

MAPPING THE INDIAN RESEARCH PRODUCTIVITY OF IMAGING SCIENCE PHOTOGRAPHIC TECHNOLOGY: A SCIENTOMETRIC ANALYSIS

Author's Name: ¹Mr. Pitty Nagarjuna, ²Mr. Shambhulinga Irappa Javali

Affiliation: ¹Senior Scientific Officer, JRD Tata Memorial Library, Indian Institute of Science, Bengaluru, Karnataka, India.

²Librarian, K.L.E. Society's, College of Pharmacy, Gadag, Karnataka, India.

E-Mail: nagarjun@iisc.ac.in

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Abstract

An analysis of 648 publications published by Indian scientists during 2001 to 2020 and indexed by Scopus online Database indicates that the publication output in the Indian Research Publication. Centre Imaging Science Photographic Technology Research Institute, Indian Institute of Technology, Defense Food Research Lab and institutes are the major producers of research output. Most of the prolific authors are from the highly productive institutions. This work is to provide a profile of research in Indian Research Publication in India. This includes tracking the number of papers, scatter of papers over journals, and its effect on publication output, authors' institutional affiliations and authorship patterns.

Keywords: Imaging, Science, Photographic, Technology, Citation Index, Scientometrics.

INTRODUCTION

India is the world's largest producer of food, next to China and has the potential of being the largest with the potential of being the largest with the food and agricultural sector. There is an opportunity for large investments in food and food processing technologies, skills and infrastructure, especially in areas of canning, dairy packaging, frozen food / refrigeration and thermo processing. Fruits and vegetables, milk and milk products, meat and poultry, packaged / convenience foods are important sub-sectors of the food processing industry. It requires increase India's contribution to research in food science and technology is assessed from an analysis of publications indexed in ISI. Food scientists develop and improve ways to process raw ingredients, such as grains, meats, milk, fruit and vegetables to safe, tasty and nutritious foods. Scientometrics is concerned with the quantitative features and characteristics of science and scientific research. Emphasis is placed on investigations in which the development and mechanism of science are studied by statistical mathematical methods.

OBJECTIVES

The main objective of this study was to use Scientometric mapping and analyze the key features of Imaging Science Photographic Technology research activities at India level:

1. To identify and analyze the rate of year wise growth of research productivity on Imaging Science Photographic Technology;
2. To note the document wise distribution of publications;
3. To identify the ranking of authors based on publications;
4. To Subject Area-wise or Domain Wise Distribution;
5. To identify journal wise distribution of publications;
6. Geographical Collaboration Wise Distribution of Publications;
7. To assess the Institution wise research concentration;
8. Global Citation Scores.

METHODOLOGY

This analytical study encompassing records output on Science from Science Citation Index (SCI) available on online (Scopus). The present study aims at analyzing the research output of researchers in the field of Imaging Science Photographic Technology. The growth rate of output in terms of research productivity is analyzed from 2001 to 2020. The authorship pattern and author productivity are examined to identify the pattern of research contribution in the field of Imaging Science Photographic Technology. The area-wise research performance is analyzed to identify hot area of research. Further, an attempt is made to measure the performance of researchers and their research concentration in the field of Imaging Science Photographic Technology and it is also analytical in nature in strengthening the empirical validity due to application of suitable statistical tools.

ANALYSIS AND INTERPRETATION

Relative Growth Rate of Publications

To analyze the year wise publication of research on Imaging Science Photographic Technology, the data has been presented in Table 1 could clearly see that during the period 2001 to 2020 a total of 648 publications were published at India level. The highest publication is 95 in 2019 with 1357 Total Citations followed by 89 papers in 2020 with 1685 Total Citations and 78 papers in 2017 with 812 Total Citations. The lowest publication is 03 in 2001 with 00 Total Citations. It shows that even minimum numbers of records were scored higher citations. The study also reveals all these 648 publications have 8450 cited references it shows that there is a healthy trend in citing reference is found in Imaging Science Photographic Technology.

Table 1: Year Wise Distribution of Publications

Year	TP	%	TC	ACP
2001	3	0.46	0	0.00
2002	4	0.62	2	0.50
2003	3	0.46	6	2.00
2004	2	0.31	7	3.50
2005	6	0.93	21	3.50
2006	5	0.77	25	5.00
2007	12	1.85	30	2.50
2008	9	1.39	57	6.33
2009	15	2.31	125	8.33
2010	19	2.93	233	12.26
2011	26	4.01	296	11.38
2012	25	3.86	388	15.52
2013	37	5.71	435	11.76
2014	41	6.33	509	12.41
2015	43	6.64	585	13.60
2016	60	9.26	788	13.13
2017	78	12.04	812	10.41
2018	76	11.73	1089	14.33
2019	95	14.66	1357	14.28
2020	89	13.73	1685	18.93
Total	648	100.00	8450	13.04

TP= Total Publications.

TC= Total Citations.

ACP= Average Citation per Publications.

Fig 1: Year Wise Distribution of Publications



Document wise Distribution of Publications

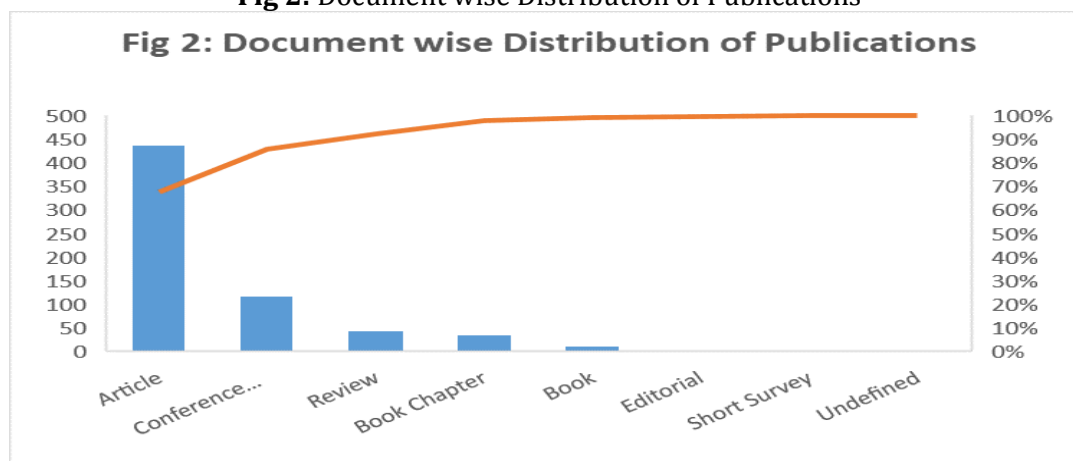
Table 2 indicates the document wise distributions of publications of Imaging Science Photographic Technology. Those documents are classified into 8 categories according to the nature of publication. The data from the table reveals that most prevalent form of publication is journal article with the India 436 records and India were 280 records. Note as a source of Conference Paper takes second place in the order to the India 118 records, followed by Review (44), Book Chapter (34), Book (11), Editorial (2), Short Survey (2) and Undefined (1).

Table 2 : Document wise Distribution of Publications

Document Type	TP	%	TC	ACP
Article	436	67.28	6010	13.78
Conference Paper	118	18.21	1553	13.16
Review	44	6.79	601	13.66
Book Chapter	34	5.25	224	6.59
Book	11	1.70	35	3.18
Editorial	2	0.31	17	8.50
Short Survey	2	0.31	3	1.50
Undefined	1	0.15	7	7.00
Total	648	100.00	8450	13.04
Article	436	67.28	6010	13.78
Conference Paper	118	18.21	1553	13.16
Total	648	100.00	8450	13.04

TP= Total Publications. TC= Total Citations. ACP= Average Citation per Publications.

Fig 2: Document wise Distribution of Publications



Ranking of Authors Based on Publications

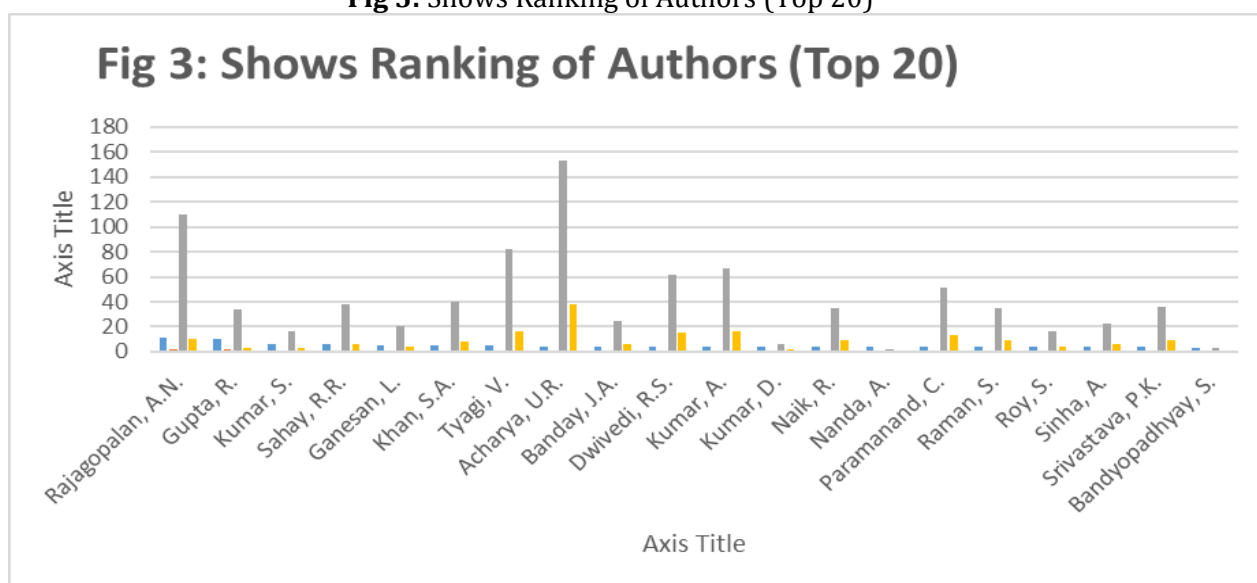
Table 3 indicates ranking of authors by number of publications. Authors “Rajagopalan, A.N.” published highest number of articles for the study period with 11 records with 110 citations, next author “Gupta, R.” is published next highest number of articles for the study period with 10 records and 34 citations. Thus the most cited authors are distinguished from the most-published ones. It is found from regard to author productivity in proliferation of research in imaging science photographic technology as the research papers equally distributed by a large number of authors.

Table 3: Shows Ranking of Authors (Top 20)

Sl. No.	Authors	TP	%	TC	ACP
1	Rajagopalan, A.N.	11	1.70	110	10.00
2	Gupta, R.	10	1.54	34	3.40
3	Kumar, S.	6	0.93	16	2.67
4	Sahay, R.R.	6	0.93	38	6.33
5	Ganesan, L.	5	0.77	20	4.00
6	Khan, S.A.	5	0.77	40	8.00
7	Tyagi, V.	5	0.77	82	16.40
8	Acharya, U.R.	4	0.62	153	38.25
9	Banday, J.A.	4	0.62	25	6.25
10	Dwivedi, R.S.	4	0.62	62	15.50
11	Kumar, A.	4	0.62	67	16.75
12	Kumar, D.	4	0.62	6	1.50
13	Naik, R.	4	0.62	35	8.75
14	Nanda, A.	4	0.62	2	0.50
15	Paramanand, C.	4	0.62	51	12.75
16	Raman, S.	4	0.62	35	8.75
17	Roy, S.	4	0.62	16	4.00
18	Sinha, A.	4	0.62	22	5.50
19	Srivastava, P.K.	4	0.62	36	9.00
20	Bandyopadhyay, S.	3	0.46	3	1.00

TP= Total Publications. TC= Total Citations. ACP= Average Citation per Publications.

Fig 3: Shows Ranking of Authors (Top 20)



Subject Area-wise or Domain-wise Distribution

The table 4 depicts the top 20 subject-wise distribution of articles published in the subject during 2001 to 2020. Computer Science subject is top ranked with 288 (44.44% total output)

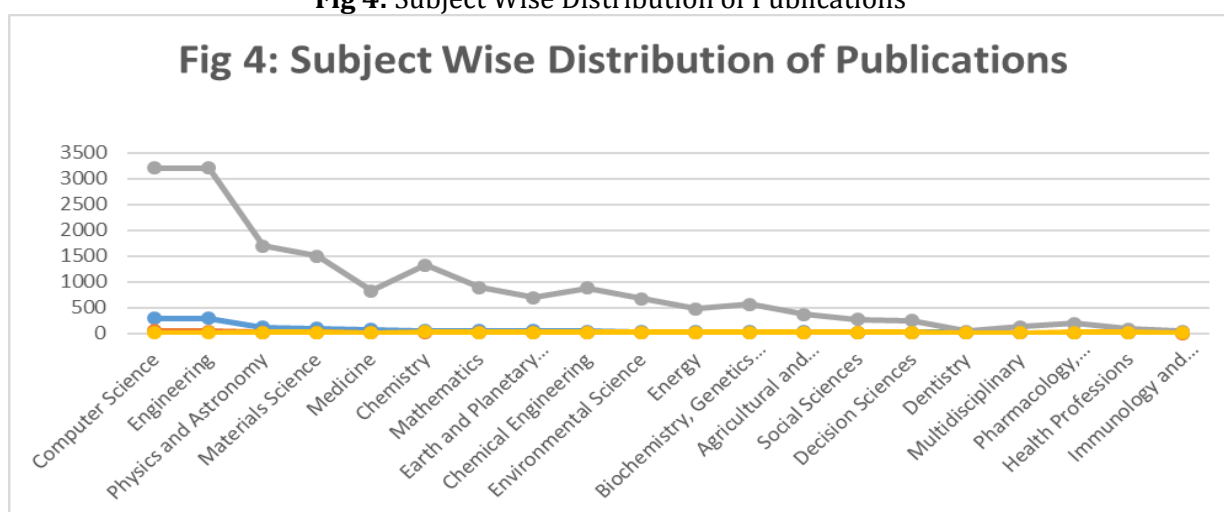
publications, followed by Engineering subjects with 287(44.29% total output) publications, while Physics and Astronomy subject ranked third with 119 (18.36% total output) publications, Materials Science 88 (13.58% total output) publications, while Medicine 73 (11.27% total output) and followed by remaining subjects. Remaining document types like Chemistry, Mathematics, Earth and Planetary Sciences, Chemical Engineering, Environmental Science, Energy, Biochemistry, Genetics and Molecular Biology, Agricultural and Biological Sciences, Social Sciences, Decision Sciences, Dentistry, Multidisciplinary, Pharmacology, Toxicology and Pharmaceutics, Health Professions, Immunology and Microbiology are low numbers of publications (below Ten percentages).

Table 4: Subject Wise Distribution of Publications

Sl. No.	Subject	TP	%	TC	ACP
1	Computer Science	288	44.44	3203	11.12
2	Engineering	287	44.29	3203	11.16
3	Physics and Astronomy	119	18.36	1690	14.20
4	Materials Science	88	13.58	1499	17.03
5	Medicine	73	11.27	828	11.34
6	Chemistry	53	8.18	1321	24.92
7	Mathematics	52	8.02	889	17.10
8	Earth and Planetary Sciences	45	6.94	689	15.31
9	Chemical Engineering	40	6.17	875	21.88
10	Environmental Science	32	4.94	670	20.94
11	Energy	31	4.78	471	15.19
12	Biochemistry, Genetics and Molecular Biology	31	4.78	563	18.16
13	Agricultural and Biological Sciences	23	3.55	363	15.78
14	Social Sciences	21	3.24	267	12.71
15	Decision Sciences	13	2.01	244	18.77
16	Dentistry	12	1.85	40	3.33
17	Multidisciplinary	11	1.70	123	11.18
18	Pharmacology, Toxicology and Pharmaceutics	9	1.39	194	21.56
19	Health Professions	7	1.08	83	11.86
20	Immunology and Microbiology	5	0.77	44	8.80

TP= Total Publications. TC= Total Citations. ACP= Average Citation per Publications.

Fig 4: Subject Wise Distribution of Publications



Journal wise Distribution of Publications

The table 5 depicts the source wise distribution of papers published in the journal during 2001 to 2020 from Imaging Science Photographic Technology scientists. Imaging Science Journal is

top ranked with 73 (11.27%) publications, followed by Multimedia Tools and Applications with 9 (1.39%) publications and followed by other Journal titles.

Table 5: Journal Wise Distribution of Publications

Sl. No.	Journal/ Source	TP	%	TC	ACP
1	Imaging Science Journal	73	11.27	11	0.15
2	Multimedia Tools And Applications	9	1.39	125	13.89
3	OPTIK	8	1.23	38	4.75
4	Advances In Intelligent Systems And Computing	7	1.08	92	13.14
5	Communications In Computer And Information Science	7	1.08	55	7.86
6	Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	7	1.08	94	13.43
7	ACM International Conference Proceeding Series	6	0.93	49	8.17
8	Journal Of Applied Physics	6	0.93	20	3.33
9	IEEE Transactions On Image Processing	5	0.77	29	5.80
10	International Journal Of Applied Engineering Research	5	0.77	18	3.60
11	Journal Of Materials Science Materials In Electronics	5	0.77	37	7.40
12	RSC Advances	5	0.77	50	10.00
13	Defence Science Journal	4	0.62	0	0.00
14	Indian Journal Of Ophthalmology	4	0.62	29	7.25
15	International Journal Of Innovative Technology And Exploring Engineering	4	0.62	18	4.50
16	Journal Of Applied Remote Sensing	4	0.62	15	3.75
17	Plos One	4	0.62	22	5.50
18	Progress In Biomedical Optics And Imaging Proceedings Of SPIE	4	0.62	9	2.25
19	Remote Sensing	4	0.62	9	2.25
20	AIP Conference Proceedings	3	0.46	35	11.67

TP= Total Publications. **TC=** Total Citations. **ACP=** Average Citation per Publications.

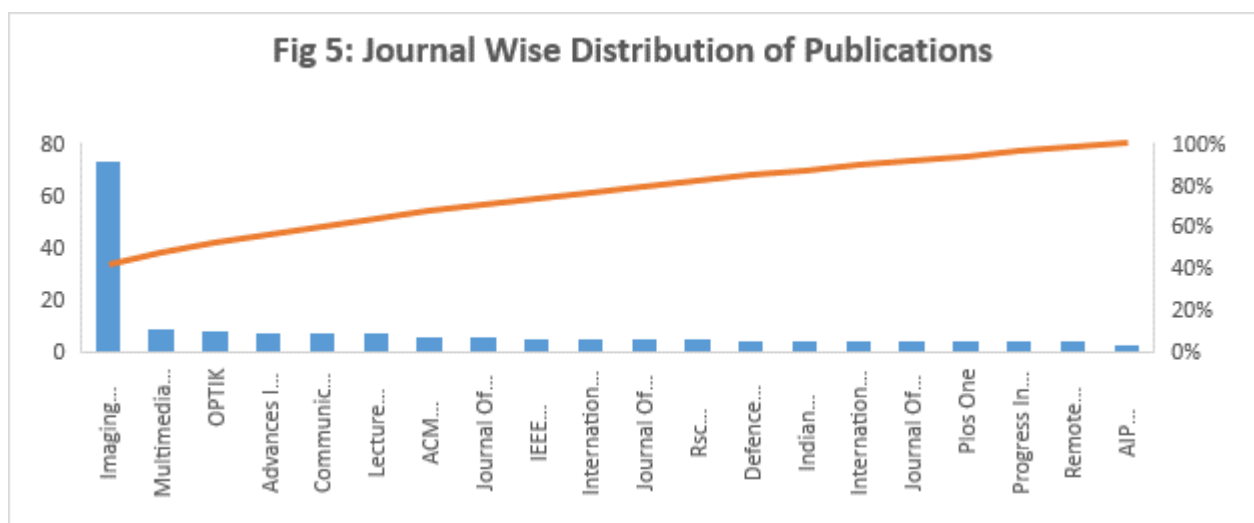


Fig 5: Journal Wise Distribution of Publications

Geographical Collaboration Wise Distribution of Publications

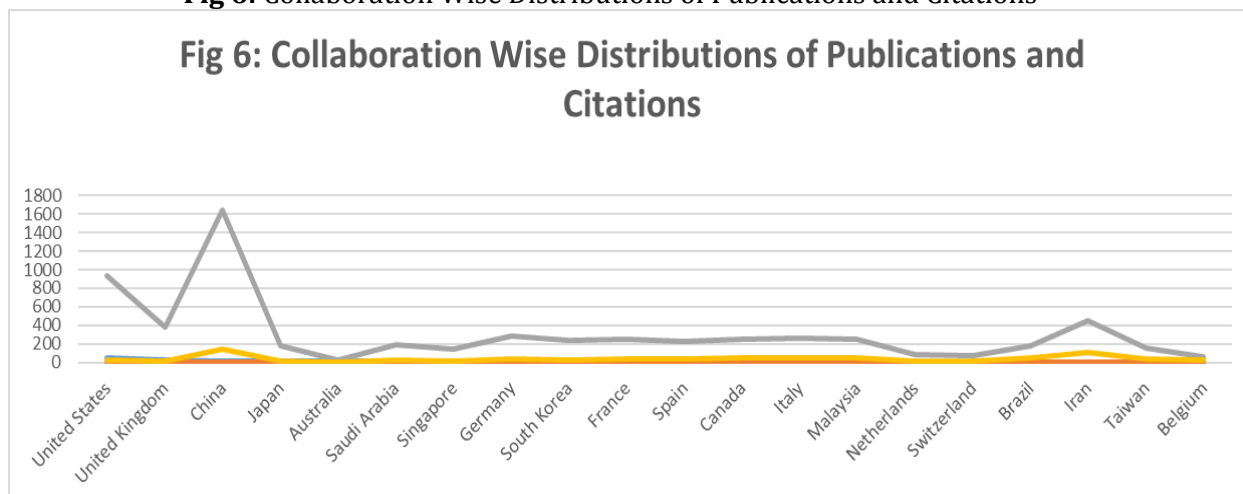
It was feasible to analyses the articles under sample according to geographical distribution of Indian collaboration research with more than 20 countries in the field of imaging science photographic technology. USA is top ranked with 44 (6.79%) publications with 932 total citations, followed by United Kingdom with 21 publications and 383 total citations, while China ranked third with 12 publications with 1648 total citations and followed by Japan, Australia, Saudi Arabia, Singapore, Germany etc. are low numbers of publications i.e. below on percentage.

Table 6: Collaboration Wise Distributions of Publications and Citations

Sl. No.	Country	TP	%	TC	ACP
1	United States	44	6.79	932	21.18
2	United Kingdom	21	3.24	383	18.24
3	China	12	1.85	1648	137.33
4	Japan	11	1.70	183	16.64
5	Australia	10	1.54	23	2.30
6	Saudi Arabia	10	1.54	192	19.20
7	Singapore	10	1.54	138	13.80
8	Germany	9	1.39	289	32.11
9	South Korea	9	1.39	240	26.67
10	France	8	1.23	253	31.63
11	Spain	6	0.93	228	38.00
12	Canada	5	0.77	247	49.40
13	Italy	5	0.77	259	51.80
14	Malaysia	5	0.77	252	50.40
15	Netherlands	5	0.77	87	17.40
16	Switzerland	5	0.77	71	14.20
17	Brazil	4	0.62	176	44.00
18	Iran	4	0.62	448	112.00
19	Taiwan	4	0.62	153	38.25
20	Belgium	3	0.46	62	20.67

TP= Total Publications. **TC=** Total Citations. **ACP=** Average Citation per Publications.

Fig 6: Collaboration Wise Distributions of Publications and Citations



Institution wise Distribution of Publications

The below table analysis indicates Institution-wise research productivity. It is noted that 500 institutions were contributed of the total research productivity in the subject of Imaging Science Photographic Technology. It is noted that Indian Institute of Technology, Madras contributed

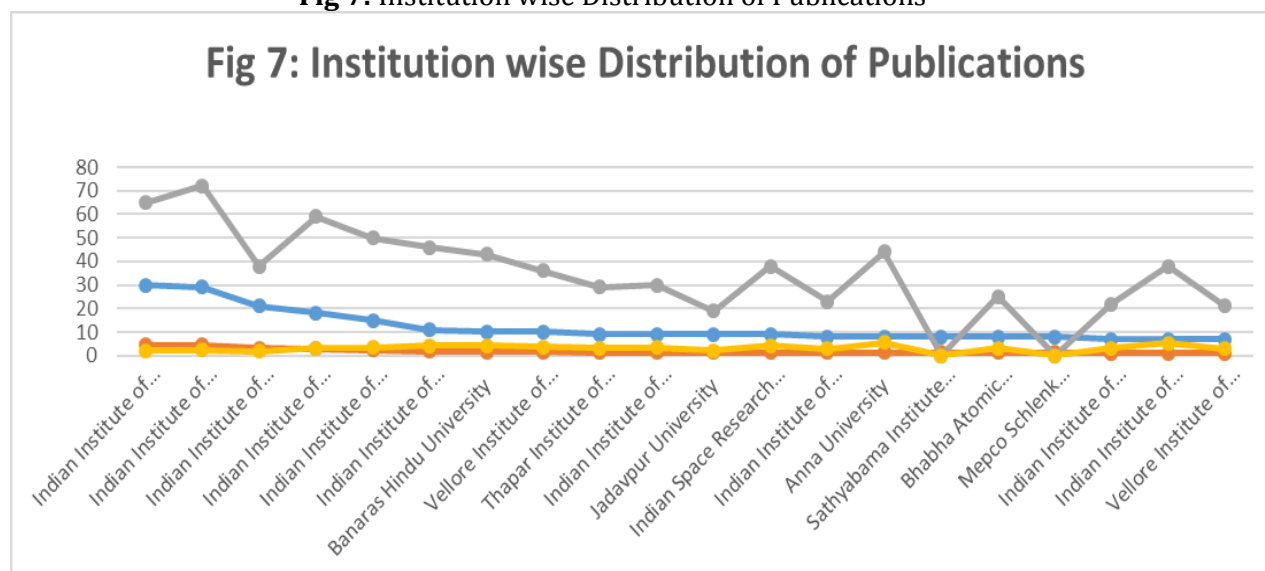
the highest number of research publications i.e. 30 records with 65 total citations.

Table 7: Institution wise Distribution of Publications

Sl. No	Institutions	TP	%	TC	ACP
1	Indian Institute of Technology Madras	30	4.63	65	2.17
2	Indian Institute of Technology, Bombay	29	4.48	72	2.48
3	Indian Institute of Technology Kharagpur	21	3.24	38	1.81
4	Indian Institute of Technology Roorkee	18	2.78	59	3.28
5	Indian Institute of Science, Bengaluru	15	2.31	50	3.33
6	Indian Institute of Technology Kanpur	11	1.70	46	4.18
7	Banaras Hindu University	10	1.54	43	4.30
8	Vellore Institute of Technology, Vellore	10	1.54	36	3.60
9	Thapar Institute of Engineering & Technology	9	1.39	29	3.22
10	Indian Institute of Technology Banaras Hindu University	9	1.39	30	3.33
11	Jadavpur University	9	1.39	19	2.11
12	Indian Space Research Organization	9	1.39	38	4.22
13	Indian Institute of Technology Indian School of Mines, Dhanbad	8	1.23	23	2.88
14	Anna University	8	1.23	44	5.50
15	Sathyabama Institute of Science and Technology	8	1.23	0	0.00
16	Bhabha Atomic Research Centre	8	1.23	25	3.13
17	Mepco Schlenk Engineering College	8	1.23	0	0.00
18	Indian Institute of Remote Sensing	7	1.08	22	3.14
19	Indian Institute of Technology Delhi	7	1.08	38	5.43
20	Vellore Institute of Technology, Chennai	7	1.08	21	3.00

TP= Total Publications TC= Total Citations ACP= Average Citation per Publications

Fig 7: Institution wise Distribution of Publications



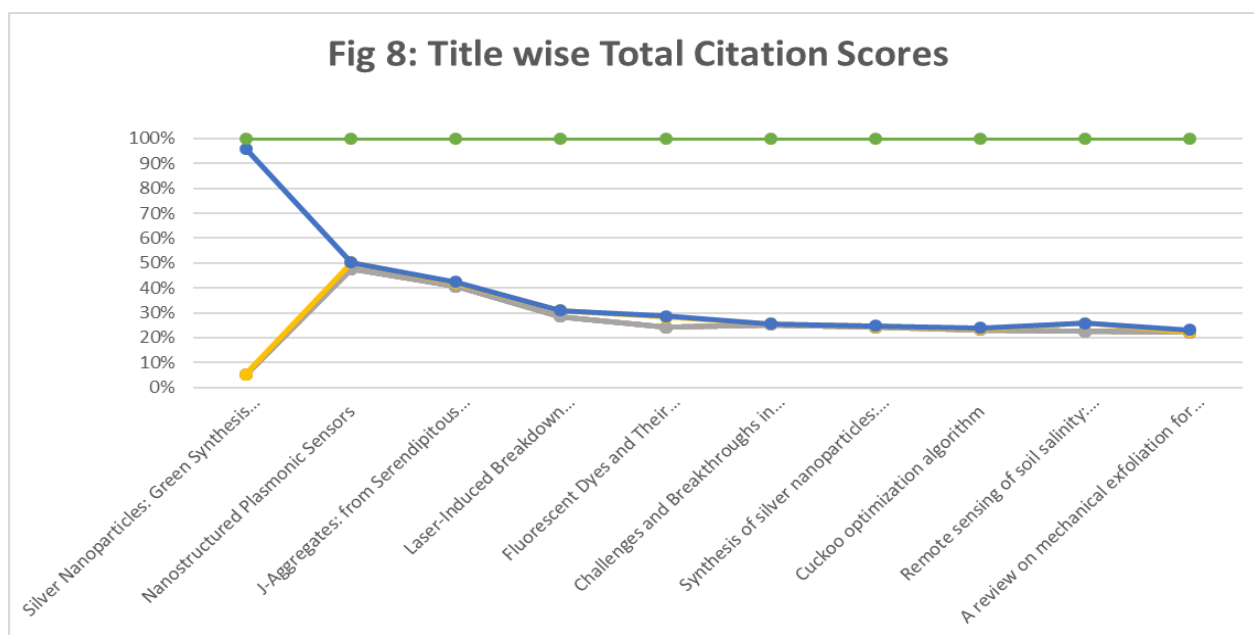
Title wise Total Citation Scores

The top 10 Title wise Total Citation Scores papers the most cited research papers span the period from 2001 to 2020 with one major network. There are only 27 links with GCS ranging between maximum 2472 and minimum 583.

Table 8: Title wise Total Citation Scores

Sl. No.	Title	TC	Journal Name	Authors	Vol.	Iss.	Year
1	Silver Nanoparticles: Green Synthesis and Their Antimicrobial Activities	24 72	Advances in Colloid and Interface Science	Sharma, V.K., Yngard, R.A., Lin, Y.	145	1-2	2009
2	Nanostructured Plasmonic Sensors	19 14	Chemical Reviews	Stewart, M.E., Anderton, C.R., Thompson, L.B., Maria, J., Gray, S.K., Rogers, J.A., Nuzzo, R.G.	108	2	2008
3	J-Aggregates: from Serendipitous Discovery to Supramolecular Engineering of Functional Dye Materials	14 20	Angewandte Chemie - International Edition	Würthner, F., Kaiser, T.E., Saha-Möller, C.R.	50	15	2011
4	Laser-Induced Breakdown Spectroscopy (Libs), Part II: Review of Instrumental And Methodological Approaches to Material Analysis and Applications to Different Fields	83 3	Applied Spectroscopy	Hahn, D.W., Omenetto, N.	66	4	2012
5	Fluorescent Dyes and Their Supramolecular Host/Guest Complexes with Macrocycles in Aqueous Solution	68 3	Chemical Reviews	Dsouza, R.N., Pischel, U., Nau, W.M.	111	12	2011
6	Challenges and Breakthroughs in Recent Research on Self-Assembly	68 0	Science and Technology of Advanced Materials	Ariga, K., Hill, J.P., Lee, M.V., Vinu, A., Charvet, R., Acharya, S.	9	1	2008
7	Synthesis of silver nanoparticles: Chemical, physical and biological methods	64 8	Research in Pharmaceutical Sciences	Iravani, S., Korbekandi, H., Mirmohammadi, S.V., Zolfaghari, B.	9	6	2014
8	Cuckoo optimization algorithm	61 2	Applied Soft Computing Journal	Rajabioun, R.	11	8	2011
9	Remote sensing of soil salinity: Potentials and constraints	61 1	Remote Sensing of Environment	Metternicht, G.I., Zinck, J.A.	85	1	2003
10	A review on mechanical exfoliation for the scalable production of graphene	58 3	Journal of Materials Chemistry A	Yi, M., Shen, Z.	3	22	2015

Fig 8: Title wise Total Citation Scores



CONCLUSION

A major work of the Scientometric is to continue to develop the techniques which will be more reliable and useful for evaluation and prediction, because Scientometric data mirror the actual published results of the work of researchers. Based on the analysis undertaken the present study, the following findings are drawn.

- The findings of Imaging Science Photographic Technology are the highest publication is 95 in 2019 with 1357 Total Citation Scores and 14.28 Average Citation Per Publication (ACP) followed by 89 papers in 2020 with 1685 Total Citation Scores and 18.93 Average Citation Per Publication (ACP) and 78 papers in 2017 with 812 Total Citation Scores and 10.33 Average Citation Per Publication (ACP). The lowest publication is 2 in 2004 with 7 Total Citation Scores and 3.5 Average Citation Per Publication (ACP)
- The authorship pattern of Imaging Science Photographic Technology identified that majority of papers are multi-authored.
- The study found that the total research output of the Imaging Science Photographic Technology for the study period (2001-2020) published in 468 journals. As the major portion of the research productivity (26.87%) covered by 20 journals that is coincide with the theory of Bradford's Law of scattering of journals in research productivity.
- Top 20 institutions were contributed 241(37.17%) articles of the total research productivity.
- The contribution of Proceedings Paper (18.21%) is lower than Journal Articles (67.28%)

This study has highlighted quantitatively the contributions made by the Indian researchers during 2001-2020 as reflected in Scopus database. During 20 years' period (2001-2020) Indian contributions in terms of number of publications is significant. A comparison of Indian output in relation to the world output may help in understanding the contribution in a better angle.

ACKNOWLEDGMENTS

This paper would not be complete without acknowledging the Scopus database. Of course the paper collected 20 years data has been collected form Scopus database due to this the paper accomplishment successfully. As we 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 both authors so there is no conflict of interest.

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