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SCIENTOMETRIC ANALYSIS OF INDIA'S RESEARCH OUTPUT ON SEISMOLOGY (2007 – 2016)

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ABSTRACT :

The present study deals with scientometric study of Seismology literature during 2007-2016 using Scopus database. The present study is based on 667 articles contributed by the authors in India's research output on Seismology. it was found that Collaborative Researchers are Predominant than Solo Researchers. The mean value for the overall degree of collaboration for the 2007-2016 is found to be 0.92. Hyderabad ranked first place with 100 (14.99%) followed by Mumbai and Chennai. CSIR-National Geophysical Research Institute was the most prolific intuition in the study.

KEYWORDS : *Scientometrics, India, Seismology.*

INTRODUCTION:

Scientometrics is the quantitative study of the disciplines of science based on published literature and communication. In 1969, vassily V. Nalimov and Z.M. Mulchenko coined the Russian equivalent of the term 'scientometric' ('nalkometriyas') (Nalimov and Mulchenko, 1969). As the name would imply, this term is mainly used for the study of all aspects of the literature of science and technology. Scientometrics is the branch of science that describes the output traits in terms of organizational research structure, resource inputs and outputs, develops benchmarks to evaluate the quality of information output. (Ramchandran, 2012),

SEISMOLOGY:

Seismology is the study of earthquakes and seismic waves and what they tell us about Earth structure. Seismology is a data-driven science and its most important discoveries usually result from analysis of new data sets or development of new data analysis methods. Most seismologists spend most of their time studying seismograms, which are simply a record of Earth motion at a particular place as a function of time.

REVIEW OF LITERATURE:

Amsaveni & Ramesh (2016) analyzed of 10464 publications published by scientists during 1989 to 2015 and indexed by Web of Science. The study indicates that The highest publications are 804 in 2015 with 884 TGCS followed by 707 papers in 2013 with 3149 TGCS and 678 papers in 2014 with 2066 TGCS.

Gupta (2016) have studied the growth and the contribution of research literature output of Library Consortia. The study shows that out of 87 articles in the field of Library Consortia, a total number of 23 articles (26.44%) are written during 1980 to 2015.

Landge & Khaparde (2016) have conducted scientometric analysis of 165 research article published on International Journal of Digital Library Services. During the periods of 2011-2015.

Sudhahar & Kumar (2016) This study analyses the research output on coconut research during the period of 2000-2014 and the analyses included research growth, rank, LCS, GCS. This study was conducted using data from the Web of science database over the time period of 2000-2014.

METHODS & MATERIALS:

The data has been extracted from SCOPUS international multidisciplinary database for database for the present study and the following search strategy has been used in the combined field of Title, Abstract & Keywords. TITLE-ABS-KEY (seismology) AND DOCTYPE (ar) AND PUBYEAR > 2006 AND PUBYEAR < 2017 AND (LIMIT-TO (AFFILCOUNTRY , "India")) .

OBJECTIVE:

1. To identify the number year-wise distribution of publication.
2. To know relative growth and doubling time of publication.
3. To identify the authorship pattern of references per articles.
4. To identify the group co-efficient value for collaborative authors of publications.
5. To study dominance factor of the most Productive Authors
6. To know publication profile of affiliated institutions
7. To identified core journals of articles
8. To identified geographical distribution of Indian publications.

Data Analysis:

Table 1: Year wise distribution of Articles

Year	Total No of Articles	%	Cumulative No. of Articles	Cumulative %
2007	34	5.09	34	5.09
2008	62	9.29	96	14.3
2009	53	7.94	149	22.3
2010	68	10.1	217	32.5
2011	70	10.4	287	43.0
2012	44	6.59	331	49.6
2013	47	7.04	378	56.6
2014	54	8.09	462	69.2
2015	104	15.5	536	80.3
2016	131	19.6	667	100
Total	667	100	-	-

Table 1 gives the year-wise distribution of articles in Seismology research. The number varies from year to year and decreases in the number of articles from the year 2007 to 2016. Out of total 667 articles, the maximum numbers of articles are in the year 2016, contributing 131 articles, which is 19.6 % the total publication. The minimum number of articles is in the year 2007 with 34 articles, which is 5.09 % of the total publication.

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Fig. No. 1: Year-wise distribution of Articles

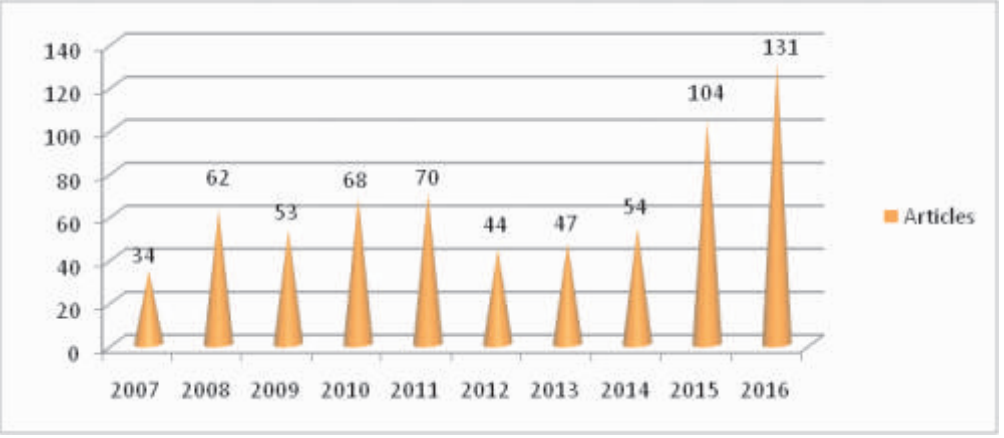

Table 2: Relative Growth Rate [R(P)] AND Doubling Time]Dt(p)] for Publication

Year	No. of Article	Cumulative no. of Article	$Log_e 1^p$	$Log_e 2^p$	[R(P)]	Mean [R(P)]	[Dt(P)]	Mean [(Dt(P)}
2007	34	34	-	3.526	-		-	
2008	62	96	3.526	4.564	1.037		0.34	
2009	53	149	4.564	5.003	0.44		1.57	
2010	68	217	5.003	5.379	0.439	0.43	1.57	1.19
2011	70	287	5.379	5.659	0.28		2.47	
2012	44	331	5.659	5.802	0.143		4.84	
2013	47	378	5.802	5.934	0.132		5.25	
2014	54	462	5.934	6.135	0.201	0.16	3.44	
2015	104	536	6.135	6.284	0.149		4.65	4.27
2016	131	667	6.284	6.502	0.218		3.17	

The Relative Growth Rate [R(P)] and Doubling Time [Dt(P)] of publications are derived and presented in Table & Fig. no. 2. It can be noticed that the Relative Growth Rate of publications [R(P)] decreased from the rate of 1.037 in 2008 to 0.218 in 2016. The mean relative growth for the first five years (i.e. 2007 to 2011) showed a growth rate of 0.43 whereas the mean relative growth rate for the lowest five years (i.e. 2012 to 2012) reduces to 0.16. The corresponding Doubling Time for different years [Dt(P)] gradually increased from 0.34 in 2008 to 3.17 in 2016.

Fig No. 2: Relative Growth Rate [R(P)] AND Doubling Time]Dt(p)] for Publication

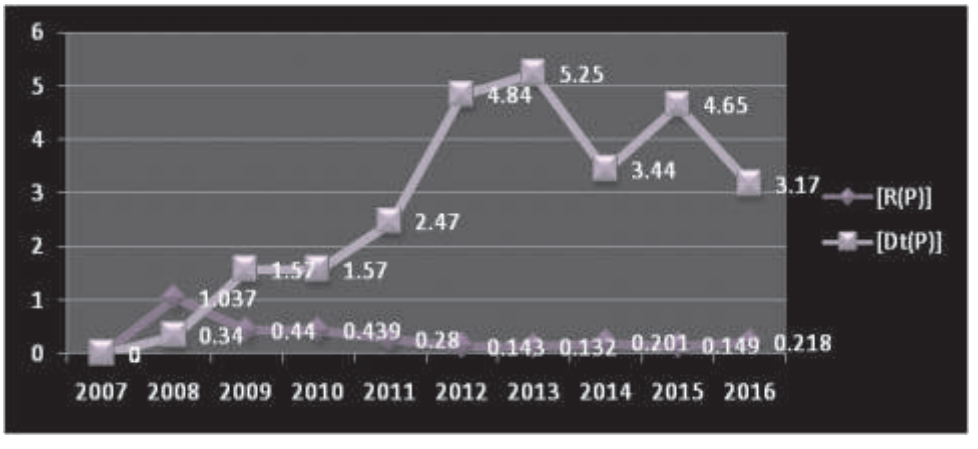

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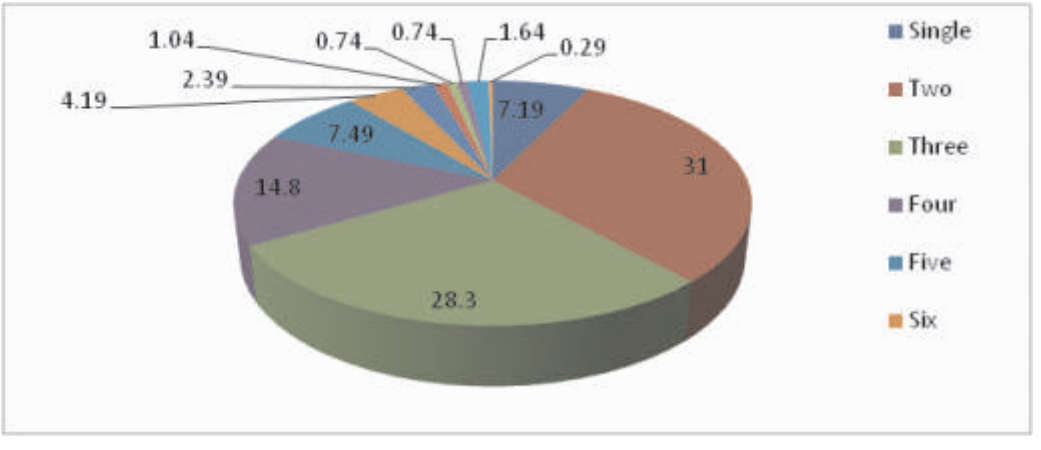
Table 3: Authorship Pattern

Sr. No	Authorship Pattern	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total	%
1	Single	2	6	4	7	6	3	5	3	6	6	48	7.19
2	Two	9	23	19	22	16	13	12	18	28	47	207	31.0
3	Three	9	13	13	16	26	14	11	15	35	37	189	28.3
4	Four	7	10	12	8	8	4	12	6	16	16	99	14.8
5	Five	6	4	-	9	2	4	2	7	7	9	50	7.49
6	Six	-	3	3	2	3	3	3	2	3	6	28	4.19
7	Seven	1	2	-	-	3		1	2	2	5	16	2.39
8	Eight	-	-	1	1	2	-	-	-	2	1	7	1.04
9	Nine		1		1	1	-	-	-	-	2	5	0.74
10	Ten	-	-	-	1	-	-	1	1	1	1	5	0.74
11	>Ten	-	-	1	1	3	2	-	-	3	1	11	1.64
17	Unidentified	-	-	-	-	-	1	-	-	1	-	2	0.29
	Total	34	62	53	68	70	44	47	54	104	131	667	100

Table 3 indicates that the details about the authorship pattern 207 (31.0 %) articles the highest contribution by two authors. Followed by three authors with 189 (28.3%). 99 (14.8%) by four authors respectively.

Fig. No. 3: Authorship Pattern



Categories of Authors and Collaborative Researches:

The Degree of Authors Collaboration is shown in Table No.6. Various methods have been proposed to calculate the degree of research collaboration. Here in this study the formula proposed by Subramanyam (1983) has been used.

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$$C = \frac{NM}{Nm+Ns}$$

Where,
C= degree of collaboration
Nm= number of multi author
Ns =number of single author

Table No.4: Group Co-Efficient Value for Collaborative Authors of Publications

Number of Authors' Publications	Number of Publication	Percentage for total publications	Value of per _____
Number of personal author publication	667		
Number of single author publications	48(Ns)	7.19	
Number of co-authors publication	619(Nm)	92.8	0.92
Two authors publications	207	31.0	0.31
Three authors publications	189	28.3	0.28
More than three authors publications	223	33.4	0.33

Table no 4, it is seen that, among the 667 articles of Seismology that published during 2007 to 2016, there were 7.19 % were written by single authors, 92.8 % belonged to co-authors. Therefore, the value of group co-efficient (gp) was only 0.92.

Dominance Factor:

Dominance Factor (DF) is the proportion of number of multi authored publications of an author as first author (Nmf) to total number of multi authored publications of author (Nmt). It is calculated with the following formula used by Sudhir Kumar & Surendra Kumar (2004).

$$DF = \frac{Nmf}{Nmt}$$

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Table 5: Dominance Factor of the Most Productive Authors

Sr. No	Name of the Author	No. of Articles	Single Authored	First Authored	Multi Authored	Dominance Factor	Rank
1	Sain, K.	21	0	4	17	0.23	10
2	Choudhury, D.	18	0	5	13	0.38	7
3	Sahoo, D.R.	13	0	4	9	0.44	5
4	Rai, S.S.	11	0	3	8	0.37	8
5	Raghukanth, S.T.G.	10	3	2	5	0.4	6
6	Srivastava, A.K.	10	1	3	6	0.5	4
7	Singh, A.	9	1	2	6	0.33	9
8	Kumar, R.	8	0	5	3	2.5	1
9	Gupta, S.	7	0	3	4	0.75	2
10	Reddy, C.D.	6	1	2	3	0.66	3

Table 4 shows the dominance factor of the authors. Here the authors are ranked not based on the number of articles published by them but by the number of articles published by them as the first author. The most prolific author, Sain, K., who has published 21 papers, is in seventh position since he is the first author only in 4 papers out of his 17 multi-authored papers. His dominance factor is just 0.23.

Table 6: Publication Profile of Affiliated Institutions

Sr. No	Institution	No. of Output	% of 667	Rank
1	CSIR-National Geophysical Research Institute	88	26.1	1
2	Indian Institute of Technology Roorkee	40	5.99	2
3	Indian Institute of Technology Bombay	37	5.54	3
4	Indian Institute of Technology Kanpur	24	3.59	4
5	Bhabha Atomic Research Centre, Mumbai	21	3.14	5
6	Indian Institute of Technology Kharagpur	20	2.99	6
7	Indian Institute of Science, Bangalore	15	2.24	7
8	Indian Institute of Technology Madras	14	2.09	8
9	Indian School of Mines, Dhangbad	14	2.09	8
10	Wadia Institute of Himalayan Geology	12	1.79	9
11	CSIR, Chennai	11	1.64	10
12	Kurukshetra University, Haryana	10	1.49	11

Only Top 12 institutes have been selected. It is analyzed that CSIR-National Geophysical Research Institute secured the first rank with 88 items (26.1 %) and second, third, fourth and fifth portions are being secured by Indian Institute of Technology Roorkee with 40 (5.99%), Indian Institute of Technology Bombay with 37 items (5.44%), Indian Institute of Technology Kanpur with 24 items (3.59%) and Bhabha Atomic Research Centre 21 items (3.14%) respectively.

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Table 7: Ranked List of Most Cited Journals

Sr.No.	Name of the Journal	No. of Articles	Rank No	%
1	Bulletin of the Seismological Society of America	49	1	7.34
2	Geophysical Journal International	29	2	4.34
3	Tectonophysics	15	3	2.24
4	Soil Dynamics and Earthquake Engineering	14	4	2.09
5	Earthquake and Structures	12	5	1.79
6	Journal of Applied Geophysics	12	5	1.79
7	Pure and Applied Geophysics	11	6	1.64
8	Engineering Structures	11	6	1.64
9	Journal of Structural Engineering (India)	10	7	1.49
10	Indian Concrete Journal	10	7	1.49
11	Marine and Petroleum Geology	9	8	1.34
12	Nuclear Engineering and Design	9	8	1.34
13	Structural Engineering and Mechanics	8	9	1.19
14	Bulletin of Earthquake Engineering	8	9	1.19
15	Earth and Planetary Science Letters	8	9	1.19
16	Geotechnical and Geological Engineering	8	9	1.19
17	ISET Journal of Earthquake Technology	7	10	1.04
18	Earthquake Engineering and Engineering Vibration	7	10	1.04
19	Geomatics, Natural Hazards and Risk	7	10	1.04
20	Indian Geotechnical Journal	7	10	1.04
21	Journal of Performance of Constructed Facilities	7	10	1.04
22	Journal of Structural Engineering (Madras)	7	10	1.04
23	Acta Geophysica	6	11	0.89
24	Astronomy and Astrophysics	6	11	0.89
25	Earthquake Engineering and Structural Dynamics	6	11	0.89
26	Electronic Journal of Geotechnical Engineering	6	11	0.89
27	Geophysical Research Letters	6	11	0.89
28	Geophysics	6	11	0.89
29	IIT Roorkee	6	11	0.89
30	Journal of Asian Earth Sciences	6	11	0.89
31	Journal of Earthquake Engineering	6	11	0.89
32	Journal of the Geological Society of India	6	11	0.89
33	Leading Edge	6	11	0.89
34	Marine Geophysical Researches	6	11	0.89
35	Physics of the Earth and Planetary Interiors	6	11	0.89
36	Acta Geodaetica et Geophysica	5	12	0.74
37	Journal of Natural Gas Science and Engineering	5	12	0.74
38	Others	294	13	44
39	Total	677	-	100

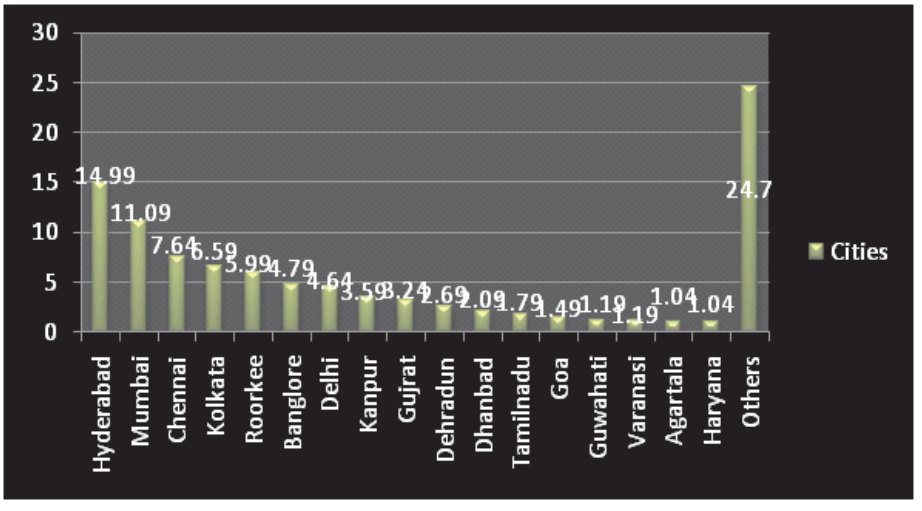
From table no 6, it is showed that, the Bulletin of the Seismological Society of America ranked as 1st most cited 49 (7.34%) journal under the study, followed by the Geophysical Journal International 29 (4.34%).

Table 8: Geographical Distribution of Indian Publications

Sr. No	Name of Cities	No. of Publications	%
1	Hyderabad	100	14.99
2	Mumbai	74	11.09
3	Chennai	51	7.64
4	Kolkata	44	6.59
5	Roorkee	40	5.99
6	Banglore	32	4.79
7	Delhi	31	4.64
8	Kanpur	24	3.59
9	Gujrat	22	3.24
10	Dehradun	18	2.69
11	Dhanbad	14	2.09
12	Tamilnadu	12	1.79
13	Goa	10	1.49
14	Guwahati	8	1.19
15	Varanasi	8	1.19
16	Agartala	7	1.04
17	Haryana	7	1.04
18	Others	165	24.7
19	**Total**	**667**	**100**

The Study regarding the Geographical Distribution of Indian Publications had been done in order to know the most dominant city in which the records are cited. It revealed that Hyderabad, Mumbai, Chennai, and Kolkata have the majority of most cited records 100 (14.99%); 74 (11.9%); 51 (7.64%) and 44 (4.59&), respectively

Fig. No. 4: Geographical Distribution of Indian Publications



FINDINGS AND CONCLUSIONS:

1.The Year-wise distributions of 667 articles published from 2007-2016. The maximum number of articles 131 (19.6%) were in the year 2016.

2. The mean relative growth for articles I the first five years 2007 to 2011 is (0.43%) reduced to (0.16%) in the

year 2012 to 2016.
3. The number of Multi authors are more in number than Single authors.
4. The mean value for the overall and Degree of Collaboration for the year 2007-2016 is found to be 0.92.
5. The most prolific author Sain, K., who has published 21 papers who's Dominance factor found 0.23.
6.CSIR-National Geophysical Research Institute secured the first rank
7.The Bulletin of the Seismological Society of America ranked as 1st most cited 49 (7.34%) journal under the study.
8.Hyderabad secured first place with 100 (14.99%).

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