

Table 1 shows the year-wise growth of Zero pollution research publications during the 10- year study period between 2012 and 2021 with 50637 research publications and 342076 citations. From the study, it is identified that a maximum of 8491(16.77%) research publications are contributed in the year 2021, followed by 7593(14.99%) publications in the year 2020, and 7059(13.94%) publications in the year 2019. The average research publication per year is 5063.7.

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During the 10 - year study it is identified that a total number of 50637 publications received 342076 citations. Out of that maximum of 51342(15.01%), citations received 4760 publications in the year 2017. Followed by 43165(12.62%) citations received 4355 publications in the year 2016 and 40093(11.72%) publications in the year 2014. The maximum citation per paper is 13.56 in the year 2012, followed by a CPP of 12.60 in the year 2013, and by CPP is 12.51 in the year 2014 and the average citation per paper is 8.417. The maximum RCI is 2.01 and the h-index is 78 in the year 2012. The minimum RCI is 0.03 and the h-index is 32 in the year 2021.

### **Top 10 Authors 'Contributions to Zero pollution research publications**

**Table 2** Top 10 Author's Contributions to Zero pollution research publications

S.No	Author	Country	Publications	%	Citations	%	CPP	H-Index	RCI
1	Singh, B.	India	497	40.28	3954	23.80	7.96	29	0.59
2	Kumar, N.	United States	161	13.05	4999	30.09	31.05	40	2.31
3	Subramanian, S.C.	United Kingdom	87	7.05	404	2.43	4.64	9	0.34
4	Pal, P.K.	Canada	84	6.81	1164	7.01	13.86	20	1.03
5	Gopakumar, K.	China	82	6.65	1425	8.58	17.38	21	1.29
6	Kumar, P.	Australia	81	6.56	885	5.33	10.93	13	0.81
7	Ghose, D.	Saudi Arabia	70	5.67	548	3.30	7.83	11	0.58
8	Narayanan, G.	Germany	62	5.02	782	4.71	12.61	15	0.94
9	Rodrigues, J.J.P.C.	South Korea	55	4.46	1604	9.65	29.16	22	2.17
10	Subudhi, B.	Malaysia	55	4.46	849	5.11	15.44	14	1.15
	Total		1234	100.00	16614	100.00			

Table 2 identified the top 10-author contributions for the research publications on zero pollution research from the Scopus database from the study, it is identified that the maximum of 497(40.28%) research publications are contributed by Singh, B. India, followed by Kumar, N. the United States with 161(13.05%) research publications, Subramanian, S.C., the United Kingdom with 87(7.05%) research publications. The highest citations of were 4999(30.091%) Kumar, N, the United States, and the lowest number of citations is 404(2.43%) Subramanian, S.C. The highest CPP is 31.05, the H-index is 40 and RCI is 2.31. The lowest CPP is 4.64, the H-index is 9 and RCI is 0.34. From this study, it is identified that 1234(100%) research publications are contributed by the top 10 authors from 10 different countries.

**Relative Growth Rate of Publications**

The relative growth of publications was analyzed by using the two parameters namely relative growth rate and doubling time originated by Mahapatra (1985)<sup>21</sup>. RGR is a measure to study the increases in the number of articles over a period of time. It is calculated as

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

Whereas

R (a) = RGR = the mean relative growth rate over the specific period of interval

W<sub>1</sub> = the logarithm of the beginning number of publications/pages

W<sub>2</sub>= the logarithm of the ending number of publications/pages after a specific period of interval

T<sub>2</sub> – T<sub>1</sub> = the unit difference between the beginning time and the ending time.

**Doubling Time**

The doubling time is the time taken for the doubling of the number of records actually published within a stipulated period. The doubling time is calculated from the relative growth rate and the natural logarithm number is used, the difference has a value of 0.693. Thus the corresponding doubling time can be calculated by the following formula,

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

**Relative Growth Rate and Doubling Time of Zero pollution research publications**

**Table 3** Relative Growth Rate and Doubling Time of Zero pollution research publications

S.No	Years	Publications	Cum	W1	W2	RGR=(W2-W1)	Dt=(0.693/RGR)
1	2012	2274	2274		7.73		
2	2013	2650	4924	7.73	8.50	0.77	0.90
3	2014	3206	8130	8.50	9.00	0.50	1.38
4	2015	3784	11914	9.00	9.39	0.38	1.81
5	2016	4355	16269	9.39	9.70	0.31	2.22
6	2017	4760	21029	9.70	9.95	0.26	2.70
7	2018	6465	27494	9.95	10.22	0.27	2.59
8	2019	7059	34553	10.22	10.45	0.23	3.03
9	2020	7593	42146	10.45	10.65	0.20	3.49
10	2021	8491	50637	10.65	10.83	0.18	3.78
	Total	50637					

The relative growth rate and the doubling time (Dt) were calculated and the results are presented in table 3. From the study, it is identified that the relative growth rate is 0.77 in the year 2013 and 0.18 in the year 2021. This study confirmed that the relative growth rate is decreasing trend. At the same time doubling time was found that 0.90 in the year 2013 and .3.78 in the year 2021 and it is confirmed that doubling time is an increasing trend.



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### **Subject wise of Zero pollution research publications**

**Table 4** Subject wise of Zero pollution research publications

S. No	Subject	Publications	%
1	Agricultural and Biological Sciences	732	2.43
2	Arts and Humanities	126	0.42
3	Biochemistry, Genetics, and Molecular Biology	2802	9.32
4	Business, Management, and Accounting	1329	4.42
5	Chemical Engineering	2227	7.41
6	Chemistry	1211	4.03
7	Computer Science	18054	60.04
8	Decision Sciences	2451	8.15
9	Dentistry	141	0.47
10	Earth and Planetary Sciences	999	3.32
	Total	30072	100.00

Table 4 identified the top ten subject contributions for the research publications of zero pollution research from the Scopus database. From the study it is identified that a maximum of 18054(60.04%) research publications are contributed by computer science, followed by Biochemistry, Genetics, and Molecular Biology with 2802(9.32%) research publications, Decision science with 2451(8.15%) research publications. The lowest subject is Arts and Humanities with 126(0.42%). Research publications.

### **Time Series Analysis**

Time series analysis reveals the estimated growth values are identified based on previous data. A straight-line equation is adapted to measure the future values based on previous data. Time series analysis used by **Jeysankar and Ramesh babu (2013)<sup>22</sup> Ravichandran (2020)<sup>23</sup>**

### **Time Series Analysis of Zero pollution research publications**

**Table 5** Time Series Analysis of Zero pollution research publications

S. No	Years	Count(Y)	X	X <sup>2</sup>	XY
1	2012	2274	-5	25	-11370
2	2013	2650	-4	16	-10600
3	2014	3206	-3	9	-9618
4	2015	3784	-2	4	-7568
5	2016	4355	-1	1	-4355
6	2017	4760	1	1	4760
7	2018	6465	2	4	12930
8	2019	7059	3	9	21177
9	2020	7593	4	16	30372
10	2021	8491	5	25	42455
	Total	50637		110	68183

Table 5 shows that the time series analysis formula has been predicted for Zero pollution research publications for the years 2025 and 2030

The straight Line Equation is

$$Y = a + bx$$

Here,

$$\sum Y = 50637, \sum X^2 = 110, \sum XY = 68183$$

$$a = \sum Y/N = 50637/10 = 5063.7 = 5063$$

$$b = \sum XY / \sum X^2 = 68183/10 = 6818.3 = 6818$$

Estimated publications in the year 2025 are when  $X=2025-2015=10$

$$Y = a + bx$$

$$= 5063 + (6818 * 10) = 5063 + 68180 = 73243$$

The estimated literature in 2030 is when  $X=2030-2015=15$

$$Y = a + bx$$

$$= 5063 + (6818 * 15) = 5063 + 102270 = 107333$$

The estimated growth based on a time series analysis statistical application will be expected in the zero pollution research publications in the year 2025 is around equal to 73243 and in the year 2030 is around equal to 107333. So that time serious analysis confirmed that the publications on zero pollution research are increasing trend.

### Document Types of Zero pollution research publications

**Table 6** Document Type of Zero pollution research publications

S.No	Document Type	Publications	%	Cumulative	%
1	Article	24224	47.84	24224	3.88
2	Conference Paper	22562	44.56	46786	7.50
3	Review	1613	3.19	48399	7.76
4	Book Chapter	1488	2.94	49887	8.00
5	Letter	313	0.62	50200	8.05
6	Note	141	0.28	50341	8.07
7	Retracted	90	0.18	50431	8.08
8	Editorial	71	0.14	50502	8.10
9	Book	65	0.13	50567	8.11
10	Short Survey	33	0.07	50600	8.11
11	Erratum	25	0.05	50625	8.12
12	Data Paper	6	0.01	50631	8.12
13	Undefined	6	0.01	50637	8.12
	Total	50637	100.00	623830	100.00

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Document types identified during the 10- year study period on zero pollution research publications are shown in table 6. From the study, it is identified that a maximum of 24224(47.84%) research publications are contributed by articles, followed by 22562(44.56%) research publications are Conference Paper and third placed in the Review with 1613(3.19%) research publications. The lowest document type of data paper, and undefined 6(0.01%) research publications. This study confirmed that more than 92.39% of research publications are contributed by articles and conference papers. The remaining nearby 7.61% of research publications are identified in the other form documents.

### **Journal's Contributions to Zero pollution research publications**

**Table 7** top 10 Journal Contributions to Zero pollution research publications

S. No	Journals	Publications	%	Citations	%	CPP	H-Index	RCI
1	SAE Technical Papers	1860	26.98	2328	21.23	1.25	11	0.79
2	Advances In Intelligent Systems And Computing	756	10.97	1662	15.15	2.20	14	1.38
3	Materials Today Proceedings	724	10.50	2501	22.80	3.45	19	2.17
4	Lecture Notes In Electrical Engineering	682	9.89	753	6.87	1.10	8	0.69
5	International Journal of Applied Engineering Research	678	9.84	1172	10.69	1.73	14	1.09
6	Lecture Notes In Mechanical Engineering	527	7.65	319	2.91	0.61	6	0.38
7	Ito Conference Series Materials Science And Engineering	496	7.20	826	7.53	1.67	10	1.05
8	International Journal of Innovative Technology And Exploring Engineering	444	6.44	602	5.49	1.36	10	0.85
9	International Journal of Recent Technology And Engineering	395	5.73	461	4.20	1.17	9	0.73
10	Journal Of Advanced Research In Dynamical And Control Systems	331	4.80	343	3.13	1.04	9	0.65
	Total	6893	100.00	10967	100.00			

Table 7 shows the top10 journals' contributions in the field of zero pollution research. From the study, it is identified that the maximum of 1860(26.98%) research publications are contributed by the SAE Technical Papers, followed by Advances in Intelligent Systems and Computing with 756(10.97%) research publications, third-placed in the Materials Today Proceedings with 724(10.50%) research publications. During 10- the year study period the highest number of citations was 2501(22.80%) from the Materials Today Proceedings, the CPP is 3.45, the H-Index is 19 and RCI is 2.17. The Lowest citations were 319(2.91%) Lecture Notes In Mechanical Engineering, the CPP is 0.61, the H-Index is 06 and the RCI is 0.38 During the 10- year study period the top 10 journals contributed by 6893(100. %) research publications.

**Top 10 Institution contributions to Zero pollution research publications**

**Table 8** Top 10 Institutions’ contributions to Zero pollution research publications

S.No	Organization	Publications	%	Citations	%	CPP	H-Index	RCI
1	Vellore Institute of Technology	1185	14.26	6685	9.50	5.64	40	0.67
2	Indian Institute of Technology Delhi	1106	13.31	10574	15.02	9.56	44	1.13
3	Indian Institute of Technology Madras	891	10.72	8524	12.11	9.57	37	1.13
4	Indian Institute of Science	855	10.29	10978	15.59	12.84	43	1.52
5	Anna University	827	9.95	4727	6.71	5.72	29	0.67
6	SRM Institute of Science and Technology	807	9.71	3072	4.36	3.81	23	0.45
7	Indian Institute of Technology Bombay	734	8.83	7128	10.13	9.71	39	1.15
8	Indian Institute of Technology Kharagpur	708	8.52	9963	14.15	14.07	47	1.66
9	Indian Institute of Technology Roorkee	648	7.80	6770	9.62	10.45	37	1.23
10	Sathyabama Institute of Science and Technology	548	6.60	1978	2.81	3.61	18	0.43
	Total	8309	100.00	70399	100.00			

During the 10-year study period, the top 10 institutions’ contributions are identified in table 8, from the study the maximum of 1185(14.26%) contributions are Vellore Institute of Technology, followed by Indian Institute of Technology Delhi contributed with 1106(713.31%) research publications, Indian Institute of Technology Madras contributed with 891(10.72%) research publications. The highest citations were 10574(1502%) from the Indian Institute of Technology Delhi, and the CPP is 9.56 the H- Index is 44, and RCI is 1.66. The lowest citations of 1978(2.81%) Sathyabama Institute of Science and Technology, and a CPP is 3.61, H-Index is 18 and RCI is 0.43. . During 10- the year study period Top 10 institutions are contributed by 8309(100%) research publications.

**Top 10- countries’ Contributions to Zero pollution research publications**

**Table 9** Country-wise Contributions to Zero pollution research publications

S. No	Country	Publications	%	Citations	%	CPP	H-Index	RCI
1	India	50637	89.82	64085	22.38	1.27	64	0.25
2	United States	2093	3.71	53952	18.84	25.78	90	5.07
3	United Kingdom	734	1.30	32212	11.25	43.89	63	8.64

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4	Canada	523	0.93	24626	8.60	47.09	52	9.27
5	China	469	0.83	21867	7.64	46.62	50	9.18
6	Australia	445	0.79	21290	7.43	47.84	52	9.42
7	Saudi Arabia	426	0.76	17009	5.94	39.93	42	7.86
8	Germany	383	0.68	20629	7.20	53.86	44	10.60
9	South Korea	351	0.62	16581	5.79	47.24	45	9.30
10	Malaysia	312	0.55	14115	4.93	45.24	35	8.91
	Total	56373	100.00	286366	100.00			
	Others Country - 144	5277						
	total	61650						

Table 9 shows the top 10 countries' research publications for zero pollution research during the study period from 2012-2021. From this study, it is identified that a maximum of 50637(89.82%) research publications are contributed by India, followed by the United States with 2093(3.71%) research publications, and third place is the United Kingdom with 734(1.30%) research publications. During ten year study period the highest number of citations was 64085(22.38%) in India, the CPP is 53.86, the H-index is 90 and RCI is 10.60. The lowest citations of were 14115 (4.93%) in Malaysia. The CPP is 1.27, the H-index is 35 and RCI is 0.25. The top 10 countries contributed 56373(100. %) research publications.

#### **Top 10- Funding agency's Contributions to Zero pollution research publications**

**Table 10** top 10 Funding agency's Contributions to Zero pollution research publications

S. No	Funding agency	Publications	%
1	Department of Science and Technology, Ministry of Science and Technology, India	1106	26.90
2	Science and Engineering Research Board	549	13.35
3	Council of Scientific and Industrial Research, India	465	11.31
4	Department of Science and Technology, Government of Kerala	380	9.24
5	University Grants Commission	370	9.00
6	Indian Council of Medical Research	296	7.20
7	Department of Biotechnology, Ministry of Science and Technology, India	280	6.81
8	Ministry of Human Resource Development	244	5.93
9	National Institutes of Health	228	5.54
10	University Grants Committee	194	4.72
	Total	4112	100.00

Table 10 shows the top 10 funding agencies' research publications for zero pollution research during the study period from 2012-2021. From this study, it is identified that a maximum of 1106(26.90%) research publications are contributed by the Department of Science and Technology, Ministry of Science and Technology, India, followed by Science and Engineering Research Board with 549(13.35%) research publications, and third place is the Council of

Scientific and Industrial Research, India with 465(11.31%) research publications. The lowest funding agency 194(4.72%) University Grants Committee. The top 10 funding agencies contributed 4112(100%) research publications.

**Highly Cited paper top 10 Zero pollution research publications**

**Table 11** Highly Cited paper top 10 Zero pollution research publications

S. No	Authors	Citation	Document Type
1	Vos, T., et.al (2017) Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016, <i>The Lancet</i> , 390(10100): 1211-1259.	3462	Article
2	Ade, P.A.R., et.al (2014) Planck 2013 results. I. Overview of products and scientific results, <i>Astronomy and Astrophysics</i> , 571, Art.No: A1.	2812	Article
3	Naghavi, M. et.al (2017) Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: A systematic analysis for the Global Burden of Disease Study 2016, <i>The Lancet</i> , 390(10100):1151-1210.	2575	Article
4	Marchetti, M.C., et.al (2013) Hydrodynamics of soft active matter, <i>Reviews of Modern Physics</i> , 85(3):1143-1189.	2041	Article
5	Harrison, F.A., et.al (2013) The Nuclear Spectroscopic Telescope Array (NuSTAR) high-energy X-ray mission, <i>Astrophysical Journal</i> , 770(2), Art.No:103.	1247	Article
6	Hay, S.I., et.al (2017) Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries, and 390(10100):1260-1344.	1163	Article
7	Feigin, V.L., et.al (2019) Global, regional, and national burden of neurological disorders, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016, <i>The Lancet Neurology</i> , 18(5):459-480.	1046	Article
8	Feigin, V.L., et.al (2017) Global, regional, and national burden of neurological disorders during 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015, <i>The Lancet Neurology</i> , 16(11):877-897.	1020	Article
9	O'Donnell, M.J., et.al (2016) Global and regional effects of potentially modifiable risk factors associated with acute stroke in 32 countries (INTERSTROKE): a case-control study, <i>The Lancet</i> , 388(10046):761-775.	856	Article
10	Senapati, S., et.al (2018)Controlled drug delivery vehicles for cancer treatment and their performance, <i>Signal Transduction and Targeted Therapy</i> , 3(1), Art.No:7	734	Review

Table 11 the highly cited top 10 zero pollution research publications during the selected 10- year study period. From the study, it is identified that a maximum of 3462 citations are received for the publication of Vos, T., et.al (2017)

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Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016, *The Lancet*, 390(10100): 1211-1259. Followed by 2812 citations by Ade, P.A.R., et.al (2014) Planck 2013 results. I. Overview of products and scientific results, *Astronomy and Astrophysics*, 571, Art.No: A1. And 2575 Naghavi, M. et.al (2017) Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: A systematic analysis for the Global Burden of Disease Study 2016, *The Lancet*, 390(10100):1151-1210. The top 10 highly cited publications are covered by 09 articles and 01 review.

### **MAJOR FINDING**

- ❖ During the 10- year study period between 2012 and 2021 with 50637 research publications and 342076 citations. From the study, it is identified that a maximum of 8491(16.77%) research publications are contributed in the year 2021, followed by 7593(14.99%) publications in the year 2020, and 7059(13.94%) publications in the year 2019. The average research publication per year is 5063.7.
- ❖ During the author the maximum of 497(40.28%) research publications are contributed by Singh, B. India, followed by Kumar, N. the United States with 161(13.05%) research publications, Subramanian, S.C., the United Kingdom with 87(7.05%) research publications.
- ❖ The relative growth rate is 0.77 in the year 2013 and 0.18 in the year 2021. This study confirmed that the relative growth rate is decreasing trend. At the same time doubling time was found that 0.90 in the year 2013 and .3.78 in the year 2021 and it is confirmed that doubling time is an increasing trend.
- ❖ During the subject maximum of 18054(60.04%) research publications are contributed by computer science, followed by Biochemistry, Genetics, and Molecular Biology with 2802(9.32%) research publications, and Decision science with 2451(8.15%) research publications.
- ❖ The time series analysis statistical application will be expected in the zero pollution research publications in the year 2025 is around equal to 73243 and in the year 2030 is around equal to 107333. So that time serious analysis confirmed that the publications on zero pollution research are increasing trend.
- ❖ The document types a maximum of 24224(47.84%) research publications are contributed by articles, followed by 22562(44.56%) research publications are Conference Paper and third placed in the Review with 1613(3.19%) research publications.
- ❖ During the journals the maximum of 1860(26.98%) research publications are contributed by the SAE Technical Papers, followed by Advances in Intelligent Systems and Computing with 756(10.97%) research publications, third-placed in the Materials Today Proceedings with 724(10.50%) research publications.
- ❖ During the Institute the maximum of 1185(14.26%) contributions are Vellore Institute of Technology, followed by the Indian Institute of Technology Delhi contributed with 1106(713.31%) research publications, Indian Institute of Technology Madras contributed with 891(10.72%) research publications.
- ❖ In the country a maximum of 50637(89.82%) research publications are contributed by India, followed by the United States with 2093(3.71%) research publications, and third place is the United Kingdom with 734(1.30%) research publications.
- ❖ During the funding agency maximum of 1106(26.90%) research publications are contributed by the Department of Science and Technology, Ministry of Science and Technology, followed by Science and

Engineering Research Board with 549(13.35%) research publications, and third place is the Council of Scientific and Industrial Research, India with 465(11.31%) research publications

- ❖ During the maximum of 3462 citations are received for the publication of Vos, T., et.al (2017) Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016, *The Lancet*, 390(10100): 1211-1259.

## REFERENCE

- [1] [https://ec.europa.eu/environment/ecoap/about-eco-innovation/policies-matters/zero-pollution-and-how-achieve-it\\_en](https://ec.europa.eu/environment/ecoap/about-eco-innovation/policies-matters/zero-pollution-and-how-achieve-it_en) (Online accessed on 25.09.2022)
- [2] Pritchard, A. (1969). Statistical bibliography or bibliometrics, *Journal of Documentation*, 24: 348–9.
- [3] Wilson, C.S. (1999). Informatics, in M. Williams (ed.), *Annual Review of Information Science and Technology*. Medford, NJ: *Information Today*, 34, 107-247.
- [4] Nalimov, V.V. and Mulchenko, B.M. (1969). Scientometrics. Moscow: *Nauka*, 15(1): 213-224.
- [5] Wolfram, D. (2003). *Applied Informetrics for Information Retrieval Research*. Westport, CT: *Libraries Unlimited*, 4(3): 431-432.
- [6] Ana Andres (2009). *Measuring Academic Research: How to undertake a bibliometric study*, New Delhi, *Chandos Publishing Oxford*, Cambridge, ISBN 1843345285.
- [7] Van Raan AFJ (1997). Scientometrics state- of The Art, *Scientometrics*, 38(1): 205-218.
- [8] Beck MT (1978) “Editorial Statement”. *Scientometrics*. 1(1): 3-4.
- [9] Bookstein A (1976). The bibliometric distributions. *Library Quarterly*, 46(4): 416-423.
- [10] Ingwersen P and Christensen FH (1997). “Data set isolation for bibliometric online analysis of research publication: fundamental methodological issues”. *Journal of the American Society for Information Science*, 48, 205-217.
- [11] P. Rajendran et.al (2013) Scientometric Analysis of India’s Research Output on Wireless Communication (2001 – 2012), *Journal of Advances in Library and Information Science*, 2(3): 105-111
- [12] V. Viswanathan et.al (2017) Mapping of Andrology Research Productivity: A Scientometric Study Based on Scopus Database, *International Journal of Library and Information Studies*, 7(4): 1-11.
- [13] N.Amsaveni & Hari Krishnan C.A (2018) a scientometric analysis of environmental management research output from 1989 to 2014, *Library Philosophy and Practice (e-journal)*. 1846. 1-13.
- [14] S. Ravichandran et.al (2022) Covid-19 and Infertility: A Scientometric Assessment of Global Publications, *International Journal of Research in Library Science (IJRLS)*, 8(3): 191-206.
- [15] E. Nishavathi and R. Jeyshankar (2020) A Scientometric Social Network Analysis of International Collaborative Publications of All India Institute of Medical Sciences, India, *Journal of Information Science Theory and Practice*, 8(3): 64-76.
- [16] B. Elango and B.M.Gupta (2022) Application of Artificial Intelligence to Covid-19: A Scientometric Analysis of Global Publications during 2020-21, *library herald*, 60(1): 1-12.
- [17] N. Siva et.al (2019) Global Research Publications on Hepatitis C from SCOPUS Database (2009-2018): A Scientometric Study, *Library Philosophy and Practice (e-journal)*. 2454, 1-12.



## ***Citations and Publications on Zero Pollution Research during 2012-2021. A Scientometric Study***

- [18] R. Jeyshankar and A. Vellaichamy (2016) Scientometric Analysis of Autism Research Output during 2007-2011, *SRELS Journal of Information Management*, 53(1): 1-9
- [19] S. Ravichandran and S. Vivekanandhan (2022) Scientometric Analysis of Soil Pollution Research Publications from Scopus Database during 2011 – 2020, *JIM - Journal of Information Management* 9(1): 71-82.
- [20] Bharvi, D. and Khaiser, N. (2016). Scientometric analysis of global solar cell research. *Annals of Library and Information Studies*, 63, 31-41.
- [21] Mahapatra, M, (1985) on the validity of the theory of exponential growth of scientific literature. *Proceedings of the 15th IASLIC Conference, Bangalore*, 61-70.
- [22] Jeyashankar R, Ramesh Babu B, (2013) Scientometric Analysis of Leukemia Research output 1960-2011: An Indian perspective, *Asia Pacific Journal of Library and information science*, 3(2): 1-15.
- [23] Ravichandran.S &.Vivekanandhan.S (2021) Scientometric analysis of wastewater management research publications from Scopus database during 2010-2019, *Library Philosophy and Practice (e-journal)*, 5139:1-18.
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