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Bibliometric Analysis on the Scientific Output of India

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in Zusammenarbeit mit

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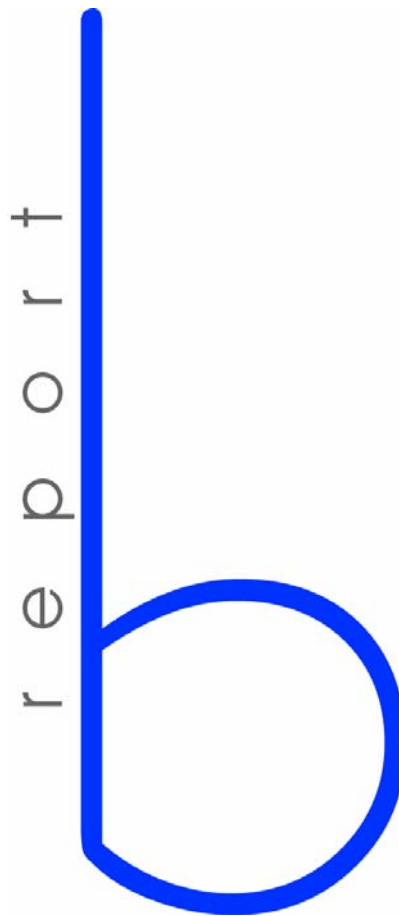


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Bibliometric Analysis On the Scientific Output of India



**Management Summary
and
Data**

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Date database was accessed: August / September 2006



Management Summary

Bibliometric analyses provide information on publication performance (quantitative), the perception and impact of publications in the specialist community (qualitative), integration into the science scene and the international perception of persons or institutions in comparisons with others (ranking).

There are different forms of scientific publications – from books to conference papers to papers in science journals. However, when the citation rate is being calculated, usually only science journals are taken into account. The reason for this is the composition of the underlying data: a database, known to scientists as the Science Citation Index (SCI), evaluates approximately 6,100 science journals on a regular basis. Another 1,200 also come from the social sciences. It sounds like a lot, but it isn't really: worldwide, there are approx. 120,000 science journals covering all disciplines.

Therefore, only around 5 % of all science journals are evaluated and used as the basis for bibliometric analyses. Only a very small amount of the countless number of books and conference papers are taken into account.

It therefore stands to reason that only the citations from these publications (5 % of all scientific publications) are accounted for.

Choosing data for the natural sciences is less problematic as a result of the international orientation of the Science Citation Index as a database. Scientific topics are of global interest; the issues are similar. The language of communication is English and a large proportion of scientific research appears in the form of papers in journals. Books only play a minor role in the natural sciences.

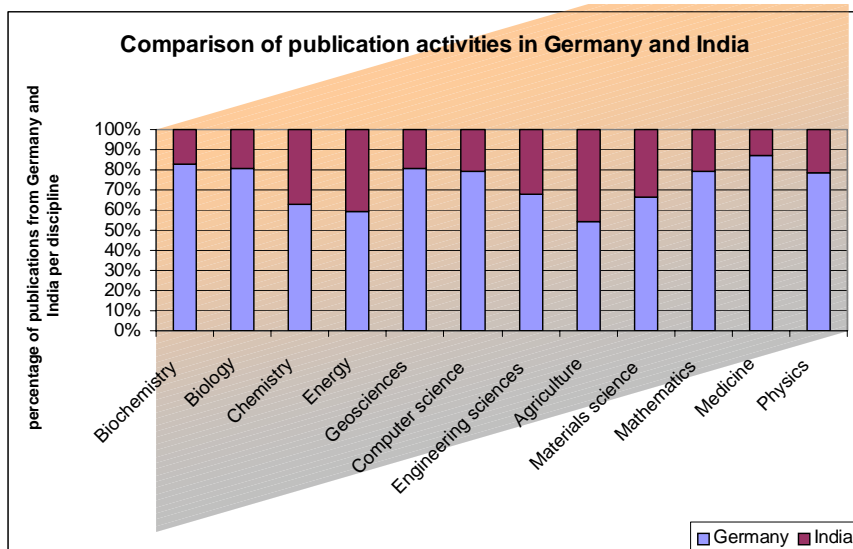
It can also be said that very similar standards exist throughout the world in the natural sciences. This is an important advantage as it means that international comparisons can be made.

This analysis focuses on four issues:

1. **Where is India present?**

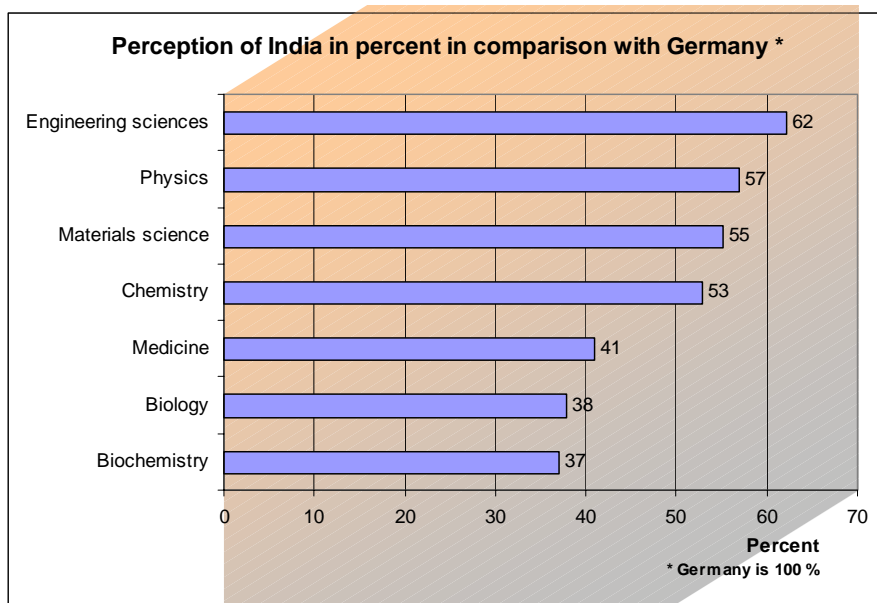
List of publication activities and percentage increase of the production of articles in all scientific subject categories listed in the Science Citation Index for India.

→ Compared to Germany, India has a high publication rate for scientific articles on agriculture. Here, India achieves 84 % of the publications in relation to Germany. India also publishes quite a lot on topics dealing with energy.



For the period 2001 – 2005, an increase in the number of articles published could be observed for all disciplines compared to the preceding five years (1996 – 2000). The most significant increase was obvious in materials science and medicine, although the figures biochemistry also improved.

2. **Excellence in India** in relation to Germany:
Calculation of the citation rates for selected subject categories in relation to Germany.



→ The citation rate (number of citations per article) is an indicator that can be used to compare perception within disciplines independent of size. We compared what disciplines had the highest perception in relation to Germany. India's best result was in the engineering sciences: with a citation rate of 1.7, India obtained 62 % of the perception that German publications in this discipline achieve. This was followed by physics, materials science and chemistry.



3. **Excellent institutions:**

Analysis of selected subject categories in terms of leading institutions. What institutions publish the most?

What institution has above-average citation rates?

→ Analyses were conducted in five disciplines on what institutions publish the most and which of them were best perceived.

It was revealed that there are very few highly active institutions and a high proportion of institutions with a relatively low level of activity. This means that a large proportion of those institutions that publish heavily also belong to those with the highest perception.

With regard to excellent institutions, the following disciplines were examined:

- biochemistry
- chemistry
- engineering sciences
- materials science
- medicine

4. **Co-publication:** What countries publish most often with India in selected subject categories?

In what subject categories does Germany publish most often with India?

→ For the periods 1996 – 2000 and 2001 – 2005, five countries cooperate most often with India in the chosen disciplines: USA, Germany, United Kingdom, France and Japan. Germany is India's second most important cooperation partner in the disciplines investigated. This is also an endorsement of Germany's scientific research and its excellent international reputation.

Data



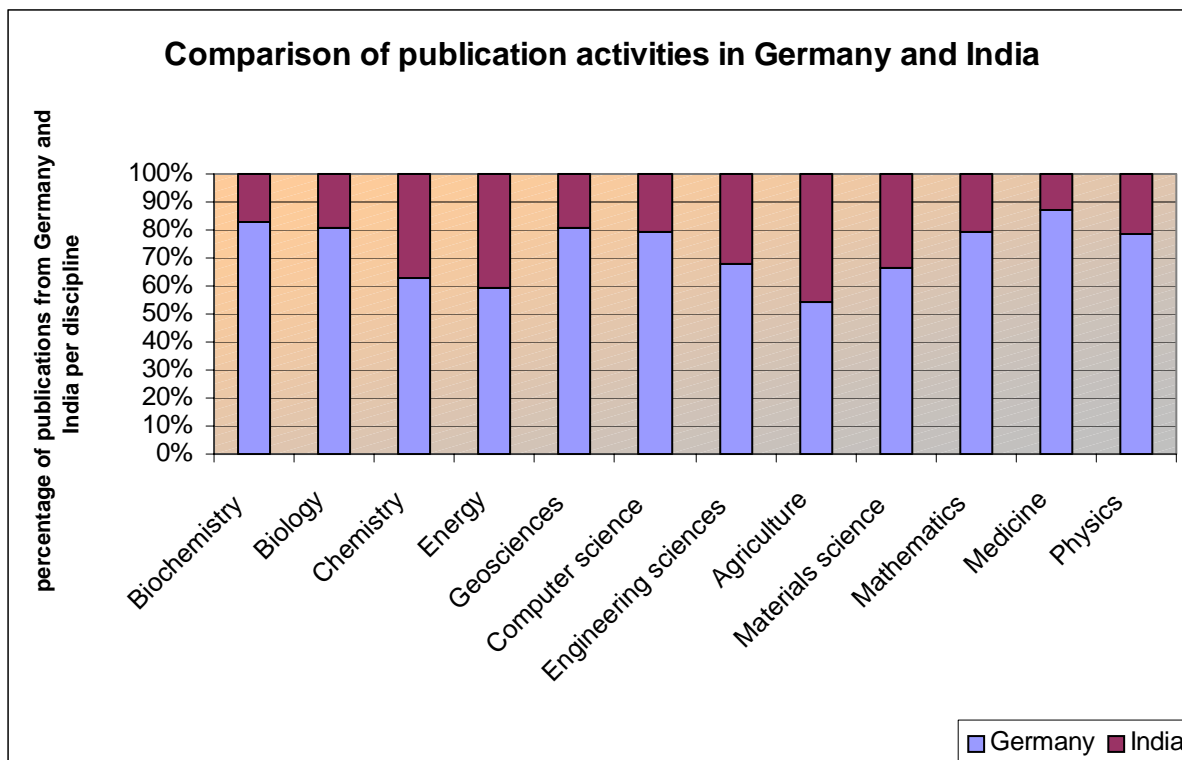
1. Where is India present?

a) Publication activity

The following provides a comparison of publication activity between Germany and India and shows what disciplines India displays more publication activity for and what disciplines it displays less for. The observation period stretches from 2001 to 2005. In order to gain a better overview, the approx. 170 subject categories in the Science Citation Index were condensed into the main scientific disciplines.

Table 1: Publications from Germany and India in the main scientific disciplines

Category	Germany: number of articles 2001-2005	India: number of articles 2001-2005	Proportion of Indian/German publications
Biochemistry	27125	5620	21%
Biology	62284	14586	23%
Chemistry	46817	27336	58%
Energy	1580	1090	69%
Geosciences	30926	7495	24%
Computer science	7601	1967	26%
Engineering sciences	29396	14040	48%
Agriculture	10001	8403	84%
Materials science	18191	9301	51%
Mathematics	12132	3146	26%
Medicine	167083	24287	15%
Physics	70844	19138	27%



Research in Germany is used as a benchmark for India's publication activity. The absolute number of articles in each main discipline was first determined for Germany and India for the period 2001 – 2005 (Table 2) and then for India for 1996 – 2000 and 2001 – 2005 (Table 3). The percentages in Table 2 show how much publication activity India achieved compared to Germany for the period 2001 – 2005.

Due to different communication and publication habits, a direct interdisciplinary comparison of the absolute number of publications is not possible.

Compared to Germany, India has a high publication rate for scientific articles on agriculture. Here, India achieves 84 % of the total number of Germany's publications. Proportionately, India also publishes very heavily on topics dealing with energy but publishes very little in the fields of biochemistry (21 %) and biology (23 %). Surprisingly, very little is also published in the field of computer science. One explanation for this is that computer science tends to publish a lot at conferences. Since the Science Citation Index consists mainly of journal publications, it contains fewer publications for computer science overall.

This breakdown shows us the different priorities that Indian research has, which in turn reveals the topics that have been concentrated on up until now and starting points for the future. In the following, all subject categories in the Science Citation Index have been analysed and are listed individually. This table is one way of highlighting each sub-discipline individually.



Table 2: Publications from India and Germany 2001-2005

ISI subject category	Germany: number of articles 2001 - 2005	India: number of articles 2001- 2005	Proportion of Indian/ German publications
ACOUSTICS	1030	397	39%
AGRICULTURAL ENGINEERING	79	435	551%
AGRICULTURE, DAIRY & ANIMAL SCIENCE	1288	2248	175%
AGRICULTURE, MULTIDISCIPLINARY	934	1176	126%
AGRICULTURE, SOIL SCIENCE	1290	356	28%
AGRONOMY	1472	1658	113%
ALLERGY	1324	85	6%
ANATOMY & MORPHOLOGY	935	77	8%
ANDROLOGY	194	76	39%
ANESTHESIOLOGY	3569	477	13%
ASTRONOMY & ASTROPHYSICS	7430	1277	17%
AUTOMATION & CONTROL SYSTEMS	712	281	39%
BEHAVIORAL SCIENCES	1544	126	8%
BIOCHEMICAL RESEARCH METHODS	4375	741	17%
BIOCHEMISTRY & MOLECULAR BIOLOGY	23792	5172	22%
BIODIVERSITY CONSERVATION	484	81	17%
BIOLOGY	2982	778	26%
BIOPHYSICS	5909	1479	25%
BIOTECHNOLOGY & APPLIED MICROBIOLOGY	5724	2642	46%
CARDIAC & CARDIOVASCULAR SYSTEMS	13222	832	6%
CELL BIOLOGY	12346	1459	12%
CHEMISTRY, ANALYTICAL	4781	1904	40%
CHEMISTRY, APPLIED	2268	1795	79%



ISI subject category	Germany: number of articles 2001 - 2005	India: number of articles 2001- 2005	Proportion of Indian/ German publications
CHEMISTRY, INORGANIC & NUCLEAR	7922	2504	32%
CHEMISTRY, MEDICINAL	2587	1930	75%
CHEMISTRY, MULTIDISCIPLINARY	10398	7142	69%
CHEMISTRY, ORGANIC	7066	6341	90%
CHEMISTRY, PHYSICAL	12279	4953	40%
CLINICAL NEUROLOGY	12859	1265	10%
COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE	1390	446	32%
COMPUTER SCIENCE, CYBERNETICS	244	62	25%
COMPUTER SCIENCE, HARDWARE & ARCHITECTURE	626	303	48%
COMPUTER SCIENCE, INFORMATION SYSTEMS	1466	325	22%
COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS	2289	747	33%
COMPUTER SCIENCE, SOFTWARE ENGINEERING	1572	382	24%
COMPUTER SCIENCE, THEORY & METHODS	1711	343	20%
CONSTRUCTION & BUILDING TECHNOLOGY	369	251	68%
CRITICAL CARE MEDICINE	2841	190	7%
CRYSTALLOGRAPHY	3448	2129	62%
DENTISTRY, ORAL SURGERY & MEDICINE	2283	224	10%
DERMATOLOGY	4677	778	17%
DEVELOPMENTAL BIOLOGY	2029	272	13%
ECOLOGY	3012	400	13%
EDUCATION, SCIENTIFIC DISCIPLINES	133	88	66%
ELECTROCHEMISTRY	1365	820	60%
EMERGENCY MEDICINE	885	65	7%
ENDOCRINOLOGY & METABOLISM	6046	639	11%



ISI subject category	Germany: number of articles 2001 - 2005	India: number of articles 2001- 2005	Proportion of Indian/ German publications
ENERGY & FUELS	1580	1090	69%
ENGINEERING, AEROSPACE	496	228	46%
ENGINEERING, BIOMEDICAL	2026	202	10%
ENGINEERING, CHEMICAL	5754	3080	54%
ENGINEERING, CIVIL	914	842	92%
ENGINEERING, ELECTRICAL & ELECTRONIC	6840	2924	43%
ENGINEERING, ENVIRONMENTAL	1658	515	31%
ENGINEERING, GEOLOGICAL	155	247	159%
ENGINEERING, INDUSTRIAL	533	864	162%
ENGINEERING, MANUFACTURING	742	617	83%
ENGINEERING, MARINE	16	12	75%
ENGINEERING, MECHANICAL	2182	1503	69%
ENGINEERING, MULTIDISCIPLINARY	1056	856	81%
ENGINEERING, OCEAN	113	122	108%
ENGINEERING, PETROLEUM	187	84	45%
ENTOMOLOGY	1092	364	33%
ENVIRONMENTAL SCIENCES	5797	2747	47%
EVOLUTIONARY BIOLOGY	1335	97	7%
FISHERIES	357	272	76%
FOOD SCIENCE & TECHNOLOGY	3230	1996	62%
FORESTRY	840	220	26%
GASTROENTEROLOGY & HEPATOLOGY	6158	523	8%
GENETICS & HEREDITY	7813	1058	14%
GEOCHEMISTRY & GEOPHYSICS	4104	604	15%



ISI subject category	Germany: number of articles 2001 - 2005	India: number of articles 2001- 2005	Proportion of Indian/ German publications
GEOGRAPHY, PHYSICAL	985	133	14%
GEOLOGY	716	121	17%
GEOSCIENCES, MULTIDISCIPLINARY	4072	2180	54%
GERIATRICS & GERONTOLOGY	1257	111	9%
HEALTH CARE SCIENCES & SERVICES	930	88	9%
HEMATOLOGY	12083	584	5%
HISTORY & PHILOSOPHY OF SCIENCE	1269	33	3%
HORTICULTURE	516	455	88%
IMAGING SCIENCE & PHOTOGRAPHIC TECHNOLOGY	233	142	61%
IMMUNOLOGY	8895	1539	17%
INFECTIOUS DISEASES	2541	826	33%
INSTRUMENTS & INSTRUMENTATION	4510	880	20%
INTEGRATIVE & COMPLEMENTARY MEDICINE	367	302	82%
LIMNOLOGY	468	34	7%
MARINE & FRESHWATER BIOLOGY	2334	360	15%
MATERIALS SCIENCE, BIOMATERIALS	605	124	20%
MATERIALS SCIENCE, CERAMICS	1536	537	35%
MATERIALS SCIENCE, CHARACTERIZATION & TESTING	468	361	77%
MATERIALS SCIENCE, COATINGS & FILMS	1624	494	30%
MATERIALS SCIENCE, COMPOSITES	358	447	125%
MATERIALS SCIENCE, MULTIDISCIPLINARY	13396	7036	53%
MATERIALS SCIENCE, PAPER & WOOD	570	41	7%
MATERIALS SCIENCE,	245	443	181%



ISI subject category	Germany: number of articles 2001 - 2005	India: number of articles 2001- 2005	Proportion of Indian/ German publications
TEXTILES			
MATHEMATICS	5413	1294	24%
MATHEMATICS, APPLIED	5681	1442	25%
MATHEMATICS, INTERDISCIPLINARY APPLICATIONS	996	247	25%
MECHANICS	3128	1392	45%
MEDICAL ETHICS	52	6	12%
MEDICAL INFORMATICS	709	36	5%
MEDICAL LABORATORY TECHNOLOGY	1591	476	30%
MEDICINE, GENERAL & INTERNAL	5846	1539	26%
MEDICINE, LEGAL	566	195	34%
MEDICINE, RESEARCH & EXPERIMENTAL	4118	901	22%
METALLURGY & METALLURGICAL ENGINEERING	3512	1849	53%
METEOROLOGY & ATMOSPHERIC SCIENCES	3276	658	20%
MICROBIOLOGY	6769	1315	19%
MICROSCOPY	611	19	3%
MINERALOGY	1231	193	16%
MINING & MINERAL PROCESSING	756	335	44%
MULTIDISCIPLINARY SCIENCES	3534	4652	132%
MYCOLOGY	710	224	32%
NEUROIMAGING	1562	89	6%
NEUROSCIENCES	16227	1707	11%
NUCLEAR SCIENCE & TECHNOLOGY	5436	1253	23%
NURSING	62	10	16%
NUTRITION & DIETETICS	1629	590	36%
OBSTETRICS & GYNECOLOGY	3066	596	19%



ISI subject category	Germany: number of articles 2001 - 2005	India: number of articles 2001- 2005	Proportion of Indian/ German publications
OCEANOGRAPHY	1454	425	29%
ONCOLOGY	12988	1157	9%
OPERATIONS RESEARCH & MANAGEMENT SCIENCE	925	421	46%
OPHTHALMOLOGY	4836	991	20%
OPTICS	5492	1516	28%
ORNITHOLOGY	269	19	7%
ORTHOPEDICS	2723	202	7%
OTORHINOLARYNGOLOGY	2353	195	8%
PALEONTOLOGY	1252	108	9%
PARASITOLOGY	735	316	43%
PATHOLOGY	3835	686	18%
PEDIATRICS	3696	1283	35%
PERIPHERAL VASCULAR DISEASE	8384	336	4%
PHARMACOLOGY & PHARMACY	14078	3281	23%
PHYSICS, APPLIED	12076	3055	25%
PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	8887	2122	24%
PHYSICS, CONDENSED MATTER	14860	4046	27%
PHYSICS, FLUIDS & PLASMAS	3573	859	24%
PHYSICS, MATHEMATICAL	4434	1279	29%
PHYSICS, MULTIDISCIPLINARY	10556	4090	39%
PHYSICS, NUCLEAR	5747	1367	24%
PHYSICS, PARTICLES & FIELDS	6654	1427	21%
PHYSIOLOGY	4169	223	5%
PLANT SCIENCES	6546	2851	44%
POLYMER SCIENCE	5185	2893	56%
PSYCHIATRY	15406	968	6%
PSYCHOLOGY	2157	82	4%



ISI subject category	Germany: number of articles 2001 - 2005	India: number of articles 2001- 2005	Proportion of Indian/ German publications
PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	5038	2090	41%
RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING	10964	811	7%
REHABILITATION	878	62	7%
REMOTE SENSING	361	177	49%
REPRODUCTIVE BIOLOGY	1397	359	26%
RESPIRATORY SYSTEM	2841	599	21%
RHEUMATOLOGY	3122	134	4%
ROBOTICS	167	31	19%
SPECTROSCOPY	3739	864	23%
SPORT SCIENCES	1420	55	4%
STATISTICS & PROBABILITY	1825	579	32%
SUBSTANCE ABUSE	860	86	10%
SURGERY	12213	1855	15%
TELECOMMUNICATIONS	1026	762	74%
THERMODYNAMICS	1311	685	52%
TOXICOLOGY	2535	1182	47%
TRANSPLANTATION	3279	182	6%
TRANSPORTATION SCIENCE & TECHNOLOGY	111	69	62%
TROPICAL MEDICINE	270	706	261%
UROLOGY & NEPHROLOGY	5119	594	12%
VETERINARY SCIENCES	4082	2218	54%
VIROLOGY	2866	360	13%
WATER RESOURCES	1817	979	54%
ZOOLOGY	2468	397	16%



Table 3: Rate of increase in India's scientific publication activity (main categories)

Category	India: number of articles 1996 - 2000	India: number of articles 2001-2005	Variation
Biochemistry	4030	5620	39%
Biology	11106	14586	31%
Chemistry	19397	27336	41%
Energy	1044	1090	4%
Geosciences	5542	7495	35%
Computer science	1732	1967	14%
Engineering sciences	11167	14040	26%
Agriculture	7706	8403	9%
Materials science	6229	9301	49%
Mathematics	2764	3146	14%
Medicine	16426	24287	48%
Physics	15293	19138	25%

Table 3 shows the different rates of increase for publication activity in the main disciplines. For the period 2001 – 2005, an increase in the number of articles published could be observed for all main disciplines compared to the preceding five years (1996 – 2000). Materials science and medicine come out on top here, but biochemistry also shows improvement. The development of article production in the field of energy can almost be described as stagnant. Compared to Germany, India is already at a very high level at 69 % of article production in Germany. Another area with a single-digit increase is agriculture – but again the same is true here as for energy research: India already has a very high level.

Table 4 lists the rates of increase for the individual subject categories. This breakdown reveals that the sub-disciplines have not just experienced increases in the number of publications but also decreases.



Table 4: Variations in India's scientific publication activity in the individual subject categories

Subject Category ISI	India: number of articles: 1996 - 2000	India: number of articles: 2001 - 2005	Variation
ACOUSTICS	326	397	22%
AGRICULTURAL ENGINEERING	272	435	60%
AGRICULTURE, DAIRY & ANIMAL SCIENCE	2242	2248	0%
AGRICULTURE, MULTIDISCIPLINARY	1365	1176	-14%
AGRICULTURE, SOIL SCIENCE	377	356	-6%
AGRONOMY	2008	1658	-17%
ALLERGY	85	85	0%
ANATOMY & MORPHOLOGY	60	77	28%
ANDROLOGY	52	76	46%
ANESTHESIOLOGY	234	477	104%
ASTRONOMY & ASTROPHYSICS	1081	1277	18%
AUTOMATION & CONTROL SYSTEMS	207	281	36%
BEHAVIORAL SCIENCES	48	126	163%
BIOCHEMICAL RESEARCH METHODS	426	741	74%
BIOCHEMISTRY & MOLECULAR BIOLOGY	3801	5172	36%
BIODIVERSITY CONSERVATION	41	81	98%
BIOLOGY	804	778	-3%
BIOPHYSICS	1187	1479	25%
BIOTECHNOLOGY & APPLIED MICROBIOLOGY	1986	2642	33%
CARDIAC & CARDIOVASCULAR SYSTEMS	643	832	29%
CELL BIOLOGY	1224	1459	19%
CHEMISTRY, ANALYTICAL	1425	1904	34%
CHEMISTRY, APPLIED	1163	1795	54%
CHEMISTRY, INORGANIC & NUCLEAR	1908	2504	31%
CHEMISTRY, MEDICINAL	936	1930	106%
CHEMISTRY, MULTIDISCIPLINARY	5495	7142	30%
CHEMISTRY, ORGANIC	3988	6341	59%
CHEMISTRY, PHYSICAL	3321	4953	49%
CLINICAL NEUROLOGY	652	1265	94%
COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE	275	446	62%
COMPUTER SCIENCE, CYBERNETICS	126	62	-51%
COMPUTER SCIENCE, HARDWARE & ARCHITECTURE	270	303	12%
COMPUTER SCIENCE, INFORMATION SYSTEMS	216	325	50%
COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS	646	747	16%
COMPUTER SCIENCE, SOFTWARE ENGINEERING	257	382	49%
COMPUTER SCIENCE, THEORY & METHODS	458	343	-25%
CONSTRUCTION & BUILDING TECHNOLOGY	149	251	68%



Subject Category ISI	India: number of articles: 1996 - 2000	India: number of articles: 2001 - 2005	Variation
CRITICAL CARE MEDICINE	113	190	68%
CRYSTALLOGRAPHY	1259	2129	69%
DENTISTRY, ORAL SURGERY & MEDICINE	134	224	67%
DERMATOLOGY	457	778	70%
DEVELOPMENTAL BIOLOGY	134	272	103%
ECOLOGY	291	400	37%
EDUCATION, SCIENTIFIC DISCIPLINES	86	88	2%
ELECTROCHEMISTRY	737	820	11%
EMERGENCY MEDICINE	21	65	210%
ENDOCRINOLOGY & METABOLISM	533	639	20%
ENERGY & FUELS	1044	1090	4%
ENGINEERING, AEROSPACE	233	228	-2%
ENGINEERING, BIOMEDICAL	198	202	2%
ENGINEERING, CHEMICAL	2344	3080	31%
ENGINEERING, CIVIL	592	842	42%
ENGINEERING, ELECTRICAL & ELECTRONIC	2433	2924	20%
ENGINEERING, ENVIRONMENTAL	243	515	112%
ENGINEERING, GEOLOGICAL	230	247	7%
ENGINEERING, INDUSTRIAL	705	864	23%
ENGINEERING, MANUFACTURING	356	617	73%
ENGINEERING, MECHANICAL	1052	1503	43%
ENGINEERING, MULTIDISCIPLINARY	813	856	5%
ENGINEERING, OCEAN	90	122	36%
ENGINEERING, PETROLEUM	67	84	25%
ENTOMOLOGY	293	364	24%
ENVIRONMENTAL SCIENCES	1770	2747	55%
EVOLUTIONARY BIOLOGY	62	97	56%
FISHERIES	115	272	137%
FOOD SCIENCE & TECHNOLOGY	1401	1996	42%
FORESTRY	135	220	63%
GASTROENTEROLOGY & HEPATOLOGY	526	523	-1%
GENETICS & HEREDITY	749	1058	41%
GEOCHEMISTRY & GEOPHYSICS	436	604	39%
GEOGRAPHY, PHYSICAL	101	133	32%
GEOLOGY	115	121	5%
GEOSCIENCES, MULTIDISCIPLINARY	1863	2180	17%
GERIATRICS & GERONTOLOGY	33	111	236%
HEALTH CARE SCIENCES & SERVICES	38	88	132%
HEMATOLOGY	344	584	70%
HISTORY & PHILOSOPHY OF SCIENCE	30	33	10%
HORTICULTURE	326	455	40%
IMAGING SCIENCE & PHOTOGRAPHIC TECHNOLOGY	143	142	-1%
IMMUNOLOGY	1180	1539	30%
INFECTIOUS DISEASES	487	826	70%
INSTRUMENTS & INSTRUMENTATION	613	880	44%



Subject Category ISI	India: number of articles: 1996 - 2000	India: number of articles: 2001 - 2005	Variation
INTEGRATIVE & COMPLEMENTARY MEDICINE	165	302	83%
LIMNOLOGY	23	34	48%
MARINE & FRESHWATER BIOLOGY	228	360	58%
MATERIALS SCIENCE, BIOMATERIALS	72	124	72%
MATERIALS SCIENCE, CERAMICS	323	537	66%
MATERIALS SCIENCE, CHARACTERIZATION & TESTING	189	361	91%
MATERIALS SCIENCE, COATINGS & FILMS	200	494	147%
MATERIALS SCIENCE, COMPOSITES	232	447	93%
MATERIALS SCIENCE, MULTIDISCIPLINARY	5012	7036	40%
MATERIALS SCIENCE, PAPER & WOOD	32	41	28%
MATERIALS SCIENCE, TEXTILES	313	443	42%
MATHEMATICS	1218	1294	6%
MATHEMATICS, APPLIED	1151	1442	25%
MATHEMATICS, INTERDISCIPLINARY APPLICATIONS	177	247	40%
MECHANICS	1200	1392	16%
MEDICAL INFORMATICS	45	36	-20%
MEDICAL LABORATORY TECHNOLOGY	193	476	147%
MEDICINE, GENERAL & INTERNAL	1353	1539	14%
MEDICINE, LEGAL	35	195	457%
MEDICINE, RESEARCH & EXPERIMENTAL	869	901	4%
METALLURGY & METALLURGICAL ENGINEERING	1739	1849	6%
METEOROLOGY & ATMOSPHERIC SCIENCES	458	658	44%
MICROBIOLOGY	1011	1315	30%
MICROSCOPY	17	19	12%
MINERALOGY	149	193	30%
MINING & MINERAL PROCESSING	301	335	11%
MULTIDISCIPLINARY SCIENCES	3711	4652	25%
MYCOLOGY	212	224	6%
NEUROIMAGING	58	89	53%
NEUROSCIENCES	1060	1707	61%
NUCLEAR SCIENCE & TECHNOLOGY	1254	1253	0%
NUTRITION & DIETETICS	451	590	31%
OBSTETRICS & GYNECOLOGY	333	596	79%
OCEANOGRAPHY	548	425	-22%
ONCOLOGY	786	1157	47%
OPERATIONS RESEARCH & MANAGEMENT SCIENCE	403	421	4%
OPHTHALMOLOGY	518	991	91%
OPTICS	1150	1516	32%
ORNITHOLOGY	11	19	73%
ORTHOPEDICS	96	202	110%
OTORHINOLARYNGOLOGY	102	195	91%
PALEONTOLOGY	67	108	61%



Subject Category ISI	India: number of articles: 1996 - 2000	India: number of articles: 2001 - 2005	Variation
PARASITOLOGY	248	316	27%
PATHOLOGY	600	686	14%
PEDIATRICS	597	1283	115%
PERIPHERAL VASCULAR DISEASE	173	336	94%
PHARMACOLOGY & PHARMACY	1764	3281	86%
PHYSICS, APPLIED	2291	3055	33%
PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	1714	2122	24%
PHYSICS, CONDENSED MATTER	3127	4046	29%
PHYSICS, FLUIDS & PLASMAS	688	859	25%
PHYSICS, MATHEMATICAL	1086	1279	18%
PHYSICS, MULTIDISCIPLINARY	3407	4090	20%
PHYSICS, NUCLEAR	1221	1367	12%
PHYSICS, PARTICLES & FIELDS	1194	1427	20%
PHYSIOLOGY	186	223	20%
PLANT SCIENCES	2301	2851	24%
POLYMER SCIENCE	2190	2893	32%
PSYCHIATRY	462	968	110%
PSYCHOLOGY	28	82	193%
PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	1336	2090	56%
RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING	565	811	44%
REHABILITATION	42	62	48%
REMOTE SENSING	160	177	11%
REPRODUCTIVE BIOLOGY	227	359	58%
RESPIRATORY SYSTEM	272	599	120%
RHEUMATOLOGY	41	134	227%
ROBOTICS	17	31	82%
SPECTROSCOPY	575	864	50%
SPORT SCIENCES	23	55	139%
STATISTICS & PROBABILITY	619	579	-6%
SUBSTANCE ABUSE	54	86	59%
SURGERY	1339	1855	39%
TELECOMMUNICATIONS	704	762	8%
THERMODYNAMICS	541	685	27%
TOXICOLOGY	747	1182	58%
TRANSPLANTATION	108	182	69%
TRANSPORTATION SCIENCE & TECHNOLOGY	35	69	97%
TROPICAL MEDICINE	675	706	5%
UROLOGY & NEPHROLOGY	343	594	73%
VETERINARY SCIENCES	2253	2218	-2%
VIROLOGY	199	360	81%
WATER RESOURCES	588	979	66%
ZOOLOGY	411	397	-3%



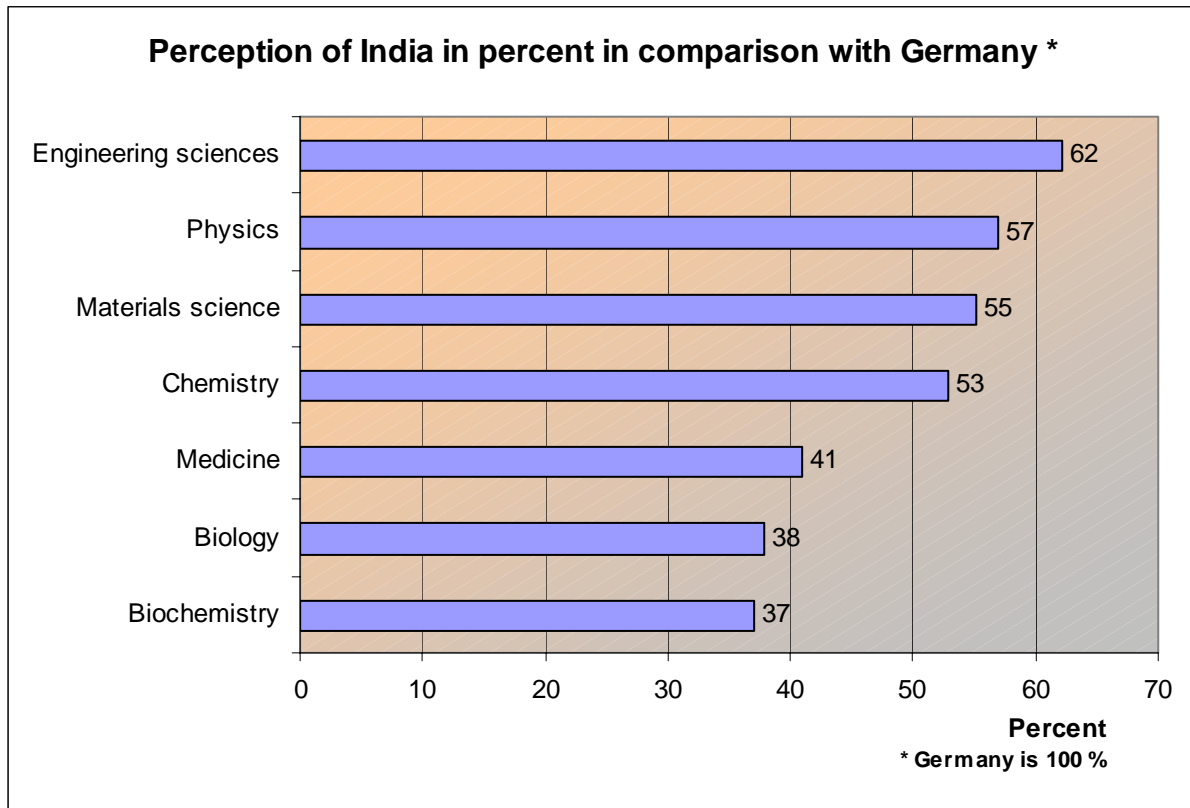
2. Where is India perceived?

The perception of scientific publications can be measured using citation by other scientists in the form of the average number of citations per article (citation rate). In the natural sciences, the Science Citation Index (SCI) is used almost exclusively as the data source for this purpose. It consists predominantly of internationally respected journal articles and records the citations of articles published. The citation rate is an indicator that is independent of the size of an institution but not of the size of the individual discipline. This means that the citation rate is not suitable for interdisciplinary comparisons.

The perception of India is measured against the perception of Germany in the following. Similar to section 1, the observation period here stretches from 2001 – 2005.

Table 5: Scientific perception of Germany and India

Category	Germany: number of articles 2001-2005	Germany: number of citations 2001 - 2005	Citation rate Germany 2001 - 2005	India: number of articles 2001-2005	India: number of citations 2001 - 2005	Citation rate India 2001 - 2005	Perception of India as a percentage (compared to Germany)
Biochemistry	27125	279786	10.3	5620	21425	3.8	37%
Biology	62284	500992	8.0	14586	44361	3.0	38%
Chemistry	46817	281158	6.0	27336	86899	3.2	53%
Engineering sciences	29396	79987	2.7	14040	23765	1.7	62%
Materials science	18191	74858	4.1	9301	21120	2.3	55%
Medicine	167083	865599	5.2	24287	51434	2.1	41%
Physics	70844	442422	6.2	19138	68017	3.6	57%



India's best result was in the engineering sciences: with a citation rate of 1.7, India obtained 62 % of the perception that German publications in this discipline achieve. This is followed by physics (57 %), materials science (55 %) and chemistry (53 %).



3. Excellent institutions

Analyses were conducted in five disciplines on what institutions published the most and which of them were best perceived. India was broken down into individual states and union territories for the analysis and the institutions were then assessed for each state/union territory. It was revealed that there are very few highly active institutions and a high proportion of institutions with a relatively low level of activity. This means that a large proportion of those institutions that publish heavily also belong to those with the best perception.

The 10 institutions with the highest number of publications and the most citations per article (citation rate) in a discipline are presented. The citation rate enables us to determine the institution in a discipline with the best response to research, independent of the size of the institutions. In order to be taken into account in the ranking, an institution must have at least 10 % of the total number of articles published by the institution with the highest number of publications in a discipline. This is a safeguard which prevents distortion and guarantees a minimum level of publication activity.



a) Biochemistry

Top publishers

Institution	State/Union Territory	Number of articles
Indian Institute of Science	Bangalore	661
Central Drug Research Institute	Uttar Pradesh	252
University of Delhi	Delhi	240
Institute of Microbial Technology	Chandigarh	216
Centre for Cellular and Molecular Biology	Andhra Pradesh	202
Bose Institute	West Bengal	190
Jawaharlal Nehru University	Delhi	182
Indian Institute of Chemical Biology	West Bengal	165
Bhabha Atomic Research Centre	Maharashtra	164
All India Institute of Medical Sciences	Delhi	151

Highest perception

Institution	State/Union Territory	Number of articles	Number of citations	Citation rate
Jawaharlal Nehru Centre for Advanced Scientific Research,	Karnataka	96	661	6.9
International Centre for Genetic Engineering and Biotechnology	Delhi	112	661	5.9
Indian Institute of Science	Bangalore	661	3741	5.7
Bose Institute	West Bengal	190	1063	5.6
Institute of Microbial Technology	Chandigarh	216	1196	5.5
Indian Institute of Technology	Delhi	101	494	4.9
National Chemical Laboratory	Maharashtra	126	616	4.9
University of Madras	Tamil Nadu	122	569	4.7
Centre for Cellular and Molecular Biology	Andhra Pradesh	202	918	4.5
Tata Institute of Fundamental Research	Maharashtra	136	597	4.4



b) Chemistry

Top publishers

Institution	State/Union Territory	Number of articles
Indian Institute of Chemical Technology	Andhra Pradesh	1614
National Chemical Laboratory	Maharashtra	1425
Indian Institute of Science	Karnataka	1356
Bhabha Atomic Research Centre	Maharashtra	1173
Indian Institute of Technology Kanpur	Uttar Pradesh	772
Indian Institute of Technology Bombay	Maharashtra	735
Indian Institute of Technology Kharagpur	West Bengal	667
Indian Association for the Cultivation of Science	West Bengal	633
Central Drug Research Institute	Uttar Pradesh	581
Jadavpur University	West Bengal	568

Highest perception

Institution	State/Union Territory	Number of articles	Number of citations	Citation rate
Jawaharlal Nehru Centre for Advanced Scientific Research	Karnataka	363	3683	10.1
University of Hyderabad	Andhra Pradesh	374	3526	9.4
Indian Institute of Science	Karnataka	1356	8394	6.2
CSIR, Regional Research Laboratory	Kerala	326	2003	6.1
National Chemical Laboratory	Maharashtra	1425	8432	5.9
Indian Association for the Cultivation of Science	West Bengal	633	3459	5.5
Central Salt & Marine Chemicals Research Institute	Gujarat	197	1040	5.3
Indian Institute of Chemical Technology	Andhra Pradesh	1614	8509	5.3
Indian Institute of Technology	Maharashtra	735	3534	4.8
Indian Institute of Technology	Uttar Pradesh	772	3706	4.8



c) Engineering sciences

Top publishers

Institution	State/Union Territory	Number of articles
Indian Institute of Technology	Uttar Pradesh	1061
Indian Institute of Science	Karnataka	1035
Indian Institute of Technology	West Bengal	996
Indian Institute of Technology	Delhi	859
Indian Institute of Technology	Tamil Nadu	770
Indian Institute of Technology	Maharashtra	750
Bhabha Atomic Research Centre	Maharashtra	536
Indira Gandhi Centre for Atomic Research	Tamil Nadu	322
Anna University	Tamil Nadu	300
Banaras Hindu University	Uttar Pradesh	296

Highest perception

Institution	State/Union Territory	Number of articles	Number of citations	Citation rate
National Chemical Laboratory	Maharashtra	260	1037	4.0
Mumbai (Bombay) University	Maharashtra	289	958	3.3
Indian Statistical Institute	West Bengal	117	343	2.9
Indian Institute of Chemical Technology	Andhra Pradesh	146	386	2.6
Defence Metallurgical Research Laboratory	Andhra Pradesh	144	303	2.1
Bhabha Atomic Research Centre	Maharashtra	536	1034	1.9
Indian Institute of Science	Karnataka	1035	1956	1.9
Indian Institute of Technology	Maharashtra	750	1367	1.8
National Physical Laboratory	Delhi	107	186	1.7
Banaras Hindu University	Uttar Pradesh	296	492	1.7



d) Materials science

Top publishers

Institution	State/Union Territory	Number of articles
Indian Institute of Science	Karnataka	805
Bhabha Atomic Research Centre	Maharashtra	682
Indian Institute of Technology	West Bengal	663
Indira Gandhi Centre for Atomic Research	Tamil Nadu	434
Indian Institute of Technology	Delhi	415
Indian Institute of Technology	Tamil Nadu	396
Indian Institute of Technology	Uttar Pradesh	361
Indian Institute of Technology	Maharashtra	345
National Chemical Laboratory	Maharashtra	344
Banaras Hindu University	Uttar Pradesh	273

Highest perception

Institution	State/Union Territory	Number of articles	Number of citations	Citation rate
University of Hyderabad	Andhra Pradesh	80	527	6.6
National Chemical Laboratory	Maharashtra	344	1787	5.2
Regional Research Laboratory, Council of Scientific & Industrial Research (CSIR)	Kerala	141	509	3.6
Indian Institute of Science	Karnataka	805	2761	3.4
Shivaji University	Maharashtra	198	573	2.9
Alagappa University	Tamil Nadu	97	273	2.8
Central Leather Research Institute	Tamil Nadu	147	411	2.8
Mahatma Gandhi University	Kerala	96	264	2.8
University of Poona	Maharashtra	103	280	2.7
Deemed University	West Bengal	80	198	2.5



e) Medicine

Top publishers

Institution	State/Union Territory	Number of articles
All India Institute of Medical Sciences	Delhi	3447
Post Graduate Institute of Medical Education & Research	Chandigarh	2028
University of Delhi	Delhi	1110
Sanjay Ghandi Post Graduate Institute of Medical Science	Uttar Pradesh	979
Christian Medical College and Hospital, Vellore	Tamil Nadu	935
Tata Memorial Hospital, Mumbai	Maharashtra	479
National Institute of Mental Health & Neuroscience	Karnataka	422
King Edward Memorial Hospital	Maharashtra	402
Banaras Hindu University	Uttar Pradesh	387
Kasturba Medical College	Karnataka	369

Highest perception

Institution	State/Union Territory	Number of articles	Number of citations	Citation rate
University of Madras	Tamil Nadu	367	1324	3.6
Banaras Hindu University	Uttar Pradesh	387	1260	3.3
Sanjay Ghandi Post Graduate Institute of Medical Science	Uttar Pradesh	979	2418	2.5
University of Delhi	Delhi	1110	2574	2.3
All India Institute of Medical Sciences	Delhi	3447	7844	2.3
King Edward Memorial Hospital	Maharashtra	402	867	2.2
Christian Medical College and Hospital, Vellore	Tamil Nadu	935	1932	2.1
Kasturba Medical College	Karnataka	369	726	2.0
Tata Memorial Hospital, Mumbai	Maharashtra	479	889	1.9
National Institute of Mental Health & Neuroscience	Karnataka	422	762	1.8



4. Co-publication

The number of publications generated by Indian research institutions together with foreign cooperation partners was examined for the periods 1996 – 2000 and 2001-2005. Co-publications with the five most important cooperation partners were examined along with co-publication with China, which could be interesting in terms of regional aspects.

a) Co-publication: India in cooperation with other countries 1996 - 2000

Category: biochemistry	Number of articles: 1996 - 2000	Percentage of India's total number of co-publications
USA	167	4.1%
Germany	90	2.2%
France	33	0.8%
United Kingdom	65	1.6%
Japan	65	1.6%
China	8	0.2%
Total number of Indian articles	4030	

Category: biology	Number of articles: 1996 - 2000	Percentage of India's total number of co-publications
USA	440	4.0%
Germany	234	2.1%
France	90	0.8%
United Kingdom	246	2.2%
Japan	167	1.5%
China	30	0.3%
Total number of Indian articles	11106	



Category: chemistry	Number of articles: 1996 - 2000	Percentage of India's total number of co-publications
USA	463	2.4%
Germany	239	1.2%
France	157	0.8%
United Kingdom	155	0.8%
Japan	159	0.8%
China	24	0.1%
Total number of Indian articles	19397	

Category: engineering sciences	Number of articles: 1996 - 2000	Percentage of India's total number of co-publications
USA	320	2.9%
Germany	142	1.3%
France	66	0.6%
United Kingdom	120	1.1%
Japan	117	1.0%
China	20	0.2%
Total number of Indian articles	11167	

Category: materials science	Number of articles: 1996 - 2000	Percentage of India's total number of co-publications
USA	161	2.6%
Germany	108	1.7%
France	88	1.4%
United Kingdom	67	1.1%
Japan	114	1.8%
China	13	0.2%
Total number of Indian articles	6229	



Category: medicine	Number of articles: 1996 - 2000	Percentage of India's total number of co-publications
USA	660	4.0%
Germany	154	0.9%
France	125	0.8%
United Kingdom	393	2.4%
Japan	150	0.9%
China	48	0.3%
Total number of Indian articles	16426	

Category: physics	Number of articles: 1996 - 2000	Percentage of India's total number of co-publications
USA	1086	7.1%
Germany	752	4.9%
France	539	3.5%
United Kingdom	419	2.7%
Japan	343	2.2%
China	221	1.4%
Total number of Indian articles	15293	



b) Co-publication: India in cooperation with other countries 2001 -2005

For the period 2001 – 2005, almost no differences were noted in the order of the main cooperation partners for the disciplines examined. Germany is still India's second most important cooperation partner. China remains insignificant in almost all disciplines, except for physics.

Category: biochemistry	Number of articles: 2001-2005	Percentage of India's total number of co- publications
USA	469	8.3%
Germany	141	2.5%
Japan	112	2.0%
United Kingdom	79	1.4%
France	62	1.1%
Canada	32	0.6%
Italy	27	0.5%
South Korea	25	0.4%
Hungary	24	0.4%
Denmark	21	0.4%
Israel	21	0.4%
Spain	20	0.4%
China	20	0.4%
Sweden	19	0.3%
Netherlands	19	0.3%
Belgium	17	0.3%
Singapore	16	0.3%
Australia	15	0.3%
Brasil	13	0.2%
Austria	11	0.2%
Total number of Indian articles	5620	



Category: biology	Number of articles: 2001-2005	Percentage of India's total number of co- publications
USA	1072	7.3%
Germany	329	2.3%
Japan	284	1.9%
United Kingdom	337	2.3%
France	164	1.1%
Canada	94	0.6%
South Korea	88	0.6%
Italy	80	0.5%
Australia	78	0.5%
China	76	0.5%
Netherlands	66	0.5%
Bangladesh	47	0.3%
Sweden	47	0.3%
Belgium	47	0.3%
Hungary	46	0.3%
Philippines	44	0.3%
Brasil	43	0.3%
Switzerland	42	0.3%
Spain	40	0.3%
Denmark	38	0.3%
Total number of Indian articles	14586	



Category: Chemistry	Number of articles: 2001-2005	Percentage of India's total number of co- publications
USA	1000	3.7%
Germany	605	2.2%
Japan	403	1.5%
United Kingdom	376	1.4%
France	271	1.0%
Taiwan	187	0.7%
Spain	179	0.7%
Italy	164	0.6%
Canada	152	0.6%
South Korea	142	0.5%
China	96	0.4%
Australia	83	0.3%
Switzerland	66	0.2%
Netherlands	61	0.2%
Belgium	54	0.2%
Israel	52	0.2%
Czech Republic	49	0.2%
Denmark	47	0.2%
Malaysia	41	0.1%
Poland	40	0.1%
Total number of Indian articles	27336	



Category: engineering sciences	Number of articles: 2001-2005	Percentage of India's total number of co- publications
USA	757	5.4%
Germany	345	2.5%
Japan	229	1.6%
United Kingdom	195	1.4%
Canada	116	0.8%
Singapore	105	0.7%
France	104	0.7%
South Korea	104	0.7%
Australia	86	0.6%
China	68	0.5%
Netherlands	67	0.5%
Malaysia	66	0.5%
Italy	53	0.4%
Sweden	51	0.4%
Taiwan	41	0.3%
Russia	30	0.2%
Switzerland	30	0.2%
Spain	26	0.2%
Iran	23	0.2%
Brasil	21	0.1%
Total number of Indian articles	14040	



Category: materials science	Number of article: 2001-2005	Percentage of India's total number of co- publications
USA	399	4.3%
Germany	306	3.3%
Japan	256	2.8%
United Kingdom	138	1.5%
France	104	1.1%
South Korea	98	1.1%
Taiwan	75	0.8%
Italy	63	0.7%
China	39	0.4%
Canada	39	0.4%
Australia	37	0.4%
Singapore	36	0.4%
Mexico	29	0.3%
Belgium	21	0.2%
Russia	19	0.2%
Netherlands	19	0.2%
Sweden	18	0.2%
Spain	17	0.2%
Israel	17	0.2%
Switzerland	17	0.2%
Total number of Indian articles	9301	



Category: medicine	Number of articles: 2001-2005	Percentage of India's total number of co- publications
USA	1652	6.8%
United Kingdom	684	2.8%
Germany	266	1.1%
Japan	242	1.0%
France	205	0.8%
Australia	182	0.7%
Canada	159	0.7%
Switzerland	132	0.5%
China	130	0.5%
Italy	112	0.5%
Netherlands	85	0.3%
Singapore	77	0.3%
Brasil	66	0.3%
Belgium	65	0.3%
Bangladesh	64	0.3%
Thailand	62	0.3%
South Korea	59	0.2%
Sweden	58	0.2%
Spain	58	0.2%
Israel	55	0.2%
Total number of Indian articles	24287	

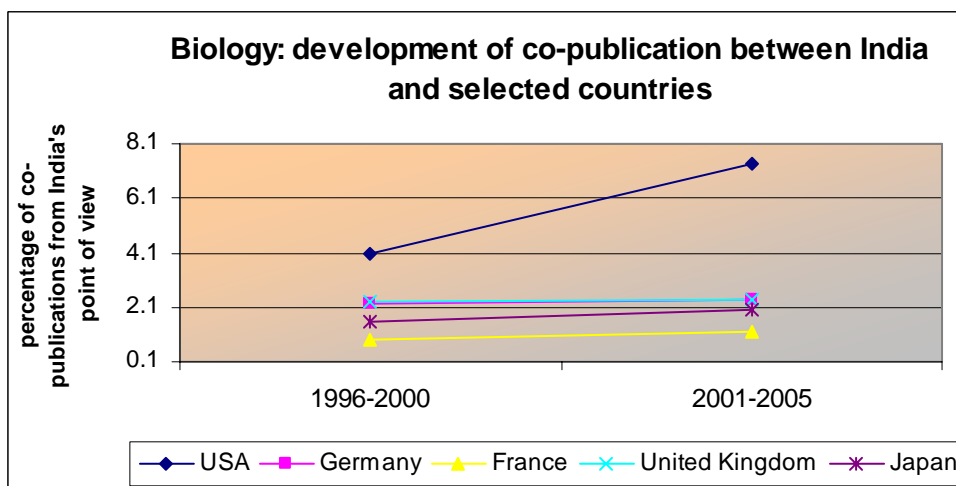
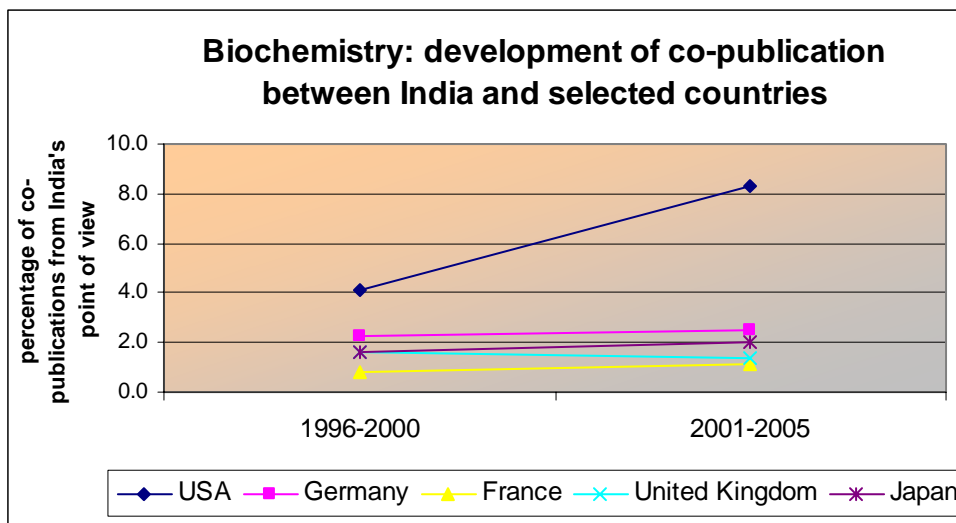


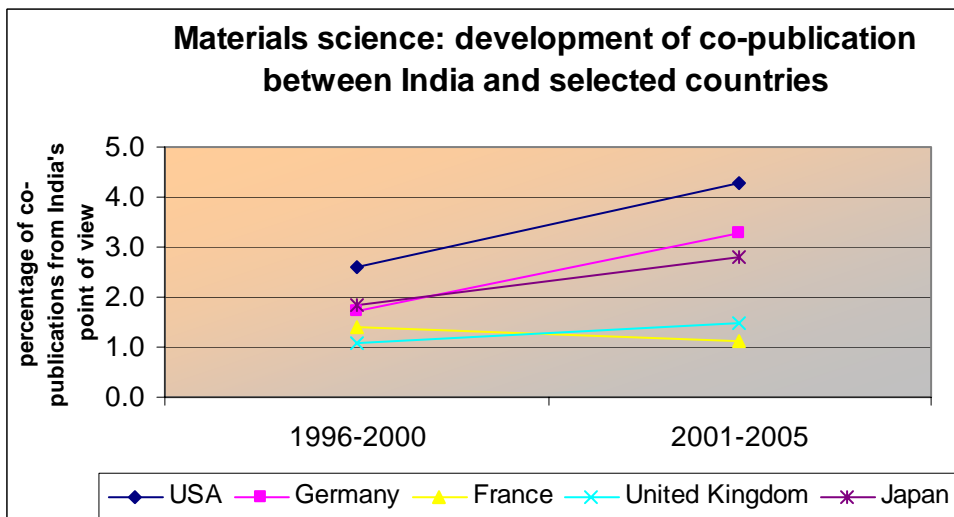
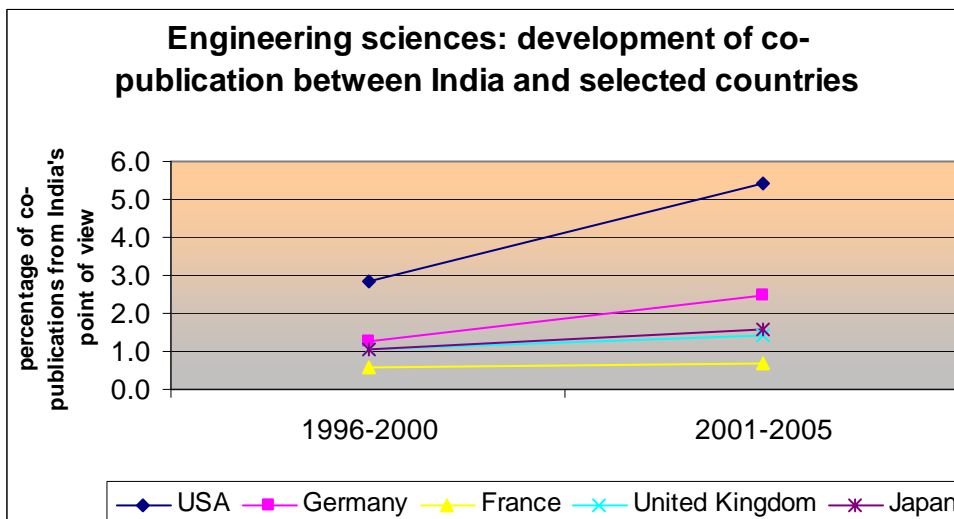
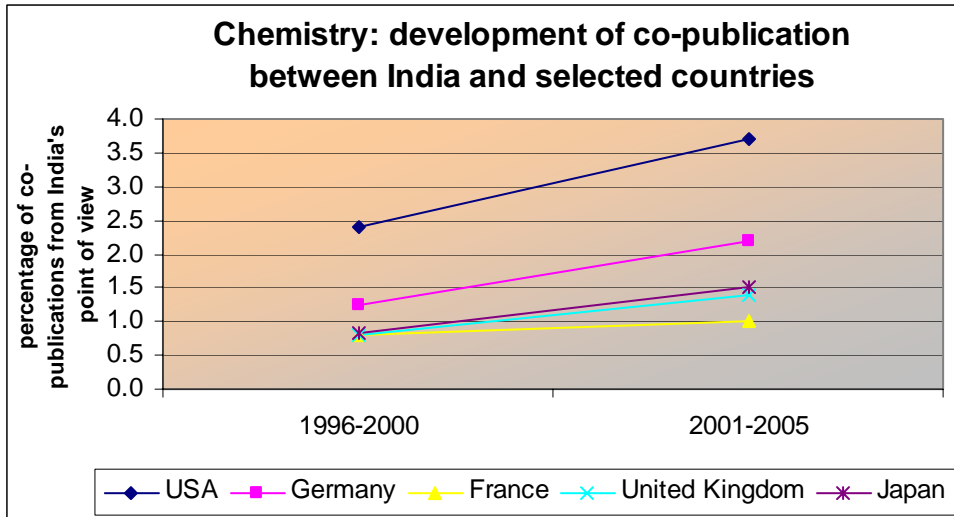
Category: physics	Number of articles: 2001-2005	Percentage of India's total number of co- publications
USA	2051	10.7%
Germany	1341	7.0%
Japan	945	4.9%
France	725	3.8%
China	524	2.7%
Russia	515	2.7%
United Kingdom	590	3.1%
South Korea	505	2.6%
Italy	462	2.4%
Taiwan	408	2.1%
Switzerland	343	1.8%
Poland	331	1.7%
Netherlands	309	1.6%
Australia	267	1.4%
Canada	262	1.4%
Brasil	258	1.3%
Spain	220	1.1%
Austria	183	1.0%
Sweden	178	0.9%
Hungary	153	0.8%
Total number of Indian articles	19138	

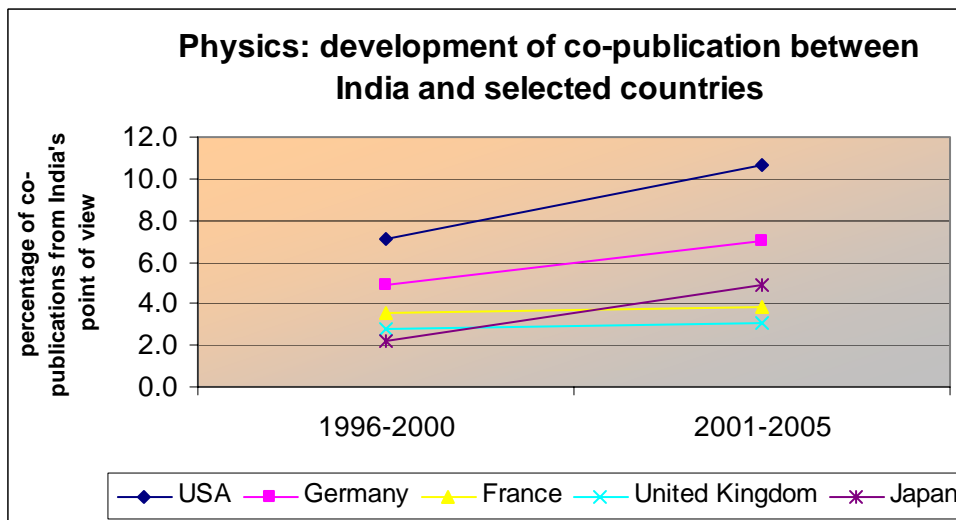
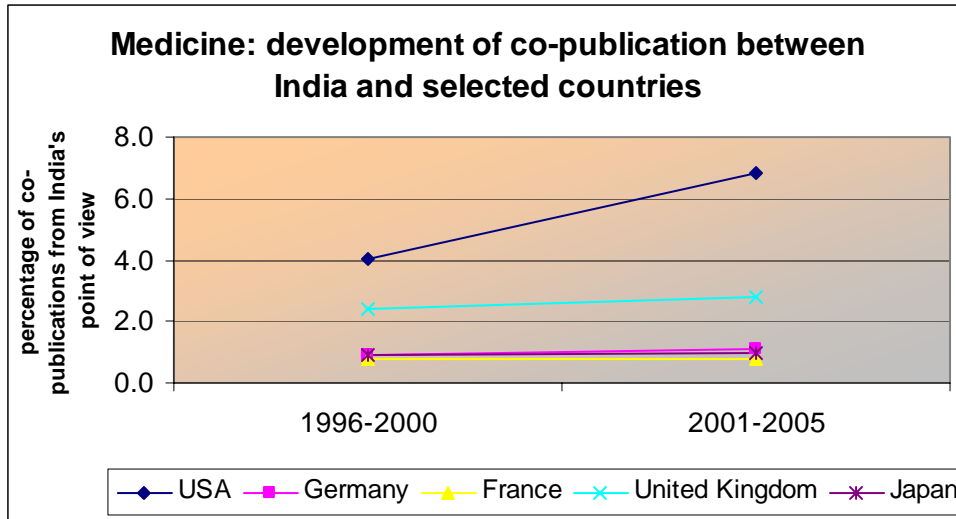


c) Increase in co-publications with individual countries – graphic representation

If we compare the period 2001 – 2005 with 1996 – 2000, we see that in most cases India succeeded in increasing the proportion of articles published with its top cooperation partners in all disciplines. Cooperations between Germany and India in the disciplines examined here have been extended and intensified.









c) Increase in co-publications with individual countries – tabular representation

	<u>Biochemistry</u>		
	1996-2000	2001-2005	Increase
USA	4.1	8.3	100.3%
Germany	2.2	2.5	11.9%
France	0.8	1.1	34.3%
United Kingdom	1.6	1.4	-13.2%
Japan	1.6	2.0	24.0%

	<u>Biology</u>		
	1996-2000	2001-2005	Increase
USA	4.0	7.3	84.3%
Germany	2.1	2.3	9.2%
France	0.8	1.1	35.7%
United Kingdom	2.2	2.3	3.8%
Japan	1.5	1.9	26.4%

	<u>Chemistry</u>		
	1996-2000	2001-2005	Zuwachs
USA	2,4	3,7	55,0%
Germany	1,2	2,2	78,5%
France	0,8	1,0	23,5%
United Kingdom	0,8	1,4	75,2%
Japan	0,8	1,5	83,0%

	<u>Engineering Sciences</u>		
	1996-2000	2001-2005	Increase
USA	2.9	5.4	88.4%
Germany	1.3	2.5	96.6%
France	0.6	0.7	18.4%
United Kingdom	1.1	1.4	30.3%
Japan	1.0	1.6	52.7%



	<u>Materials Science</u>		
	1996-2000	2001-2005	Increase
USA	2.6	4.3	66.4%
Germany	1.7	3.3	90.3%
France	1.4	1.1	-22.1%
United Kingdom	1.1	1.5	39.5%
Japan	1.8	2.8	53.0%

	<u>Medicine</u>		
	1996-2000	2001-2005	Increase
USA	4.0	6.8	69.2%
Germany	0.9	1.1	17.3%
France	0.8	0.8	5.1%
United Kingdom	2.4	2.8	17.0%
Japan	0.9	1.0	9.5%

	<u>Physics</u>		
	1996-2000	2001-2005	Increase
USA	7.1	10.7	50.7%
Germany	4.9	7.0	42.4%
France	3.5	3.8	7.8%
United Kingdom	2.7	3.1	13.2%
Japan	2.2	4.9	118.5%

b) Co-publications: Germany and India

For the period 2001 – 2005, we looked at the role of co-publications with India in terms of all publications by German research institutions. This proportion is quite low for all disciplines. The largest relative proportion of co-publications is 2.1 % for the field of energy research which also has a relatively low number of publications overall. This is followed by physics, materials science, chemistry and the engineering sciences with values between 1.2 % and 1.9 %. For all other disciplines, co-publications with India account for less than 1 % of all German publications.



Category	Germany: number of articles per category 2001-2005	Number of co- publications with India	Proportion of German co-publication activity with India
Biochemistry	27125	141	0.5%
Biology	62284	329	0.5%
Chemistry	46817	605	1.3%
Energy	1580	33	2.1%
Geosciences	30926	281	0.9%
Computer science	7601	48	0.6%
Engineering sciences	29396	345	1.2%
Agriculture	10001	77	0.8%
Materials science	18191	306	1.7%
Mathematics	12132	81	0.7%
Medicine	167083	266	0.2%
Physics	70844	1341	1.9%