Mapping of Research Publications on Hydrology in India from 1989 to 2020: A Scientometric Study

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The purpose of this study is to explore the research output in the subject of hydrology using scientometric analysis and mapping technique using Web of Science (Clarivate) database. The related publications from 1989 to 2020 were collected through the Web of Science Core Collection (Clarivate) database on June 20, 2021. With the search topics "hydrology" and "India", a total of 513 publications satisfying these search criteria were pulled out to perform further analysis. The 513 publications were from 607 institutions, 500 countries, 1499 authors, and 485 articles. They were written in 04 languages. It was found that The highly productive year for publication on hydrology under the study period is 2020. English is the highly preferred language for publication of research on hydrology under the study period. The highly preferred form of communication of research output on hydrology is journal articles. Sinha, R is the most profile author on hydrology under the study period. The Water Resources is the subject in which highest number of publications published under the study period. The highly productive organization is Indian Institute of Technology System. The highly preferred journal for communication of research output on hydrology by scholars under the study period is Journal of Hydrology. India is the highly productive country in publication of research output on hydrology under the study period. The two key terms "hydrology" and "India" were used for data collection. The study does not include print format research publications of the scholars working in the field of hydrology. The research publications that appeared in local journal and other printed sources were not included.

Introduction

Water is essential to life and is the characteristic of Earth. Water is intimately linked to human existence and is the source of societal and cultural development, traditions, rituals, and religious beliefs.

Hydrology is subject in discipline Geosciences. Hydrology is the scientific study of the movement, distribution, and management of water on Earth and other planets, including the water cycle, water resources, and environmental watershed sustainability [1].

According to National Geographic Society, USA, hydrology is the study of the distribution and movement of water both on and below the surface of earth. It also studies the impact of human activity on water availability and conditions [2].

In Merriam-Webster Dictionary, hydrology is defined as a science dealing with the properties, distribution, and circulation of water on and below the surface of earth and in the atmosphere [3].

The Fondriest Environment Learning Centre mentioned that hydrology is the study of water. Hydrology refers to the physical movement of a body of water, including changes in water level, flow, and other dynamic processes in terms of environmental measurements. Most hydrology applications involve surface water systems, such as rivers, open-channels and estuaries. Hydrology, particularly water flow, can affect the local environment due to changes in water quality and quantity. These changes can be man-made or weather-related or due to a combination of both factors [4].

Hydrology is the study of the global water cycle and the physical, chemical, and biological processes involved in the different reservoirs and flow of water within this cycle. This includes water vapor, liquid water, snow, and ice. The water can be found in all three phases at temperatures and pressures of Earth surface. The global hydrological cycle includes exchanges of water between the land surface, ocean, atmosphere, and subsurface. The hydrologic cycle is the most fundamental concept in hydrology which involves the entire Earth system comprising the atmosphere (the gaseous envelop), the hydrosphere (surface and subsurface water), lithosphere (soils and rocks), the biosphere (plants and animals), and the oceans. Water passes through these five spheres of the Earth system in one or more of the three phases i.e. solid (ice), liquid, and vapour.

Hydrology is subdivided into surface water hydrology, groundwater hydrology (hydrogeology), and marine hydrology. Domains of hydrology include hydrometeorology, surface hydrology, hydrogeology, drainage-basin management, and water quality, where water plays the central role.

Hydrologist is a practitioner of hydrology. Hydrologists study earth or environmental science, civil or environmental engineering, and physical geography. They collect and analyze data to solve water related problems such as environmental preservation, natural disasters, and water management using various analytical methods and scientific techniques [5].

Hydrological processes are often affected by many complex factors such as land use, soil properties, topography, and climate. Therefore, accurate prediction of the hydrological processes is essential to make better the understanding of the impact of natural and anthropogenic disturbances on hydrological regimes [6].

The combined effects of climate, land use, and anthropogenic activities in the watershed changes the hydrological parameters. Developing countries are facing several challenges in water resource management due to climate change [7].

Greenhouse gases play critical role for increasing rainfall frequency and intensity [8]. Intergovernmental Panel on Climate Change reported that hot weather contributes more extreme precipitation and raises flood risk [9]. With increasing demand, freshwater is one of the most important issues that cannot be neglected for current and future distribution of limited water resources. At present, a significant proportion of the world's population is currently suffering from water stress issue [10].

The scientometric is the application of mathematical and statistical tools to evaluate information bearing materials in other to determine or assess the significant of such materials. Bibliometric as a concept is a field of study in library and information science specifically used to study the growth of literature in a particular subject, the quantity and quality of literature that is contributed by number of individual researchers, by groups of researchers, across institutions or countries. According to Swain and Panda, bibliometric analysis is a tool which is use in the identification of the numbers of research publications, the age, the citation, the impact factor as well as any other important features that are of interest to the research publication under study. It helps in demonstrating the significance of research in an academic environment [11].

Bibliometric analysis is viewed as one of the best means of evaluating and assessing research productivity of an individual author, institution, country and journal publication with the aim of identifying the pattern and quality of the research output. Research is an essential component of development, advancement, innovation, as well as extending frontiers of knowledge; this is because research is the process that involves careful and systematic collection, analyzing and interpretation of data [12].

The scholars all over the world are expected to carry out research as well as communicating the research findings in reputable publications. The purpose of this study is to explore the research output in the subject of hydrology using scientometric analysis and mapping technique using Web of Science (Clarivate Analytics) database.

2. Review of Literatures

The literature reviewed for this paper is comprised of scholarly articles published in various national and international journals that represent a strong account and state of the art of hydrological research in India from several dimensions. The literatures on hydrological researches in India are represented in following three periods.

a. Period (1989 to 2000)

In 1992, Szatmari has reported the accumulation of oil requires a favorable source, a reservoir, good seal-rock quality, and suitably timed thermal history and structuring. The accumulated oil, especially its light fractions, may be subsequently removed by hydrologically controlled processes such as water washing, biodegradation, and tilting of the oil-water contact. These processes are dependent on the climate [13].

The study of Rosin has broader implications for an understanding of the human-shaped hydrology of northwestern India, where the earlier system has been overlaid, but not fully displaced by subsequent irrigation projects [14].

Divya and Mehrotra repoted that on a regional scale, some of the most profound impacts of climate change due to increases in greenhouse gases would probably be major changes in the hydrological cycle, in water availability, in agricultural production and in the use of energy [15].

A simple hierarchical classification of wetlands based on their location (coastal or inland), salinity (saline or freshwater), physiognomy (herbaceous or woody), duration of flooding (permanent or seasonal) and the growth forms of the dominant vegetation was reported [16].

The tree physiognomy has played a significant role with regard to rainfall partitioning into the various components of the hydrological cycle [17].

Sharma and others have reported some increasing tendency of temperature and precipitation based on analysis of meteorological and hydrological time series from 1947 to 1993 [18].

b. Period (2001 to 2010)

In 2001, Rao has reported a total of 40 species of zooplanktons, four crustaceans, 15 molluscs, 51 insects, 83 fishes, 12 freshwater turtles, two crocodiles, 48 aquatic birds and two mammal species have been identified in the upper Ganga River, in his study. The river has been under constant threat of pollution by sewage and industrial wastes, disposal of dead bodies, deforestation, excessive use of fertilizers and pesticides, bathing, pilgrimage and water development programmes [19].

Kale reported the major themes in Indian fluvial geomorphology including the hydrology of monsoonal rivers; forms and processes in alluvial channels; causes of avulsion, channel migration; and anomalous variations in channel patterns; dynamics of suspended sediment; and the geomorphic impacts of floods [20].

According to Mukherjee and Shah, there is a need for a paradigm shift in the way groundwater is presently perceived and managed-from management to governance mode [21].

Over-exploitation of groundwater is leading to reduction of low flows in the rivers, declining of the groundwater resources, and salt water intrusion in aquifers of the coastal areas [22].

R K. Mall and others have found that the changes in cropping pattern and land-use pattern, over-exploitation of water storage and changes in irrigation and drainage are modifying the hydrological cycle in many climate regions and river basins of India [23].

The study of Roy and Mazumdar clearly indicates significant changes in the hydrological behaviour of the region characterised by an increase in temperature levels and a substantial reduction in rainfall and river flows [24].

According to G. D. Martin, monsoon-induced hydrology plays an important role in regulating the nutrients, secondary production and even the migrant fauna of the estuary [25].

Erwin, in 2009, reported that wetland systems are vulnerable to changes in quantity and quality of their water supply, and it is expected that climate change will have a pronounced effect on wetlands through alterations in hydrological regimes with great global variability [26].

Mukhopadhyay and Dutta presented a stream water availability model for Upper Indus Basin (UIB) utilizing the most up-to-date datasets for topography, temperature, precipitation, net radiation, land cover, soil type, and digital atlas. Multiple datasets have been evaluated and the ones with best accuracy and temporal coverage have been selected for the final model [27].

c. Period (2011 to 2020)

In 2011, Mishra reported that urban agglomeration is causing radical changes in groundwater recharge and modifying the existing mechanisms. Majority of the cities are sited on unconfined or semi confined aquifers depend upon river water and groundwater for most of their water supply and disposal of most of their liquid effluents and solid residues to the rivers and ground [28].

Biemans reported that reservoirs contribute significantly to irrigation water supply in many regions. Basins that rely heavily on reservoir water are the Colorado and Columbia River basins in the United States and several large basins in India, China, and central Asia [29].

In his study in 2012, Reddy found that in absence of scientific information with the communities, extraction of groundwater resources for productive purposes has become a risky venture leading to adverse impacts on livelihoods. The externalities associated with over exploitation of groundwater resources and the resulting widespread well failure is identified as one of the main reasons for pushing farmers into debt trap and one of the reasons for farmer suicides in India [30].

Wada and Heinrich reported that 8% of transboundry aquifers (TBAs) worldwide are currently stressed due to human overexploitation. Over these TBAs the rate of groundwater pumping increased substantially during the past fifty years, which worsened the aquifer stress condition [31].

Jain and Kumar reported in 2014 that environmental flows are necessary for aquatic ecosystems to remain in a healthy state and for the sustainable use of water resources. The major focus areas for the development of environmental flow assessment (EFA) research in India are the creation of a shareable database for hydrological, ecological and socioeconomic data, developing hydrology-ecology relationships, evaluation of ecosystem services, addressing pollution due to anthropogenic activities and promotion of research on environmental flow assessment [32].

Niu ,in his study, in 2014 found that groundwater research experienced notable growth in the past two decades (i. e. 1990 to 2010). Environmental sciences, water resources and multidisciplinary geosciences were the three major subject categories. The Journal of Hydrology published the largest number of groundwater-related publications in the surveyed period [33].

Srinivasan reported that groundwater pumping, expansion of eucalyptus plantations and, to a lesser extent, channel fragmentations are much more likely to have caused the decline in surface flows in the TG Halli catchment than changing climate. The multiple-hypothesis approach presents a systematic way to quantify the relative contributions of proximate anthropogenic and climate drivers to hydrological change [34].

Li found that the decreasing water resources are jointly induced by climate change and population growth. The latter is responsible for roughly 40 % of the water declines. Both basins are facing water shortages at present and the water shortages will intensify in the future [35].

According to Manivasagam and Nagarajan, supplemental irrigation can be obtained from groundwater reserves and by adopting early sowing strategy can provide opportunities for improving water productivity in rainfed farming [36].

Roy and Sinha reported that the rivers flowing through a tectonically stable landscape are graded in nature where higher discharge tends to create more concave longitudinal profiles compared to those in tectonically unstable landscape [37].

Qibin Chen in his study reported that the United States and China contributed 56.4% of the total publications and were the major powers in groundwater remediation research. The United States, Canada, and China have considerable capabilities and expertise in groundwater remediation research. Groundwater remediation research is a multidisciplinary field, covering water resources, environmental sciences and ecology, environmental sciences, and engineering, among other fields. Journals such as Environmental Science and Technology, Journal of Contaminant Hydrology, and Water Research were the major sources of cited works. The research fronts of groundwater remediation were transitioning from the pump-and-treat method to permeable reactive barriers and nanoscale zero-valent iron particles. The combination of new persulfate ion-activation technology and nanotechnology is receiving much attention [38].

Hengade and Eldho study results provide insights into the impacts of the climate and land cover (LC) changes on the basin [39].

Hydrological parameters are highly influenced by increase in urbanization [40].

Al Balasmeh and Karmaker found that the growth of the vegetation starts when the average temperature is 10 degrees C or higher. Beyond that the increase in temperature may have a negligible effect on growth of vegetation. However, with excessive rainfall, a declining trend in vegetation growth was observed [41].

In 2020, Das and others reported that the algal blooms were found to be substantially influenced by the seasonal-nutrients flux and discharge location [42].

The combined soil-water-vegetation efforts strengthened water resilience and environmental systems in agricultural landscape [43].

Li and others reported that the impacts of climate change on water quality influenced the aggravation of eutrophication, changes in the flow, hydrological and thermal conditions, and the destruction of ecosystems and biodiversity [44].

Zhang and others in their study in 2020 reported that a rapid growth of scientific outputs with a gradually increasing proportion of internationally collaborative articles is shown. Environmental Sciences, Water Resources, and Soil Science were the most frequently used subject categories, and the Journal of Hydrology

had the highest number of publications in this field. The institutions from the USA and China were the most active, and the USA occupied a leading position in soil water research, producing the most articles and having the most considerable number of citations [45].

3. Scope and Limitations

The study focuses on the scientometrics analysis of research publications of scholars in the field of hydrology in India. The coverage of the study is restricted to data retrieved from Web of Science (Clarivate Analytics) database for period of thirty two years from 1989-2020. Only Web of Science indexed publications are considered for this study. The two key terms "hydrology" and "India" were used for data collection. The study does not include print format research publications of the scholars working in the field of hydrology. The research publications that appeared in local journal and other printed sources were not included.

4. Objectives of the Study

The general objective of this study is to evaluate the publication output of hydrology for the selected period from 1989 -2020. However the study intended to perform some specific objectives are as follows:

1. To examine the year-wise research publication during the selected period of study,
2. To find the most preferred language for research publications during the selected period of study.
3. To identify the highly preferred form of research communication during the selected period of study,
4. To find the most prolific authors of hydrology during the selected period of study,
5. To examine the subject-wise distribution of research publication,
6. To examine highly ranked institutions for research publication during the selected period of study,
7. To find out the highly preferred journal for publication of research output on hydrology during the selected period of study, and
8. To find the highly ranked country in the research publication during the selected period of study.

5. Methodology

It is essential for researchers to quickly and accurately locate publications. Bibliometric analysis is a quantitative and reliable analysis tool based on mathematical and statistical methods that can represent historical achievements, explore development trends, and predict future directions of a certain research domain [46]. Using this method, the emerging trends of research on hydrology in India over the 32 years study period may be presented. Hence, the comprehensive, systematic, and objective bibliometric analysis of the research in hydrology was performed.

The related publications on hydrology from 1989 to 2020 were collected through the Web of Science Core Collection (Clarivate Analytics) database on June 20, 2021. With the search topics "hydrology" and "India", a total of 513 publications satisfying these search criteria were pulled out to perform further analysis. The

513 publications were from 607 institutions, 500 countries, 1499 authors, and 485 articles. They were written in 04 languages.

6. Data Presentation

To review the research development on hydrology, a total of 513 publications from 1989 to 2020 were presented in following tables as given below:

Table 1: Year-wise Publications

Sl. No.	Years	Number of Publications	%age of 513
1.	2020	58	11.31
2.	2019	54	10.53
3.	2018	50	9.75
4.	2017	41	7.99
5.	2016	33	6.43
6.	2015	31	6.04
7.	2014	33	6.43
8.	2013	24	4.68
9.	2012	25	4.87
10.	2011	23	4.48
11.	2010	22	4.29
12.	2009	14	2.73
13.	2008	17	3.31
14.	2007	10	1.95
15.	2006	11	2.14
16.	2005	12	2.34
17.	2004	5	0.98
18.	2003	9	1.75
19.	2002	6	1.17
20.	2001	3	0.59
21.	2000	8	1.56
22.	1999	4	0.78
23.	1998	2	0.39
24.	1997	2	0.39
25.	1996	4	0.78

Table 1 shows that there are fluctuations in annual number of research publications but the recent five years publications continuously have increased significantly over the study period. The publication on hydrology is highest in 2020 with 58 (11.31%) publications followed by 54 (10.53%) in 2019, 50 (9.75%) in 2018, 41 (7.99%) in 2017, and 33 (6.43%) publications respectively. The highly productive year for publication on hydrology under the study period is 2020.

Table 2: Language-wise Publications

Sl. No.	Languages	Number of Publications	%age of 513
1	English	510	99.42
2	Malay	1	0.2
3	Portuguese	1	0.2
4	Spanish	1	0.2

As seen in Table 2, four languages English, Malay, Portuguese, and Spanish were selected for communication of their research output by scholars. The highly preferred language for publication of research output of scholars under the study period is English with 510 (99.42%) publications. Thus, English is the highly preferred language for publication of research output on hydrology under the study period.

Table 3: Forms of Research Communications

Sl. No.	Forms	Number of Publications	%age of 513
1	Article	485	94.54
2	Review	21	4.09
3	Proceedings Paper	16	3.12
4	Editorial Material	6	1.17
5	Data Paper	1	0.2
6	News Item	1	0.2

Table 3 shows that the major form of research communication selected by researcher in hydrology is journal article as data collected from Web of Science (Clarivate Analytics) database. The journal articles with 485 (94.54%) publications is highly preferred form of research communication followed by review with 21 (4.09), proceeding papers with 16 (3.12%), editorial materials with 6 (1.17%), and data paper and news item with 1 (0.02%) publications, respectively. Thus, the highly preferred form of communication of research output on hydrology is journal articles.

Table 4: Highly Productive Authors

Sl. No.	Name of Authors	Number of Publications	%age of 513
1.	Sinha R	11	2.14
2.	Ghosh S	10	1.95
3.	Mujumdar P P	8	1.56
4.	Gupta P K	7	1.37
5.	Kumar A	7	1.37
6.	Kumar R	7	1.37
7.	Singh A	7	1.367
8.	Garg K K	6	1.17
9.	Goyal M K	6	1.17
10.	Jain S K	6	1.17
11.	Jeelani G	6	1.17
12.	Kumar P	6	1.17
13.	Singh R	6	1.17
14.	Ahmed S	5	0.98
15.	Eldho T I	5	0.98
16.	Garg V	5	0.98
17.	Kale V S	5	0.98
18.	Mishra S K	5	0.98
19.	Mukherjee A	5	0.98
20.	Sarkar S	5	0.98
21.	Singh A K	5	0.98
22.	Singh R P	5	0.98
23.	Sridhar A	5	0.98
24.	Thayyen R J	5	0.98
25.	Wani S P	5	0.98

The authors having 5 or more publications during the study period are shown in Table 4 along with their number of publications. Sinha, R is the most productive author with 11 (2.14%) publications, followed by Ghosh, S with 10 (1.95%) publications, Mujumdar, P P with 8 (1.56%) publications, respectively. Thus, Sinha, R is the most profile author on hydrology under the study period.

Table 5: Research Areas

Sl. No.	Research Areas	Number of Publications	%age of 513
1.	Water Resources	205	39.96
2.	Geology	172	33.53
3.	Environmental Sciences Ecology	138	26.9
4.	Engineering	91	17.74
5.	Meteorology Atmospheric Sciences	60	11.7
6.	Science Technology Other Topics	58	11.31
7.	Physical Geography	31	6.04
8.	Agriculture	27	5.26
9.	Marine Freshwater Biology	24	4.68
10.	Remote Sensing	22	4.29
11.	Chemistry	10	1.95
12.	Imaging Science Photographic Technology	10	1.95
13.	Geochemistry Geophysics	9	1.75
14.	Biodiversity Conservation	7	1.37
15.	Computer Science	6	1.17
16.	Geography	5	0.98
17.	Astronomy Astrophysics	4	0.78
18.	Energy Fuels	4	0.78
19.	Forestry	4	0.78
20.	Paleontology	4	0.78
21.	Fisheries	3	0.59
22.	History	2	0.39
23.	Life Sciences Biomedicine Other Topics	2	0.39
24.	Mathematics	2	0.39
25.	Nuclear Science Technology	2	0.39

Table 5 shows high productive subjects which are contributing more than 2 articles. The highly productive subject is Water Resources with 205 (39.96%) publications followed by Geology with 172 (33.53%), Environmental Sciences Ecology with 138 (26.90%), Engineering with 91(17.74%), and Meteorology Atmospheric Sciences with 60 (11.70) publications, respectively. The Water Resources is the subject in which highest number of publications published under the period of study.

Table 6: Highly Productive Organizations

Sl. No.	Name of Organizations	Number of Publications	%age of 513
1.	Indian Institute of Technology System	102	19.88
2.	Department of Space Government of India	35	6.82
3.	National Institute of Hydrology	35	6.82
4.	Ministry of Earth Sciences India	30	5.85
5.	Indian Institute of Technology IIT Bombay	25	4.87
6.	Indian Space Research Organisation	25	4.87
7.	National Institute of Technology	24	4.68
8.	Indian Institute of Science Bangalore	22	4.29
9.	Indian Institute of Technology Roorkee	22	4.29
10.	Indian Council of Agricultural Research	21	4.09
11.	Indian Institute of Technology Kharagpur	20	3.9
12.	Council Of Scientific Industrial Research India	16	3.12
13.	CGAIR	15	2.92
14.	Department of Science Technology India	13	2.53
15.	Indian Institute of Tropical Meteorology	13	2.53
16.	Chinese Academy of Sciences	11	2.14
17.	Indian Institute of Technology Iit Kanpur	11	2.14
18.	Space Applications Centre	11	2.14
19.	University of Kashmir	11	2.14
20.	Indian Institute of Technology Delhi	10	1.95
21.	Jawaharlal Nehru University New Delhi	10	1.95
22.	Bhabha Atomic Research Center	9	1.75
23.	Indian Institute of Remote Sensing	9	1.75
24.	National Institute of Technology Karnataka	9	1.75
25.	Centre National De La Recherche Scientifique	8	1.56

The most productive institutions with 8 or more publications are shown in Table 6. Among these, the most of organizations are from India. The highly productive institution is Indian Institute of Technology System with 102 (19.88%) publications followed by Department of Space, Government of India with 35 (6.82%), National Institute of Hydrology with 35 (6.82%), and Ministry of Earth Sciences, India with 30 (5.85%)

publications, respectively. Thus, the highly productive organization is Indian Institute of Technology System.

Table 7: Highly Preferred Journals for Communication

Sl. No.	Name of Journals	Number of Publications	%age of 513
1.	Journal of Hydrology	42	8.19
2.	Current Science	25	4.87
3.	Hydrological Sciences Journal	20	3.9
4.	Hydrological Processes	17	3.31
5.	Journal of Earth System Science	16	3.12
6.	Water Resources Management	16	3.12
7.	Hydrology and Earth System Sciences	12	2.34
8.	Geomorphology	11	2.14
9.	Journal of The Geological Society of India	11	2.14
10.	Arabian Journal of Geosciences	10	1.95
11.	Journal of Hydrologic Engineering	10	1.95
12.	Water Resources Research	10	1.95
13.	International Journal of Climatology	8	1.56
14.	Journal of The Indian Society of Remote Sensing	8	1.56
15.	Environmental Earth Sciences	7	1.37
16.	Water	7	1.37
17.	Isotopes in Environmental and Health Studies	6	1.17
18.	Agricultural Water Management	5	0.98
19.	Applied Water Science	5	0.98
20.	Environmental Monitoring and Assessment	5	0.98
21.	Proceedings of the Institution of Civil Engineers Water Management	5	0.98
22.	Science of the Total Environment	5	0.98
23.	Atmospheric Research	4	0.78
24.	Climate Dynamics	4	0.78
25.	Geocarto International	4	0.78

Table 7 gives the leading journals with more than 4 publications each with number of publications. Journal of Hydrology with 42 (8.19%) publications is the highly preferred journals for communication of their research output by scholars on hydrology under the study period followed by Current Science with 25 (4.87%), Hydrological Sciences Journal with 20 (3.9%), Hydrological Processes with 17 (3.31%), Journal of Earth System Science with 16 (3.12%), and Water Resources Management with 16 (3.12%) publications, respectively. The highly preferred journal for communication of research output on hydrology by scholars under the study period is Journal of Hydrology.

Table 8: Highly Productive Countries

Sl. No.	Name of Countries	Number of Publications	%age of 513
1.	India	388	75.63
2.	USA	68	13.26
3.	England	33	6.43
4.	Germany	29	5.65
5.	Peoples R China	21	4.09
6.	Australia	15	2.92
7.	France	15	2.92
8.	Netherlands	15	2.92
9.	Sweden	11	2.14
10.	Canada	8	1.56
11.	Nepal	6	1.17
12.	Bangladesh	5	0.98
13.	Iran	5	0.98
14.	Japan	5	0.98
15.	Spain	5	0.98
16.	Austria	4	0.78
17.	Brazil	4	0.78
18.	Italy	4	0.78
19.	Norway	4	0.78
20.	Ethiopia	3	0.59
21.	Georgia	3	0.59
22.	Iraq	3	0.59
23.	Scotland	3	0.59
24.	Singapore	3	0.59
25.	Sri Lanka	3	0.59

The distribution of publications of highly productive countries with 3 or more publications is shown in Table 8. India with 388 (75.63%) publications is the highly productive country followed by USA with 68 (13.26%), England with 33 (6.43%), Germany with 29 (5.65%), Peoples R China with 21 (4.09%), Australia with 15 (2.92%), France with15 (2.92%), and Netherlands with 15 (2.92%) publications, respectively. Thus, India is the highly productive country in publication of research output on hydrology under the study period.

7. Conclusion

The quality of water is very important for organisms. Hydrology is study of all the aspects of water such as forms of presence, location of presence, quality of water, flow of water, etc. The highly productive year for publication on hydrology under the study period is 2020. English is the highly preferred language for publication of research output on hydrology under the study period. The highly preferred form of communication of research output on hydrology is journal articles. Sinha, R is the most profile author on hydrology under the study period. The Water Resources is the subject in which highest number of publications published under the period of study. The highly productive organization is Indian Institute of Technology System. The highly preferred journal for communication of research output on hydrology by scholars under the study period is Journal of Hydrology. India is the highly productive country in publication of research output on hydrology under the study period.

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