

INDIAN RESEARCH OUTPUT ON MEMS LITERATURE USING SCOPUS DATABASE : A SCIENTOMETRIC STUDY

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ABSTRACT

The study explores the research output of MEMS literature from 1970 to 2013, data collected from Scopus database. The total number of publications has been identified as 294573 records among Indian contribution were 8050 records. The Indian contribution has been analysed and tabulated in this paper, from the study, 2.73 % (8050 items) by Indian authors, growth of publications from 1970 to 2013, author collaboration is single authored 11.4%, remaining are collaboration in nature, the length of the articles was counted by pages which confirms that most of the articles are in range of 6 to 10 pages.

Keywords: *Bibliometrics, MEMS, Authorship Pattern, Scientometrics, Scopus database*

1. INTRODUCTION

Scientometric is one of the research methods in sciences. The research output of the scientometric study give the views of the subject developments and the persons involved on the subjects in the globe. This subject is dealt by library and information science, because the analysis of the subjects, authors publications, indexing of the articles, and so on. It analyses the quantitative analysis and statistics to describe the patterns of publications in the given field of study. Bibliometrics is first known in information science and have been applied by F.J. Cole and N.B. Eales in 1917. This study intends to make a scientometric study of MEMS based on literature being contributed by Indian authors. Scientometric study is a simple statistical method of bibliography counting to evaluate and quantify the growth of a subject. The data was collected from Scopus the period of 1970 to 2013 to examine the growth of MEMS research in India, the sources of publications and collaboration in nature.

2. BIBLIOMETRIC STUDY

The similar terms of bibliometrics are scientometrics, informetrics, webometrics. The term scientometrics and Informetrics have become a standard tool of science policy and research management in the recent years. Bibliometric analysis is employed by researchers to study the growth of literature in given field. Scientometrics for science policy and its management is the domain of research

evaluation at present the most important topic in the field. Pritchard (1969) defined the term Bibliometric as the application of statistical and mathematical methods to books and other communication. It is an important research method to identify the thrust areas of the research and incorporating different branches of human knowledge. There are famous Laws of Bibliometric i.e. (Lotka 1926) of scientific productivity, Bradford's law (Bradford, 1934) of scattering and Zips law (Zips, 1949) on frequency of words. However, the bibliometrics study is unique and common to all the subjects after sixties.

3. MEMS: A BRIEF NOTE

MEMS, acronym for Micro-Electro Mechanical Systems, are the one of the emerging filed in electronics. The 21st century is witnessing the developed technology using and identifying the potential to revolutionize both industrial and also consumer products. It is a combination of silicon-based microelectronics and micromachining technology used in the products. MEMS is interdisciplinary nature utilizing the various areas like design, engineering and manufacturing expertise from a wide and diverse range of technical areas including IC technology, IC fabrication technology, mechanical engineering, electrical and material engineering, chemistry and chemical engineering and also fluid engineering, optics, instrumentation and packaging. This technology is used for very small devices. The small devices are called to be nano-scale, so



MEMS is also the same way to non-electromechanical systems (NEMS) and technology. This has been prepared as a proposal and submitted to DARPA in 1986 and introduced the term “microelectromechanical” systems. It has very good impact on global economy for using this techniques and micro system based devices. To create tiny integrated product or devices are both the combination of mechanical and electrical components. Integrated circuit (IC) has been used to fabricate the devices using these techniques and the ranges from millimeters to micro-millimeters.

4. OBJECTIVES OF THE STUDY

The objectives of the study are

1. To examine the worldwide research production in MEMS from 1970-2013.
2. To identify the document type of the publications in MEMS.
3. To compare and measure the growth rate of literature published.
4. To examine the journal producing more on MEMS during 1970-2013.
5. To find out the authorship pattern among Indian Authors during 1970-2013

5. HYPOTHESES

The following hypotheses have been formulated for this study based on objectives.

- There exists substantial literature on MEMS.
- Growth of publications in MEMS research in Indian authors
- There exists domination of collaborative research in MEMS.
- There exists steady growth in Indian publication production in MEMS.

6. COLLECTION OF DATA

For this study, the literature on MEMS research data has been downloaded from ‘Scopus’, multidisciplinary online database, which is an international indexing and abstracting database, using the search term “MEMS”. For this study, publications commencing from 1970-2013 (44 years) has been downloaded from the database. A total of 2,94,573 data has been identified. Further, Indian Authors contributions were 8,050 during the same period. The collected data has been

classified by using Excel and the same was loaded in to SPSS (Statistical Package for Social Sciences) for the purpose of analysis. Statistical tools such as frequency distribution and percentage analysis and Scientometric techniques such as Authorship pattern, Relative Growth Rate (RGR), Doubling time (Dt), etc has been used for the study.

The Relative Growth Rate (RGR) is the increase in number of articles/pages per unit of time. This definition is derived from the definition of relative growth rates in the study of growth analysis of individual plants and effectively applied in the field of botany (Hunt, 1978), which in turn, had its origin from the study of the rate of interest in the financial investment (Blackman, 1919). The mean Relative Growth Rate (R) over the specific period of interval can be calculated from the following equations. There exists a direct equivalence between the relative growth rate and the doubling time (Mahapatra, 1985).

Description	Formula
Relative Growth Rate (RGR)	$1-2 \bar{R} = \frac{\log_e {}_2W - \log_e {}_1W}{\frac{T}{2} - T_1}$
Doubling Time (Dt (a))	$Dt (a) = \frac{0.693}{1-2 \bar{R} (aa-1 \text{ year-1})}$
Doubling Time (Dt (p))	$Dt (p) = \frac{0.693}{1-2 \bar{R} (pp-1 \text{ year-1})}$

7. DATA ANALYSIS

7.1 Country Wise Distribution and Growth of Articles

The MEMS publications have been using the country wise production along with comparing Rate of Growth of literature of USA contributions with the rest of the world as well as the same process has been repeated with India. The process has been tabulated below (table 1).

Table 1 : Country Wise Distribution and Growth of Articles

COUNTRY	TP	%	RoG with USA	RoG with India
USA	99766	33.87	1.00	12.39
China	23609	8.01	0.24	2.93
Japan	20574	6.98	0.21	2.56
France	19815	6.73	0.20	2.46

Germany	18259	6.20	0.18	2.27
UK	16365	5.56	0.16	2.03
Italy	15282	5.19	0.15	1.90
Canada	11655	3.96	0.12	1.45
India	8050	2.73	0.08	1.00
Brazil	7939	2.70	0.08	0.99
Spain	7919	2.69	0.08	0.98
Australia	7652	2.60	0.08	0.95
South Korea	7488	2.54	0.08	0.93
Taiwan	7452	2.53	0.07	0.93
Switzerland	5585	1.90	0.06	0.69
Russian Federation	5277	1.79	0.05	0.66
Netherlands	5208	1.77	0.05	0.65
Others	6678	2.27	0.07	0.83
Total	294573	100.00	2.95	36.59

The table reveals that US contribution is 99766 (33.87%) that is one third of the production of the total articles were contributed by the authors from USA, followed by China 23609 (8.01%), Japan 20574 (6.98%), France 19815 (6.73%), Germany 18259 (6.20%), UK 16365 (5.56%), Italy 15282 (5.19%), Canada 11655 (3.96%), India 8050 (2.73%). Further it can be seen that only 8 countries were contributed more than 10,000 publications. Among the Ten countries, India position is 9th place. The growth rates of literature comparing USA with other countries are less contribution where as India with other countries are twelve times higher production in the case of USA and followed by doubled by China, Japan, France, Germany.

7.2 Year Wise Distribution of Literature on MEMS

Year wise contributions of articles across the world and India have been tabulated with Rate of growth of literature on MEMS.

Table 2 : Year Wise Global and Indian Contribution on MEMS

Figure 1 : Cumulative contribution of publications by Global

Figure 2 : Cumulative contribution of publications by Indian Authors

The contribution of articles to the literature on MEMS was steady 1973-81 but at the same time there was decrease on the part of contribution of the articles to the literature from 1982 – 1990 and again there was increase in the contribution after 1991 onwards. The same

situation prevails on the part of Indian contribution to the literature on MEMS. From the table it is observed that there was rapid growth of literature for the period 1971—1974 and 1996-1998 Internationally and same type of growth has been observed in India. The contribution of very low during the period 1980-1984 Internationally and there was no decline of contribution on the part of the Indian side.

7.3 Relative Growth Rate of Articles and Dt of Articles on MEMS by Indian Authors

Relative Growth Rate and Doubling Time of articles to the literature on MEMS have been tabulated with year wise with number of articles.

Table 3 : RGR and DT by Indian Authors

Figure 3 : Rate of Growth of Global Authors

Figure 4 : Rate of Growth of Indian Authors

Relative growth rate of contributions, a comparative study of pervious year cumulative growth, in the initial period seems to be high and slowly reduces. RGR ranges from 0.00 to 3.57. The doubling time ranges from 0.00 to 35.69 over the period. From the table it shows that the RGR is increased during the period 1970-1973, 1987-1990, 1992-1994, 1994-1996 and 2012 and RGR is decreased during the period 1978-194 and 1990-1992. There was increasing the Doubling Time during the period 1973-1975, 1977-78, 1997-1998 and it was decreased during the period 1998-2000.

7.4 Block Year Output RGR and Dt

The contribution of data has been segregated into four blocks and each block covering a period of eleven years.

Table 4 : Block Year Output with RGR and DT

Figure 5 : RGR by Indian Authors

Figure 6 : Doubling Time of Indian Authors contribution

From the table, it reveals that there was a steady growth of literature on MEMS during the above period (1992-2013). The contribution of articles during the second block period (1981-1991) was in decreasing trend.

7.5 Authorship Pattern

The Authorship pattern has been adopted by Lotka's Law. The law is used to test the regularity in the publication activity of

authors of scientific literature. It describes the frequency of publication by authors in a given field. Collaborative Index (CI) is one of the early measures of degree of collaboration derived by Lawani (1980). Let the collection K be the research papers published in a discipline or in a journal during a certain period of interest.

Table 5 : Indian Authorship Pattern on MEMS

S.No.	Authors collaboration	Frequency	%	Number of Authors
1	Single	920	11.4	920
2	Double	2371	29.5	4742
3	Three	1961	24.4	5883
4	Four	1264	15.7	5056
5	Five and Above	1534	19.1	10771
Total		8050	100.00	27372
Average Authors per article = 3.40				
Degrees of Collaboration = 0.885714				

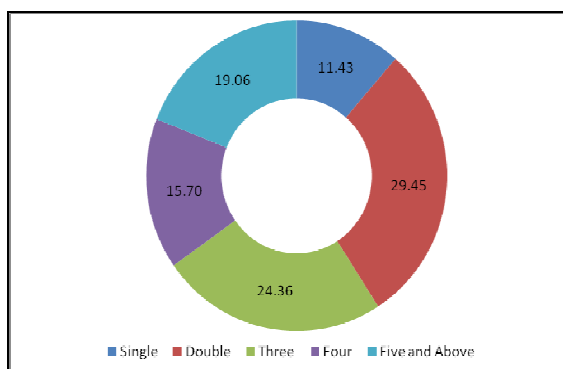


Figure 7 : Author Collaboration

The data in Table 5 reveals that multi-authorship contributions dominate this field of research. Single authored contribution accounts for 920 (11.4%), two authors is 2371 (29.5%), three authors accounts for 1961 (24.47%) and four authored 1264 (15.7%) and finally more than four authors are contributed by 1534 (19.1%). Nearly 90% of researches are collaborative in nature. The average authors' per article is 3.40 and the degrees of collaboration is 0.885714.

7.6 Authorship Collaboration - DC, CI, CC and MCC

The authorship pattern were analysed using Degrees of collaboration, Collaborative Index, Collaborative Coefficient and Modified Collaborative Coefficient for the period of 44 years on MEMS literature.

Table 6 : Indian Authorship Collaboration with DC, CI, CC and MCC

From the table 6, it is observed that Degrees of Collaboration is 1 for the years 1983, 1988, 1989, 1991, 1993. Collaborative Index in the year 1990 is 4.33 and followed by 1983 (4.0), 1991 (3.80), 1993 (3.75). The data is also subject to calculate the differentiations among levels of multiple authors CC and MCC. It has been calculated and presented in the table 6. CC is in the range between 0.00 and 0.73 and the MCC is between (1972) 0.00 and (1983) 0.76.

7.7 Bibliographical Form of Publications on MEMS from India

MEMS literature has been analysed based on the contents form like Articles in journal, conference paper, review of the articles, book and editorial, etc. The data has been presented in Table 7 for the MEMS during 1970-2013.

Table 7 : Bibliographic Form Of Publications From India

Form	Frequency	%	Cum. Percent
Article	6038	75.0	75.0
Conference Paper	1316	16.3	91.35
Review	317	3.94	95.29
Book	3	.04	95.33
Editorial	8	.10	95.43
Note	34	.42	95.85
Short Survey	16	.20	96.05
Others	318	3.95	100.00
Total	8050	100.0	

The table 7 reveals that the single most prevalent form of publication is journals (75.01%), It is followed by conference paper

(16.35%), Review is 3.94%, and others 3.95 only.

7.8 Top Authors in the Literature on MEMS

The top authors were calculated based on the publications productions in the literature on MEMS during 1970 – 2013. The table 8 shows the top 23 authors among the Indian publications,

Table 8 : Top Authors In India During The Study Period 1970 – 2013

S.No.	AUTHOR NAME	No. of Articles	%
1	Chandra, S.	52	0.65
2	Bhattacharyya, T.K.	48	0.60
3	Saravanan, R.	44	0.55
4	Jussawalla, D.J.	35	0.43
5	Bhattacharya, E.	35	0.43
6	Ganatra, R.D.	34	0.42
7	Advani, S.H.	33	0.41
8	Mishra, D.C.	32	0.40
9	Pratap, R.	31	0.39
10	Ananthasuresh, G.K.	30	0.37
11	Bhide, S.V.	30	0.37
12	Das, S.	30	0.37
13	Ranadive, K.J.	26	0.32
14	Rahaman, H.	25	0.31
15	Sharma, A.	25	0.31
16	Pandit, M.K.	25	0.31
17	Rajendran, C.P.	24	0.30
18	Koul, S.K.	24	0.30
19	Rajendran, K.	22	0.27
20	Saha, H.	22	0.27
21	Ganguly, R.	21	0.26
22	Anbarasan, R.	20	0.25
23	Kayal, J.R.	20	0.25
24	Others	7362	91.45
	Total	8050	100.00

It is observed from the table, 52 (0.65%) publications is the highest production among the Indian authors. Among the top author is Chandra, S and followed by Bhattacharyya, T.K. 58 (0.60%).

7.9 Journals Publication in the field of MEMS by Indian Authors

In this study, an analysis has been made to find out the list of top 33 journals producing

MEMS research output and the same is shown in the table 9.

Table 9 : Top Journals of Indian Contribution by Indian Authors

It is found that 'Journal of the Geological Society of India' 692 (8.6%) and *Current Science* 433 (5.4%) are the top two journals for publications on MEMS by the Indian authors.

7.10 Number of Pages by the Indian Authors

The table has been classified by using number of pages per articles like 1-5, 6-10, etc is shown. It can be observed the average number of pages written the articles on MEMS.

Table 10 : Number of Pages by the Indian Authors

S.No	No. of pages	No. of Articles	%
1	1-5	1899	23.59
2	6-10	2896	35.98
3	11-15	1329	16.51
4	16-20	645	8.01
5	21-25	288	3.58
6	26-30	121	1.50
7	Above 30	872	10.83
	Total	8050	100.00

One third of the publications length of the paper is 6-10 (2896 publications) and followed by 1899 in the length of 1-5 (23.59%).

7.11 Year wise contribution of Authors, Pages and Citations and their average

It has been tabulated year wise productions with authors, average of authors, number of pages and average of pages and number of citations and average of citations.

Table 11 : Year Wise Contribution of Authors, Pages and Citations and their average

From the table, it is observed that number of authors from Indian publications on MEMS subject. There are 8050 publications from Indian Authors and the number of authors involved to produce the publications is 27372 authors and their average is 2.83 authors. It is

understood that average of authors are from two and three authors. The same way, number of pages were also calculated, it is found that average per article pages is 9.91 and the range of pages per articles are from 4 page to 40 pages. The overall citations among the Indian authors were calculated and the average per article citations is 12.88. The maximum average citation is 53.12 in the year 1994.

8. FINDINGS AND CONCLUSION

It can be seen from the study that the total production of articles from India is 8050 (2.73%) for the period of 1970 to 2013. It is found that India occupies 9th ranking among the world production of articles on MEMS. USA contribution is the top comparing with other countries. While comparing with India the USA has twelve time higher production. There was steady growth on the subject from 1991 onwards. The Doubling Time was increasing during 1973-75, 1977-88 and 97-98 and decreasing trends during the period 1998-2000. The contribution of articles during the second block period (1981-1991) was in decreasing trend. Single authored contribution accounts for 920 (11.4%). The average authors' per article is 3.40 and the degrees of collaboration is 0.885714. The three fourth of publications are from Journals. Among the top author is Chandra, S and followed by Bhattacharyya, T.K. 58 (0.60%). *Journal of the Geological Society of India* 692 (8.6%) and *Current Science* 433 (5.4%) are the top two journals for publications on MEMS by the Indian authors. The overall citations among the Indian authors were calculated and the average per article citations is 12.88. The maximum average citation is 53.12 in the year 1994.

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Annexure - I

Table 2 : Year wise Global and Indian contribution on MEMS

S.No.	Year	Global				India			
		No. of Records	%	Cum. %	RoG	No. of Records	%	Cum. %	RoG
1	1970	271	0.09	0.09	1.00	0	0.00	0.00	0.00
2	1971	202	0.07	0.16	0.75	0	0.00	0.00	0.00
3	1972	404	0.14	0.30	2.00	2	0.02	0.02	1.00
4	1973	1373	0.47	0.76	3.40	71	0.88	0.91	35.50
5	1974	1876	0.64	1.40	1.37	51	0.63	1.54	0.72
6	1975	2062	0.70	2.10	1.10	52	0.65	2.19	1.02
7	1976	2370	0.80	2.91	1.15	55	0.68	2.87	1.06
8	1977	2372	0.81	3.71	1.00	50	0.62	3.49	0.91
9	1978	2326	0.79	4.50	0.98	55	0.68	4.17	1.10
10	1979	2336	0.79	5.29	1.00	58	0.72	4.89	1.05
11	1980	2197	0.75	6.04	0.94	44	0.55	5.44	0.76
12	1981	2376	0.81	6.85	1.08	36	0.45	5.89	0.82
13	1982	1705	0.58	7.42	0.72	16	0.20	6.09	0.44
14	1983	909	0.31	7.73	0.53	4	0.05	6.14	0.25
15	1984	626	0.21	7.95	0.69	0	0.00	6.10	0.00
16	1985	793	0.27	8.21	1.27	1	0.01	6.15	0.00
17	1986	621	0.21	8.43	0.78	1	0.01	6.16	1.00
18	1987	665	0.23	8.65	1.07	1	0.01	6.17	1.00
19	1988	742	0.25	8.90	1.12	1	0.01	6.19	1.00
20	1989	799	0.27	9.17	1.08	5	0.06	6.25	5.00
21	1990	1083	0.37	9.54	1.36	6	0.07	6.32	1.20
22	1991	1160	0.39	9.94	1.07	5	0.06	6.39	0.83
23	1992	1199	0.41	10.34	1.03	0	0.00	6.40	0.00
24	1993	1048	0.36	10.70	0.87	4	0.05	6.43	0.00
25	1994	1232	0.42	11.12	1.18	8	0.10	6.53	2.00
26	1995	1120	0.38	11.50	0.91	8	0.10	6.63	1.00
27	1996	8388	2.85	14.34	7.49	279	3.47	10.10	34.88
28	1997	8554	2.90	17.25	1.02	232	2.88	12.98	0.83
29	1998	8950	3.04	20.29	1.05	225	2.80	15.78	0.97
30	1999	9596	3.26	23.54	1.07	229	2.84	18.62	1.02
31	2000	9346	3.17	26.72	0.97	228	2.83	21.45	1.00
32	2001	10488	3.56	30.28	1.12	246	3.06	24.51	1.08
33	2002	11194	3.80	34.08	1.07	263	3.27	27.78	1.07
34	2003	12331	4.19	38.26	1.10	276	3.43	31.20	1.05
35	2004	14312	4.86	43.12	1.16	377	4.68	35.89	1.37
36	2005	15649	5.31	48.43	1.09	357	4.43	40.32	0.95
37	2006	15731	5.34	53.77	1.01	400	4.97	45.29	1.12
38	2007	15615	5.30	59.08	0.99	388	4.82	50.11	0.97
39	2008	16955	5.76	64.83	1.09	388	4.82	54.93	1.00
40	2009	18579	6.31	71.14	1.10	573	7.12	62.05	1.48
41	2010	20028	6.80	77.94	1.08	595	7.39	69.44	1.04
42	2011	21712	7.37	85.31	1.08	722	8.97	78.41	1.21
43	2012	22062	7.49	92.80	1.02	920	11.43	89.84	1.27
44	2013	21216	7.20	100.00	0.96	818	10.16	100.00	0.89
	Total	294573	100.00			8050	100.00		

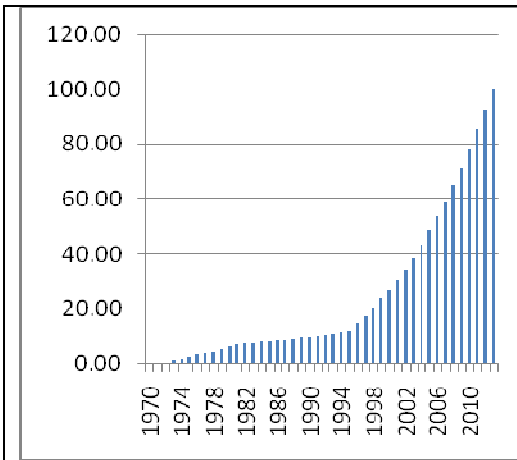


Figure 1 : Cumulative contribution of publications by Global

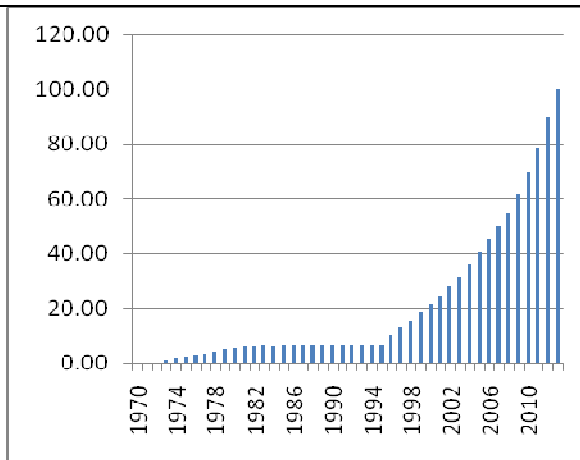


Figure 2 : Cumulative contribution of publications by Indian Authors

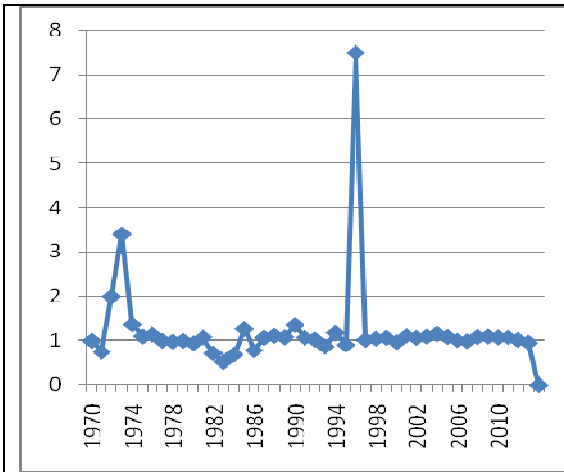


Figure 3 : Rate of Growth of Global Authors

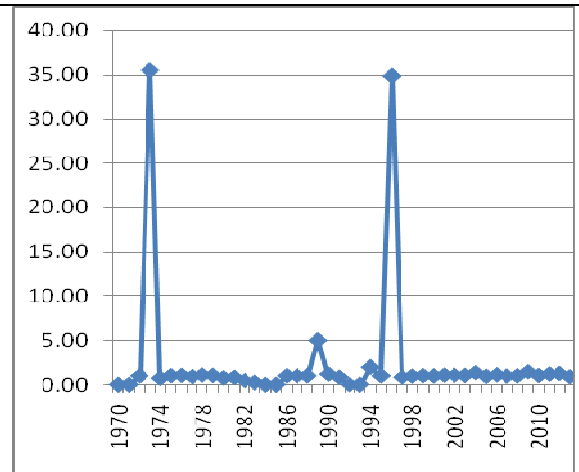


Figure 4 : Rate of Growth of Indian Authors

Table 3 : RGR and DT by Indian Authors

S.No.	Year	No. of Records	Cum	Cum. %	W1	W2	RGR	DT
1	1970	0	0	0		0	0	0.00
2	1971	0	0	0	0	0.693147	0.69	1.00
3	1972	2	2	0.02	0.693147	4.26268	3.57	0.19
4	1973	71	73	0.91	4.26268	3.931826	-0.33	-2.09
5	1974	51	124	1.54	3.931826	3.951244	0.02	35.69
6	1975	52	176	2.19	3.951244	4.007333	0.06	12.36
7	1976	55	231	2.87	4.007333	3.912023	-0.10	-7.27
8	1977	50	281	3.49	3.912023	4.007333	0.10	7.27
9	1978	55	336	4.17	4.007333	4.060443	0.05	13.05
10	1979	58	394	4.89	4.060443	3.78419	-0.28	-2.51
11	1980	44	438	5.44	3.78419	3.583519	-0.20	-3.45
12	1981	36	474	5.89	3.583519	2.772589	-0.81	-0.85
13	1982	16	490	6.09	2.772589	1.386294	-1.39	-0.50
14	1983	4	494	6.14	1.386294	0	-1.39	-0.50
15	1984	0	494	6.14	0	0	0.00	0.00
16	1985	1	495	6.15	0	0	0.00	0.00
17	1986	1	496	6.16	0	0	0.00	0.00
18	1987	1	497	6.17	0	0	0.00	0.00
19	1988	1	498	6.19	0	1.609438	1.61	0.43
20	1989	5	503	6.25	1.609438	1.791759	0.18	3.80
21	1990	6	509	6.32	1.791759	1.609438	-0.18	-3.80
22	1991	5	514	6.39	1.609438	0	-1.61	-0.43
23	1992	0	514	6.39	0	1.386294	1.39	0.50
24	1993	4	518	6.43	1.386294	2.079442	0.69	1.00
25	1994	8	526	6.53	2.079442	2.079442	0.00	0.00
26	1995	8	534	6.63	2.079442	5.631212	3.55	0.20
27	1996	279	813	10.10	5.631212	5.446737	-0.18	-3.76
28	1997	232	1045	12.98	5.446737	5.4161	-0.03	-22.62
29	1998	225	1270	15.78	5.4161	5.433722	0.02	39.33
30	1999	229	1499	18.62	5.433722	5.429346	0.00	-158.35
31	2000	228	1727	21.45	5.429346	5.505332	0.08	9.12
32	2001	246	1973	24.51	5.505332	5.572154	0.07	10.37
33	2002	263	2236	27.78	5.572154	5.620401	0.05	14.36
34	2003	276	2512	31.20	5.620401	5.932245	0.31	2.22
35	2004	377	2889	35.89	5.932245	5.877736	-0.05	-12.71
36	2005	357	3246	40.32	5.877736	5.991465	0.11	6.09
37	2006	400	3646	45.29	5.991465	5.961005	-0.03	-22.75
38	2007	388	4034	50.11	5.961005	5.961005	0.00	0.00
39	2008	388	4422	54.93	5.961005	6.350886	0.39	1.78
40	2009	573	4995	62.05	6.350886	6.388561	0.04	18.39
41	2010	595	5590	69.44	6.388561	6.582025	0.19	3.58
42	2011	722	6312	78.41	6.582025	6.824374	0.24	2.86
43	2012	920	7232	89.84	6.824374	6.706862	-0.12	-5.90
44	2013	818	8050	100.00	6.706862	8.993427	2.29	0.30
	Total	8050						

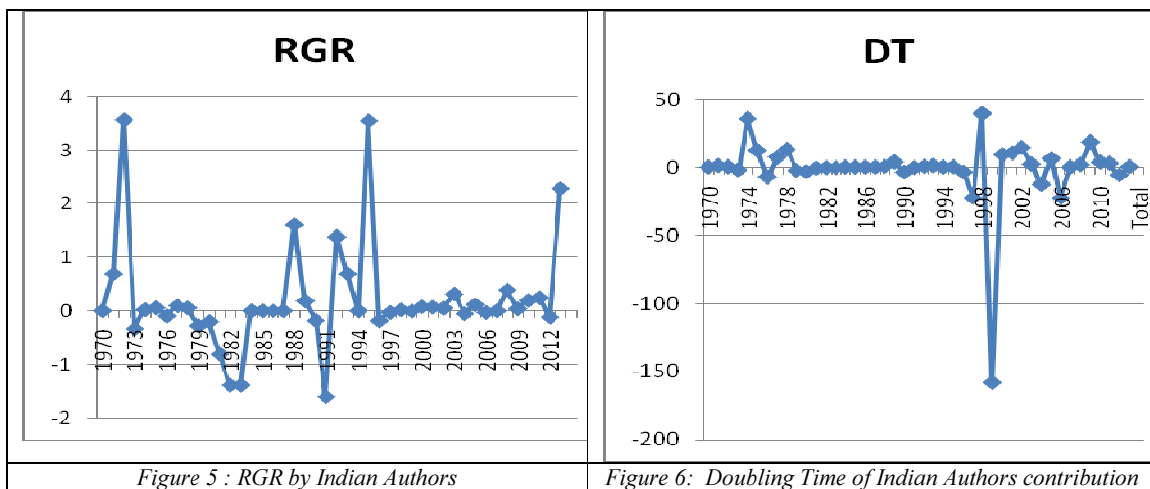


Table 4 : Block Year Output with RGR and DT

S. No	Block Year	Output	%	RoG	CAGR	Σ	W1	W2	RGR	DT
1	1970-1980	438	5.4	1.00	157.55	438		4.3307	4.33	0.16
2	1981-1991	76	.9	0.17	-38.95	514	4.3307	7.4512	3.12	0.22
3	1992-2002	1722	21.4	22.66	184.76	2236	7.4512	8.6680	1.22	0.57
4	2003-2013	5814	72.2	3.38	31.21	8050	8.6680	8.9934	0.33	2.13
	Total	8050	100.0							



Table 6 : Indian Authorship Collaboration With DC, CI, CC And MCC

S.No.	Year	Single	Double	Three	Four	>Four	Total	DC	CI	CC	MCC
1	1970	0	0	0	0	0	0	0	0	0	0
2	1971	0	0	0	0	0	0	0	0	0	0
3	1972	2	0	0	0	0	2	0.00	1.00	0.00	0.00
4	1973	14	25	18	7	7	71	0.80	2.55	0.50	0.52
5	1974	25	11	10	2	3	51	0.51	1.96	0.32	0.33
6	1975	13	13	10	12	4	52	0.75	2.63	0.49	0.51
7	1976	9	14	15	13	4	55	0.84	2.80	0.54	0.57
8	1977	13	16	12	7	2	50	0.74	2.38	0.46	0.48
9	1978	9	12	19	11	4	55	0.84	2.80	0.55	0.57
10	1979	8	18	14	11	7	58	0.86	2.84	0.55	0.58
11	1980	4	10	12	9	9	44	0.91	3.20	0.61	0.64
12	1981	1	10	16	4	5	36	0.97	3.06	0.63	0.66
13	1982	2	5	5	3	1	16	0.88	2.75	0.56	0.58
14	1983	0	0	2	0	2	4	1.00	4.00	0.73	0.76
15	1984	0	0	0	0	0	0	0.00	0.00	0.00	0.00
16	1985	0	0	1	0	0	1	1.00	3.00	0.67	0.69
17	1986	1	0	0	0	0	1	0.00	1.00	0.00	0.00
18	1987	1	0	0	0	0	1	0.00	1.00	0.00	0.00
19	1988	0	1	0	0	0	1	1.00	2.00	0.50	0.52
20	1989	0	2	2	0	1	5	1.00	3.00	0.63	0.65
21	1990	1	0	0	0	5	6	0.83	4.33	0.67	0.69
22	1991	0	2	0	0	3	5	1.00	3.80	0.68	0.71
23	1992	0	0	0	0	0	0	0.00	0.00	0.00	0.00
24	1993	0	1	1	0	2	4	1.00	3.75	0.69	0.72
25	1994	1	3	1	0	3	8	0.88	3.13	0.57	0.59
26	1995	1	4	2	1	0	8	0.88	2.38	0.51	0.53
27	1996	42	100	61	36	40	279	0.85	2.76	0.54	0.56
28	1997	31	76	52	29	44	232	0.87	2.91	0.56	0.58
29	1998	52	64	51	23	35	225	0.77	2.67	0.49	0.52
30	1999	45	64	54	32	34	229	0.80	2.76	0.52	0.54
31	2000	36	64	61	20	47	228	0.84	2.90	0.55	0.57
32	2001	43	66	51	43	43	246	0.83	2.91	0.54	0.57
33	2002	39	69	54	49	52	263	0.85	3.02	0.57	0.59
34	2003	28	81	62	46	59	276	0.90	3.10	0.59	0.62
35	2004	45	119	95	56	62	377	0.88	2.92	0.57	0.59
36	2005	55	104	83	59	56	357	0.85	2.88	0.55	0.57
37	2006	51	113	98	64	74	400	0.87	2.99	0.57	0.60
38	2007	43	124	97	58	66	388	0.89	2.95	0.57	0.60
39	2008	37	112	93	62	84	388	0.90	3.11	0.60	0.62
40	2009	59	171	131	99	113	573	0.90	3.06	0.59	0.61
41	2010	42	164	141	106	142	595	0.93	3.24	0.62	0.65
42	2011	57	206	167	122	170	722	0.92	3.20	0.61	0.64
43	2012	56	286	254	153	171	920	0.94	3.11	0.61	0.64
44	2013	54	241	216	127	180	818	0.93	3.17	0.62	0.64
	Total	920	2371	1961	1264	1534	8050	0.89	3.02	0.58	0.60

Table 9: Top Journals Of Indian Contribution By Indian Authors

S.No.	Source Title	Frequency	(%)	Cumu. (%)
1	Journal of the Geological Society of India	692	8.6	8.6
2	Current Science	433	5.4	14.0
3	Advanced Materials Research	166	2.1	16.0
4	Indian Journal of Cancer	160	2.0	18.0
5	Proceedings of SPIE - The International Society for Optical Engineering	140	1.7	19.8
6	Indian Minerals	109	1.4	21.1
7	Gondwana Research	81	1.0	22.1
8	Proceedings of the Indian Academy of Sciences, Earth and Planetary Sciences	59	.7	22.9
9	Precambrian Research	55	.7	23.5
10	Monthly Notices of the Royal Astronomical Society	54	.7	24.2
11	Indian Journal of Marine Sciences	49	.6	24.8
12	Tectonophysics	48	.6	25.4
13	Indian Journal of Medical Research	46	.6	26.0
14	Indian Journal of Experimental Biology	43	.5	26.5
15	Exploration and Research for Atomic Minerals	41	.5	27.0
16	Journal of Micromechanics and Microengineering	41	.5	27.5
17	Memorias do Instituto Oswaldo Cruz	38	.5	28.0
18	Astronomy and Astrophysics	37	.5	28.5
19	Journal of Earth System Science	34	.4	28.9
20	Sedimentary Geology	33	.4	29.3
21	Microsystem Technologies	32	.4	29.7
22	Oriental Insects	30	.4	30.1
23	Applied Surface Science	28	.3	30.4
24	Journal of Asian Earth Sciences	27	.3	30.8
25	Pure and Applied Geophysics	27	.3	31.1
26	Phytomorphology: An International Journal of Plant Morphology	26	.3	31.4
27	Sensors and Transducers	26	.3	31.7
28	Earth and Planetary Science Letters	25	.3	32.0
29	Geophysical Journal International	25	.3	32.4
30	Geophysical Research Letters	25	.3	32.7
31	International Journal of Earth Sciences	25	.3	33.0
32	International Journal of Mathematical Analysis	25	.3	33.3
33	Journal of Applied Physics	25	.3	33.6
34	Others	5300	66.5	100.0
Total		8050	100.0	

Table 11 : Year Wise Contribution Of Authors, Pages And Citations And Their Average

S.No.	Year	No. of Records	No. of Authors	NOA Avg	Pages	Pages Avg	Citations	Citations Avg
1	1970	0	0	0	0	0	0	0
2	1971	0	0	0	0	0	0	0
3	1972	2	2	1	17	8.5	4	4
4	1973	71	182	2.56	437	6.15	61	2.44
5	1974	51	100	1.96	298	5.84	111	7.92
6	1975	52	140	2.69	449	8.63	44	3.66
7	1976	55	154	2.8	312	5.67	110	7.33
8	1977	50	122	2.44	289	5.78	126	6.3
9	1978	55	159	2.89	297	5.4	52	3.05
10	1979	58	170	2.93	311	5.36	114	5.42
11	1980	44	152	3.45	199	4.52	47	3.35
12	1981	36	116	3.22	196	5.44	69	4.92
13	1982	16	46	2.87	106	6.62	40	6.66
14	1983	4	16	4	37	9.25	19	19
15	1984	0	0	0	0	0	0	0
16	1985	1	3	3	40	40	97	97
17	1986	1	1	1	18	18	0	0
18	1987	1	1	1	5	5	0	0
19	1988	1	2	2	15	15	36	36
20	1989	5	16	3.2	133	26.6	45	9
21	1990	6	37	6.16	32	5.33	91	15.16
22	1991	5	30	6	62	12.4	114	28.5
23	1992	0	0	0	0	0	0	0
24	1993	4	15	3.75	85	21.25	88	22
25	1994	8	26	3.25	71	8.87	425	53.12
26	1995	8	19	2.37	116	14.5	116	16.57
27	1996	279	837	3	2935	10.51	3322	14.83
28	1997	232	748	3.22	2342	10.09	2099	10.7
29	1998	225	662	2.94	2508	11.14	3171	16.34
30	1999	229	695	3.03	2667	11.64	3335	16.92
31	2000	228	712	3.12	2306	10.11	3846	20.34
32	2001	246	793	3.22	2841	11.54	3787	18.65
33	2002	263	846	3.21	3141	11.94	3429	16.02
34	2003	276	1057	3.82	2982	10.8	4045	17.36
35	2004	377	1214	3.22	3923	10.4	4020	13.35
36	2005	357	1100	3.08	3742	10.48	3223	11.46
37	2006	400	1268	3.17	4680	11.7	3000	9.67
38	2007	388	1244	3.2	3955	10.19	3112	10.69
39	2008	388	1329	3.42	3883	10	3262	11.99
40	2009	573	1945	3.29	5781	10.08	3238	8.23
41	2010	595	2224	3.73	6591	11.07	3247	8.07
42	2011	722	2705	3.74	7611	10.54	1957	4.94
43	2012	920	3344	3.63	8853	9.62	1348	3.5
44	2013	818	3140	3.83	8342	10.19	494	2.2
	Total	8050	27372	2.83	82608	9.91	55744	12.88