Library Waves: A Biannual Peer Reviewed Journal of Library and Information Science
Volume 10, Issue 1 (January-June, 2024); ISSN: 2455-2291 (Online); Website: www.librarywaves.com

Indian Research Output on Remote Sensing Literature Using Scopus Database: A Bibliometric Study (2015-2022)

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Received: 12 June 2024 ***Accepted: 30 June 2024***

Abstract

For the marked time (2015-2022), this article used the Scopus database to analyse the literature output on "Remote Sensing," and it discovered a total of 9418 records in the area of remote sensing and GIS research. The most popular statistical tools to assess and analyse publication patterns in the social and natural sciences are scientometrics and bibliometric. The study examined and observed a number of quantitative factors, including the distribution of publications by year, the annual growth rate (AGR) and compound annual growth rate of publications (CAGR), the relative growth rate (RGR), and the doubling time (Dt), along with the most prolific authors and preferred sources. The study's analysis and observation produced the finding that, out of 9418 publications overall, 3,289 (34.93%) of the research articles were from the years 2021 and 2022. It has been noted that the highest annual growth rate (AGR) was 45.21 and the highest compound annual growth rate (CAGR) was 0.24 in the year 2016, while the highest relative growth rate (1.65) in the year 2021 and doubling time (1.3(Dt)) was registered in year 2016. With 71 contributions, 33 h-index, and 3984 citations, Dadhwal, V. K. from the "Indian institute of remote sensing Dehradun," India, was identified as the most prolific author.

Keywords: Remote Sensing, India, GIS, Satellite imagery, Land use, Image Processing, Space Optics, Satellites, Mapping, Spectroscopy, Space Applications.

1. Introduction

Allan Pritchard coined the phrase "bibliometrics" to substitute statistical bibliography in 1969 (E. W. Hulme in 1923). The word "bibliometrics" is made up of the Latin terms "metrics" and "biblio," where "metrics" is Latin for measurement and "biblio" is Latin for "books." It alludes to the statistical and mathematical examination of written communication in order to discover the patterns of publications through the counting and examination of the various aspects of knowledge that have been published. According to some, remote sensing is both an art and a science that involves observing something or something that is happening and gathering information about it without coming into direct physical touch with it. The word "remote sensing" is a combination of the words "remote" and "sensing," where "remote" refers to something that is "not exactly in contact" and "sensing" refers to "to sense" or "getting information." Humans use distant sensing in their daily activities through their

senses of sight, hearing, and smell, which function or detect when the information source is at a distance. By sensing and recording the emitted and reflected electromagnetic radiations to measure the physical properties of the target objects with the help of images, this process gathers information about the earth's surface without any physical contact. These records are then further analysed to obtain specific results in accordance with the study's objectives.

2. Scope of the Study

The scope of the current study is focused on mapping the output of remote sensing technology research throughout an eight-year period. (2015-2022). It is based on the Scopus database, and its primary objective is to analyse all of the literature that has been published within the relevant time of study.

3. Review of Literature

A bibliometric study has been examined by Tianyue & others (2022) where they analysed the bibliometric trend of research progress and focussed on “Rice Remote Sensing” of over 42 years in which they evaluated the increasing trend of publications. They also studied various interdisciplinary factors like agriculture, geography, ecology, etc. China, the USA, & Japan are considered major rice producing as well the top countries with largest publications. Similarly, another bibliometric analytical study has been conducted by Siluch, Bartminski and Zglobicki (2022) which emphasized the analysis of remote sensing in growing season. The paper presented the analysis and impact of remote sensing on the growth of plants and ecosystems. The study used the data from web of science and analysed various aspects by using different statistical tools like authorship pattern, most active countries having maximum research on growing season i.e. Asia, Europe & North America. The study summarized that over 75% of analysed research data for the period of 21 years (2000-2021) focused on the growth of natural plants in which Rice and Wheat were considered the most frequent studied crops.

A bibliometric examination of GIS from 2007 to 2016 by Melo & Quiroz (2019) revealed a steady increase in the number of publications over that time. In addition, this analysis identified Computer Science and Geography as two of the most prolific academic disciplines, with an annual growth rate (AGR) of 1.8%. The International publication of Geographic Information Science is the most popular and high-caliber publication in this field and the three major publishing clusters are North America, Western Europe, and Eastern Asia. Another bibliometric analysis of the "Journal of the Indian Society of Remote Sensing" spanning four decades, from 1973 to 2014, was carried out by Rajgoli, Mamdapur, and Prabhar (2017), which emphasised the publication trends of the time. The study also concentrated on authorship patterns, and it came to the conclusion that 85% of all articles had multiple authors. The "International Journal of Remote Sensing" is thought to be the best journal in terms of high-quality research content, and journals were discovered to be the most popular type of publishing. The "International Journal of Remote Sensing" (2006-2015) was the subject of a second, related analysis by Murugan & Saravanan (2017), which revealed an erratic pattern of publications but revealed that articles were the most popular format, accounting for 92.88% of all entries. Li J was identified as the top author contributor and Chinese Academy of Science as the most productive institution. In their 2017 study, Chaman Sab, Dharani, and Biradar examined the literature on remote sensing in India from 2011 to 2015 and discovered an upward trend in publications. They also evaluated other metrics such as Lokta's law, relative growth rate, citation count, and doubling time. The results also

showed that "Journal of the Indian Society of Remote Sensing" was the best journal and that Indian Institute of Technology was the most successful institute for RS research in India, followed by ISRO.

Similar analysis was conducted on worldwide remote sensing research during a four-year period by Zhang (2016), who discovered that the number of publications nearly doubled over that time. According to the survey, environmental science is the field that contributes the most, and the International Journal of Remote Sensing is the most productive journal, with the United States leading the list of producing nations. Since 1991, the expansion of scientific literature has increased dramatically, with more collaboration indexes, references, and citations, according to Liu, Lin, Wang, Pang, and Hong's (2016) observation of global trends of geographic information systems during the designated period (1961–2010). The analysis identified the US as the top contributor country, the US as the most productive journal, and a correlation between the advancement of personal computers and GIS research. The study's main contributors were from "North America, Western Europe, and East Asia," and it sheds light on the growth pattern of GIS research over the previous 50 years. Vijaylakshmi & Ambuja (2013) conducted another bibliometric analysis of RS research based on the SCOPUS database limited to 42 years, i.e. (1970-2012), in which a record of 1,31,883 articles is found with a gradual increase in publishing trend during the period. The study used a variety of statistical approaches to analyse the literature and concluded that the US was the leading provider to RS research. A bibliometric analysis of the RS literature for the five-year research period, from 2006 to 2010, was carried out by to examine a number of bibliometric variables and discovered that publications were on the rise and that in research publications, author collaboration predominates over solo work (Vijaylakshmi & Ambuja, 2011).

4. Objectives of the Study

The core objectives of the study are:

- To examine the year-wise distribution of published documents.
- To evaluate the “annual growth rate” (AGR) and “compound growth rate” (CAGR) of published literature.
- To find out the “relative growth rate” (RGR) and “doubling time” (Dt) of publications.
- To evaluate the collaboration coefficient and collaborative index of authorship pattern.
- To find out the most creative authors, affiliations and the top journals.

5. Methodology

The data for this study is extracted from Scopus database, an International online database from Elsevier, an abstract and citation database of peer-reviewed literature from numerous fields, as well as a collection of technical tools for tracking, analysing, and evaluating research. It is accessible on a subscription basis covering about 38,377 titles of which 35,336 are peer-reviewed journals and also about 6.4 million conference papers were directly available on it. The following search strategy was used for data collection i.e. (TITLE-ABS-KEY("Remote Sensing") AND (LIMIT-TO (PUBYEAR,2022) OR LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO (PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2016) OR LIMIT-TO (PUBYEAR,2015)) AND (LIMIT-TO (PUBSTAGE,"final")) AND (LIMIT-TO (AFFILCOUNTRY,"India")) AND (LIMIT-TO (LANGUAGE,"English")))and a total of 9,418 records were found during the eight years of study.

The data was extracted in two files each having authors data and publications data including complete bibliographical information regarding Title, Authors data, Sources, Year of publications, Affiliation, Document Type, etc. the data so obtained was exported to excel sheets where the final examination and assessment was performed with the application of various statistical tools to achieve the aim of the study.

6. Data Analysis

1.1 Year-wise distribution of publications of Remote Sensing Literature

Table 1 signifies the year-wise distribution of publications and total citations of each year. The total number of publications during the study period is 9,418 and their total citations of eight years are equals to 31978 citations. It shows that the year 2015 having a minimum number of publications i.e. 679 and 5706 total citations among these eight years of research. The growth in no. of publication is noted with the proceeding years which indicated a continuous research progress in the particular field. The maximum no. of publications is noted in the year 2022with 1820 publications having the maximum number of total citations i.e 9,253 among all the years under study (2015-2022). The number of total citations tends to decline over the course of the years 2015 to 2019 and the year 2019 is accorded with the least no. of citations i.e. 1303. However, a sudden increase in the no. of citations is seen from the year 2020 to 2022 having the maximum no. of citations in the year 2022 with 9,253 citations.

Table 1: Temporal Rise and Citation Count

Year	Number of Publications	Total Citations received	Percentage distribution of Citations
2015	679	5706	17.84
2016	986	4525	14.15
2017	965	3548	11.10
2018	969	2756	8.62
2019	1178	1303	4.07
2020	1352	1846	5.77
2021	1469	3041	9.51
2022	1820	9253	28.94
Total	9418	31978	100.00

1.2 Annual Growth Rate (AGR) and Compound Annual Growth Rate (CAGR) of year-wise publications of Remote Sensing Research.

The growth rate of remote sensing research papers over the designated study period is shown in Table 2 and Fig. 1 on an annual basis (2015-2022). The pattern of the growth rate of publications over the course of these eight years reveals that the most research was published in the year 2022 (1820), followed by the year 2021 (1469), and that there was a sudden increase in the number of publications after the year 2017, which had the least annual growth rate of publications (-2.13).The table also shows the "annual growth rate" (AGR) and "compound annual growth rate" (CAGR) of annually distributed publications, with the maximum AGR of 45.21 recorded in 2016—and the minimum AGR of (-2.13) in the year 2017—while the "compound annual growth rate" of publications is highest in 2016—and lowest in 2017 where the number of publications has been dropped once in the eight years

under study. Shukla conducted a follow-up analysis of genetic condition articles in 2019 using the same formula and discovered that the AGR and CAGR had the same erratic tendency as the specific study. The data are well represented in the table below:

Kumar & Kaliyaperumal (2015) formulated an equation to calculate the "*Annual Growth Rate"* for the rate of growth of publication. Using the formula given below, the following calculations in the figure are depicted.

$$AGR = \frac{EndValue - FirstValue}{FirstValue} \times 100$$

"Compound Annual Growth Rate" (CAGR) is derived from the formula provided below (https://www.investopedia.com/terms/c/ cagr.asp).

$$\mathbf{CAGR} = [(\mathbf{EndingValue} / \mathbf{BeginningValue})^{1/n} - \mathbf{1}]$$

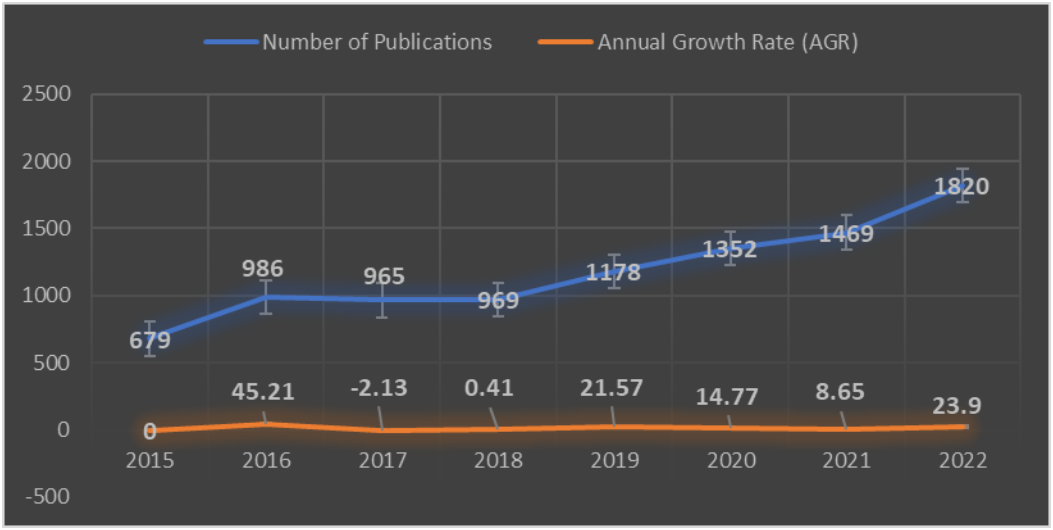

Figure 1: Annual Growth Rate and Compound Annual Growth Rate of Publications

1.3 Relative Growth Rate (RGR) and Doubling Time (Dt) of Publications

In the designated time period of the study, the table 2 shows the "relative growth rate and doubling time" of publications on remote sensing research. "The growth rate of all articles is calculated using the specific RGR and Dt model" (Mahapatrain, 1985). Relative Growth Rate, which has a relationship with Doubling Time, is used to examine the increase in publications per unit of time. The presented data makes it evident that the maximum RGR, 1.65, was found in the year 2021 and that the lowest, 0.53, was found in the year 2016 and that the lowest, 0.42 Doubling Time, was found in the two years i.e.2021 & 2022, highlighting the declining and growing trends, respectively.

The table below provides a full description of both components on an annual basis. The following statement provides a mathematical representation of the mean relative growth rate of articles over a certain time period:

$$RGR = \frac{W2 - W1}{T2 - T1}$$

Doubling Time

According to the statement, "relative growth rate" (RGR) and "doubling time" are directly correlated (Dt). The sentence "If the number of contributions produced by a subject double over the length of the investigation, the difference between the logarithms of the numbers initially and towards the end must be the logarithms of the number 2" can be used to prove this. "This variation has a specific value of 0.693 if one employs a 'natural logarithm'" (Beaie & Acol, 2009).

The mathematical formula of correlated Doubling time of literature.

$$DoublingTime(Dt) = \frac{0.693}{R}$$

Table 2: "Relative Growth Rate and Doubling" Time of publications

Year	No. of Publications	Cumulative Sum	W1	W2	RGR	Dt
2015	679	679	6.52	6.52	0	0
2016	986	1665	6.89	7.42	0.53	1.3
2017	965	2630	6.87	7.87	1.0	0.64
2018	969	3599	6.87	8.19	1.31	0.53
2019	1178	4777	7.07	8.47	1.40	0.49
2020	1352	6129	7.20	8.72	1.51	0.46
2021	1469	7598	7.29	8.93	1.65	0.42
2022	1820	9418	7.51	9.15	1.64	0.42

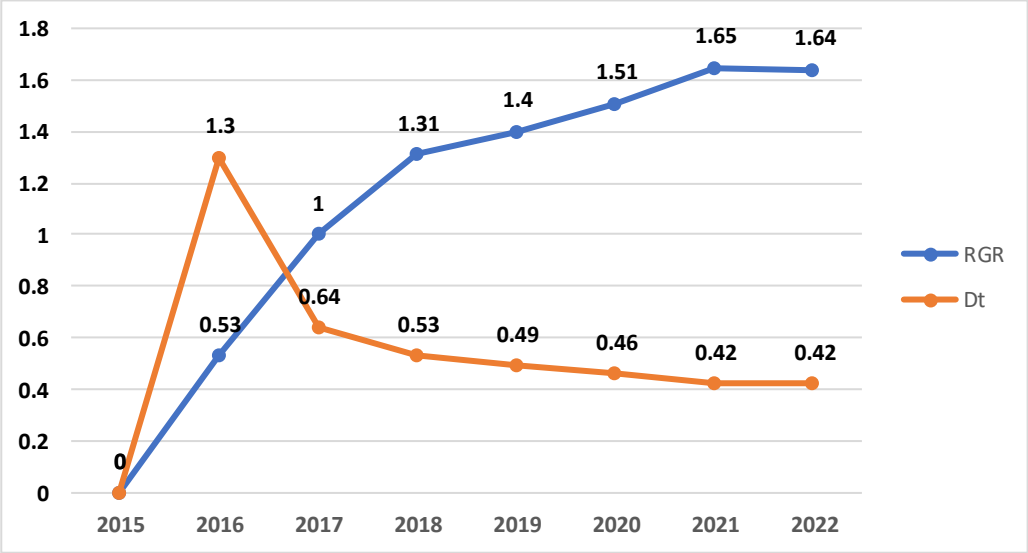

Figure 2: Relative Growth Rate and Doubling Time of publications

1.4 Source-wise distribution of Remote Sensing Literature

The data about the type of documents/sources published in the study period (2015-2022) are presented in the figure 3. The table 3 basically represents the format of documents and preferred form of publications and it results that the most preferred form of publications is articles as it contributes about 5120 i.e. 54.36% of total publications. In addition to research

articles, 3071 conference papers, 780 book chapters, 266 reviews, 68 books, 32editorials, 24 note, 17 retracted, 13 letter, 11erratum, 12 data paper, and 4 short surveys has been published that contributes to total 9418 publications of remote sensing literature.

Table 3: Source-wise distribution of Publications

S.N.	Source-type	Publication output	% of publications
1	Articles	5120	54.36
2	Conference Paper	3071	32.60
3	Book Chapter	780	8.28
4	Review	266	2.82
5	Book	68	0.72
6	Editorial	32	0.33
7	Note	24	0.25
8	Retracted	17	0.18
9	Data Paper	12	0.13
10	Letter	13	0.14
11	Erratum	11	0.12
12	Concise Survey-type	4	0.04
13	Outcome	9418	100.0

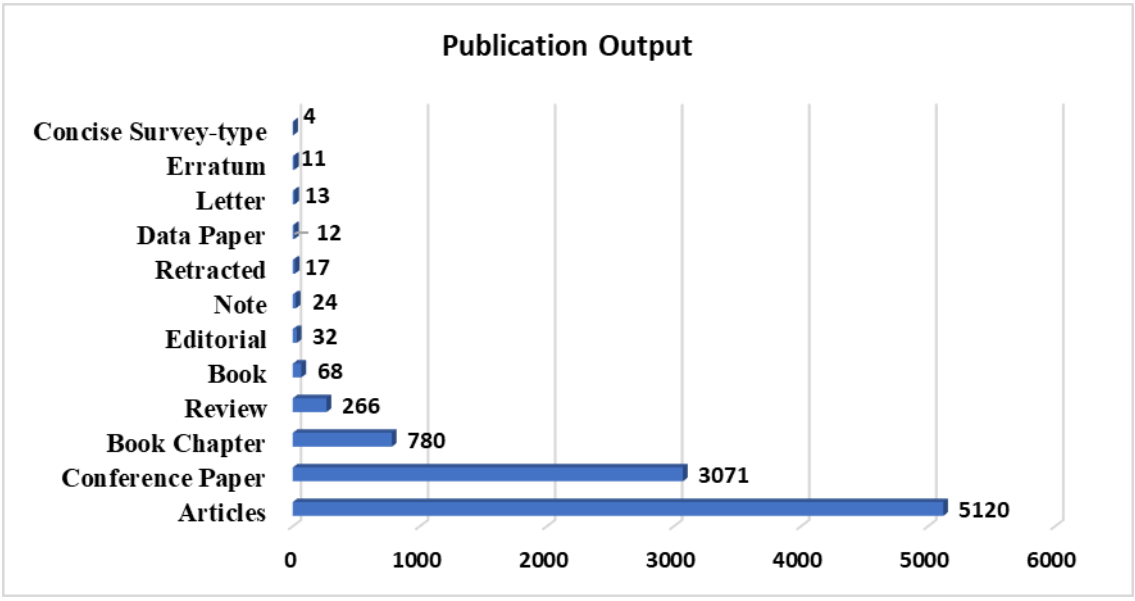

Figure 3: Document type distribution of publications

1.5 Most productive authors with their affiliations, h- index and total citations

The most prolific authors in the field of remote sensing are shown in and fig. 4 together with information about their affiliations, h-indexes, and total citation counts. The author with the most publications among the prolific authors is Dadhwal, V.K. from the Indian Institute of Remote Sensing in Dehradun, India, who has produced 71 articles with an h-index of 33 and

3984 total citations. Srivastava, P.K. has produced second highest no. of articles i.e. 67 with an h-index of 30 and 3679 total citations followed by Bhattacharya, A. with 55 articles, h-index of 19 and having 2312 total citations. Garg, V., from Indian Institute of Remote Sensing, India, has the fewest publications among these top authors with 35, 20 h-index, and 1182 total citations.

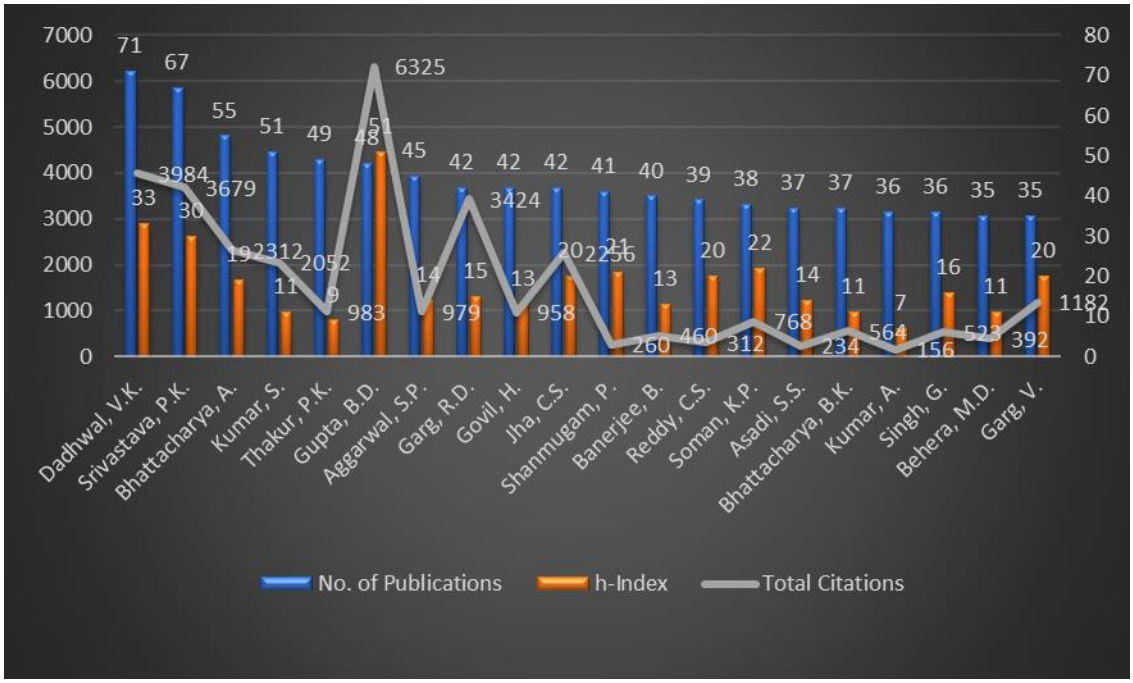

Fig 4: Most prolific authors with their affiliations, h-index and total citations

1.6 Collaboration Coefficient and Collaborative Index of Authorship Pattern of Remote Sensing Research

Table 4 describes the clear picture of the authorship pattern of distribution of publications relating to remote sensing research during the marked period of study. Authors are categorized yearly on basis of their individual or collaborative work where, the year 2015 have total 679 publications, out of which 38 articles were published by single author, 214 by double authors, 181 by three authors, 105 by four authors and remaining 141 were published by more than four authors. According to the same pattern, authors' contributions will be amplified as the number of publications varies from year to year. This is evident in the final year under study, 2022, which had a total of 1820 publications, out of which 277 articles were published by single authors, 469 by double authors, 560 by three authors, 271 by four authors, and the remaining 243 were the result of collaborations involving more than four authors. The majority of articles were written by three writers working together, followed by double authors, more than four authors, four authors, and least by single authors, according to the overall data on authorship patterns.

Accordingly, the Collaborative Coefficient (CC) and Collaborative Index (CI) has been calculated for the authorship pattern of distribution and found that the year 2015, 2016, and 2017 resulted with similar Collaborative Coefficient i.e. 0.62 and after it get 0.61 for the year 2019, where for up to last year 2022 it came up with the maximum result of 0.65CC. In terms of the Collaborative Index, it is shown that the highest Collaborative Index i.e. 3.24 resulted

in the last year i.e. 2022 followed by 2021 (3.23), and the lowest Collaborative Index is 3.13 for the year 2015.

Table 4: Collaboration Coefficient and Collaborative Index of authorship pattern

Year	Single Author	Two Authors	Three Authors	Four Authors	More than Four Author	Total	Collaboration Coefficient (CC)	Collaborative Index (CI)
2015	38	214	181	105	141	679	0.62	3.13
2016	59	283	273	180	191	986	0.62	3.17
2017	79	246	271	177	192	965	0.62	3.18
2018	64	286	255	154	210	969	0.61	3.17
2019	112	347	354	172	193	1178	0.63	3.2
2020	161	373	414	191	213	1352	0.64	3.22
2021	186	392	458	232	201	1469	0.64	3.23
2022	277	469	560	271	243	1820	0.65	3.24

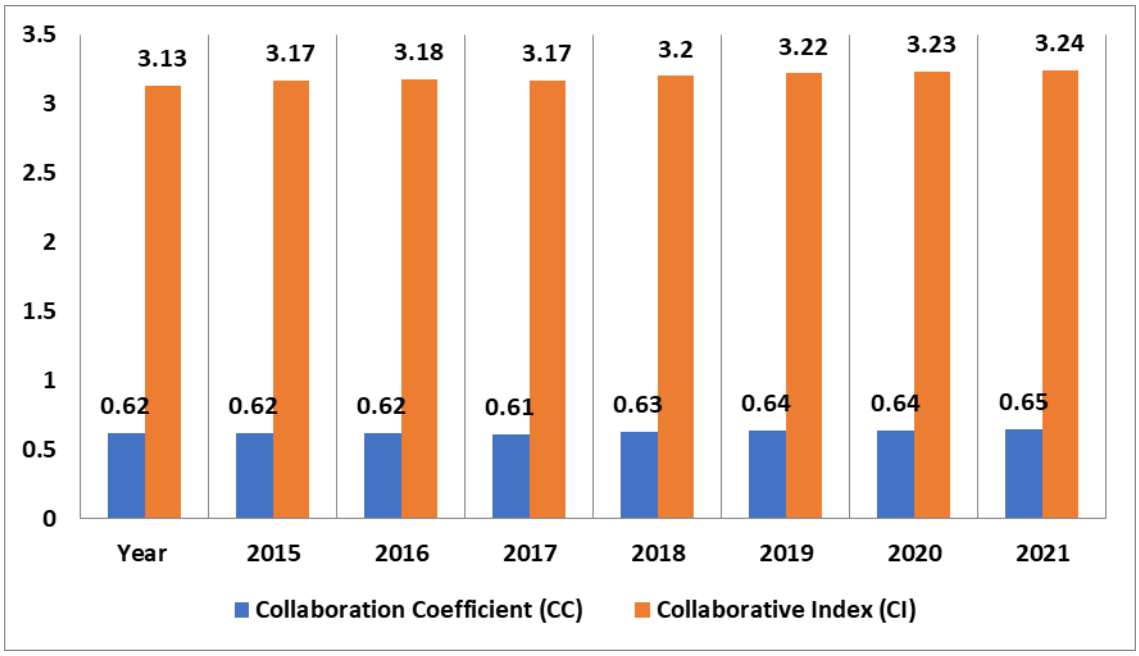

Figure 5: Collaboration Coefficient and Collaborative Index

1.7 Subject distribution of Publications

The subject-by-subject contribution to remote sensing research over the designated study period is shown in Table 5 and Fig. 6. It shows that 3499 articles in the field of computer science received the most publications, followed by 3308 articles in the field of earth and planetary sciences. After that, there comes Engineering with 2871 articles, environmental sciences with 2554 articles and the subject with least contribution among these top 20 subject

areas is from Immunology and Microbiology with 39 articles. The data marked computer science as the highest contributor to remote sensing research.

Table 5: Top 20 Subject-wise distribution of Publications

Subject Area	No. of Publications	Percentage
Computer Science	3499	18.19
Earth and Planetary Sciences	3308	17.20
Engineering	2871	14.92
Environmental Science	2554	13.27
Social Sciences	1365	7.10
Physics and Astronomy	1245	6.47
Agricultural and Biological Sciences	862	4.48
Mathematics	828	4.31
Materials Science	568	2.95
Decision Sciences	406	2.11
Energy	369	1.92
Medicine	329	1.71
Biochemistry, Genetics and Molecular Biology	229	1.19
Multidisciplinary	214	1.11
Business, Management and Accounting	159	0.83
Chemical Engineering	130	0.68
Chemistry	109	0.57
Pharmacology, Toxicology and Pharmaceutics	76	0.39
Economics, Econometrics and Finance	72	0.37
Immunology and Microbiology	39	0.20

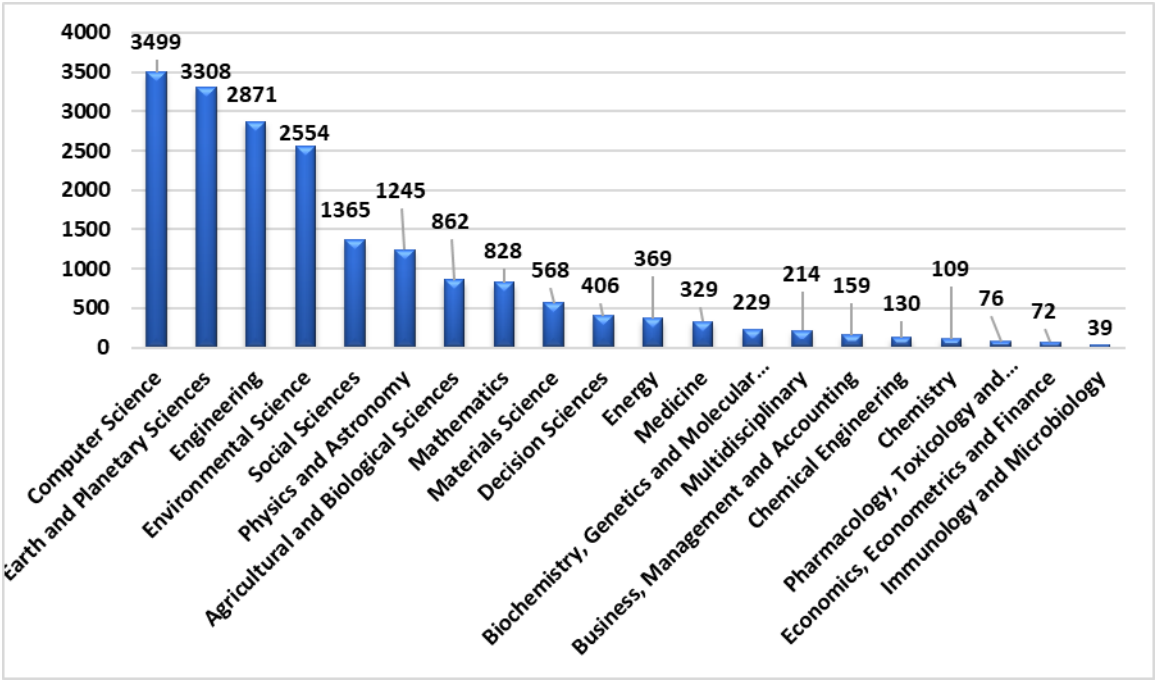

Figure 6: Subject-wise distribution of publications

1.8 Affiliation wise distribution of Publications

Table 6 lists the top affiliations along with their productivity of these top 20 affiliations, Indian Space Research Organization (ISRO) contributed the most publications (1015), followed by "Indian Institute of Remote Sensing" (454 publications) and "Indian Institute of Technology," Bombay (403 publications). Indian Institute of Space Science and Technology had the fewest publications (87 during these eight years of study), according to Table 8. Detailed records of institutes with their publications are represented below and Indian Space Research Organization (ISRO) is finally marked as the top contributor to remote sensing research.

Table 6: Most productive affiliations with their publications

Affiliation	No. of publications	Percentage
Indian Space Research Organization	1015	23.61
IIRS	454	10.57
IIT, Bombay	403	9.37
IIT, Roorkee	309	7.18
IIT, Kharagpur’	269	6.25
Vellore Institute of Technology, Vellore	188	4.37
Indian Institute of Science, Bengaluru	173	4.02
Banaras Hindu University	172	4.01
Anna University	145	3.37
Ministry of Earth Sciences Government of India	138	3.21
Jawaharlal Nehru University	128	2.98
ICAR	116	2.69
IIT Delhi	110	2.56
Vidyasagar University	106	2.47
Jadavpur University	103	2.40
K L Deemed to be University	102	2.38
NIT Karnataka	97	2.25
Indian Institute of Technology Indian School of Mines, Dhanbad	95	2.21
Amity University	88	2.05
Indian Institute of Space Science & Technology	87	2.03

6.9 Funding Agencies with their Publications Distribution

Table 7 presents the top funding agencies with their number of publications during the study period where the agency with the highest number of publications is “Department of Science and Technology, Ministry of Science and Technology” with a total of 366 publications followed by Indian Space Research Organisation (ISRO) having 329 publications and the agency with least number of publications is Ministry of Environment, Forest & Climate Change having 37 publications during the period of eight years of research in remote sensing.

Table 7: Funding Agencies with their number of publications

Funding sponsor	No. of publications	Percentage
Department of Science and Technology, Ministry of Science and Technology	366	15.88
Indian Space Research Organisation	329	14.27
U.S. Geological Survey	222	9.63
National Aeronautics and Space Administration	197	8.55
University Grants Commission	164	7.11
Science and Engineering Research Board	142	6.16
Department of Science & Technology, Govt. of Kerala	112	4.86
European Space Agency	112	4.86
Ministry of Earth Sciences	105	4.56
Council of Scientific and Industrial Research, India	78	3.38
Ministry of HRD	66	2.86
Space Applications Centre	56	2.43
ICAR	55	2.39
National Science Foundation	50	2.17
University Grants Committee	49	2.13
National Natural Science Foundation of China	44	1.90
National Remote Sensing Centre	41	1.78
Ministry of Education India	40	1.74
National Oceanic & Atmospheric Administration	40	1.74
Ministry of Environment, Forest & Climate Change	37	1.61

7. Conclusions

The study measures different bibliometric parameters on “Remote Sensing” research in India based on records of 9,418 publications retrieved from the Scopus database. It is observed that the 3,289 (34.93%) of total publications were published in last two years i.e. 2021 and 2022, while only 679 articles were published in the year 2015. The study results to clear that the research in the field of remote sensing technology is in its growing phase as it has rapidly grown after the year 2019 to 2022 and is expected grow more in future. There was a total of 31,978 citations during eight years of publications, out of which the highest is 9253 citations received by the year 2022, followed by 5706 in 2015 and least 1303 citations in the year 2019. The year 2016 had the highest "Annual Growth Rate" (AGR) and "Compound Annual Growth Rate" (CAGR), at 45.21 and 0.24, respectively. In 2019, the greatest "Relative Growth Rate" (RGR) was 1.65, while in 2016; the highest "Doubling Time" (Dt) was 1.3. It also shows that, as the number of succeeding years increased, the relative growth rate followed a falling trend and that, during the study period, the doubling time followed an ascending trend. With 71 contributions, 33 h-index and 3984 citations among the prolific authors, Dadhwal, V.K. from the "Indian Institute of remote sensing Dehradun, India" is thought to be the most inventive writer. The “Proceedings of SPIE, The International Society for Optical Engineering” is recognised as the most popular journal with 310 publications followed by the “*Journal of the Indian Society of Remote Sensing*” with 288 articles, and ISRO holds the top spot for the most productive affiliation with 1015 (23.61%) publications. During the designated study period, “Department of Science and Technology, Ministry of Science and Technology” followed by ISRO served as the top funding agency for remote sensing research.

References

1. Ball, R. (2017). An introduction to bibliometrics: New development and trends. Chandos Publishing.
2. Campbell, J.B. & Wynne, R.H. (2011). History and scope of remote sensing. Introduction to remote sensing (pp.3-21). New York: Guilford Press.
3. Department of Space, Indian Space Research Organisation. (n.d). Earth observation satellites. Retrieved from https://www.isro.gov.in/spacecraft/earth-observation-satellites
4. Eriksson, H. (2015). Introduction to remote sensing [Power Point Slides]. Retrieved from https://www.nateko.lu.se/sites/nateko.lu.se/files/intro_rs_he2015.pdf
5. GIS data in everyday Life. Retrieved from https://nobelsystemsblog.com/gis-data-business/
6. Introduction and scope of remote sensing. Retrieved from https://owlcation.com/stem/-Introduction-and-Scope-of-Remote-Sensing
7. Kumar, P.D., & Biradar, B. S. (2017). Remote sensing research in India: An analysis of publications output during 2011–2015.
8. Liu, F., Lin, A., Wang, H., Peng, Y., & Hong, S. (2016). Global research trends of geographical information system from 1961 to 2010: A bibliometric analysis. *Scientometrics, 106*(2), 751-768.
9. Melo, A.V.F.D., & Queiroz, A.P.D. (2019). Bibliometric mapping of papers on geographical information systems (2007-2016). *Boletim de Ciências Geodésicas, 25*(3).
10. Murugan, K., & Saravanan, G. (2017). A scientometric study on international journal of remote sensing: 2006-2015. *Journal of Advances in Library and Information Science, 6*(2), 139-145.
11. Pandey, P. (2019). The growth of GIS and remote sensing research publications of Indian scientists during the period 1991 to 2014 a bibliometric study. Sardar Patel University. http://hdl.handle.net/10603/262522
12. Shukla, R. (2019). Indian research output on Jaundice literature using Scopus database: A scientometric study (1998-2017). *Journal of Indian Library Association, 55*(3), 29-37.
13. Siłuch, M., Bartmiński, P., & Zgłobicki, W. (2022). Remote sensing in studies of the growing season: a bibliometric analysis. *Remote Sensing, 14*(6), 1331.
14. Vijaylakshmi, S., & Ambuja, R. (2013). Growth of remote sensing literature: A bibliometric analysis. *International Journal of Advanced Library and Information Science, 2*, 157-165.
15. Vijaylakshmi, S., & Ambuja, R. (2013). Remote sensing literature in Scopus database: A bibliometric analysis. *International Journal of Library and Information Studies, 3*(1), 70-86.
16. Xu, Y., Yang, Y., Chen, X., & Liu, Y. (2022). Bibliometric analysis of global NDVI research trends from 1985 to 2021. *Remote Sensing*, *14*(16), 3967.
17. Xu, T., Wang, F., Yi, Q., Xie, L., & Yao, X. (2022). A bibliometric and visualized analysis of research progress and trends in rice remote sensing over the past 42 years (1980–2021). *Remote Sensing, 14*(15), 3607.
18. Zhang, H., Li, G., Huang, M., Zhang, L., Xie, J., & Tian, C. (2016). Bibliometric analysis on global remote sensing research during 2010-2014. In 2016 IEEE International Geoscience and Remote Sensing Symposium (IGARSS) (pp. 5510-5513).
19. Zhuang, Y., Liu, X., Nguyen, T., He, Q., & Hong, S. (2013). Global remote sensing research trends during 1991–2010: A bibliometric analysis. *Scientometrics*, *96*(1), 203-219.

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