



(RESEARCH ARTICLE)



## Research Output from IISc during 1999-2020: Scientometrics Analysis Case Study

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Publication history: Received on 16 November 2020; revised on 10 December 2020; accepted on 12 December 2020

Article DOI: <https://doi.org/10.30574/wjaets.2020.1.2.0025>

### Abstract

Over the past Seven decades the knowledge or web of science database maintaining the core collections of Science Citation Index Expanded, and past Conference Proceedings Citation Index- Science and past two decades SciELO Citation Index, Journal citation reports. This paper analyses a results of a scientometric analytical case study of the research activities of highly cited papers from 1999 to 2020. This paper study a growth of publications, citations, average citations per publication and H- index of top scientists or researchers, at Indian Institute of Science, Bengaluru, India. Besides that, this paper presents a citation-based mapping of data on global scientific activities from Indian Institute of Science, Bengaluru, India research publications using Web of Science Database. Using different kind of scientometric approaches, such as a h-index and Global Citation Scores. Researchers have published 32191 publications during 1999-2020 and cited at least 5519 times by end of 2020 are analyzed. Authors have been able to place their papers in high impact journals such as Physics, Engineering, Chemistry, Materials Science, Science & Technology, Computer Science, Biochemistry Molecular Biology, Mechanics, Mathematics, Telecommunications, and Crystallography. The study discloses an output of Indian Institute of Science Research Publications has greatly increased over period.

**Keywords:** Web of Science; Scientometrics; Citation Map; Indian Institute of Science; Global Citation Scores

### 1. Introduction

In the area of library and information science scientometrics is a branch. Scientometrics tools shall be used to measure and compare the scientific activities at various levels including distribution of publications such as year wise, document type-wise, subject wise, source/journal wise, countries-wise, authors wise and highly cited papers with citation map. It is concerned with a characteristics of science and scientific research and quantitative features.

#### 1.1. About Indian institute of science

Indian Institute of Science, Bengaluru, is a forefront of research and education in a basic science subjects and engineering technology subjects. Today, Institute has a very high international reputation in the academic world, in view of the fact; it has expertise both in conventional and emerging areas of science and engineering. It also offers post graduate research and course work. The Institute has more than 45 departments and centers staffed by high caliber scientists. The Institute offers an opportunity for young researchers to pursue doctoral and post-doctoral studies in science subjects and engineering subjects. The institute also offers undergraduate program by providing an opportunity for young scientist.

#### 1.2. Objectives of the study:

- To analyze the yearly growth of publications and it related citations.
- To analyze the document type-wise distribution of publications.
- To know the top subject-wise publications.

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- To know the top country-wise publications.
- To know the top source/journal-wise publications.
- To identify the prolific authors wise distributions of Publications.
- To identify the highly cited papers with Citation Map from Indian Institute of Science, Bangalore

## 2. Material and methods

From Web of Science database the data collected for the period 1999-2020. It can be seen that nearly 32191 bibliographic records of contribution by Indian Institute of Science Bengaluru, India researchers over the period of 22 years. The researcher applied a search strings "Indian Inst Sci" that has used for related information abstraction from the database of Science Citation Index total 21 years to download related data. A total of 32191 records are downloaded by using Web of Science inbuilt software applications as per the objectives of the study. Further based on citation per paper with number of high quality papers are also applied to find out the quality. The study aims to analyze the thrust areas of research concentration.

## 3. Results and discussion

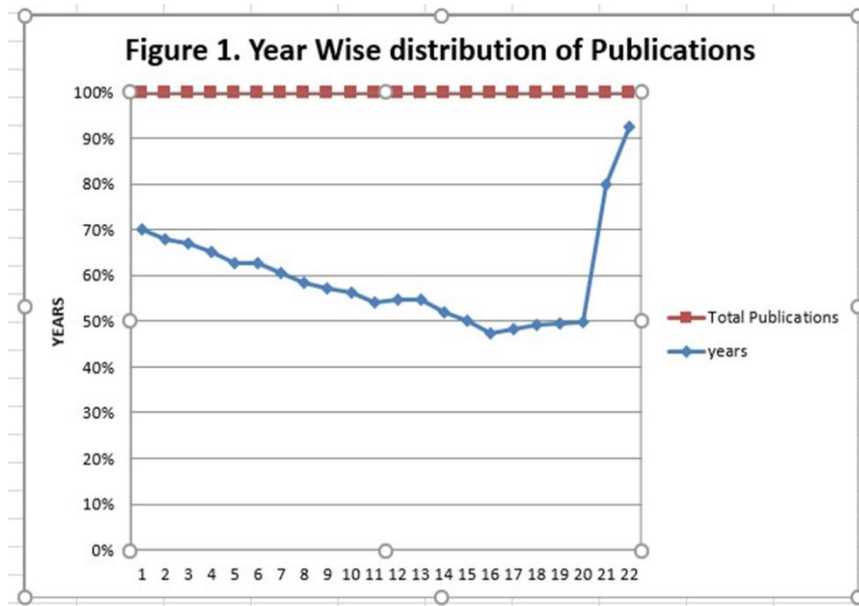
### 3.1. Analysis and Interpretations yearly growth of publications and it related citations

Table 1 shows that in the period of 22 years (1999-2020) a total of 32191 publications were published at Global level. The huge publication is 2239 in 2014 followed by 2160 papers in 2015 and 2086 papers in 2016. The lowest number 162 in the year 2020. In my study reveals all these 519184 publications have Total Global Citation Score it shows that there is a maximum no of citation are published among the scientists from Indian Institute of Science, Bengaluru.

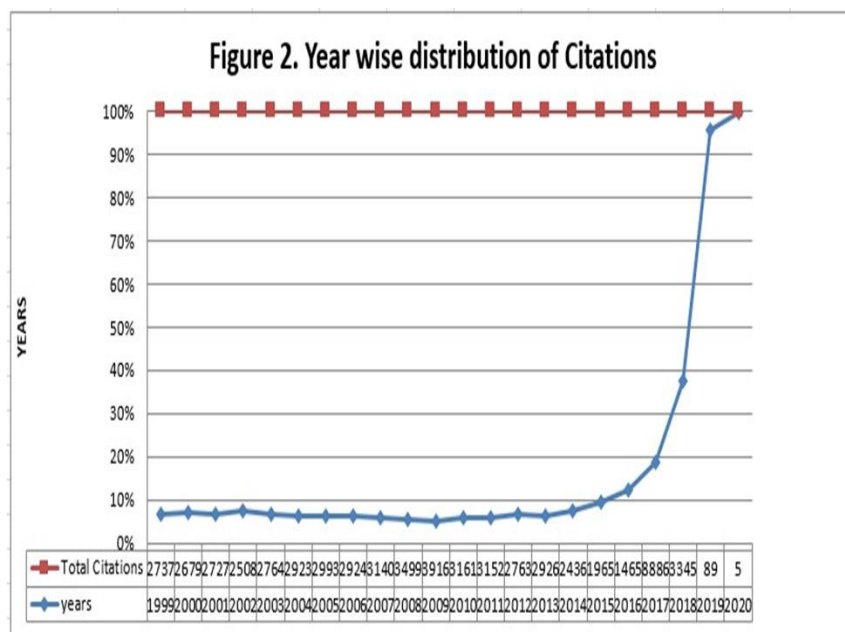
**Table 1** Yearly growth of Publications and its related citations.

Years	Total Publications (TP)	Percentage	Total Citations (TC)	Average Citation Per Publications (ACP)	H-Index
1999	852	2.66	27372	32.12	64
2000	943	2.94	26797	28.41	76
2001	992	3.09	27275	27.49	74
2002	1064	3.32	25080	23.57	70
2003	1190	3.71	27648	23.23	72
2004	1191	3.71	29239	24.54	74
2005	1310	4.09	29935	22.85	74
2006	1430	4.46	29243	20.44	74
2007	1507	4.70	31409	20.84	71
2008	1554	4.85	34998	22.52	81
2009	1699	5.30	39165	23.05	81
2010	1657	5.17	31612	19.07	70
2011	1668	5.20	31520	18.89	68
2012	1861	5.81	27631	14.84	60
2013	2007	6.25	29264	14.58	63
2014	2239	6.99	24362	10.88	54
2015	2160	6.74	19656	9.1	48
2016	2086	6.51	14653	7.02	37
2017	2062	6.43	8886	4.30	31
2018	2045	6.38	3345	1.63	16
2019	512	1.59	89	0.17	3
2020	162	0.03	5	0.03	1
Total	32,191	100.00	5,19,184	365.57	1,262

Source: Web of Science February 2020



**Figure 1** Yearly growth of publications and its related citations and highest publication is 2239 in the year 2014 and lowest publication is 162 in the year 2020



**Figure 2** Shows the highest Citations is 39165 in the year 2009 and lowest citations is 5 in the year 2020

### 3.2. Document wise Distribution of Publications

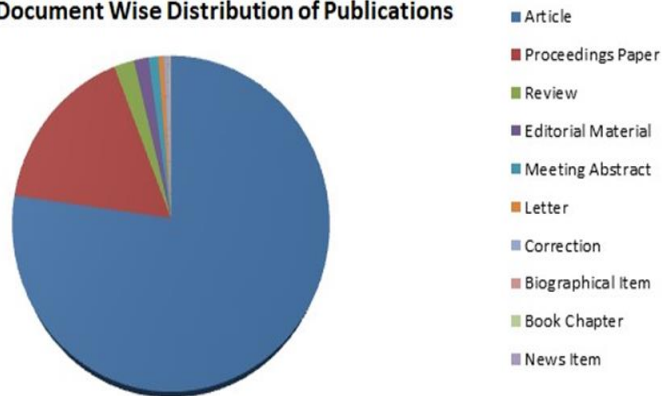
The table 2 depicts the top 10 document wise distribution of articles published in the journal during 1999 to 2020. The productivity of scientists spreads over variety of publication media, such that journal articles; article, proceedings paper; Meeting abstract, review; letter; editorial materials; correction; meeting abstracts; article, book chapters; correction, Item about an individual and other news items. Table-2 analysis that the share of Articles is the most prominent bibliographic publications and it occupies 25666 (77.15%). Proceedings Paper has 5603 (13.71%) contributions, Review papers has 705 (1.99%) contributions, Editorial materials has 508 (1.47%), Meeting abstract has 344 (1.01%) and followed by remaining Letter, Correction, Bibliographic Item. Remaining document types like Book Chapter, News item are scored the lowest total number 31 (0.09%) of publications for communication among the scientists.

**Table 2** Document Wise Distributions of Publications

Document Types	TP	Percentage
Article	25666	77.15
Proceedings Paper	5603	13.71
Review	705	1.99
Editorial Material	508	1.47
Meeting Abstract	344	1.01
Letter	198	0.58
Correction	124	0.37
Biographical Item	51	0.15
Book Chapter	35	0.10
News Item	31	0.09

Source: Web of Science February 2020

**Figure 3. Document Wise Distribution of Publications**



**Figure 3** Shows journal articles is top ranked with 25666 (77.15%) and News item is lowest rank with 31 (0.09%)

**3.3. Subject Wise Distributions of publications**

The table 3 depicts the top 10 subject-wise distribution of articles published in the journal during 1999 to 2020. Materials Science Multidisciplinary subject is top ranked with 5051 (21.03%) publications, followed by Engineering Electrical Electronic subjects with 3813 (8.09%) publications, while Physics Applied subject ranked third with 3009 (14.74%) publications and followed by remaining subjects.

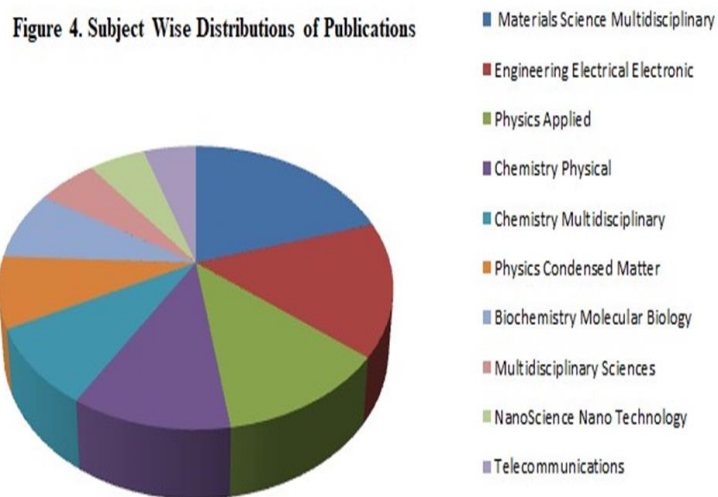
**Table 3** Subject Wise Distributions of Publications

Sl. No.	Subjects	TP	Percentage	TC	ACP	H-Index
1	Materials Science Multidisciplinary	5051	21.03	106212	21.02	116
2	Engineering Electrical Electronic	3813	8.09	30830	8.08	68
3	Physics Applied	3009	14.74	44364	14.74	80
4	Chemistry Physical	2775	26.49	73496	26.48	111
5	Chemistry Multidisciplinary	2216	28.89	64017	28.88	101
6	Physics Condensed Matter	2016	17.86	36012	17.86	77
7	Biochemistry Molecular Biology	1990	19.34	38479	19.33	72
8	Multidisciplinary Sciences	1435	17.83	25580	17.82	64
9	Nanoscience Nanotechnology	1353	23.21	31400	23.20	73
10	Telecommunications	1271	4.64	5894	4.63	35

Source: Web of Science February 2020

Remaining document types like Chemistry Physical, Chemistry Multidisciplinary, Physics Condensed Matter, Biochemistry Molecular Biology, Multidisciplinary Sciences, Nanoscience Nanotechnology and Telecommunications are lowest numbers 1271 (4.64), 1353 (23.21), 1990 (19.34), 2016 (17.86) and 1435 (17.83%) respectively for subject wise distributions of publications.

Figure-4 Shows subject physics is top rank with 4285 (19.01%) and Subject Crystallography is lowest rank with 733 (3.25%).



**Figure 4** Shows subject Materials Science Multidisciplinary is top rank with 5051 (21.03%) and Subject Telecommunications is lowest rank with 1271 (4.64%).

### 3.4. Top country-wise Distribution of Publication

The table 4 depicts the top 10 country-wise distribution of articles published in the journal during 1999 to 2020 from Indian Institute Science scientists/authors. India is top ranked with 32032 (NA %) publications, followed by USA with 3398 (25.42%) publications, while France ranked third with 1177 (21.86%) publications and followed by England, Japan etc. Remaining country wise distribution of publications like South Korea, Italy Japan, Peoples R China and Australia are lowest numbers 453 (18.22%), 490 (20.71%), 534 (24.47%), 544 (17.15%), and 548 (36.98%) respectively.

**Table 4** Country Wise Distribution of Publications

Sl. No.	Counties	TP	Percentage	TC	ACP	H-Index
1	India	32032	NA	NA	NA	NA
2	USA	3398	25.42	86393	25.42	116
3	France	1177	21.86	25725	21.85	70
4	Germany	1145	19.77	22633	19.76	63
5	England	948	25.19	23884	25.19	65
6	Japan	548	36.98	20266	36.98	63
7	South Korea	544	17.15	9332	17.15	42
8	Italy	534	24.47	13068	24.47	52
9	Peoples R China	490	20.71	10148	20.71	45
10	Australia	453	18.22	8255	18.22	39

Source: Web of Science February 2020

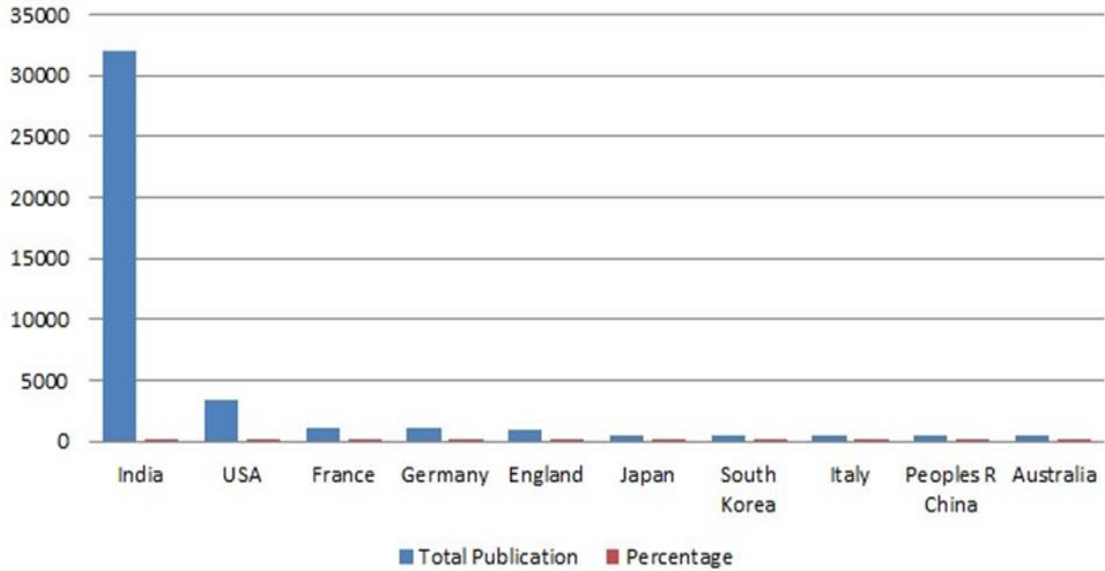


Figure 5 Shows country wise India is top rank with 3032(Na%) and Australia is lowest rank with 453(18.22%)

### 3.5. Source Wise Distribution of Publications

The table 5 depicts the source wise distribution of publications published in the journal during 1999 to 2020 from IISc scientists/authors. Current Science is top ranked with 683 (8.57%) publications, followed by Physical Review B with 468 (26.75%) publications, Journal of Chemical Physics ranked third with 309 (16.67%) publications and followed by other Journal titles. Remaining source wise distribution of publications like Lecture Notes in Computer Science, Journal of Physical Chemistry B, Applied Physics Letters and Physical Review Letters are low numbers of publications i.e. below on percentage.

Table 5 Source Wise Distribution of Publications

Sl. No.	Journal Title	TP	Percentage	TC	ACP	H-Index
1	Current Science	683	8.57	5855	8.57	36
2	Physical Review B	468	26.75	12521	26.75	57
3	Journal of Chemical Physics	309	16.67	5152	16.67	35
4	Journal of Applied Physics	297	14.57	4326	14.56	33
5	Lecture Notes In Computer Science	279	2.51	699	2.50	11
6	Journal of Physical Chemistry B	244	34.76	8481	34.75	48
7	AIP Conference Proceedings	236	0.64	151	0.63	5
8	Journal Of High Energy Physics	234	12.32	2883	12.32	29
9	Applied Physics Letters	232	16.26	3773	16.26	33
10	Physical Review Letters	231	41.64	9619	41.64	55

Source: Web of Science February 2020

### 3.6. Prolific authors wise distributions of publications

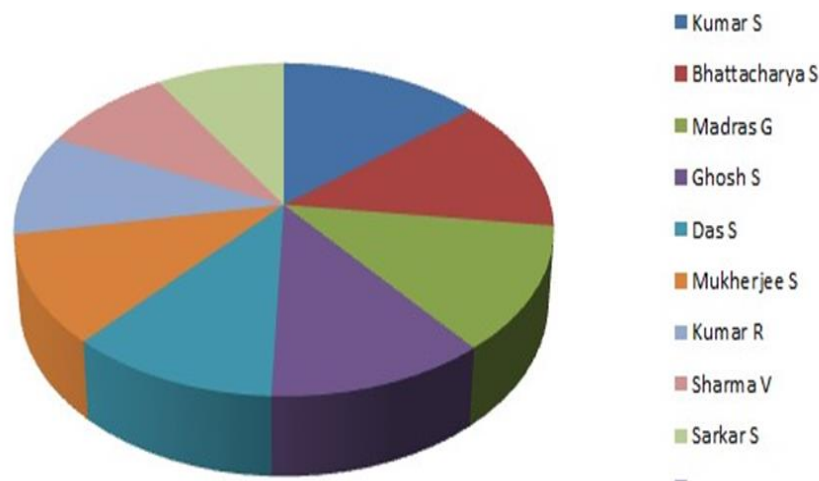
In this analytical period, authors were published 32191 paper contributions scattered over 500 premier journals. The first 10 of authors are identified highest contributors of research at Indian Institute Science, Bengaluru. The table 6 depicts the authors wise distributions of publications published in the journal during 1999 to 2020 from Indian Institute of Science scientists/authors. In the below table shown the total global citation score and h-index. Kumar A is author who published 701 papers with 9451 Total Global Citation Scores with first place and in the below table-6 shows only

top 10 authors with citation and h-index. Kumar S with 573 papers with 8828 TGCS articles come second place and followed by other scientists/authors.

**Table 6** Authors wise distributions of Publications

Sl. No.	Authors	TP	Percentage	TC	ACP	h-index
1	Kumar A	701	13.48	9451	13.48	40
2	Kumar S	573	15.41	8828	15.40	42
3	Bhattacharya S	536	18.46	9895	18.46	56
4	Madras G	499	25.77	13119	26.29	51
5	Ghosh S	470	14.63	6874	14.62	42
6	Das S	450	9.0	4051	9.0	31
7	Mukherjee S	434	11.69	5072	11.6	39
8	Kumar R	406	14.27	5794	14.27	29
9	Sharma V	372	5.11	1900	5.10	19
10	Sarkar S	364	12.57	4576	15.57	26

Source: Web of Science February 2020



**Figure 6** Shows prolific author wise publications Kumar A are top rank with 701 (13.48%) and Sarkar S is lowest rank with 364 (12.57%).

### 3.7. Citation Map of Highly Cited Authors

A Citation Map shows that the citation relationships between a paper and other papers using various visualization tools and techniques. Citation mapping analysis can be applied as subject similarity indicators. It is defined as “the frequencies with two documents are cited together”. (Source: Web of Science Database)

**Table 7** Top 10 Highly Cited Papers from IISC, Bengaluru, India.

Sl. No.	Citations	Title	Authors	Source	Year
1	5519	Data clustering: A review	Jain, AK; Murty, MN; Flynn, PJ	Acm Computing Surveys	1999
2	2568	Graphene: The New Two-Dimensional Nanomaterial	Rao, C. N. R.; Sood, A. K.; Subrahmanyam, K. S.; et al.	Angewandte Chemie-International Edition	2009
3	2318	A dipole mode in the tropical Indian Ocean	Saji, NH; Goswami, BN; Vinayachandran, PN; et al.	Nature	1999
4	2089	Monitoring dopants by Raman scattering in an electrochemically top-gated graphene transistor	Das, A.; Pisana, S.; Chakraborty, B.; et al.	Nature Nanotechnology	2008
5	1890	Overview No.144 - Mechanical behavior of amorphous alloys	Schuh, Christopher A.; Hufnagel, Todd C.; Ramamurty, Upadrasta	Acta Materialia	2007
6	1713	Recent Advances and Industrial Applications of Multilevel Converters	Kouro, Samir; Malinowski, Mariusz; Gopakumar, K.; et al.	IEEE Transactions On Industrial Electronics	2010
7	1712	Guidelines for the use and interpretation of assays for monitoring autophagy (3rd edition)	Klionsky, Daniel J.; Abdelmohsen, Kotb; Abe, Akihisa; et al.	Autophagy	2016
8	1471	Supramolecular Coordination: Self-Assembly of Finite Two- and Three-Dimensional Ensembles	Chakrabarty, Rajesh; Mukherjee, Partha Sarathi; Stang, Peter J.	Chemical Reviews	2011
9	1445	Supramolecular gels: Functions and uses	Sangeetha, NM; Maitra, U	Chemical Society Reviews	2005
10	1069	Adaptive probabilities of crossover and mutation in genetic algorithms classifier design	Srinivas, M; patnaik, LM	IEEE Transactions On Systems Man And Cybernetics	1994

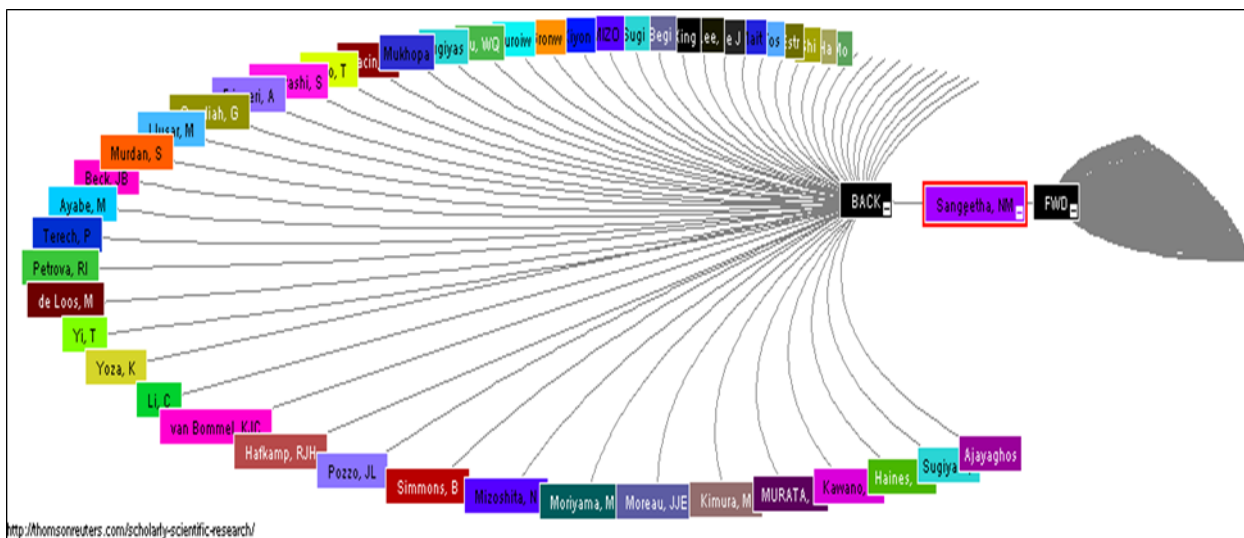
Source: Web of Science February 2020

### 3.7.1. Citation Map of Rao, C.N.R.

Out of the total 32191 numbers of publications, author Rao, CNR is Global Citation Scores 2568 and single paper received 261 citations. The ACPP of Rao, CNR 48.49. The h-index is 57 and below figure 6 shows the citation map.







**Figure 10** Shows bibliographic details: Title: Supramolecular gels: Functions and uses, Author(s): Sangeetha N, Maitra U, Source: CHEMICAL SOCIETY REVIEWS, Volume: 34, Issue: 10, Pages: 821-836, DOI: 10.1039/b417081b, published: 2005, Times Cited: 911.

#### 4. Conclusion

In my research study discloses the following findings. Total number of publications is 32191 and 519184 times cited by others scientist/authors, its average citation value is 365.57. The overall year's h – index value is 57.36. Document wise distributions of publications for the article is top ranked with 25666 (77.15%) and News Item last ranked with 31 (0.09%). Subject wise distributions for the Materials Science Multidisciplinary subject is top ranked with 5051 (21.03%) Publications and Telecommunications subject is last rank with 1271 (4.64%). Country-wise distribution of articles published in the journal India is top ranked with 32032 (NA %) publications and Australia is last rank with 453 (18.22%). Journal/source wise publications published in the journal Current Science is number one ranked with 683 (8.57%) and Physical Review Letters is last rank with 231 (41.64%). Prolific author wise publications Kumar A are top rank with 701 (13.48%) and Sarkar S is lowest rank with 364 (12.57%). The group of citing papers includes a large number of highly cited papers we would describe as citation classics. The highest publication is 2239 in 2014 and next level by 2160 papers in 2015 and 2086 papers in 2016. The few publication 162 from 2020 year. This research paper results shows that there is considerable growth in the research output of the journal during 1999-2020 in Indian Institute of Science researchers. Overall, at the global level single author publications should be encouraged. Citation Map help the researcher and scientist to know the growth, development and research impact of particular field of research to know citation, h-index and number of publications.

#### Compliance with ethical standards

##### Acknowledgments

This paper would not be complete without acknowledging the Thomson Reuters Web of Science database. Of course the paper collected 22 years data has been collected form Web of Science database due to this the paper accomplishment successfully. As I knew without data it is not possible to complete the objectives of these study in this paper.

I also takes this opportunity to thanks all authors in the references I has been mentioned in the bellow. Who are published in the previous years, I have been referred their published article and got clear idea to write this paper successfully.

##### Disclosure of conflict of interest

As the paper is authored by single author so there is no conflict of interest.

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