Indian Science & Technology Research: A scientometric Mapping Based on Science Citation Index

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This paper attempts to analyse quantitatively the growth and development of Science and Technology research in India in terms of publication output as reflected in *Science Citation Index* (SCI) (1990-2004). Total of 182111 papers were published by the Indian scientists and engineers to various domains: Chemical Sciences (62856) (34.52%), Physical Sciences (53844) (29.57%), Medical Sciences (30143) (16.55%), Biological Sciences (18239) (10.02%), Multidisciplinary Sciences (8616) (4.73%), Agricultural Sciences (5461) (3.00%) and Geological Sciences (2952) (1.62%). The study also focused on the visualization of Indian contribution to various micro-domains: Chemistry-Multidisciplinary (10800), Organic Chemistry (10362), Materials Science-Multidisciplinary (8107), Multidisciplinary Sciences (7771), Physics-multidisciplinary (7112), Condensed Matter Physics (6938), Physical Chemistry (5931), and Biochemistry & Molecular Biology (5307). A total of 168 micro-domains were identified in which the scientific research in India is concentrated. A steady growth of publications was observed. The average number of publications per year were 12140.73. The highest number of publications (15414) were published in 2003. Single authored papers were 18224 (10%) and Multi-authored papers were 163887 (90%). Authorship and collaboration trend was towards multi-authored papers. Five hundred fifty nine papers had more than 100 authors each. There were 371 papers with 255 authors each and 51 papers with 225 authors each. Intensive international collaboration was found during the period and bilateral collaboration accounted for 13.67 percent of the total 31186 collaborative papers followed by trilateral collaboration with 2.27 percent. India had collaboration with 167 countries. The highest number of papers collaborated were 11869 with USA followed by 4640 papers with Germany, 3202 papers with England and 2988 papers with Japan. A comparative publication productivity between India and Peoples-R-China has been carried out. India was ahead of Peoples-R-China till 1996. Peoples-R-China out paced India in 1997. The highly productive Indian Institutes were: Indian Institute of Science, Bangalore with 10247 publications, Bhabha Atomic Research Centre, Mumbai with 6782 publications, Tata Institute of Fundamental Research, Mumbai with 5132 publications and Banaras Hindu University, Varanasi with 4487 publications. The most preferred journals by the scientists were: *Current Science* (6848), *Indian Journal Chemistry-B* (3566), *Indian Journal Chemistry-A* (3272) and *Pramana* (1904).

1. Introduction

India's tradition of science and technology dates back to 5000 years. A resurgence was seen in the first half of the twentieth century. After independence in 1947 India set up a multi-layered facet of science and science administration consisting of

Government agencies, Autonomous bodies, University system, Industrial R&D, both in the public and private sectors. The major scientific agencies like Department of Atomic energy (DAE), Department of Biotechnology (DBT), Department of Ocean Development (DOD), Department of Electronics (DOE), Department of Space (DOS), Defense Research and Development Organization (DRDO), Department of Science and Technology (DST), Council of Scientific and Industrial Research (CSIR), Indian Council of Agriculture Research (ICAR), and Indian Council of Medical Research (ICMR) account for major share of research funding. The main objectives of these agencies are to support and co-ordinate research in their respective areas. The research is carried out through a chain of research laboratories/research institutes under them as well as through research grants/sponsored projects to higher education sectors, national laboratories and establishments. Academic institutions like Indian Institute of Science, IITs have also a major role to play in carrying out R&D activities.

Evaluation is one of the key components of any research and development activity. One well-known productivity indicator is the number of publications produced by the scientists, institutions and countries. Studies like this will provide some insight into the complex dynamics of research activity and enable the scientists, policy makers and science administrators to provide adequate facilities and proper guidance in which direction the research has to be conducted.

Research publications are clearly one of the quantitative measures for the basic research activity in a country. It must be added, however, that what excites the common man, as well as the scientific community, are the peaks of scientific and technological achievement, not just the statistics on publications. There are also other kinds of research and technology development-mission oriented, industry-oriented, country-specific, etc., progress in these cannot be obviously measured by counting only the number of publications[1]. Many scientometric studies have appeared in the literature dealing with the scientific output of different countries[2-10].

2. Objectives

The main objective of the study is to present the growth of literature and make the quantitative assessment of status of science and technology research in India by way of analyzing the following features of research output:

Country-wise distribution of research output in Science & Technology,
To find out year-wise growth of publications,
To find out domain wise distribution of publications,
To find out authorship and collaboration pattern in the publications,
To find out publication productivity of India and Peoples-Republic of China,
To find out the extent of international collaboration,
To find out the highly productive international institutes with whom India had collaborated,
To find out the highly productive Indian institutes,
To find out language-wise distribution of publications, and
To find out the channels of communications used by the scientists.

3. Materials and Methods

Data was collected from the Science Citation Index (1990-2004) published by the Institute of Scientific Information, Philadelphia (now a division of the Thomson Corporation). Science Citation Index is one of the comprehensive databases covering all aspects of science which covers about 4000 journals with high impact factors. By using suitable search strategy (India in Address word field) records by Indian authors affiliated at least to one Indian institute were downloaded for the years 1990-2004. A total of 182111 records were downloaded and analysed as per objectives of the study.

4. Results and Discussion

4.1 Country-wise distribution of research output in Science & Technology

The publication productivity of top 20 countries actively involved in research in Science and Technology during 1990-2004 is depicted in Figure-1. USA topped the list with 3917974 publications followed by Japan with 920925 publications, England with 839771 publications, Germany with 796414 publications and France with 611225 publications. India ranked fifteenth among other countries in terms of publication output with 182111 publications.

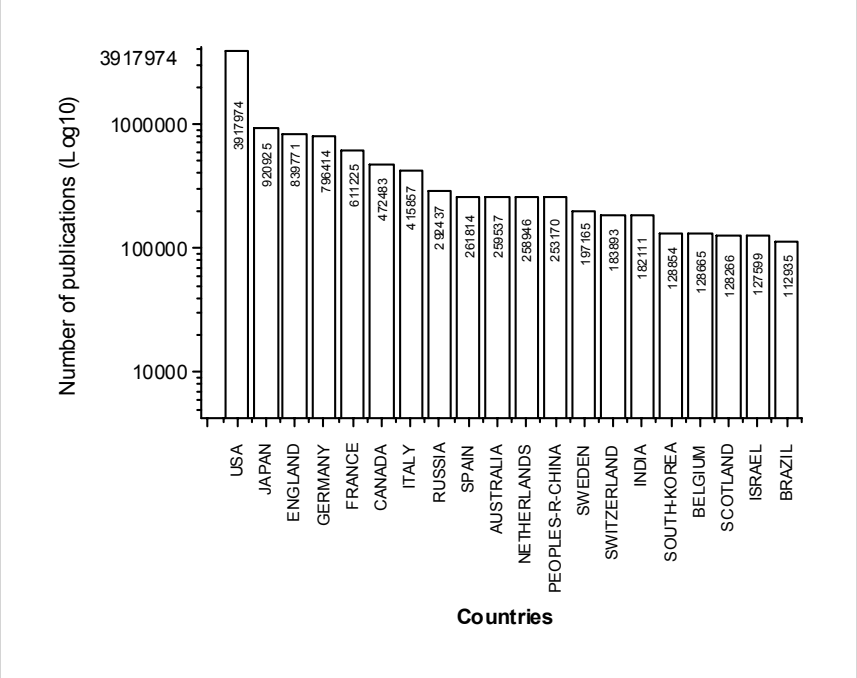

Figure 1: Top 20 highly productive countries in Science & Technology

4.2 Year wise growth of publications

During fifteen years period (1990-2004) India has produced 182111 publications. The highest number of publications were 15414 (8.46%) in 2003. The average number of publications per year was 12140.73. The highest collaboration rate 0.92 was found in 2003 and 2004. India maintained a consistent growth of publications during the period. Figure-2 gives year wise productivity, collaboration trend and collaboration rate in the Indian publications.

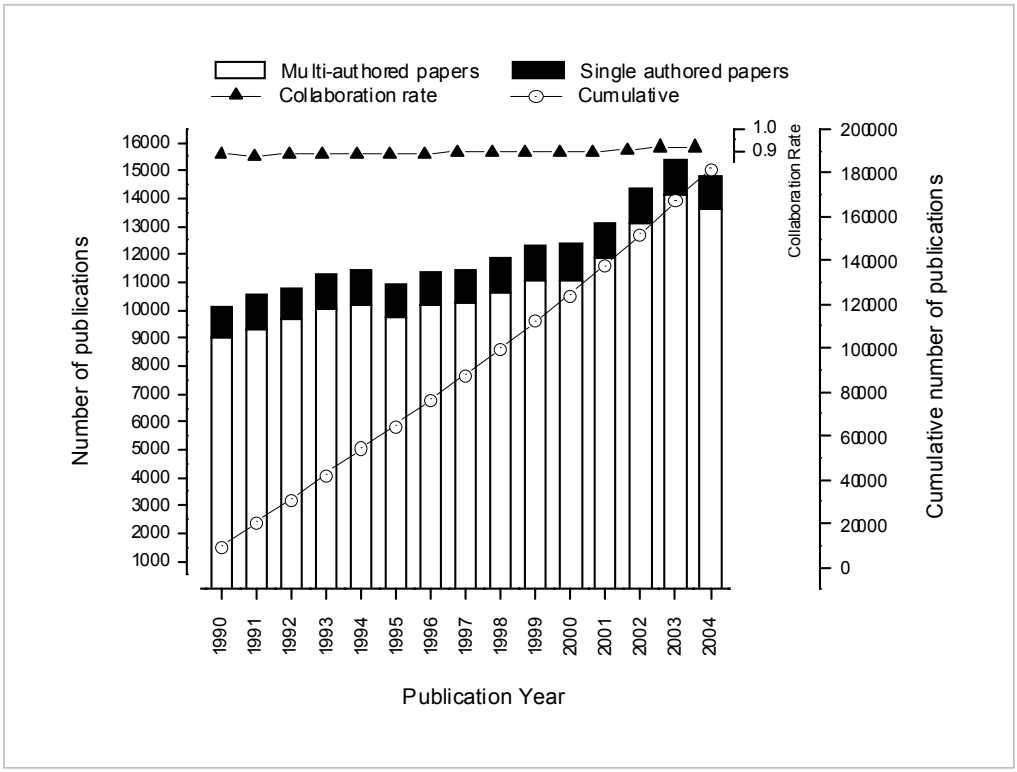

Figure 2: Year-wise productivity, collaboration and collaboration rate in the publications by the Indian Scientists (1990-2004)

4.3 Domain-wise distribution of publications

During fifteen years period (1990-2004) Indian scientists have contributed significantly to the following domains, which have been broadly grouped as:

- Chemical Sciences,
- Physical Sciences,
- Medical Sciences,
- Biological Sciences,
- Multidisciplinary Sciences,
- Agricultural Sciences, and
- Geological Sciences.

There were 62856 (34.52%) publications in 'Chemical Sciences' domain followed by 53844 (29.57%) publications in 'Physical Sciences', 30143 (16.55%) publications in 'Medical Sciences', 18239 (10.02%), publications in 'Biological Sciences', 8616 (4.73%) publications in 'Multidisciplinary Sciences', 5461 (3.00%) publications in

'Agricultural Sciences' and 2952 (1.62%) publications in 'Geological Sciences'. Figure–3 gives the domain-wise distribution of Indian publications. Table-1 gives the distribution of publications in various Micro-domains. There were a total of 165 micro-domains in which the Indian scientific research has been carried out. The Micro-domain 'Chemistry-Multidisciplinary' had 10800 publications followed by Organic Chemistry with 10362 publications, Materials Science-Multidisciplinary with 8107 publications, Multidisciplinary Sciences with 7771 publications, Physics-multidisciplinary with 7112 publications, Condensed Matter Physics with 6938 publications, Physical Chemistry with 5931 publications, and Biochemistry and Molecular Biology with 5307 publications. Figure-4 gives the visualization of the micro-domains.

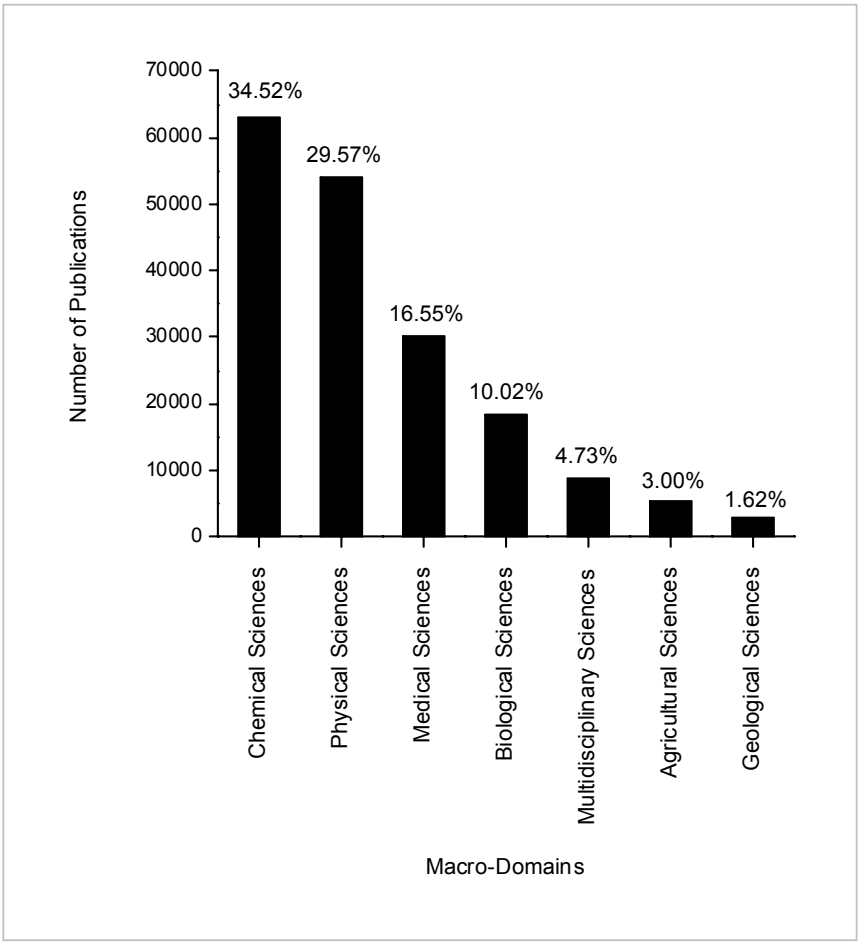

Figure 3: Distribution of India's contributions to Macro-domains

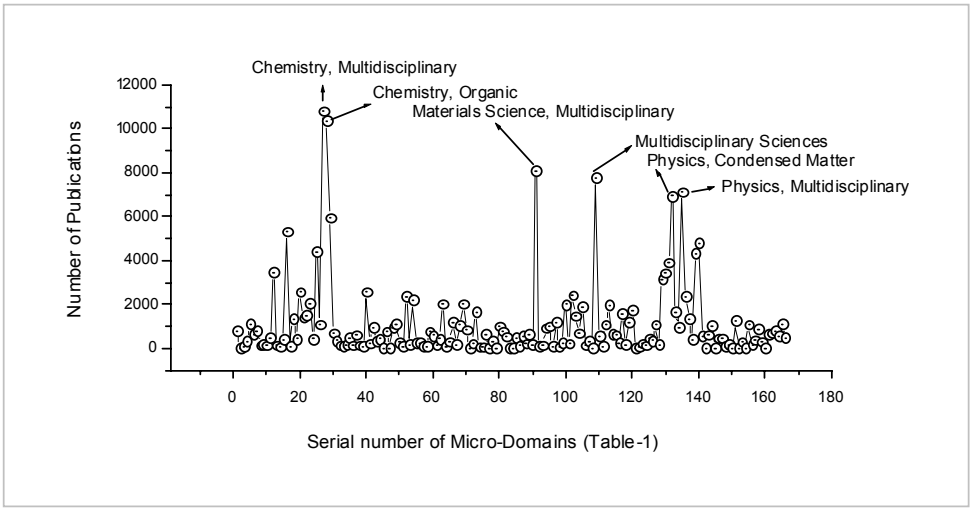

Figure 4: India's scientific publications and their distribution in various Micro-domains

Table 1: Indian scientific research concentrated in various micro-domains

Serial Number	Micro-domains	Publications		Total Publications	Percentage	
		Domestic	International Collaborative		Domestic	International
1.	Acoustics	761	47	808	94.180	5.820
2.	Agricultural Economics & Policy	5	11	16	31.250	68.750
3.	Agricultural Engineering	72	28	100	72.000	28.000
4.	Agriculture, Dairy & Animal Science	279	33	312	89.420	10.580
5.	Agriculture, Multidisciplinary	990	124	1114	88.870	11.130
6.	Agriculture, Soil Science	496	153	649	76.430	23.570
7.	Agronomy	566	228	794	71.280	28.720
8.	Allergy	106	13	119	89.080	10.920
9.	Anatomy & Morphology	153	30	183	83.610	16.390
10.	Andrology	109	16	125	87.200	12.800
11.	Anesthesiology	462	31	493	93.710	6.290
12.	Astronomy & Astrophysics	2193	1266	3459	63.400	36.600
13.	Automation & Control Systems	81	47	128	63.280	36.720
14.	Behavioral Science	45	14	59	76.270	23.730
15.	Biochemical Research Methods	304	74	378	80.420	19.580
16.	Biochemistry & Molecular Biology	4537	770	5307	85.490	14.510
17.	Biodiversity Conservation	67	12	79	84.810	15.190
18.	Biology	1178	166	1344	87.650	12.350
19.	Biophysics	347	83	430	80.700	19.300
20.	Biotechnology & Applied Microbiology	2234	314	2548	87.680	12.320
21.	Cardiac & Cardiovascular Systems	1209	171	1380	87.610	12.390
22.	Cell Biology	1262	228	1490	84.700	15.300
23.	Chemistry, Analytical	1906	160	2066	92.260	7.740
24.	Chemistry, Applied	377	50	427	88.290	11.710
25.	Chemistry, Inorganic & Nuclear	3629	793	4422	82.070	17.930
26.	Chemistry, Medicinal	948	125	1073	88.350	11.650
27.	Chemistry, Multidisciplinary	9559	1241	10800	88.510	11.490

Serial Number	Micro-domains	Publications		Total Publications	Percentage	
		Domestic	International Collaborative		Domestic	International
28.	Chemistry, Organic	9507	855	10362	91.750	8.250
29.	Chemistry, Physical	4983	948	5931	84.020	15.980
30.	Clinical, Neurology	593	74	667	88.910	11.090
31.	Computer Science, Artificial Intelligence	258	92	350	73.710	26.290
32.	Computer Science, Cybernetics	89	27	116	76.720	23.280
33.	Computer Science, Hardware & Architecture	64	41	105	60.950	39.050
34.	Computer Science, Information System	127	46	173	73.410	26.590
35.	Computer Science, Interdisciplinary	404	88	492	82.110	17.890
36.	Computer Science, Software Engineering	69	46	115	60.000	40.000
37.	Computer Science, Theory & Method	440	150	590	74.580	25.420
38.	Construction & Building Technology	132	7	139	94.960	5.040
39.	Critical Care Medicine	55	13	68	80.880	19.120
40.	Crystallography	1803	763	2566	70.270	29.730
41.	Dentistry, Oral Surgery & Medicine	175	25	200	87.500	12.500
42.	Dermatology	846	79	925	91.460	8.540
43.	Developmental biology	276	52	328	84.150	15.850
44.	Ecology	323	102	425	76.000	24.000
45.	Education, Scientific Disciplines	14	1	15	93.330	6.670
46.	Electrochemistry	635	128	763	83.220	16.780
47.	Emergency Medicine	4	0	4	100.000	0.000
48.	Endocrinology & Metabolism	725	226	951	76.240	23.760
49.	Energy & Fuels	957	128	1085	88.200	11.800
50.	Engineering, Aerospace	247	21	268	92.160	7.840
51.	Engineering, Biomedical	61	12	73	83.560	16.440
52.	Engineering, Chemical	2060	284	2344	87.880	12.120
53.	Engineering, Civil	130	29	159	81.760	18.240
54.	Engineering, Electrical & Electronics	1832	384	2216	82.670	17.330
55.	Engineering, Environmental	196	50	246	79.670	20.330
56.	Engineering, Geological	182	45	227	80.180	19.820
57.	Engineering, Industrial	81	6	87	93.100	6.900
58.	Engineering, Manufacturing	80	27	107	74.770	25.230
59.	Engineering, Mechanical	664	92	756	87.830	12.170
60.	Engineering, Multidisciplinary	497	80	577	86.140	13.860
61.	Engineering, Ocean	95	26	121	78.510	21.490
62.	Engineering, Petroleum	0	1	1	0.000	100.000
63.	Entomology	348	80	428	81.310	18.690
64.	Environmental Sciences	1766	248	2014	87.690	12.310
65.	Evolutionary Biology	32	39	71	45.070	54.930
66.	Fisheries	230	47	277	83.030	16.970
67.	Food Science & Technology	1102	90	1192	92.450	7.550
68.	Forestry	135	42	177	76.270	23.730
69.	Gastroenterology & Hepatology	935	117	1052	88.880	11.120
70.	Genetics & Heredity	1499	519	2018	74.280	25.720
71.	Geochemistry & Geophysics	595	249	844	70.500	29.500
72.	Geography, Physical	12	5	17	70.590	29.410
73.	Geology	126	72	198	63.640	36.360
74.	Geosciences, Multidisciplinary	1263	403	1666	75.810	24.190
75.	Geriatrics & Gerontology	49	10	59	83.050	16.950
76.	Health Care Sciences & Services	27	30	57	47.370	52.630
77.	Hematology	491	136	627	78.310	21.690
78.	History & Philosophy of Science	8	0	8	100.000	0.000
79.	Horticulture	264	31	295	89.490	10.510
80.	Imaging Science & Photographic Technology	12	1	13	92.310	7.690
81.	Immunology	791	192	983	80.470	19.530
82.	Infectious Disease	520	247	767	67.800	32.200

Serial Number	Micro-domains	Publications		Total Publications	Percentage	
		Domestic	International Collaborative		Domestic	International
83.	Instruments & Instrumentation	461	54	515	89.510	10.490
84.	Integrative & Complementary Medicine	12	2	14	85.710	14.290
85.	Limnology	5	3	8	62.500	37.500
86.	Marine & Freshwater Biology	395	97	492	80.280	19.720
87.	Materials Science, Biomaterials	96	14	110	87.270	12.730
88.	Materials Science, Ceramics	456	76	532	85.710	14.290
89.	Materials Science, Characterization	185	18	203	91.130	8.870
90.	Materials Science, Coatings & Films	521	119	640	81.410	18.590
91.	Materials Science, Composites	104	40	144	72.220	27.780
92.	Materials Science, Multidisciplinary	6750	1357	8107	83.260	16.740
93.	Materials Science, Paper & Wood	56	8	64	87.500	12.500
94.	Materials Science, Textiles	121	3	124	97.580	2.420
95.	Mathematics	612	307	919	66.590	33.410
96.	Mathematics, Applied	722	269	991	72.860	27.140
97.	Mathematics, Interdisciplinary App.	57	10	67	85.070	14.930
98.	Mechanics	998	179	1177	84.790	15.210
99.	Medical Ethics	0	1	1	0.000	100.000
100.	Medical Informatics	51	11	62	82.260	17.740
101.	Medical Laboratory Technology	219	34	253	86.560	13.440
102.	Medicine, General & Internal	1740	252	1992	87.350	12.650
103.	Medicine, Legal	198	14	212	93.400	6.600
104.	Medicine, Research & Experimental	2238	169	2407	92.980	7.020
105.	Metallurgy & Metallurgical Engineering	1190	275	1465	81.230	18.770
106.	Meteorology & Atmospheric Science	539	126	665	81.050	18.950
107.	Microbiology	1494	381	1875	79.680	20.320
108.	Microscopy	113	10	123	91.870	8.130
109.	Mineralogy	193	103	296	65.200	34.800
110.	Mining & Mineral Processing	2	2	4	50.000	50.000
111.	Multidisciplinary Sciences	7185	586	7771	92.460	7.540
112.	Mycology	418	117	535	78.130	21.870
113.	Neuroimaging	72	8	80	90.000	10.000
114.	Neurosciences	865	213	1078	80.240	19.760
115.	Nuclear Science & Technology	1588	365	1953	81.310	18.690
116.	Nutrition & Dietetics	547	115	662	82.630	17.370
117.	Obstetrics & Gynecology	544	62	606	89.770	10.230
118.	Oceanography	174	49	223	78.030	21.970
119.	Oncology	1277	303	1580	80.820	19.180
120.	Operations Research & Management	95	55	150	63.330	36.670
121.	Ophthalmology	878	318	1196	73.410	26.590
122.	Optics	1402	315	1717	81.650	18.350
123.	Ornithology	11	6	17	64.710	35.290
124.	Orthopedics	41	3	44	93.180	6.820
125.	Otorhinolaryngology	184	17	201	91.540	8.460
126.	Paleontology	75	47	122	61.480	38.520
127.	Parasitology	336	109	445	75.510	24.490
128.	Pathology	289	54	343	84.260	15.740
129.	Pediatrics	964	113	1077	89.510	10.490
130.	Peripheral Vascular Disease	120	29	149	80.540	19.460
131.	Pharmacology & Pharmacy	2828	323	3151	89.750	10.250
132.	Physics, Applied	2635	797	3432	76.780	23.220
133.	Physics, Atomic, Molecular, & Chemical	2975	925	3900	76.280	23.720
134.	Physics, Condensed Matter	5391	1547	6938	77.700	22.300
135.	Physics, Fluids & Plasmas	1198	463	1661	72.130	27.870
136.	Physics, Mathematical	695	229	924	75.220	24.780
137.	Physics, Multidisciplinary	5065	2047	7112	71.220	28.780

Serial Number	Micro-domains	Publications		Total Publications	Percentage	
		Domestic	International Collaborative		Domestic	International
138.	Physics, Nuclear	1796	574	2370	75.780	24.220
139.	Physics, Particles fields	686	636	1322	51.890	48.110
140.	Physiology	323	54	377	85.680	14.320
141.	Plant Sciences	3539	791	4330	81.730	18.270
142.	Polymer Science	4396	400	4796	91.660	8.340
143.	Psychiatry	415	130	545	76.150	23.850
144.	Psychology	14	3	17	82.350	17.650
145.	Public, Environmental & Occupational	486	123	609	79.800	20.200
146.	Radiology, Nuclear Medicine & Medical	893	132	1025	87.120	12.880
147.	Rehabilitation	7	1	8	87.500	12.500
148.	Remote Sensing	396	54	450	88.000	12.000
149.	Reproductive Biology	387	68	455	85.050	14.950
150.	Respiratory System	87	14	101	86.140	13.860
151.	Rheumatology	124	22	146	84.930	15.070
152.	Robotics	17	6	23	73.910	26.090
153.	Spectroscopy	1057	197	1254	84.290	15.710
154.	Sport Sciences	6	0	6	100.000	0.000
155.	Statistics & Probability	126	144	270	46.670	53.330
156.	Substance Abuse	18	5	23	78.260	21.740
157.	Surgery	1013	65	1078	93.970	6.030
158.	Telecommunications	127	47	174	72.990	27.010
159.	Thermodynamics	301	58	359	83.840	16.160
160.	Toxicology	779	84	863	90.270	9.730
161.	Transplantation	264	9	273	96.700	3.300
162.	Transportation Science & Technology	18	8	26	69.230	30.770
163.	Tropical Medicine	501	122	623	80.420	19.580
164.	Urology & Nephrology	612	63	675	90.670	9.330
165.	Veterinary Sciences	729	83	812	89.780	10.220
166.	Virology	432	144	576	75.000	25.000
167.	Water Resources	928	175	1103	84.130	15.870
168.	Zoology	384	91	475	80.840	19.160
1 – 168. Total		150925	31186	182111	82.880	17.120

4.4 Publication productivity of India and Peoples-Republic of China

Peoples–Republic of China an immediate neighbor of India and one of the fastest growing economies in the world has also given importance to Research & Development work in science and technology[11-13]. Peoples–Republic of China had published 253170 publications in science and technology during 1990-2004. There were only 6407 publications when compared to India's 10113 publications in 1990. However, China's publication productivity has grown tremendously and surpassed India's contribution in the year 1997 with 1038 (9.1%) more publications, 2811 (23.75%) more publications in 1998, 5002 (40.56%) more publications in 1999, 10342 (83.67%) more publications, in 2000, 12866 (98.03%) more publications in 2001, 14833 (103.34%) more publications in 2002, 20765 (134.72%) more publications in 2003, and 22212 (150.36%) more publications in 2004. In all 71059 (39.02%) more publications were published by China in comparison with India's scientific contributions during the period under study. Figure-5 gives year wise publication productivity between India and Peoples–Republic of China.

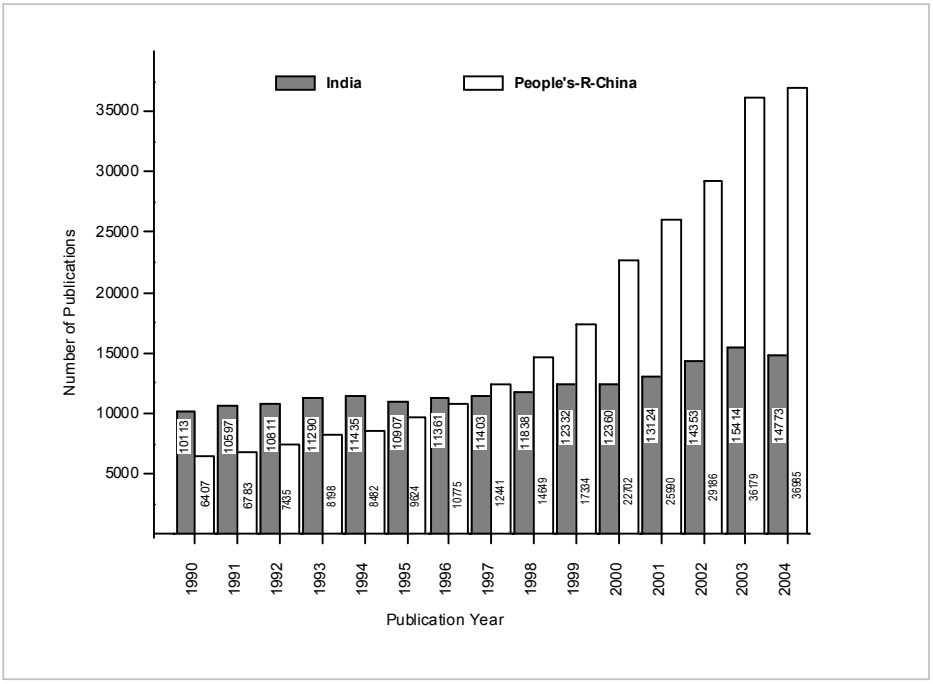

Figure 5: Publication productivity of India and Peoples-R-China

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4.5 Authorship and collaboration pattern

Year-wise authorship and collaboration pattern in the publications is given in Table-2 and Figure-1 respectively. The authorship trend is towards mega-authored papers. Two authored papers account for 30.62 percent followed by three authored papers with 25.90 percent, four authored papers with 15.66 percent, and single authored papers with 10.02 percent. It can be seen from the Table-2 that intensive collaboration was witnessed throughout the period under study. There were 74 papers with 50-99 authors, 39 papers with 100–150 authors, 61 papers with 151-199 authors, and 462 papers with 200-255 authors.

Table 2: Year-wise collaboration and authorships pattern

Papers with Number of authorships	Year															Total Publications	%
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		
1	1121	1242	1137	1272	1238	1181	1196	1164	1218	1278	1269	1264	1241	1288	1115	18224	10.022
2	3663	3795	3854	3870	3961	3679	3627	3581	3652	3603	3576	3566	3762	3898	3690	55777	30.624
3	2848	2867	2897	3072	2953	2863	2910	2988	3022	3198	3091	3336	3578	3886	3670	47179	25.902
4	1394	1529	1578	1592	1705	1619	1705	1721	1861	1941	1978	2182	2416	2675	2628	28524	15.661
5	581	621	691	767	826	749	919	955	922	1036	1094	1211	1467	1602	1624	15065	8.271
6	257	287	341	366	357	372	462	464	494	566	585	669	833	896	883	7832	4.299
7	114	125	130	163	160	172	229	212	250	272	297	354	405	455	448	3786	2.078
8	65	66	66	74	87	102	113	95	143	158	159	182	227	251	253	2041	1.121
9	24	24	37	37	58	55	58	64	77	64	78	104	134	148	125	1087	0.597
10	14	8	18	18	22	22	33	28	39	41	52	66	66	65	61	553	0.304
11	4	5	10	12	16	16	16	22	23	26	29	34	37	54	57	361	0.198
12	4	4	5	5	9	7	9	16	10	16	23	23	26	27	36	220	0.121
13	2	5	5	1	1	3	9	12	10	12	20	15	11	18	19	143	0.079
14	2	2	2	2	4	8	2	5	12	10	8	7	11	9	11	95	0.052
15	2	3	2	2	4	7	4	8	5	9	11	10	18	9	16	110	0.060
16		1	2	1	3	1	4	5	7	5	3	8	8	11	5	64	0.035
17		1	1	2		2	3	1	3	4	4	4	8	5	6	44	0.024
18	1			2	1	1	2	1	3	4	4	5	6	8	4	42	0.023
19			1		1	1	1		4	3	1	2	5	3	3	25	0.014
20		1	2	1	2		1	1	2	4	3		1	4	3	25	0.014
21			1		1	2	2	2	4	1	2	2	1	6	3	27	0.015
22	1	1	1	2		1	3		3	3	1	5		4	4	29	0.016
23			1	2			3			3	4	2	2	1	3	21	0.012
24	1	1	1	1		1			2	2			1	2	4	16	0.009
25									1	1		2	2	2	1	9	0.005
26		1		1	1	1	3	1	1	1	1	2		2	5	20	0.011
27	1					2		1	1	1	1	2		1	2	12	0.007
28	1				1	2	1		1	1	2	1	1	1	2	14	0.008
29	1	1						1			1				1	5	0.003
30			1				1		2	1		2		4	1	12	0.007
31			1				1			3	3	1				9	0.005
32		1			2			1	1	3	1	1	1	1	1	13	0.007
33						1	1		1			1	2	2	1	9	0.005
34					1		1			1	1	1		1		6	0.003
35		1		1			1			1	1			1		6	0.003
36											1	2	1	1		5	0.003
37					1		2		1						1	5	0.003
38			1						1		2	1	1	3		9	0.005
39						1		1			2		2		2	8	0.004
40	1			1	1			1	1	3	1	4			1	14	0.008
41			1				1		1	3		1				7	0.004
42					1	1			1			1		2		6	0.003
43					1		2	1								4	0.002
44							1						1	1		3	0.002

Papers with Number of authorships	Year															Total Publications	%
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		
45							1							1	1	3	0.002
47														1		1	0.001
48							1	1						2		4	0.002
49														1		1	0.001
50	**1**		**1**					**2**	**1**							**5**	0.003
51					**2**		**1**									**3**	0.002
52									**1**	**1**	**1**			**2**	**1**	**6**	0.003
53						**1**		**1**				**1**			**1**	**4**	0.002
54													**1**	**1**	**1**	**3**	0.002
56		**1**														**1**	0.001
58							**1**		**2**							**3**	0.002
59						**1**										**1**	0.001
61							**1**									**1**	0.001
62			**3**	**2**	**1**	**1**									**1**	**8**	0.004
63														**1**		**1**	0.001
64				**1**												**1**	0.001
65				**1**			**1**				**1**					**3**	0.002
67							**1**							**1**		**2**	0.001
68							**1**									**1**	0.001
69												**1**				**1**	0.001
70														**1**		**1**	0.001
71			**1**					**1**								**2**	0.001
72									**1**							**1**	0.001
73	**1**															**1**	0.001
74												**1**			**1**	**2**	0.001
77	**1**									**2**						**3**	0.002
79	**1**											**1**				**2**	0.001
83													**1**			**1**	0.001
86				**1**	**1**											**2**	0.001
87								**1**								**1**	0.001
88									**1**							**1**	0.001
89	**1**															**1**	0.001
90		**1**	**1**						**1**							**3**	0.002
91	**1**							**2**		**1**						**4**	0.002
93					**1**											**1**	0.001
94										**1**						**1**	0.001
95						**1**							**1**			**2**	0.001
97			**1**													**1**	0.001
101				**1**												**1**	0.001
104			**2**	**1**		**2**	**1**	**1**								**7**	0.004
105					**1**											**1**	0.001
106					**1**	**3**										**4**	0.002
111								**1**								**1**	0.001
116									**1**							**1**	0.001
117								**2**								**2**	0.001
118								**1**					**1**			**2**	0.001
120									**1**							**1**	0.001
122										**1**			**1**	**1**		**3**	0.002
125									**1**							**1**	0.001
127														**2**		**2**	0.001
128													**1**	**1**	**1**	**3**	0.002
133															**1**	**1**	0.001
140													**1**			**1**	0.001
141															**1**	**1**	0.001
142															**1**	**1**	0.001
143															**1**	**1**	0.001
144															**1**	**1**	0.001
145															**3**	**3**	0.002
149															**1**	**1**	0.001
152															**2**	**2**	0.001
153														**2**		**2**	0.001
154														**1**		**1**	0.001
155							**1**								**1**	**2**	0.001
158									**1**						**2**	**3**	0.002
160															**1**	**1**	0.001
162								**1**								**1**	0.001

Papers with Number of authorships	Year															Total Publications	%
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		
163									1						2	3	0.002
164															3	3	0.002
165									1							1	0.001
166											1				3	4	0.002
167											1				1	2	0.001
168										1	1			1	1	4	0.002
169												1		1		2	0.001
170										1	1			1		3	0.002
171										1				2		3	0.002
172												1				1	0.001
174														1		1	0.001
176															1	1	0.001
177												1				1	0.001
178														1		1	0.001
181														1	1	2	0.001
182													1	1		2	0.001
183													1			1	0.001
185														1		1	0.001
188													1	2		3	0.002
190													1			1	0.001
192														2		2	0.001
193														1		1	0.001
194													2			2	0.001
195													1			1	0.001
198													2			2	0.001
199													1			1	0.001
200												1	1			2	0.001
201													2			2	0.001
202													2		1	3	0.002
204													1			1	0.001
205													2	2		4	0.002
206												1		1		2	0.001
207												1	1	1		3	0.002
209													1			1	0.001
210													1			1	0.001
211													1	1		2	0.001
212												1				1	0.001
213													1			1	0.001
214													3			3	0.002
215														1		1	0.001
216													1			1	0.001
217													2			2	0.001
220													2	1		3	0.002
224													1			1	0.001
225														2	49	51	0.028
230												1	1			2	0.001
235												1				1	0.001
236													1			1	0.001
252												1				1	0.001
253												1				1	0.001
255	5	3	15	16	10	26	25	37	46	45	45	36	37	25		371	0.204
Total	10113	10597	10811	11290	11435	10907	11361	11403	11838	12332	12360	13124	14353	15414	14773	182111	100.000

4.6 International collaboration

In recent years, every country has realised the importance of scientific research for its growth and started initiating programmes which makes scientists to have more interactions with other scientists, both at national and international levels. Table-3 provides year wise India's international collaboration pattern in Science and Technology. India had collaboration with 167 countries. There were 31186 (17.12%) international collaborative papers. There were papers with 30-country collaboration. The highest number of international collaborative papers were 3219 (1.77%) in 2003.

Bilateral collaboration accounts for 13.67 percent of total international collaborative papers followed by trilateral collaboration with 2.27 percent. India had the highest collaborative papers with United States with 11869 papers followed by Germany with 4640 papers, England with 3202 papers, Japan with 2988 papers, France with 2669 papers, Canada with 1751 papers, Italy with 1741 papers, Peoples Republic of China with 1153 papers, Australia with 1092 papers, Russia with 1012 papers and Switzerland with 1004 papers. Table-4 provides a list of countries with whom India had collaboration and number of papers produced.

Table 3: Year-wise distribution of Indian contribution and International collaboration pattern

Number of Countries	Year															Total Publications	%
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		
2	919	1110	1162	1236	1332	1318	1491	1410	1672	1796	1936	2177	2424	2489	2424	24896	13.671
3	84	130	162	204	179	200	207	257	270	286	368	388	421	478	502	4136	2.272
4	14	26	25	23	36	34	48	47	78	50	65	85	83	95	109	818	0.449
5	10	5	5	11	9	11	17	13	15	13	34	32	30	36	34	275	0.151
6	3	3	1	3	4	5	7	5	5	16	14	14	18	21	22	141	0.077
7	7	2	1		6	6	4	2	4	10	14	6	8	10	7	87	0.048
8		1	2	2	5	15	5	8	5	4	6	2	5	5	4	69	0.038
9	2	2	2	2	2		15	11	8	9	3	6	6	2	3	73	0.040
10	1		3	2	5	3	5	3	17	18	7	9	5	5	9	92	0.051
11			3	3	1	10	4	2	5	7	10	11	10	9	6	81	0.044
12		1	3	1	1	1		1	1	6	1	2	4	13	31	66	0.036
13	4	2	7		1			4	5	6	12	3	28	24	24	120	0.066
14	1		4	7	3	1		2	5	3	5	4	9	9	5	58	0.032
15			4	7	1			4			2	10	1	2	2	33	0.018
16			1	1	3	6	7	23	4		1	23	18	2	1	90	0.049
17					2	7	7	2	24	26	27	2	9	14	15	135	0.074
18					1										3	4	0.002
19									1	1			1			3	0.002
20														4		4	0.002
22														1		1	0.001
23										1						1	0.001
28			1													1	0.001
29								1								1	0.001
30													1			1	0.001
Total	1045	1282	1386	1502	1591	1617	1817	1795	2119	2252	2505	2774	3081	3219	3201	31186	17.125
Percentage	0.57	0.7	0.76	0.82	0.87	0.89	1.00	0.99	1.16	1.24	1.38	1.52	1.69	1.77	1.76	17.125	-

Table 4: International Collaboration of India's scientific publications

Country	No. of Collaborative papers with India	Country	No. of Collaborative papers with India	Country	No. of Collaborative papers with India
USA	11869	HONG-KONG	71	LEBANON	7
GERMANY	4640	ECUADOR	68	ERITREA	6
ENGLAND	3202	KENYA	65	GUATEMALA	6
JAPAN	2988	TURKEY	65	MONACO	6
FRANCE	2669	VIETNAM	65	PANAMA	6
CANADA	1751	INDONESIA	61	PAPUA-N-GUINEA	6
ITALY	1741	UKRAINE	48	ICELAND	5
PEOPLES-R-CHINA	1153	SRI-LANKA	46	LUXEMBOURG	5
AUSTRALIA	1092	UZBEKISTAN	46	QATAR	5
RUSSIA	1012	USSR	45	BHUTAN	4
SWITZERLAND	1004	OMAN	42	CONGO	4
NETHERLANDS	970	SYRIA	38	FIJI	4
SOUTH-KOREA	892	ARMENIA	36	GUADELOUPE	4
SPAIN	832	U-ARAB-EMIRATES	36	AA	3
TAIWAN	756	KAZAKHSTAN	33	BARBADOS	3
SWEDEN	611	VENEZUELA	31	DOMINICAN-REP	3
BRAZIL	596	CROATIA	27	FR-POLYNESIA	3
POLAND	536	NIGER	27	GUINEA-BISSAU	3
HUNGARY	510	CUBA	26	HONDURAS	3
BELGIUM	458	YUGOSLAVIA	26	LATVIA	3
SCOTLAND	410	ZIMBABWE	26	MADAGASCAR	3
MEXICO	386	LIBYA	25	MALTA	3
FINLAND	330	ETHIOPIA	24	SURINAM	3
MALAYSIA	321	MALAWI	23	AZERBAIJAN	2
BULGARIA	320	CZECHOSLOVAKIA	22	BURKINA-FASO	2
ISRAEL	315	MACEDONIA	22	CAMBODIA	2
DENMARK	314	MOROCCO	22	FRENCH-GUIANA	2
SINGAPORE	307	JORDAN	21	GAMBIA	2
AUSTRIA	304	MALI	20	LESOTHO	2
ROMANIA	266	PERU	20	MAURITANIA	2
BANGLADESH	254	TUNISIA	20	SENEGAL	2
WALES	250	BYELARUS	19	SEYCHELLES	2
CYPRUS	236	COSTA-RICA	19	SIERRA-LEONE	2
SOUTH-AFRICA	220	MAURITIUS	18	TAJIKSTAN	2
CZECH-REPUBLIC	206	SUDAN	18	AFGHANISTAN	1
ARGENTINA	193	ZAMBIA	17	BAHAMAS	1
NORTH-IRELAND	184	ALGERIA	16	BENIN	1
PHILIPPINES	184	BAHRAIN	16	BERMUDA	1
COLOMBIA	167	TANZANIA	16	BOLIVIA	1
NORWAY	153	LITHUANIA	15	GABON	1
THAILAND	141	ESTONIA	14	GUINEA	1
IRELAND	139	UGANDA	13	KYRGYZSTAN	1
NEW-ZEALAND	138	BRUNEI	12	LAOS	1
SLOVENIA	124	GHANA	12	MACAO	1
CHILE	120	REP-OF-GEORGIA	12	MALAGASY-REPUBL	1
FED-REP-GER	115	TRINID-&-TOBAGO	11	MOLDOVA	1
EGYPT	109	YEMEN	11	MOZAMBIQUE	1
PORTUGAL	104	BOTSWANA	10	NAMIBIA	1
IRAN	102	COTE-IVOIRE	9	NEW-CALEDONIA	1
GREECE	101	JAMAICA	9	NORTH-KOREA	1
NEPAL	85	MONGOL-PEO-REP	8	RWANDA	1
SAUDI-ARABIA	85	MYANMAR	8	SENEGAMBIA	1
PAKISTAN	78	URUGUAY	8	ST-LUCIA	1
SLOVAKIA	78	CAMEROON	7	TURKMENISTAN	1
KUWAIT	75	GER-DEM-REP	7	YEMEN-PEO-DEM-R	1
NIGERIA	75	IRAQ	7		

4.7 Collaboration with international institutions

India had collaboration with the important international institutions during 1990-2004 were: Istituto Nazionale di Fisica Nucleare-Italy (1909 publications) followed by University of Maryland, USA (533 publications), Rheinisch-Westfalische Technische Hochschule, Aachen, Germany (529 publications), and University of Michigan, USA (502 publications).

4.8 Highly productive Indian R & D institutions

There were 11555 Indian research institutes, Universities and other research organizations involved in research and development activity. Table-5 shows the highly productive 35 Indian institutes publishing more than 1100 publications during 1990-2004. Indian Institute of Science, Bangalore topped the list with 10247 publications followed by Bhabha Atomic Research Centre, Mumbai with 6782 publications, Tata Institute of Fundamental Research, Mumbai with 5132 publications, Banaras Hindu University, Varanasi with 4487 publications. All India Institute of Medical Sciences, New Delhi with 4201 publications, Indian Institute of Technology, Kharagpur with 3957 publications, University of Delhi, New Delhi with 3902 and National Chemical Laboratory, Pune with 3813 publications. Figure-6 provides year-wise growth of publications of top eight Indian institutes.

Table 5: Top 35 highly productive Indian institutes as per *Science Citation Index* (1990-2004)

Rank	R & D Institute	Number of publications															Total Number of Publications	Percentage
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		
1	INDIAN-INST-SCI-Bangalore	491	500	590	612	682	617	726	649	640	690	748	828	835	867	772	10247	5.627
2	BHABHA-ATOM-RES-CTR-Mumbai	397	399	395	410	442	366	418	427	420	456	445	505	589	568	545	6782	3.724
3	TATA-INST-FUNDAMENTAL-RES-Mumbai	264	259	250	307	321	330	370	334	351	356	417	397	440	357	379	5132	2.818
4	BANARAS-HINDU-UNIV-Varanasi	315	354	375	298	320	321	316	289	321	283	281	273	245	266	230	4487	2.464
5	ALL-INDIA-INST-MED-SCI-New Delhi	200	214	198	196	218	204	270	267	321	299	297	356	405	404	352	4201	2.307
6	INDIAN-INST-TECHNOL-Kharagpur	195	211	228	242	236	215	216	228	243	319	301	314	294	336	379	3957	2.173
7	UNIV-DELHI-New Delhi	202	232	236	257	225	254	248	240	251	262	229	291	306	357	312	3902	2.143
8	NATL-CHEM-LAB-Pune	160	185	223	208	231	234	229	268	285	267	257	324	294	310	338	3813	2.094
9	INDIAN-INST-TECHNOL-Chennai	220	214	224	264	258	278	281	263	279	268	266	222	221	238	237	3733	2.050
10	INDIAN-INST-TECHNOL-Kanpur	166	220	206	232	217	220	246	237	260	240	269	249	289	305	326	3682	2.022
11	INDIAN-INST-TECHNOL-New Delhi	221	222	229	224	267	225	245	204	235	218	228	253	270	310	328	3679	2.020
12	INDIAN-INST-TECHNOL-Mumbai	174	198	203	170	217	220	236	272	246	228	275	284	294	303	341	3661	2.010
13	INDIAN-ASSOC-CULTIVAT-SCI-Kolkata	158	143	178	197	206	211	247	235	260	266	206	218	250	272	231	3278	1.800
14	INDIAN-INST-CHEM-TECHNOL-Hyderabad	149	129	141	161	135	121	112	150	200	235	243	241	285	341	342	2985	1.639
15	JADAVPUR-UNIV-Kolkata	184	164	184	205	194	174	182	186	187	182	198	214	204	251	232	2941	1.615
16	PANJAB-UNIV-Chandigarh	160	173	149	141	160	152	163	168	193	189	161	191	239	225	214	2678	1.471
17	POSTGRAD-INST-MED-EDUC-&-RES-Chandigarh	173	172	161	156	137	115	144	155	163	193	166	194	183	225	212	2549	1.400
18	UNIV-KOLKATA-Kolkata	181	192	157	163	165	148	164	159	151	149	142	131	149	148	139	2338	1.284
19	UNIV-HYDERABAD-Hyderaba	106	137	142	154	191	170	166	161	165	146	168	158	164	154	138	2320	1.274
20	UNIV-MADRAS-Chennai	126	89	111	166	142	147	143	142	158	184	143	152	146	184	159	2192	1.204
21	SAHA-INST-NUCL-PHYS-Kolkata	87	82	112	97	90	120	148	146	180	155	143	170	141	194	153	2018	1.108
22	ALIGARH-MUSLIM-UNIV-Aligarh	129	97	93	115	126	114	100	93	90	82	85	104	110	149	124	1611	0.885
23	OSMANIA-UNIV-Hyderabad	135	140	122	124	137	124	114	79	93	96	111	70	92	100	69	1606	0.882
24	CENT-DRUG-RES-INST-Lucknow	155	109	108	92	104	109	99	106	104	115	73	87	102	114	122	1599	0.878
25	ANNA-UNIV-Chennai	58	54	56	65	75	81	112	97	102	129	129	115	152	183	186	1594	0.875
26	JAWAHARLAL-NEHRU-UNIV-New Delhi	75	96	104	121	91	96	95	86	120	94	104	133	119	116	117	1567	0.860
27	INDIRA-GANDHI-CTR-ATOM-RES-Kalpakkam	54	56	71	89	78	70	100	100	115	104	128	118	133	133	108	1457	0.800
28	NATL-PHYS-LAB-New-Delhi	92	106	105	106	122	107	105	99	74	97	80	91	91	77	96	1448	0.795
29	PHYS-RES-LAB-Ahmedabad	46	70	73	93	82	79	87	114	123	116	124	118	105	132	79	1441	0.791
30	INDIAN-STAT-INST-Kolkata	58	55	68	61	80	89	99	102	108	103	118	129	129	113	118	1430	0.785
31	CHRISTIAN-MED-COLL-&-HOSP-Vellore	54	63	59	89	94	63	93	94	97	95	85	99	92	119	109	1305	0.717
32	UNIV-RAJASTHAN-Jaipur	120	97	92	103	92	70	64	60	63	65	63	75	86	124	91	1265	0.695
33	JAWAHARLAL-NEHRU-CTR-ADV-SCI-RES-Bangalore	1	7	30	38	42	38	63	67	93	126	138	159	147	171	141	1261	0.692
34	UNIV ROORKEE	100	88	103	97	114	83	100	109	110	98	100	96	33	3	4	1238	0.680
35	SANJAY-GANDHI-POSTGRAD-INST-MED-Lucknow	9	17	50	70	87	81	82	86	81	72	90	90	122	130	103	1170	0.642

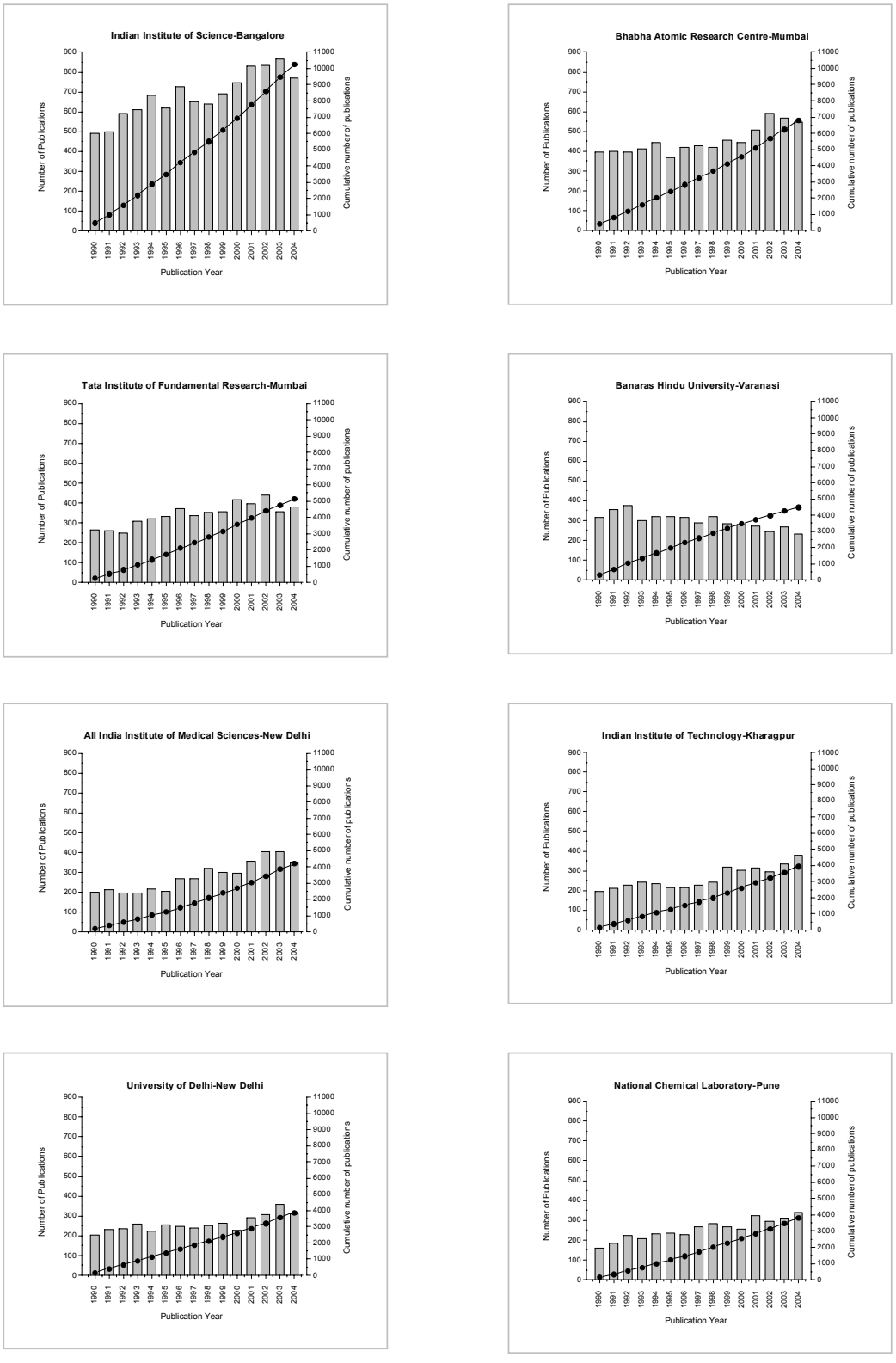

Figure 6: Top ranking Indian R & D Institutes

4.9 Language wise distribution of publications

English has topped the list with 182017 (99.941%) publications, followed by French and Russian with 23 (0.126%) publications each, German with 21 (0.0115%) publications, and Chinese with 11 (0.0060%) publications. Indian scientists have contributed predominantly in English with a few exceptions. The publications in other foreign languages are mainly due to collaboration with respective foreign institutions.

4.10 Preference of channels of communication by Indian Scientists

The Indian scientists have communicated their research results in variety of communication channels. Table–6 depicts the year wise distribution of publications as per publication types. More than 85% of the Indian Science and Technology research was published as journal articles followed by Notes with 4.47 percent, Letters with 3.87 percent and Meeting abstracts with 2.48 percent.

Table 6: Year-wise distribution of publications as per publication types

Publication Type	Year															Total Publications
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Articles	8030	8487	8706	8880	8849	8528	10335	10169	10636	11046	11076	11811	12726	13559	13192	156030
Notes	1317	1260	1300	1460	1519	1289	10									8155
Letters	419	445	390	469	498	476	431	403	444	526	497	487	461	573	535	7054
Meeting-Abstracts	140	162	135	173	260	240	215	462	302	309	280	308	553	624	356	4519
Reviews	109	128	132	158	142	169	175	196	203	230	269	248	342	339	335	3175
Editorial-Materials	76	76	81	83	93	117	127	123	159	122	160	189	185	213	248	2052
Corrections			2	23	17	24	31	20	46	41	29	45	46	59	49	432
Biographical-Items	4	13	11	10	21	12	15	15	27	20	15	18	19	23	33	256
Discussions	17	21	52	32	30	40	7									199
News-Items						8	13	13	18	28	29	15	16	17	23	180
Reprints		5		1	6	4	2	2	1	7	3	3	3	3	2	42
Book-Reviews				1					1	2	2		2	1		9
Software-Reviews	1		2						1	1				1		6
Bibliography														2		2
Total	10113	10597	10811	11290	11435	10907	11361	11403	11838	12332	12360	13124	14353	15414	14773	182111
Percentage	5.55	5.82	5.94	6.20	6.28	5.99	6.24	6.26	6.50	6.77	6.79	7.21	7.88	8.46	8.11	100.00

4.11 Preference of journals for communication by Indian scientists

The Indian publications spread over 3895 journals. The 'Medical Sciences' publications were published in 1188 journals followed by 'Physical Sciences' publications in 966 journals, 'Chemical Sciences' publications in 679 journals, 'Biological Sciences' publications in 659 journals, 'Agricultural Sciences' publications in 194 journals, 'Geological Sciences' publications in 116 journals, and 'Multidisciplinary Sciences' publications in 93 journals. The leading journals preferred by the scientists were *Current Science* with 6848 (3.76%) papers, *Indian Journal of Chemistry-B* with 3566 (1.95%) papers, *Indian Journal of Chemistry-A* with 3272 (1.79%) papers and *Pramana-Journal of Physics* with 1904 (1.04%) papers. Table-7 provides the top 50 journals preferred by the Indian scientists. Figure-7 provides the distribution of publications published in journals as per impact factors range. More than 92 percent of the publications were published in the journals with impact factors ranging from 0.01 to 35.04 indicating the publication behaviour of scientists. About 7.74 percent of the publications were published in the journals

having no impact factors. A significant number of publications (66.52%) have been published in impact factors 0.01 to 1.50. However, 25.74 percent of the publications have appeared in journals with impact factors greater than 2. Figure-8 provides the Bradford-Zipf bibliograph of distribution.

Table 7: Major journals preferred for publishing by the Indian Scientists as per *Science Citation Index* during 1990-2004

Sl.No.	Journal Title	Country	Number of Publications	IF 2003
1.	*CURRENT SCIENCE*	India	6848	0.694
2.	*INDIAN JOURNAL OF CHEMISTRY SECTION B*	India	3566	0.492
3.	*INDIAN JOURNAL OF CHEMISTRY SECTION A*	India	3272	0.489
4.	*PRAMANA-JOURNAL OF PHYSICS*	India	1904	0.333
5.	*TETRAHEDRON LETTERS*	England	1745	2.326
6.	*JOURNAL OF APPLIED POLYMER SCIENCE*	United States	1741	1.017
7.	*PHYSICAL REVIEW B*	United States	1670	2.962
8.	*SYNTHETIC COMMUNICATIONS*	United States	1158	0.853
9.	*PHYSICAL REVIEW D*	United States	1054	4.599
10.	*PHYSICS LETTERS B*	Netherlands	963	4.066
11.	*JOURNAL OF MATERIALS SCIENCE LETTERS*	Netherlands	960	0.47
12.	*JOURNAL OF APPLIED PHYSICS*	United States	946	2.171
13.	*INDIAN JOURNAL OF MEDICAL RESEARCH*	India	913	0.452
14.	*SOLID STATE COMMUNICATIONS*	United States	835	1.602
15.	*JOURNAL OF MATERIALS SCIENCE*	Netherlands	831	0.826
16.	*PHYSICAL REVIEW A*	United States	827	2.589
17.	*TETRAHEDRON*	England	824	2.641
18.	*CHEMICAL PHYSICS LETTERS*	Netherlands	816	2.438
19.	*PHYSICAL REVIEW LETTERS*	United States	799	7.035
20.	*PROC OF THE INDIAN ACADEMY OF SCI-CHE SCI*	India	797	0.649
21.	*ACTA CRYSTALLOGRAPHICA SECTION C*	Denmark	796	0.828
22.	*SYNTHESIS AND REACTIVITY IN INORGANIC AND METAL*	United States	795	0.472
23.	*PHYSICAL REVIEW E*	United States	749	2.202
24.	*PHYSICAL REVIEW C*	United States	741	2.708
25.	*MATERIALS LETTERS*	Netherlands	727	0.774
26.	*NATIONAL MEDICAL JOURNAL OF INDIA*	India	710	0.644
27.	*JOURNAL OF PHYSICS-CONDENSED MATTER*	England	706	1.757
28.	*JOURNAL OF CHEMICAL PHYSICS*	United States	701	2.95
29.	*POLYHEDRON*	England	696	1.584
30.	*JOURNAL OF BIOSCIENCES*	India	690	0.72
31.	*JOURNAL OF CHEMICAL RESEARCH-S*	England	689	0.382
32.	*PHYTOCHEMISTRY*	England	679	1.889
33.	*PHYSICS LETTERS A*	Netherlands	669	1.324
34.	*ABST OF PAP OF THE AME CHEMICAL SOCIETY*	United States	666	-
35.	*TRANSITION METAL CHEMISTRY*	Netherlands	635	0.84
36.	*PHYSICA C-SUPERCONDUCTIVITY AND ITS APPLICATIONS*	Netherlands	611	1.192
37.	*BULLETIN OF ENVI CONTAMINATION AND TOXI*	United States	596	0.599
38.	*MATERIALS CHEMISTRY AND PHYSICS*	Switzerland	587	1.183
39.	*PHYSICA B-CONDENSED MATTER*	Netherlands	584	0.908
40.	*ASTROPHYSICS AND SPACE SCIENCE*	Netherlands	539	0.522
41.	*JOURNAL OF SOUND AND VIBRATION*	United States	527	0.724
42.	*BIOCHEMICAL AND BIOPHYSICAL RES COMM*	United States	521	2.836
43.	*SPECTROCHIMICA ACTA PART A*	England	520	1.315
44.	*ASTROPHYSICAL JOURNAL*	United States	502	6.604
45.	*JOURNAL OF ORGANIC CHEMISTRY*	United States	498	3.297
46.	*CRYSTAL RESEARCH AND TECHNOLOGY*	Germany	486	0.652
47.	*JOURNAL OF ETHNOPHARMACOLOGY*	Ireland	479	1.269
48.	*THIN SOLID FILMS*	Netherlands	474	1.598
49.	*LANCET*	England	464	18.316
50.	*NUCLEAR INST & METH IN PHY RES SEC B*	Netherlands	462	1.041

truncated

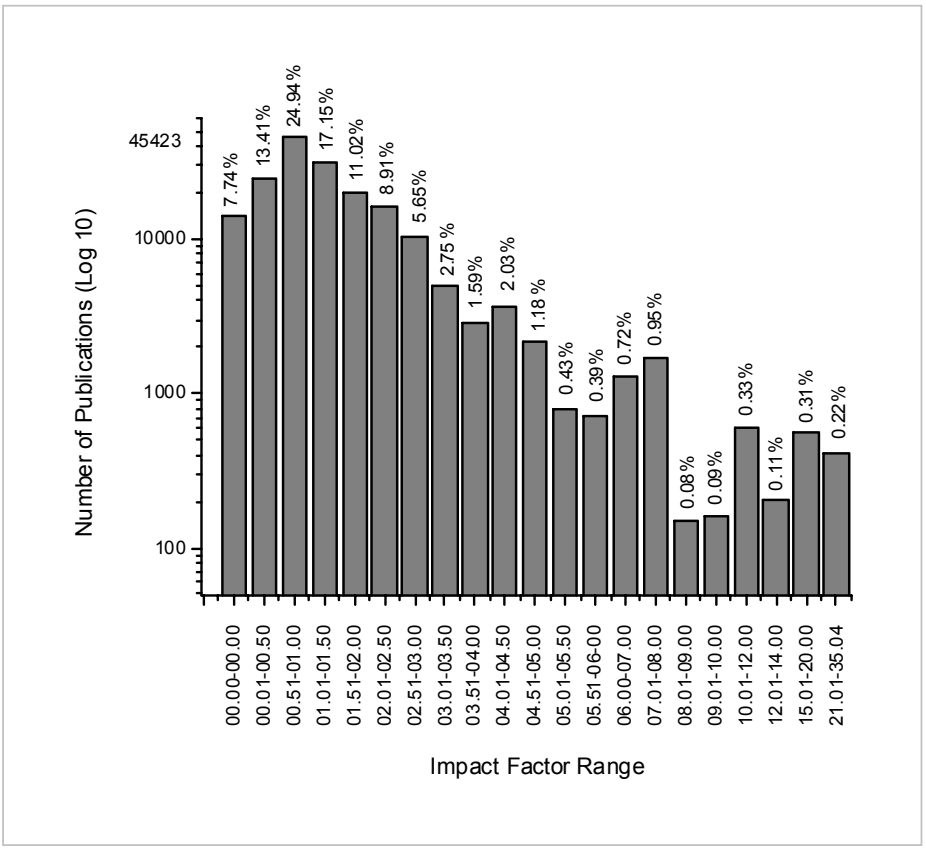

Figure 7: Distribution of Indian publications in journals as per Impact Factors range

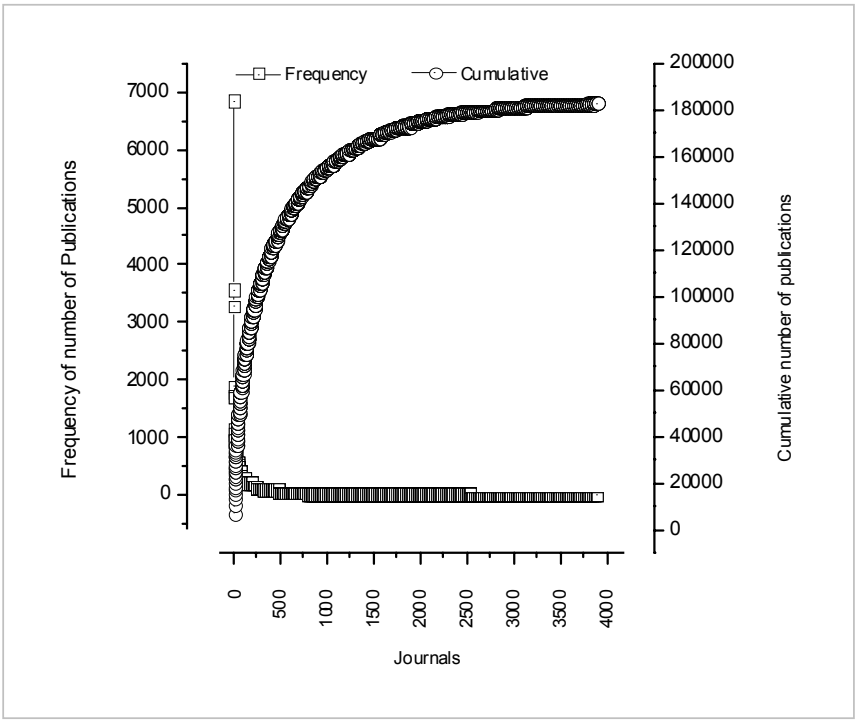

Figure 8: Bradford-Zipf bibliograph of distribution of journals

5 Conclusion

This paper has highlighted quantitatively the contribution made by the Indian scientists during 1990-2004 as reflected in *Science Citation Index*. During 15 years (1990-2004) period Indian scientists have contributed significantly to various macro and micro-domains. Physical sciences, Chemical science and Medical sciences are the major strong areas of Indian science and Micro-domains of strength were: Chemistry-Multidisciplinary, Organic Chemistry, Materials Science-Multidisciplinary, Multidisciplinary Sciences, Physics-Multidisciplinary, Condensed Matter Physics, Physical Chemistry, and Biochemistry and Molecular Biology. Indian publication productivity was almost steady throughout the period. Peoples-Republic of China has dramatically outpaced India's publication productivity after 1997.

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