



# Scientometric Analysis of Indian Space Research Organization (ISRO) (2008-2022) as Reflected in Web of Science Database

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**Abstract:** This paper focuses on the growth and development of Indian Space Research Organization (ISRO) research publications output as reflected in Web of Science during 2008--2022. Total 8128 papers were published and received 86502 citations with 10.64 ACPP. Further study analyzed the Compound Annual Growth Rate (CAGR) for the period was 0.06, Relative Growth Rate for the period (RGR) was 0.10 and Doubling Time (Dt.) for the period was 22.76. Study analysis various scientometric tools such as Exponential Growth Rate (EGR), Relative Citation Index, citation, h-index, publication type, prolific authors, authorship pattern, degree of collaboration, most preferred journals, top rated research institutions.

**Key Words:** Scientometrics, ISRO, Annual Growth Rate (AGR), Relative Growth Rate (RGR), Doubling Time (Dt.), EGR, RCI.

## 1. INTRODUCTION :

Indian Space Research Organization (ISRO) is the space agency of India. The organization works in science, engineering, and technology to help India and humanity benefit from space exploration. Indian Space Research Organization (ISRO) is an important division of the Department of Space (DOS) Government of India. The Indian Space Programme is mostly carried out by the different ISRO centers or units. ISRO was formerly the Indian National Committee for Space Research (INCOSPAR), set up by the Government of India in 1962, as envisaged by Dr. Vikrama Sarabhai. ISRO was formed on August 15, 1969, and replaced INCOSPAR with an expanded part to harness space technology. Presently The Indian Space Research Organization (ISRO) is the sixth-largest space agency in the world. Very recently, two major successes for ISRO occurred i.e. Chandrayaan- 3, the lunar exploration which successfully made landfall on the lunar charge. With this India is one of the four nations to have landed on the Moon, and the first to land on the South Pole of the Moon. Second, The Polar Satellite Launch Vehicle (PSLV-C57) launched the Aditya-L1 spacecraft from the Satish Dhawan Space Centre (SDSC) in Sriharikota on September 2, 2023. This was India's first mission to the sun.

## 2. Objectives of the Study :

- Status of Annual Growth Rate and Comparative Annual Growth Rate of Literature.
- To find the most influential Authors, prominent journals, Publications, and Institutes
- Determine the Relative Growth Rate (RGR) and Doubling Time (Dt.) of ISRO.
- To Identify the Exponential Growth Rate and Relative Citation Index of ISRO.
- Network visualization of Authors, Organisation, and Country collaboration Authorship Pattern and keyword Co-occurrence.
- Co-Citation and cluster Analysis of author, Institute, and Keywords

## 3. METHODOLOGY :

The study retrieved and downloaded 15-year publication data of the Indian Space Research Organization (ISRO) research from the Web of Science database ([www.isiknowledge.com](http://www.isiknowledge.com)) covering the period 2008-2022. The present study



uses the following search strategy under “OG=(Indian Space Research Organization (ISRO))”. This study aims to analyze the research output of Researchers in space technology research output. The downloaded data was converted into an MS Excel file. This article covered the year-wise growth, the share of global publications, document types, highly prolific authors, preferred sources, distribution of articles among research areas, institution-wise productivity, international collaboration, and highly cited papers was analyzed.

#### 4. ANALYSIS AND INTERPRETATION:

##### 4.1: Growth of Publications of the Indian Space Research Organization

The table 1 shows the year-wise publications of the Indian Space Research Organization (ISRO) from 2008 to 2022. According to the Web of Science database, the institution has published a total of 8128 research papers and received a total of 86502 citations with 10.64 ACPP. The highest number of research papers were published in the year 2021 i.e. 766, followed by 699 in 2016 and the lowest i.e. 333 in 2008. Publications of the year 2009 have received the highest number of citations, i.e. 7897 (with 358 publications) citations, followed by 7661 (with 699 publications) citations for the publications of the year 2016 and 7356 (with 577 publications) citations for the publications of the year 2015. The highest ACPP i.e. 22.06 was recorded in the year 2009. , The highest H index received followed in the year 2009 i.e. 44, and the lowest is 13 in the year 2022.

**Table- 1: Growth of Publications of the Indian Space Research Organization**

Sl. No	Year	TP	TC	ACPP	NCP	H
1	2008	333	5455	16.38	6012	40
2	2009	358	7897	22.06	8725	44
3	2010	336	7268	21.63	7962	42
4	2011	378	5786	15.31	6400	36
5	2012	390	6039	15.48	6340	42
6	2013	472	7167	15.18	7941	43
7	2014	547	5556	10.16	6034	35
8	2015	577	7356	12.75	7981	40
9	2016	699	7661	10.96	8334	41
10	2017	615	6968	11.33	7729	40
11	2018	634	4974	7.85	5281	32
12	2019	652	4673	7.17	5164	30
13	2020	647	4605	7.12	5162	31
14	2021	766	3675	4.80	4069	23
15	2022	724	1422	1.96	1550	13
		<b>8128</b>	<b>86502</b>	<b>10.64</b>		

(TP: Total Publications; TC=Total Citations; ACPP: Average Citation per Publication, Number of Cited Papers)

##### 4.2 indicates the Relative Growth Rate and Doubling Time of the Indian Space Research Organisation (ISRO)

The table 2 indicates the Relative Growth Rate and Doubling Time of the Indian Space Research Organisation (ISRO) from 2008 to 2022. It has been noticed that the relative growth rate is not in a stable position during the study period. The relative growth rate in the year 2010 is recorded as 0.00 and in the year 2018 there was a negative impact on the growth i.e. -0.05. In the study period highest relative growth rate was recorded in the year 2009 (0.73). When compared to the relative growth rate (RTG) during the study period, the rate of doubling time (Dt) for various years increases. The rate of doubling time has increased gradually in different years. In the study period highest doubling time was recorded in the year 2010 i.e. 159.47 and in the year 2018 there was a negative impact on the growth i.e. -13.66.



**Table – 2: Relative Growth Rate (RGR) and Doubling Time (Dt.) of Publications**

Sl No	Year	TP	CUM	LOG 1	LOG 2	RGR	Dt
1	2008	333	333		5.81		
2	2009	358	691	5.81	6.54	0.73	0.95
3	2010	336	694	6.54	6.54	0.00	159.97
4	2011	378	714	6.54	6.57	0.03	24.39
5	2012	390	768	6.57	6.64	0.07	9.51
6	2013	472	862	6.64	6.76	0.12	6.00
7	2014	547	1019	6.76	6.93	0.17	4.14
8	2015	577	1124	6.93	7.02	0.10	7.07
9	2016	699	1276	7.02	7.15	0.13	5.46
10	2017	615	1314	7.15	7.18	0.03	23.62
11	2018	634	1249	7.18	7.13	-0.05	-13.66
12	2019	652	1286	7.13	7.16	0.03	23.74
13	2020	647	1299	7.16	7.17	0.01	68.90
14	2021	766	1413	7.17	7.25	0.08	8.24
15	2022	724	1490	7.25	7.31	0.05	13.06
		<b>8128</b>				<b>0.10</b>	<b>22.76</b>

(TP: Total Publications; RGR=Relative Growth Rate; Dt.=Doubling Time)

### 4.3 Annual Growth Rate (AGR) of publications

The Annual Growth Rate (AGR) is calculated on the formula given by Gracio et al. (2013). AGR is a simple standard for measuring the growth in a particular year using only two parameters, i.e. First Value and End Value. According to Choi et al. (2011), the Growth rate is measured with the Compound Annual Growth Rate (CAGR). The topmost AGR, i.e. 21.14 was recorded for 2015 followed by 21.03 in 2012 and 18.39 in 2020. While the minimum AGR was recorded, i.e. -100.00 in 2020. The Compound Annual Growth Rate (CAGR) for the total period has appeared at 0.06.

**Table 3: Annual Growth Rate (AGR) of publications**

Sl. No	Year	TP	CUM	AGR
1	2008	333	333	7.51
2	2009	358	691	-6.15
3	2010	336	694	12.50
4	2011	378	714	3.17
5	2012	390	768	21.03
6	2013	472	862	15.89
7	2014	547	1019	5.48
8	2015	577	1124	21.14
9	2016	699	1276	-12.02
10	2017	615	1314	3.09
11	2018	634	1249	2.84
12	2019	652	1286	-0.77
13	2020	647	1299	18.39



14	2021	766	1413	-5.48
15	2022	724	1490	-100.00
			<b>CAGR</b>	<b>0.06</b>

#### 4.4: Exponential Growth Rate of Publications

The exponential growth rate was calculated to determine the increase in number of publications. There were fluctuations in the exponential growth rate. The minimum growth rate was 0.88 in the year 2017 and the maximum growth rate was 1.21 in the year 2016.

**Table:-4 Exponential Growth Rate of publications**

Sl.No	Year	TP	EGR
1	2008	333	
2	2009	358	1.08
3	2010	336	0.94
4	2011	378	1.13
5	2012	390	1.03
6	2013	472	1.21
7	2014	547	1.16
8	2015	577	1.05
9	2016	699	1.21
10	2017	615	0.88
11	2018	634	1.03
12	2019	652	1.03
13	2020	647	0.99
14	2021	766	1.18
15	2022	724	0.95

#### 4. 5: Relative Citation Index (RCI) of publications

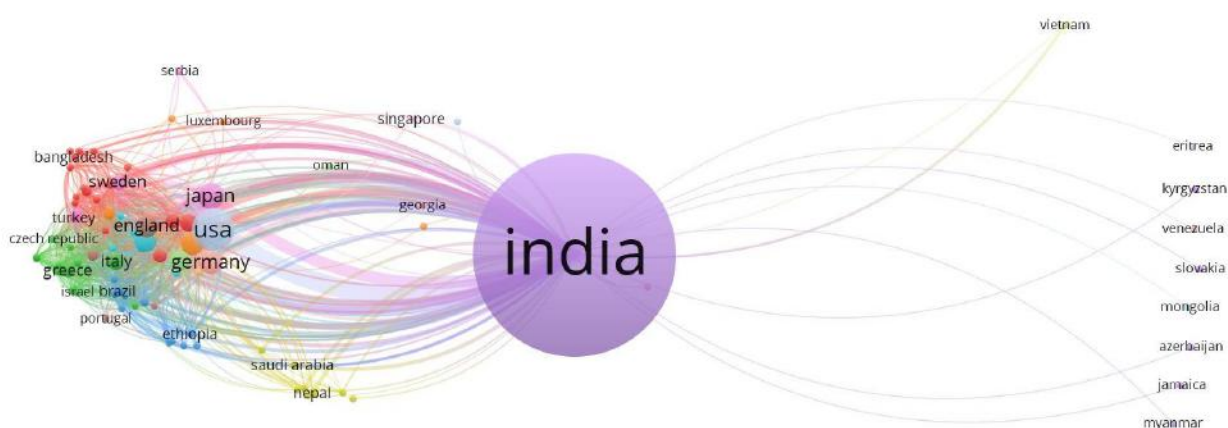
RCI of top 15 countries ranged from 0.64 to 1.58. People's Republic of China has the highest Relative Citation Index with 1.58. The second rank in the Relative Citation Index is Australia with 1.44, followed by Italy with 1.34. The Relative Citation Index (RCI) of other countries is given in Table 5.

**Table 5: Relative Citation Index (RCI) of publications**

Sl. No	Countries	TP	TC	ACPP	RCI	H
1	USA	367	9379	25.56	0.97	54
2	Japan	141	2834	20.10	0.76	30
3	Germany	112	3391	30.28	1.14	26
4	England	109	2272	20.84	0.79	26
5	Netherlands	108	2860	26.48	1.00	29
6	France	97	2765	28.51	1.08	29
7	Canada	86	2242	26.07	0.98	26
8	Peoples Republic of China	69	2891	41.90	1.58	25



9	Italy	54	1913	35.43	1.34	21
10	Sweden	50	1072	21.44	0.81	23
11	Australia	49	1872	38.20	1.44	22
12	Switzerland	44	910	20.68	0.78	22
13	South Korea	38	749	19.71	0.74	13
14	Finland	34	572	16.82	0.64	14
15	Spain	30	1033	34.43	1.30	16
		<b>1388</b>	<b>36755</b>	<b>26.48</b>		



**4. 6: Top 15 Most Influential Researchers of ISRO**

The distribution of the top most productive authors is shown in Table 6. The research productivity among authors varied from 101 to 242 publications. The finding revealed that out of 15 authors, a total number of 242 publications and received 3513 citations were published by Dadhwal. V. K. followed by Kumar A published 196 papers and received 1159 citations, Kumar, S was published 183 papers and received 2098 citations. This table also concentrates on other scientometric indicators like ACP, NCP, and H-index.

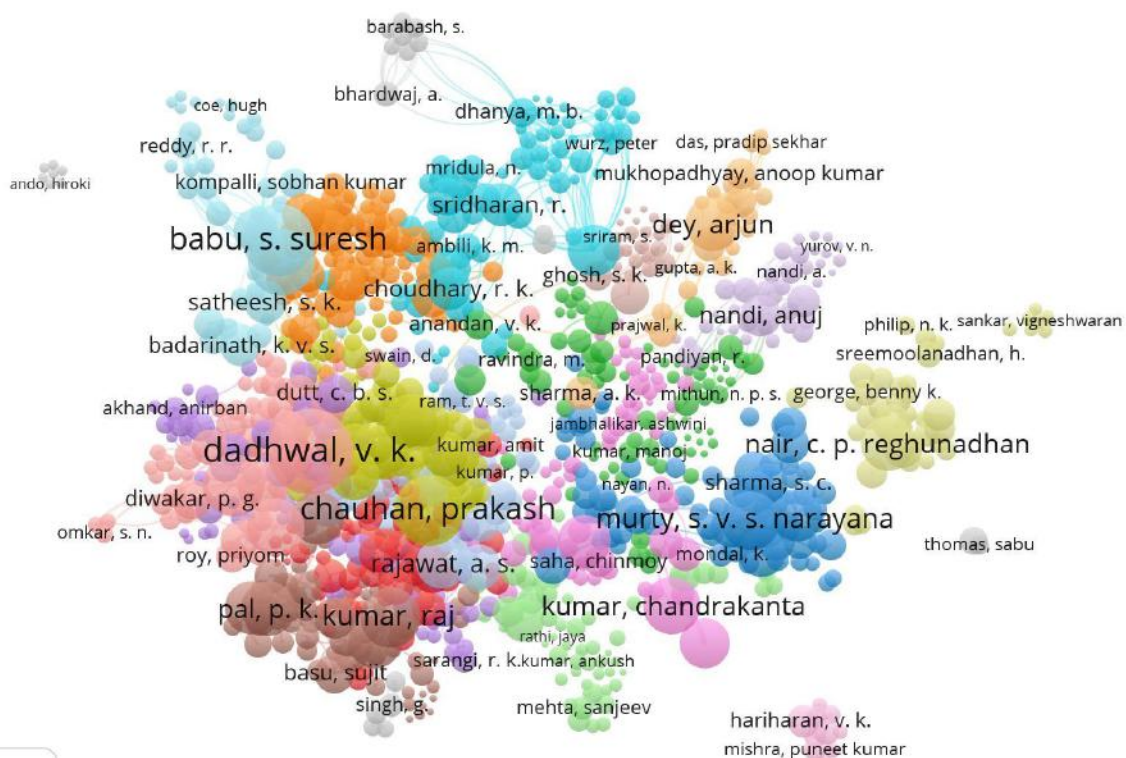
**Table – 6: Top 15 Most Influential Researchers of ISRO**

Sl. No	Authors	TP	TC	ACPP	H	NCP
1	Dadhwal VK	242	3513	14.52	34	4210
2	Kumar A	196	1159	5.91	14	1479
3	Kumar S	183	2098	11.46	24	2454
4	Babu SS	156	2498	16.01	38	5183
5	Chauhan P	155	1259	8.12	19	1451
6	Kumar P	146	1846	12.64	23	2131
7	Kumar R	141	1649	11.70	24	1970



8	Moorthy KK	134	2103	15.69	39	4760
9	Reddy CS	131	1459	11.14	26	1907
10	Murty SVSN	124	1459	11.77	25	1822
11	Pant TK	120	773	6.44	18	1085
12	Bhardwaj A	106	895	8.44	23	1691
13	Kumar KK	104	837	8.05	20	1124
14	Kumar KV	103	1519	14.75	22	2076
15	Kumar C	101	1056	10.46	25	1557

(TP: Total Publications; TC=Total Citations; ACP: Average Citation per Publication, Number of Cited Papers)



#### 4. 7: Top 15 Most Influential Institute of ISRO

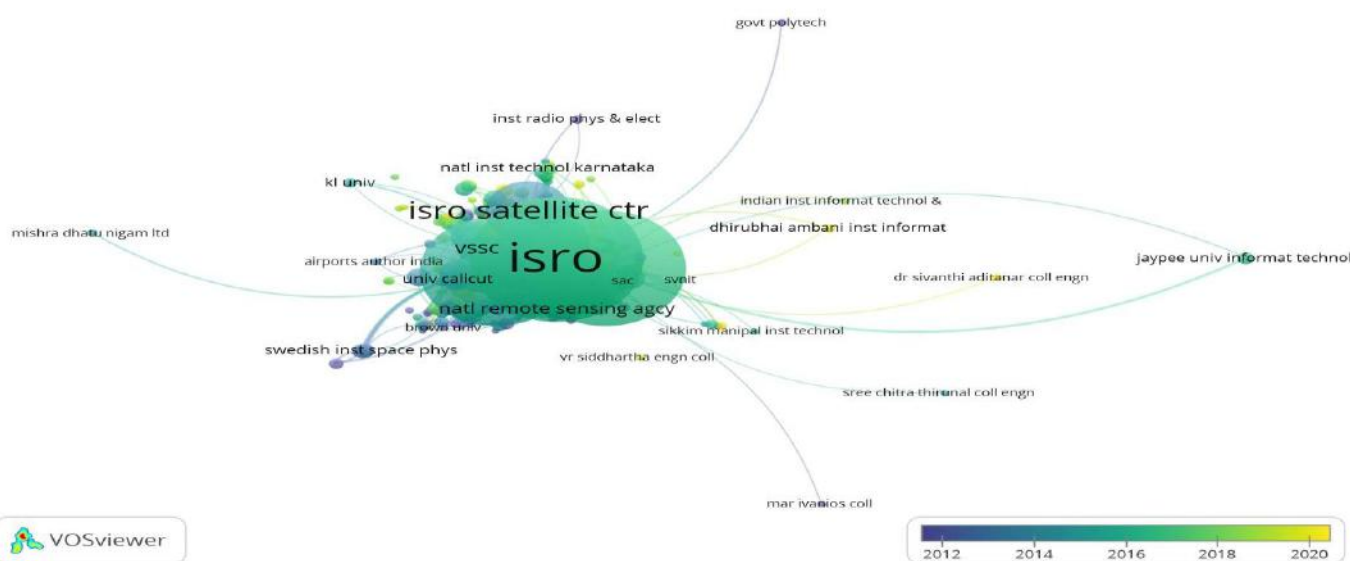
The table 7 lists the top 15 contributing institutions of the ISRO. Among them, Vikram Sarabhai Space Center occupied the top spot with 2227 publications and received 9.42 Average citations per paper, followed by Space Applications Centre with 2190 publications and received 6.91 Average citations per paper,. National Remote Sensing Centre with 1217 and received 11.98 Average citations per paper. Among the top 15 institutes, Vikram Sarabhai Space Center received the highest h-index of 64.

**Table – 7: Top 15 Most Influential Institute of ISRO**

Sl No	Affiliation	TP	TC	ACPP	H-Index
1	Vikram Sarabhai Space Center	2227	20971	9.42	64
2	Space Applications Centre	2190	15131	6.91	51



3	National Remote Sensing Centre	1217	14575	11.98	59
4	Indian Institute of Technology System	1115	12419	11.14	52
5	Indian Institute of Remote Sensing	1035	11811	11.41	53
6	U R Rao Satellite Centre	1031	6925	6.72	45
7	Indian Institute of Science	403	4703	11.67	41
8	Department Of Science Technology India	302	3816	12.64	36
9	Indian Institute of Space Science Technology	301	2961	9.84	29
10	Ministry of Earth Sciences	268	3210	11.98	29
11	Council of Scientific Industrial Research	261	4231	16.21	33
12	National Institute of Technology	242	2026	8.37	25
13	Physical Research Laboratory	218	2911	13.35	28
14	Indian Institute of Technology	209	3116	14.91	29
15	Indian Institute of Technology	203	2518	12.40	26



#### 4. 8: Top 15 Most Influential Journals of ISRO

The table 8 presents the top 15 most preferred journals by the researchers in ISRO. Journal Of The Indian Society of Remote Sensing with 419 publications, followed by Current Science with 373 publications, and International Archives of The Photogrammetry Remote Sensing and Spatial Information Sciences with 179 publications. Among the top 15 most preferred journals, Current Science has received the highest i.e. 2971 citations, followed by the International Journal of Remote Sensing has received 2833 citations. Further, the Journal of Geophysical Research-Atmospheres has recorded the highest h-index i.e. 30.

**Table – 8: Top 15 Most Influential Journals of ISRO**

Sl. No	Name of the Journals	TP	TC	ACPP	H
1	Journal of The Indian Society of Remote Sensing	419	2630	6.28	24



2	Current Science	373	2971	7.97	27
3	International Archives of The Photogrammetry Remote Sensing and Spatial Information Sciences	179	461	2.58	9
4	International Journal of Remote Sensing	177	2833	16.01	23
5	Advances in Space Research	153	1418	9.27	18
6	Journal of Earth System Science	149	1861	12.49	25
7	Geocarto International	140	936	6.69	16
8	Journal of Atmospheric and Solar-Terrestrial Physics	133	1323	9.95	19
9	Proceedings of SPIE	133	371	2.79	7
10	ISPRS Technical Commission VIII Symposium	109	307	2.82	8
11	Journal of Geophysical Research Space Physics	105	1122	10.69	22
12	Journal of Geophysical Research Atmospheres	81	2123	26.21	30
13	Environmental Monitoring and Assessment	71	1065	15.00	20
14	Atmospheric Environment	69	1182	17.13	25
15	Atmospheric Research	63	1022	16.22	21

## 5. Findings of the Study

- ❖ The research output of ISRO Institutions' total contribution is 8128 papers in the study period.
- ❖ A total number of 8128 papers received 86502 citations during the period. The average citation per paper is 10.64.
- ❖ The study observed that a fluctuating trend was observed for AGR during the study period.
- ❖ Relative Growth Rate and Doubling Time suggest a steady increase in the publications of ISRO.
- ❖ The study observed that Exponential Growth Rate publications of ISRO were fluctuations in the exponential growth rate during the study period.
- ❖ Among international collaboration, the USA is the most collaborative country in the selected top 15 countries. But as compared with the Relative Citation Index, the People's Republic of China has the highest Relative Citation Index with 1.58.
- ❖ A selected top 15 authors in the ISRO institution. A total number of 242 publications and 3513 citations were published by Dadhwal. V.K. followed by Kumar A published 196 papers and received 1159 citations and many others.
- ❖ Among the Institutions Vikram Sarabhai Space Center occupied top spot with 2227 publications and received 9.42 Average citations per paper, followed by Space Applications Centre with 2190 publications and received 6.91 Average citations per paper and many others.
- ❖ Among the top 15 most preferred journals by the researchers in ISRO. Journal Of The Indian Society of Remote Sensing with 419 publications, followed by Current Science with 373 publications and many others are listed in the table.

## 6. Conclusion :

This study finds out the influential researchers, publications, journals, institutions, and various scientometrics indicator performance in the study period. The most productive year was noted in 2021 in terms of publication. The present study chose the top 15 authors, preferred journals, and institution collaboration pattern along with VOSviewer graphic representation. This study used the growth models of scientometric indicators like Annual Growth Rate, Relative Growth Rate and doubling time, Exponential Growth Rate, and relative Citation Index during the study period.





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