

Scientometric Analysis on Water Treatment During 2011 to 2020

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Abstract - The present study examines the Scientometric Analysis on Water Treatment during 2011 to 2020. The data were collected from the Scopus database and 7582 records are retrieved within the Scientometric study. Mostly published articles in 2020 within 1079 (14.23%) records are highest during the ten years periods. The RGR was 0.73 in 2012 which declined up to 0.15 within 2020. A mean RGR of 1.79 might be deduced for the study period. The general mean DT was 1.79. Top ten ranking of Prolific Authors of Water Treatment Research within 10 author's highest number of articles from the Wang, C and most citation who contributed 50 articles. The Ranking wise Subject Areas ecology with 7013 records (28.28%) is top most level followed by second ranked as on Engineer, 5200 (20.97%), Chemical Engineering, 3006 (12.12%) scored as a 3rd rank.

Keywords: Water Treatment, Scientometrics, Relative Rate of Growth, Doubling Time and Zipf's Law

I. INTRODUCTION

The water has important for our life. Water from surface sources is typically contaminated by microbes; whereas groundwater is usually safer, but even groundwater are often contaminated by harmful chemicals from human activities or from the natural environment. Rainwater captured by a rooftop harvesting system or with small catchment dams is relatively safe, as long because the primary water is allowed to flow to waste when the season starts. the number of water to be treated should even be assessed. this may be estimated by assuming that each person will need a minimum of 20-50 liters of water every day for drinking, cooking, laundry and personal hygiene. The usage of household and community water-treatment technologies are described in greater in household water-treatment systems are namely as a boiling, household slow sand filter, domestic chlorination and Community variety of the water-treatment systems are storage and sedimentation, up-flow roughing filter, slow sand filtration and chlorination in piped water-supply systems.

II. REVIEW OF LITERATURE

Valdiviezo Gonzales *et al.*, (2021) analyzed a study Scientometric study of drinking water treatments technologies: Present and future challenges. The study reveals the knowledge of the tendencies of the drinking water treatments was changing through the previous decades and necessary for human life. The data were collected from the Web of Science and Scopus databases during 2010-2020. The majority of the most cited

publications are received from the China, the USA and the Netherlands. Concludes there is a need for research on different technologies that contribute positively to obtaining quality water for consumption and for the use of routine activities, being the combination and different treatment processes a challenge for future studies in coming years.

Heylmann *et al.*, (2020) wrote an article "Scientometric analysis applied to water treatment with activated carbon." The study focus with activated carbon has been highlighted as low cost material that can be used as adsorbents for the removal of carbon for the treatment of water. For the study, there were found 4,182 relevant studies in the database of the Web of Science and from these restrictions and readings were obtained 27 articles. The information was obtained to an evolution of publications, ii - distribution of articles by periodicals, spatial distribution, material precursor, activation technology, pollutants and treatment efficiency. The study reveals a result show that activated carbon produced from corn and industrial ash residues are good adsorbents.

Jiang *et al.*, (2018) carried out a study on "The role of nanomaterials and nanotechnologies in wastewater treatment: A bibliometric analysis. The study displays the top 20 productive countries during 1997-2016, top 20 productive institutes, 15 most productive subjects, journals and listed the top 20 keywords with the strongest bursts and most highly cited articles in the nanomaterials.

Murugan *et al.*, (2017) made a study "Scientometric study on Journal of Earth System Science during the year 2005-2015". The study focused a year wise growth, TLCS and TGCS values of the research. The majority of the Institution wise Journal of Environmental System Science has occupied the first position is Indian Institute of Technology, Majority of the article type of publication is 94.15% are published the contributions research production of articles. The fractional counting method more than 5 documents of organizations were selected. Of the 745 organizations, 62 items of the journal of Environmental System Science.

III. OBJECTIVES OF THE STUDY

The following objective of the study is as below

1. To spot the year-wise growth of research.
2. To seek out the Relative rate of growth and Doubling Time.

3. To review on top ten of Prolific Authors.
4. To research top ten Subject Areas.
5. To identified the document type.
6. To depict the Ranking of Keywords Occurrence of using Zipf's Law.
7. To look at the Ranking wise Funding Sponsor.
8. To explore the source type.
9. To research the countries and
10. To review the language wise publications.

IV. METHODOLOGY

The data were collected from the Scopus Database within the key words title of “Water Treatment” during 2011 to 2020. Totally 7582 records are found within the study.

V. DATA ANALYSIS

A. Year wise Water Treatment Research Productivity

Table I shows the Year wise Water Treatment Research Productivity during from 2011 to 2020. Out of 7582 records, in 2011, 601(7.93%) followed by year 2012, 647 (8.53%), in 2013, 619(8.16%), in 2014, 664 (8.76%), in 2015, 720 (9.50%), in 2016, 690(9.10%), in 2017, 798(10.52%), in 2018, 811 (10.70%), in 2019, 953 (12.57%) and 1079 (14.23%) records within 2020. The study reveals in 2011 (7.93%) to year 2020 (14.23%) has increase the water treatment research productivity.

TABLE I YEAR WISE WATER TREATMENT RESEARCH PRODUCTIVITY

Sl. No.	Year	No. of Records	Percentage
1	2011	601	7.93
2	2012	647	8.53
3	2013	619	8.16
4	2014	664	8.76
5	2015	720	9.50
6	2016	690	9.10
7	2017	798	10.52
8	2018	811	10.70
9	2019	953	12.57
10	2020	1079	14.23
Total		7582	100.00

B. Relative Growth Rate and Doubling Time

The Formula explains,

$$\text{Relative Growth Rate (1 - 2)} = \frac{w2 - w1}{T2 - T1}$$

Doubling time (a) = 0.693 R (a)

Where,

R (1-2) = Mean Relative Growth Rate over the Specified Period interval;

W1= log w1 (Natural log of the initial number of publications)

W2 = log w2 (Natural log of the initial number of publications)

T2-T1= the unit Difference between the initial time and final time.

R (a) = Relative Growth Rate per unit publication per unit of time (Year)

TABLE II RELATIVE GROWTH RATE AND DOUBLING TIME

Years	Publication	Cumulative	w1	w2	R(a)	Mean(a) 1-2	Doubling Time	Mean Dt (a) 1-2
2011	601	601	-	6.40	-	1.62	-	1.54
2012	647	1248	6.40	7.13	0.73		0.95	
2013	619	1867	7.13	7.53	0.40		1.72	
2014	664	2531	7.53	7.84	0.30		2.28	
2015	720	3251	7.84	8.09	0.25		2.77	
2016	690	3941	8.09	8.28	0.19	0.17	3.60	4.13
2017	798	4739	8.28	8.46	0.18		3.76	
2018	811	5550	8.46	8.62	0.16		4.39	
2019	953	6503	8.62	8.78	0.16		4.37	
2020	1079	7582	8.78	8.93	0.15		4.51	
Total	7582					1.79		5.67

Table II displays that Relative Growth Rate and Doubling Time of during ten year periods. The publication had grown from 2010 (610 records) to 2020 (1079 records), the relative growth rate was 0.73 in 2012 which declined up to 0.15 within 2020. A mean relative growth rate of 1.79 could be deduced for the study period. The mean doubling time during the period 2011- 2020 was 5.67 and it was decreased from 0.73 in 2011 to 0.15 in 2020. The overall mean doubling time was 1.79.

C. Top Ten of Prolific Authors

Table III and figure II shows the top ten ranking of Prolific Authors of Water Treatment Research during 2011-2020. Find out 10 authors had brought about 371 (42.64%) papers. Wang, C became the most productive author and most citation who contributed 50 articles, next to Anon, 46 Articles, followed by Pei, with 46 articles, Liang, H. 42 Articles, Westerhoff, P. 35 articles, Chen, W. Matsuda, A. with 32 articles, Huck, P.M and Li, G with 32 articles and Gao, B within 28 articles.

TABLE III TOP TEN OF PROLIFIC AUTHORS

Sl. No.	Author Name	Number of Records	Percentage
1	Wang, C.	50	14.00
2	Anon	46	12.00
3	Pei, Y.	46	12.00
4	Liang, H.	42	11.00
5	Westerhoff, P.	35	9.00
6	Chen, W.	32	9.00
7	Matsuda, A.	32	9.00
8	Huck, P.M.	30	8.00
9	Li, G.	30	8.00
10	Gao, B.	28	8.00

D. Top Ten Subject Areas

TABLE IV TOP TEN SUBJECT AREAS

Subject Area	No. of Records	Percentage	Rank
Environmental Science	7013	28.28	1
Engineering	5200	20.97	2
Chemical Engineering	3006	12.12	3
Chemistry	2802	11.30	4
Materials Science	2003	8.08	5
Agricultural and Biological Sciences	1055	4.25	6
Energy	1083	4.37	7
Medicine	1035	4.17	8
Earth and Planetary Sciences	809	3.26	9
Biochemistry, Genetics and Molecular Biology	789	3.18	10
Total	24795	100.00	

Table IV shows the Ranking Wise Subject Areas. Out of 24795 records, got it first position of the Environmental Science with 7013 records (28.28%) followed by second ranked as an Engineering, 5200 (20.97%), Chemical Engineering, 3006 (12.12%) scored as a third rank, fourth rank of Chemistry, 2802 (11.30%). Materials Science with 2003 records (8.8%) fifth place, Agricultural and Biological Sciences, 1055 (4.25%), sixth position, seventh ranked as an Energy, 1083 (4.37%), Medicine with eighth rank with 1035 records, ninth ranked as an Earth and Planetary Sciences, 809 (3.26%) and Biochemistry, Genetics and Molecular Biology, 789 records (3.18%) secured tenth rank. Note, 95(1.25%),

E. Document Type

Table V investigates the Document Type. Out of the total 7582 publications, Articles form of publication constitute 5261 (69.39%) of total output, Conference Paper, 1502 (19.81%), Review, 352 (4.64%), Book Chapter, 108 (1.42%), Erratum, 80 (1.06%), Short Survey, 64 (0.84%), Book, 25 (0.33%), Editorial, 22(0.29%), Letter, 20(0.26%), Report, 12 (0.16%). Data Paper, 11(0.15%), Business Article, 10(0.13%), Conference Review, 8(0.11%), Retracted and Abstract Report 6 (0.08).

TABLE V DOCUMENT TYPE

Sl. No.	Document Type	No. of Records	Percentage
1	Article	5261	69.39
2	Conference Paper	1502	19.81
3	Review	352	4.64
4	Book Chapter	108	1.42
5	Note	95	1.25
6	Erratum	80	1.06
7	Short Survey	64	0.84
8	Book	25	0.33
9	Editorial	22	0.29
10	Letter	20	0.26
11	Report	12	0.16
12	Data Paper	11	0.15
13	Business Article	10	0.13
14	Conference Review	8	0.11
15	Retracted	6	0.08
16	Abstract Report	6	0.08

F. Ranking of Keywords Occurrence of Using Zipf's Law

Table VI displays the keywords used in water treatment and top 20 keywords were taken for calculating Zipf's law. The law states that the relationship between the rank of a word and frequency of its appearance in a sentence are explained.

$$r * f = c$$

r' - the rank of a word and 'f'- frequency of occurrence

TABLE VI RANKING OF KEYWORDS OCCURRENCE OF USING ZIPF'S LAW

Keywords	No. of Records	Rank	Log F	Log R	Log C
Water Treatment	8315	1	3.919862	0	3.919862
Article	2547	2	3.406029	0.30103	7.325891
Drinking Water	2296	3	3.360972	0.477121	6.767001
Potable Water	2037	4	3.308991	0.60206	6.669963
Water Quality	1787	5	3.252125	0.69897	6.561116
Water Purification	1663	6	3.220892	0.778151	6.473017
Wastewater Treatment	1610	7	3.206826	0.845098	6.427718
Water Treatment Plants	1498	8	3.175512	0.90309	6.382338
Water Management	1426	9	3.15412	0.954243	6.329631
Water Supply	1274	10	3.105169	1	6.259289
Chemicals Removal (Water Treatment)	1164	11	3.065953	1.041393	6.171122
Adsorption	1152	12	3.061452	1.079181	6.127405
Water	1131	13	3.053463	1.113943	6.114915
Filtration	1107	14	3.044148	1.146128	6.09761
Coagulation	1058	15	3.024486	1.176091	6.068633
Nonhuman	1050	16	3.021189	1.20412	6.045675
Water Pollution	1016	17	3.006894	1.230449	6.028083
Water Filtration	948	18	2.976808	1.255273	5.983702
Priority Journal	940	19	2.973128	1.278754	5.949936
Disinfection	840	20	2.924279	1.30103	5.897407

G. Ranking Wise Funding Sponsor

Table VII reveals the Ranking wise Funding Sponsor. The majority of the National Natural Science Foundation of China, 767 (40.03%) occupied the top position to first rank next to European Commission, 156 (8.14%) with second rank, with 154 records (8.04%) in third place of the National Science Foundation, Ministry of Education of the People's Republic of China, 142(7.41%) in fourth, Natural

Sciences and Engineering Research Council of Canada, 134 (6.99%) secured fifth rank, sixth rank of Ministry of Science and Technology of the People's Republic of China, 133 (6.94%), Fundamental Research Funds for the Central Universities, Government of Canada, Conselho Nacional de Desenvolvimento Científico e Tecnológico and Ministry of Education, Culture, Sports, Science and Technology are subsequent ranks.

TABLE VII RANKING WISE FUNDING SPONSOR

Funding Sponsor	No. of Records	Percentage	Rank
National Natural Science Foundation of China	767	40.03	1
European Commission	156	8.14	2
National Science Foundation	154	8.04	3
Ministry of Education of the People's Republic of China	142	7.41	4
Natural Sciences and Engineering Research Council of Canada	134	6.99	5
Ministry of Science and Technology of the People's Republic of China	133	6.94	6
Fundamental Research Funds for the Central Universities	126	6.58	7
Government of Canada	119	6.21	8
Conselho Nacional de Desenvolvimento Científico e Tecnológico	94	4.91	9
Ministry of Education, Culture, Sports, Science and Technology	91	4.75	10

H. Source Type Wise Research

In Table VIII shows the Source Type wise Research. The most of the sources are derived from the journals, 5215

(68.78%) followed by Conference Proceeding, 1245 (16.42%), Trade Journal, 497 (6.55%), Book Series, 349 (4.60%), Book, 254 (3.35%), Report, 12 (0.16%) and undefined, 10 (0.3%).

TABLE VIII SOURCE TYPE WISE RESEARCH

Source Type	No. of Records	Percentage
Journal	5215	68.78
Conference Proceeding	1245	16.42
Trade Journal	497	6.55
Book Series	349	4.60
Book	254	3.35
Report	12	0.16
Undefined	10	0.13
Total	7582	100.00

I. Country Wise Publications

TABLE IX COUNTRY WISE PUBLICATIONS

Sl. No.	Country	No. of Records	Percentage
1	United States of America	2488	20.65
2	China	2078	17.25
3	Germany	700	5.81
4	United Kingdom	680	5.64
5	Japan	580	4.81
6	India	520	4.32
7	Canada	505	4.19
8	France	415	3.44
9	South Korea	400	3.32
10	Australia	380	3.15
11	Spain	370	3.07
12	Brazil	368	3.05
13	Russian Federation	289	2.40
14	Netherlands	275	2.28
15	Malaysia	260	2.16
16	Iran	230	1.91
17	South Africa	215	1.78
18	Italy	205	1.70
19	Poland	185	1.54
20	Egypt	180	1.49
21	Indonesia	175	1.45
22	Switzerland	170	1.41
23	Turkey	150	1.25
24	Taiwan	120	1.00
25	Belgium	110	0.91
	Total	12048	100.00

Table IX provides the country wise publication. The selected the top 25 countries are United States of America contributed with 2488 (20.65%) publications followed by China, 2078 (17.25%), Germany, 700 (5.81%), United

Kingdom, 680 (5.64%), Japan, 580 (4.81%), India, 520 (4.32%), Canada, 505 (4.19%), France, 415 (3.44%), South Korea, 400(3.32%), Australia, 380 (3.15%), Spain, 370 (3.07%), Brazil, 368 (3.05%), Russian Federation, Netherlands are below three percentage and Malaysia, South Africa, Italy, Poland, Egypt, Indonesia, Switzerland, Turkey Taiwan are above one percentage and Belgium is below one percentage.

J. Language Wise Publications

Table X examines the Language wise Publications. Mainly research articles are published an English language with 6086 (80.27%) publications followed by German, 435 (5.74%), Chinese, 340 (4.48%), French, 201 (2.65%), Russian, 128 (1.69%), Spanish, 85 (1.12%), Japanese, 76 (1%), Portuguese, Dutch, Polish, Italian, Korean, Croatian, Czech, Hungarian, Persian and Ukrainian are below one percentage level. The study reveals the majorities of the articles are published English language (80.27%) and followed by other languages.

TABLE X LANGUAGE WISE PUBLICATIONS

Sl. No.	Language	No. of Records	Percentage
1	English	6086	80.27
2	German	435	5.74
3	Chinese	340	4.48
4	French	201	2.65
5	Russian	128	1.69
6	Spanish	85	1.12
7	Japanese	76	1.00
8	Portuguese	72	0.95
9	Dutch	35	0.46
10	Polish	34	0.45
11	Italian	19	0.25
12	Korean	15	0.20
13	Croatian	16	0.21
14	Czech	15	0.20
15	Hungarian	9	0.12
16	Persian	9	0.12
17	Ukrainian	7	0.09
	Total	7582	100.00

VI. CONCLUSION

The study deals with Scientometric analysis on water treatment during 2011 to 2020. The research finds out 7582 publications, during ten years mostly in 2020 with 1079 records. The expansion has decreased in 2011 and year by year increased in the water treatment research. In recent years, water scarcity problem has affected many countries and due to it, a number of the communicable diseases is spreading within the society. To seek out the answer and

eradicate the disease an use of water treatment. It's applied the treatment in some ways to scale back the disease and purified the beverage et al and various purpose uses of the waters.

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