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Research Trends in Water Scarcity: A World Perspective

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Abstract

In this study Water Scarcity involves water crisis, water shortage, water deficit or water stress. Water scarcity plays a big facts or effects on the planet and attracts for several scientist to review it. Therefore, during this research topic explored the new topics and new trends of through the statistics of the journal between 2011-2020 from the attitude of scientometric supported the keyword, " water scarcity". This paper attempts to analyses the expansion and developments of water scarcity research in world supported the publications output using Scopus database. 7332 records were downloaded from the Scopus database from the category of Environmental sciences. the information were analyzed from the attitude of year wise distribution of water scarcity publications are seen as global research output on water scarcity. India secured 3rd position with 684 (9.32%) out of 7332 papers. Most of the prolific subject of Environment Science to secure highest no of publications 4399(59.99%) followed by Agricultural and Biological Sciences 2013(27.45%) respectively. Water Switzerland journals produced highest amount of research on water scarcity publications 241(3.28%).

Keywords: Water Scarcity, Scientometric Study, UN, Global warming, SCOPUS

Introduction

“Water is an elixir of life” and it is one among the foremost precious resources on the earth. Water occupies an outsized share of earth surface with a complete volume of 1.41 billion cubic meters. Water is at the guts of this global sustainability effort–implementation of “U.N Agenda 2030,” It's one in every of the Sustainable Development Goals (SDGs) and SDG6 is entirely dedicated to water. SOLARIMULSE Foundation said, “more than 1 billion people don't have access to a source of fresh beverage, and around 3 billion experience water scarcity a minimum of one month per annum. John F. Kennedy, the former President of U.S.A once said water is an important one in our life “Anyone who can solve the issues of water is merit two Nobel prizes — one for peace and one for science.”

Definition

Water scarcity arises in situations where there is insufficient water to simultaneously support both human and ecosystem water needs (White, 2014).

Types of Water Scarcity

Water scarcity can be classified as

- i) Physical water scarcity: focuses to a situation where natural water resources are unable to satisfy a region's demand.
- ii) Economic water scarcity: could be results of poor water management resources.

Causes of Water Scarcity

Various causes of water scarcity were identified during this study like 1. Global warming, 2. Pollution of water, 3. Drought 5. Natural disasters and 6. Illegal dumping.

Scientometrics

In the year 1960s, particularly Eastern Europe used the term “scientometrics” to denote “measurement of informatics process.” The term informatics was then widely accustomed mean “documentation/information handling activities;” obviously, there's not 5 much difference between bibliometrics of the West and also the scientometrics of the East Europe. Originally within the term of Scientometrics was conceived from a Russian term it had been suggested by Dolrov and Kormoni, he was stated that “Application of quantitative methods to the history of science”, which studies the quantities aspects of science.

Scientometrics approach to science and technology, a series of recent techniques are developed by various scholars like Solla Price, Eugene Garfield, Henry Small, Belvith Griffith, R. Merton, Diana Crane, N. Mullins, S. Cole, J. Cole, H. Zukerman, W. Mulkey. This scientometric approach relies on quantitative characteristics and attributes or objects of documentary flows. It mainly utilizes the bibliographic data on publications, which comprise such attributes as title of paper (including titles and phrases), authors (including their affiliations, co-authors and reputation), the title of book, journal (title, subject and origin of country, and language), etc. The objects of study in scientometrics studies are often grouped under various attributes. Scientometrics is worried with the quantitative features and characteristics of science and research. Emphasis is placed on investigations within which the event and mechanism of science are studied by statistical mathematical methods. Scientometrics analyses the quantitative aspects of the assembly, dissemination and use of scientific information with the aim of achieving a higher understanding of the mechanisms of research as a group action. Scientometrics is now considered as a component of the sociology of science and is applied to science philosophy. Thus Scientometrics involves studies in: 1. History of Science 2. Growth of literature 3. Behavior of Scientists 4. Sociology of Science, and 5. Science indicators, etc.

Review of Literature

Hamid Mehmood, (2019) studied on bibliometrics of water research: a worldwide global snapshot. In this study, the water-related bibliographic data were extracted from Scopus for the foremost recent six-year period available from 2012 to 2017. Scopus covers non-English language journals provided that they include English article titles and abstracts. The keywords' string queries were executed for every year of the six-year period under review (2012-2017) for 195 countries. Two variables were recorded from the output of those queries, i.e., the amount of documents published, and also the number of citations received by each country. The overall numbers of water-related documents and citations recorded over the complete period were 1.2 million and 1.5 million respectively. Only 88 countries were found to be publishing actively within the field of water (a country was categorized as an ‘active publisher’ if it had over one water-related publication or citation during a year.)

Velasco-Munoz, Juan F. & Aznar-Sanchez, Jose A., et al., (2018) revealed from their study that water use efficiency in agriculture (WUEA) has become a priority given increasing limitations on hydric resources. As a result, this area of research has increased in importance, becoming one in all the foremost prolific lines of study. The most main aim of this study was to present a review of worldwide WUEA research over the last 30 years. A Bibliometric analysis was

developed supported the Scopus database. The sample included 6063 articles. The variables analyzed were articles each year, category, journal, country, institutions, author, and keyword. The results indicated that an interesting growth within the number of articles published annually is happening. The most category was biology and therefore the main journal Agricultural Water Management.

Objectives of the Study

The following are main objectives of the study;

1. To look at the general year-wise production of articles worldwide in water scarcity.
2. To look at the country-wise growth of literature in water scarcity.
3. To analyse the subject-wise distribution of publications in water scarcity research.
4. To examine the document-wise kind of the publications in water scarcity.
5. To study the source-wise title of publications in water scarcity.
6. To observe the source-wise style of distribution in water scarcity publications.
7. To identify the language-wise distribution of articles in water scarcity research.
8. To recognize the organizations or affiliations conducting the research in water scarcity.
9. To make out the funding agencies which promote the research activities in water scarcity?
10. To look at the keyword search of literature in water scarcity research.

Hypotheses

The following hypotheses are formulated in this study to fulfill the stated objectives;

- There exists substantial literature published in global countries on water scarcity.
- The research productivity in water scarcity is dominated by English language.
- Articles are major source of publications for water scarcity.

Methodology

The current study focused on the research trends in water scarcity in a world perspective scientometric analysis of research publication in water scarcity. The data was collected from the most important abstract and citation database of peer-reviewed literature: scientific journals, books and conference proceedings database of “SCOPUS”. 7332 records were identified within the field of water scarcity worldwide during the period from 2011 to 2020. Microsoft Excel software was used to classify the collected data and also the classified data were analyzed. Analysis on year wise distribution, distribution of Authorship pattern, subject coverage, Document wise Distribution, Sources wise distribution, Country wise distribution, Organizations which contributed papers and Funding agencies was covered.

Data Analysis and Interpretation

Year-wise Distribution of Research Productivity on Water Scarcity

Table 1: Year-wise Distribution of Publications

| S.No. | Year | Record Count | Percentage |
|--------------|-------------|---------------------|-------------------|
| 1. | 2020 | 1286 | 17.53 |
| 2. | 2019 | 1168 | 15.93 |
| 3. | 2018 | 942 | 12.84 |
| 4. | 2017 | 783 | 10.67 |

| | | | |
|-----|------|-----|------|
| 5. | 2016 | 730 | 9.95 |
| 6. | 2015 | 615 | 8.38 |
| 7. | 2014 | 545 | 7.43 |
| 8. | 2013 | 480 | 6.54 |
| 9. | 2012 | 391 | 5.33 |
| 10. | 2011 | 392 | 5.34 |

Table 1 shows that a total of 7332 research publications in water scarcity during 2011-2020 were published with highest number of publications produced in the year 2020 is 1286 (17.53%), followed by 2019 is 1168 (15.93%), 2018 is 942 (12.84 %.), 2017 is 783 (10.67%), 2016 is 730 (9.95%), 2015 is 615 (8.38%), 2014 is 545 (7.43%), 2013 is 480 (6.54%), 2012 is 391 (5.33%), 2011 is 392 (5.34%) respectively.

Country-wise Distribution of Research Productivity

Table 2: Country-wise Distribution of Research Productivity

| S.No. | Countries/ Territories | Record Count | Percentage |
|-------|----------------------------|--------------|------------|
| 1. | United States | 1375 | 18.75 |
| 2. | China | 958 | 13.06 |
| 3. | India | 684 | 9.32 |
| 4. | Spain | 605 | 8.25 |
| 5. | Germany and United Kingdom | 484 | 6.60 |
| 6. | Australia | 427 | 5.82 |
| 7. | Netherlands | 364 | 4.96 |
| 8. | Italy | 344 | 4.69 |
| 9. | Iran | 305 | 4.15 |
| 10. | Brazil | 273 | 3.72 |

It is seen from Table 2 that collaborated countries where shown in the table, among in this study researchers concentrated top 10 countries to produced research output of Water Scarcity. Highest number of articles published in USA 1375 (18.75%) Followed by China 958 (13.06%), India 684 (9.32%), Spain 605 (8.25%), Germany and United Kingdom 484 (6.60%), Australia 427 (5.82%), Netherlands 364 (4.96%), Italy 344 (4.69%), Iran 305 (4.15%) last but not least Brazil 273 (3.72) respectively.

Subject-wise Distribution of Research Productivity on Water Scarcity

Table 3: Subjects wise Distribution of Research Productivity

| S.No. | Subjects | Record Count | Percentage |
|-------|--|--------------|------------|
| 1. | Environmental Science | 4399 | 59.99 |
| 2. | Agricultural and Biological Sciences | 2013 | 27.45 |
| 3. | Engineering | 1470 | 20.04 |
| 4. | Social Sciences | 1443 | 19.68 |
| 5. | Earth and Planetary Sciences | 1055 | 14.38 |
| 6. | Energy | 756 | 10.31 |
| 7. | Biochemistry, Genetics and Molecular Biology | 547 | 7.46 |
| 8. | Chemical Engineering | 349 | 4.75 |
| 9. | Chemistry | 342 | 4.66 |
| 10. | Business, Management and Accounting and Computer Science | 319 | 4.35 |

Table 3 explained the Water Scarcity based on Subject wise. The highest number of publication is on Environmental Science 4399 (59.99%), followed by Agricultural and Biological Sciences 2013 (27.45%), Engineering 1470 (20.04%), Social Sciences 1443 (19.68%), Earth and Planetary Sciences 1055 (14.38%), Energy 756 (10.31%), Biochemistry,

Genetics and Molecular Biology 547 (7.46%), Chemical Engineering 349 (4.75%), Chemistry 342 (4.66%), Business, Management and Accounting and Computer Science 319 (4.35%) respectively.

Document Type and Water Scarcity Productivity

Table 4: Document Type

| S.No. | Document Type | No. of Records | Percentage |
|-------|-------------------|----------------|------------|
| 1. | Article | 5382 | 73.40 |
| 2. | Conference Paper | 736 | 10.03 |
| 3. | Book Chapter | 670 | 9.13 |
| 4. | Review | 409 | 5.57 |
| 5. | Book | 62 | 0.84 |
| 6. | Editorial | 22 | 0.30 |
| 7. | Note | 20 | 0.27 |
| 8. | Short Survey | 10 | 0.13 |
| 9. | Letter | 7 | 0.09 |
| 10. | Conference Review | 5 | 0.06 |

The Table 4. Shows that Water Scarcity of the research productions has been contributed in 10 Document type wise publications are produced out of 10 categories. The highest no of research articles are published from Article out of 7332 publications 5382 (73.40%), then followed by Conference Paper 736 (10.03%), Book Chapter 670 (9.13%), Review 409 (5.57%), Book 62 (0.84%), Editorial 22 (0.30%), Note 20 (0.27%), Short Survey 10 (0.13%), Letter 7 (0.09%) and Conference Review 5 (0.06%) respectively.

Source-wise title and Water Scarcity Research

Table 5: Source -wise title Distribution of Water Scarcity Research

| S.No. | Source Title | Record Counts | Percentage |
|-------|-------------------------------------|---------------|------------|
| 1. | Water Switzerland | 241 | 3.28 |
| 2. | Science Of The Total Environment | 187 | 2.55 |
| 3. | Agricultural Water Management | 170 | 2.31 |
| 4. | Journal Of Cleaner Production | 147 | 2.00 |
| 5. | Water Resources Management | 137 | 1.86 |
| 6. | Sustainability Switzerland | 121 | 1.65 |
| 7. | Desalination And Water Treatment | 84 | 1.14 |
| 8. | Journal Of Hydrology | 76 | 1.03 |
| 9. | Water Policy | 66 | 0.90 |
| 10. | Journal Of Environmental Management | 65 | 0.88 |

Table 5 mentions that the sources preferred by the authors to publish their research output, 7332 publications have been observed to be distributed in top 10 sources of titles, out of top 10 have been listed in the above table. Water Switzerland 241(3.28%)publications is found to be the most preferred journal followed by Science Of The Total Environment 187(2.55%), Agricultural Water Management 170 (2.31), Journal Of Cleaner Production 147 (2.00%), Water Resources Management 137 (1.86%), Sustainability Switzerland 121 (1.65%), Desalination And Water Treatment 84 (1.14%), Journal Of Hydrology 76 (1.03%), water policy 66 (0.90%), Journal of Environmental Management 65 (0.88%), of the total research output.

Source-wise type of distribution in Water Scarcity Publications

Table 6: Source Type Distribution of Water Scarcity Research

| S.No. | Source wise | Record Count | Percentage |
|-------|-----------------------|--------------|------------|
| 1. | Journal | 5783 | 78.87 |
| 2. | Conference Proceeding | 623 | 8.49 |
| 3. | Book | 596 | 8.12 |
| 4. | Book Series | 294 | 4.00 |
| 5. | Trade Journal | 36 | 0.49 |

Table 6 mentions that the sources wise distribution of publications preferred by the authors to publish their research output, 7332 publications have been observed to be distributed in 05 source wise, out of top 05 have been listed in the above table. Journal 5783(78.87%) publications is found to be the most preferred journal followed by Conference proceedings 623 (8.49%), Book 596(8.12%), Book series 294 (4.00%) and Trade Journal 36 (0.49%) respectively.

Language and Water Scarcity Research

Table 7: Language-wise Distribution of Research Productivity

| S.No. | Language | Record Count | Percentage |
|-------|------------|--------------|------------|
| 1. | English | 7166 | 97.73 |
| 2. | Chinese | 57 | 0.77 |
| 3. | Spanish | 44 | 0.60 |
| 4. | Portuguese | 37 | 0.50 |
| 5. | French | 31 | 0.42 |
| 6. | German | 8 | 0.10 |
| 7. | Russian | 5 | 0.06 |
| 8. | Polish | 3 | 0.04 |
| 9. | Persian | 2 | 0.02 |
| 10. | Slovenian | 2 | 0.02 |

Table 7 shows that majority of documents published in English language 7166 (97.73%) which is followed by Chinese 57 (0.77%), Spanish 44 (0.60%), Portuguese 37 (0.50%), French 31 (0.42%), German 8 (0.10%), Russian 5 (0.06%), Polish 3 (0.04%), Persian 2 (0.02%) and Slovenian 2 (0.02%) respectively.

Affiliation and Water Scarcity Research

It is found that water scarcity research is being conducted in 7332 institutions in worldwide. Table 7 shows the list of top 10 organizations with contributed in water scarcity related productivity of publications.

Table 8: Affiliation-wise Distribution of Research Productivity

| S.No. | Affiliation | Record Count | Percentage |
|-------|---|--------------|------------|
| 1. | Chinese Academy of Sciences | 215 | 2.93 |
| 2. | Ministry of Education China | 101 | 1.37 |
| 3. | University of Twente | 94 | 1.28 |
| 4. | Wageningen University & Research | 87 | 1.18 |
| 5. | Beijing Normal University | 86 | 1.17 |
| 6. | University of Chinese Academy of Sciences | 84 | 1.14 |
| 7. | Institute of Geographical Sciences and Natural Resources Research Chinese Academy of Sciences | 76 | 1.03 |
| 8. | China Agricultural University | 69 | 0.94 |
| 9. | Consejo Superior de Investigaciones Científicas | 59 | 0.80 |
| 10. | The University of Arizona | 59 | 0.80 |

Table 7 shows that Chinese Academy of Sciences 215 (2.93%), Ministry of Education China 101(1.37%), University of Twente 94 (1.28%), Wageningen University & Research 87 (1.18%), Beijing Normal University 86 (1.17%), University of Chinese Academy of Sciences 84 (1.14%), Institute of Geographical Sciences and Natural Resources Research Chinese Academy of Sciences 76 (1.03%), China Agricultural University 69 (0.94%), Consejo Superior de Investigaciones Científicas 59 (0.80%), The University of Arizona 59 (0.80%)

Funding Sponsor and Water Scarcity Research

Table 8: Funding Sponsor –wise Distribution of Research Productivity

| S.No. | Funding Sponsor | Record Count | Percentage |
|-------|---|--------------|------------|
| 1. | National Natural Science Foundation of China | 456 | 6.21 |
| 2. | National Science Foundation | 189 | 2.57 |
| 3. | European Commission | 116 | 1.58 |
| 4. | Fundamental Research Funds for the Central Universities | 84 | 1.14 |
| 5. | National Basic Research Program of China (973 Program) | 81 | 1.10 |
| 6. | Seventh Framework Programme | 68 | 0.92 |
| 7. | Conselho Nacional de Desenvolvimento Científico e Tecnológico | 67 | 0.91 |
| 8. | European Regional Development Fund | 63 | 0.85 |
| 9. | Chinese Academy of Sciences | 56 | 0.76 |
| 10. | Bundesministerium für Bildung und Forschung | 50 | 0.68 |

It is seen from Table 8 that National Natural Science Foundation of China 456 (6.21%), followed by National Science Foundation 189 (2.57%), European Commission 116 (1.58%), Fundamental Research Funds for the Central Universities 84 (1.14%), National Basic Research Program of China (973 Program) 81 (1.10%), Seventh Framework Programme 68 (0.92%), Conselho Nacional de Desenvolvimento Científico e Tecnológico 67 (0.91%), European Regional Development Fund 63 (0.85%), Chinese Academy of Sciences 56 (0.76%), Bundesministerium für Bildung und Forschung 50 (0.68%) respectively.

Keyword wise and Water Scarcity Research

Table 9: Keyword –wise Distribution of Research Productivity

| S.No. | Keyword | Record Count | Percentage |
|-------|--------------------|--------------|------------|
| 1. | Water Scarcity | 1725 | 23.52 |
| 2. | Water Supply | 1639 | 22.35 |
| 3. | Water Management | 1599 | 21.80 |
| 4. | Climate Change | 1228 | 16.74 |
| 5. | Water Resources | 909 | 12.39 |
| 6. | Water Resource | 814 | 11.10 |
| 7. | Irrigation | 810 | 11.04 |
| 8. | Water Conservation | 806 | 10.92 |
| 9. | Article | 673 | 9.17 |
| 10. | Drought | 626 | 8.53 |

It is seen from table 9 Keyword wise water scarcity search used to retrieve the data from the SCOPUS database. In this study Highest number keyword used in water scarcity 1725 (23.52%), the followed by Water Supply 1639 (22.35%), Water Management 1599 (21.80), Climate Change 1228 (16.74%), Water Resources 909 (12.39%), Water Resource 814 (11.10%), Irrigation 810 (11.04%), Water Conservation 806 (10.92%), Article 673 (9.17%), Drought 626 (8.53%) respectively.

Major Findings

1. During this study highest number of publications produced within the year 2020 is 1286 (17.53%), followed by China 958 (13.06%), India 684 (9.32%), Spain 605 (8.25%), etc.
2. During this study researchers concentrated top 10 countries to produced research output of Water Scarcity. Highest number of articles published in USA 1375 (18.75%) Followed by China 958 (13.06%), India 684 (9.32%), Spain 605 (8.25%), Germany and United Kingdom 484 (6.60%), etc.
3. During this study subject wise research distribution of publications were produced in highest number of publication is on Environmental Science 4399 (59.99%), followed by Agricultural and Biological Sciences 2013 (27.45%), Engineering 1470 (20.04%), etc.
4. An increasing number of studies are conducted that are categorized under Document type wise publications are produced out of 10 categories. The best no of research articles are published from Article out of 7332 publications 5382 (73.40%), then followed by Conference Paper 736 (10.03%), Book Chapter 670 (9.13%).
5. In study sources preferred by the authors to publish their research output, 7332 publications have been observed to be distributed in top 10 sources of titles Water Switzerland 241(3.28%) publications is found to be the foremost preferred journal followed by Science Of the overall Environment 187(2.55%), Agricultural Water Management 170 (2.31), etc.
6. During this study majority of documents published in English 7166 (97.73%)which is followed by Chinese 57 (0.77%), Spanish 44 (0.60%), Portuguese 37 (0.50%), etc.
7. During this study researcher perform organizations wise research productivity of water scarcity in highest number of articles are produced in Chinese Academy of Sciences 215 (2.93%), Ministry of Education China 101(1.37%), University of Twente 94 (1.28%), Wageningen University &Research 87 (1.18%).
8. During this research study funding agencies are dominated to produced literature output of water scarcity in National Natural Science Foundation of China 456 (6.21%),followed by National Science Foundation 189 (2.57%), European Commission 116 (1.58%).
9. During this study Highest number keyword utilized in water scarcity 1725 (23.52%), the followed by Water Supply 1639 (22.35%), Water Management 1599 (21.80).
10. The best no of research articles are published from Article out of 4881 publications 3682 (75.43), the followed by Conference Paper 453 (9.28%).

Conclusion

This study offers a comprehensive scientometric review of water scarcity research. The most goal of this study was to look at the expansion of water scarcity research within the global level supported on Scopus database for the period from 2016 to 2020 and the sample included in 7332 articles. The analyzed quantitative data were number of articles published in 2020 is 17.53% of the publications and were the key powers in water scarcity research. In Country wise Growth of articles in water scarcity research highest number of articles published in USA 1375 (18.75%) Followed by China 958 (13.06%), India 684 (9.32%), subject wise category, Language wise, Source wise title of growth literature,

Document wise publications, institutions wise and Keyword. The study reveals that there's a gentle increase within the growth of literature yearly. Significant changes in water scarcity research are depicted through this study. USA undoubtedly could be a prime producer and publisher of literature on water scarcity research followed by the China and India.

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