

# **A Comparative Study of S&T Profile of India and Germany as reflected in Publication Output during 1996-2006**

B.M.Gupta

*National Institute of Science, Technology & Development Studies (NISTADS), CSIR,  
Dr K.S.Krishnan Marg, New Delhi 11012, India  
bmgupta1@gmail.com*

May 30th, 2008

## **Abstract**

The paper analyses the publication share and growth of India and Germany in terms of World publications output. It compares the similarities in their research profile with the top 15 most countries of the world. It also analyses the strengths of India and Germany in terms of publication output and the share of international collaborative publications in different fields of S&T, as reflected in their cumulative publications output during 1996-2006. The study analyses the collaborative research activity between Indian and Germany, as reflected in the co-authored papers between the scientists of the two countries, the areas of their focus, and the quality of their output.

## **1. Introduction**

India plays an important role as leader of the developing countries along with China and Brazil. This position is reflected on many levels (that is economic, military, political, etc). It is also reflected in its scientific and technological level. Over the years, India has invested heavily in developing infrastructure for R&D in different fields of S&T, as well as in the frontier areas, such as atomic energy, space sciences, electronics, telecommunications, and more recently in biotechnology. India's current R&D spending is around 0.8% of the Gross Domestic Product and it is likely to increase to 2% in the next five years. As for Germany, its position in G-7 is clearly reflected in its scientific and technological potential and research output. A few studies have been conducted the past to study the profile of Indian science, using publications output from Web of Science database and more recently based on Scopus database<sup>1-7</sup>.

## **2. Objectives**

The main objectives of this paper is to: (i) analyses the publication share and growth of India and Germany in terms of World publications output during 1996-2006, (ii) compares the similarities in the research profile of India and Germany with the top 15 most countries of the world, (iii) analyse the strengths of India and Germany in terms of publication output and the share of international collaborative publications in different fields of S&T, (iv) analyses the collaborative research activity between Indian and Germany, as reflected in the co-authored papers between the scientists of the two countries, the areas of their focus, and the quality of their output.

## **3. Methodology & Database Used**

The publications data on India and Germany and select countries leading in science and technology derived from Scopus database forms the basis of this study. SCOPUS is an international multidisciplinary database indexing over 15000 international peer reviewed journals in science and technology, We have used 11 years of publications data from 1996 to 2006 on India and top 15 productive countries for developing S&T indicators. Larger time coverage of data has been used to ensure accurate and reliable results. A number of absolute publication, citation and collaborative measures have been deployed for developing indicators as needed for depicting India's status in S&T from 1996 to 2006.

The Scopus database classifies each item covered under 20 subject categories of S&T and four broad subject categories, such as physical sciences, engineering sciences, life sciences and health sciences. For classification of papers, we have used the classification used in Scopus. The Scopus database classifies each paper on the basis of source subject title of the journal or conference/seminar proceeding. In this analysis, all types of items covered in Scopus database are covered in the present analysis. It predominately covers different types of items presented in journals such as papers, reviews, short notes, editorial etc and articles presented in conference/seminar proceedings.

## 4.1 Analysis

### 4.1 Publication Share, Rank and Growth Rate

The global publication share of top 15 countries in science and technology in world output ranges from 1.41% to 25.32% during 1996-06. The United States tops the list with global publication share of 25.32%, followed by Japan, United Kingdom, Germany, and China (their global publication share ranging from 5.64% to 7.31%). France, Canada, Italy, Russia, Spain, Australia, and India rank at 6<sup>th</sup> to 12<sup>th</sup> positions (their global publication share ranging from 2.04% to 4.59%). The other three countries that rank at 13<sup>th</sup> to 15<sup>th</sup> positions are Netherlands, South Korea and Sweden, with their global publication share ranging from 1.41% to 1.91% during 1996-06 (Table 1).

**Table 1. Publication Productivity and World Share of Top 15 Countries**

Country	Number of Papers				Percentage Share of Papers			
	1996	2001	2006	96-06	1996	2001	2006	96-06
World	1115295	1298515	1719186	14649750				
USA	334759	323916	369963	3710023	30.02	24.95	21.52	25.32
UK	85718	88833	121126	1071426	7.69	6.84	7.05	7.31
Japan	84525	90089	106426	1042620	7.58	6.94	6.19	7.12
Germany	70504	80424	100588	931289	6.32	6.19	5.85	6.36
China	28484	60943	179061	825819	2.55	4.69	10.42	5.64
France	53141	56873	72087	672389	4.76	4.38	4.19	4.59
Canada	40824	39072	61638	503399	3.66	3.01	3.59	3.44
Italy	36962	40627	58351	487310	3.31	3.13	3.39	3.33
Russia	31342	32565	30996	355949	2.81	2.51	1.80	2.43
Spain	22974	28263	45596	347990	2.06	2.18	2.65	2.38
Australia	22095	26420	40807	316505	1.98	2.03	2.37	2.16
India	20491	24289	40728	299042	1.84	1.87	2.37	2.04
Netherlands	21828	22429	33402	279458	1.96	1.73	1.94	1.91
South Korea	9745	18559	36803	228177	0.87	1.43	2.14	1.56
Sweden	16133	17433	22183	206173	1.45	1.34	1.29	1.41

Germany and India contributed 6.36% and 2.04% global publication share, with 4<sup>th</sup> and 12<sup>th</sup> world publication ranks during 1996-06. Amongst these two countries, the Germany's global publication share and rank has decreased from 6.32% (with 4<sup>th</sup> world rank) in 1996 to 5.85% (with 5<sup>th</sup> global rank) in 2006. India's global publication share and rank on the other hand has increased from 1.84% (with 13<sup>th</sup> world rank) in 1996 to 2.37% (with 10<sup>th</sup> world rank) in 2006 (Table 1)).

India and Germany differ in their annual average publication growth rates in science and technology. India achieved a comparatively faster annual average growth rate of 7.2% (compared

to 3.69% in Germany) during 1996-2006, rising to 10.94% (compared to 4.69% in Germany) in recent five years, 2002-2006 (Table 2).

**Table 2: Publication Growth Rate of Top 15 Countries**

Country	Average Publication Growth Rate		Country	Average Publication Growth Rate	
	2002-06	1996-06		2002-06	1996-06
World	5.85	4.49	Canada	9.63	4.39
China	25.28	21.07	Germany	4.69	3.69
South	14.9	14.4	UK	6.43	3.6
India	10.94	7.2	Sweden	5.09	3.35
Spain	10.07	7.17	France	4.94	3.17
Australia	9.13	6.39	Japan	3.45	2.38
Italy	7.59	4.76	USA	2.75	1.05
Netherlands	8.37	4.47	Russia	-0.78	0.01

#### 4.1. Subject Priorities of Top 15 Countries in S&T

The subject priorities of top 15 countries in science and technology have been determined by computing their national publication share in physical, engineering, life and health sciences during 1996-2006 (Table 3).

**Table 3. Subject Priorities of Top 15 Productive Countries as reflected in their Cumulative Publications Output during 1996-2006**

Broad Subject	World	USA	UK	Japan	China	Germany	France	Canada
Life Sciences	26.27	33.61	32.06	31.08	14.85	29.98	31.41	33.97
Health Sci.	29.45	33.97	36.27	26.85	10.98	30.13	29.52	29.26
Physical Sci.	27.72	25.4	26.22	18.56	39.07	37.36	37.15	29.09
Engineering Sci.	28.63	20.65	19.52	31.65	50.54	23.72	24.08	23.71
Total	1464975 0	371002 3	107142 6	104262 0	82581 9	931289	67238 9	503399

Broad Subject	Italy	Russia	Spain	Australia	India	Netherlands	South Korea	Sweden
Life Sciences	32.39	17.62	33.76	35.14	30.34	34.73	24.24	36.62
Health Sciences	34.99	3.62	32.4	33.92	21.6	37.34	14.07	34.73
Physical Sci.	33.97	62.96	35.93	28.18	41.23	28.12	38.74	29.2
Engineering Sci.	21.63	35.51	20.7	18.34	29.52	19.59	50.16	21.18
Total	48731 0	35594 9	34790 0	316505	29904 2	279458	228177	206173

The magnitude of national publication share of a country in the broad subject reflects its research priority in the field. For example, India's national publication share by subject in its total output has been the highest (41.23%) in physical sciences, followed by life sciences (30.34%), engineering sciences (29.52%) and health sciences (21.6%). In contrast, Germany's national publication share by subject in its total output has been the highest (37.36%) in physical sciences, followed by health sciences (30.13%), life sciences (29.98%), and engineering sciences (23.72%) (Table 3).

In the world context, India's national publication share in physical sciences, life sciences, and engineering sciences has been above the global average in each broad discipline. But in health sciences its share has been below the global average. In comparison, Germany's national publication share physical, life and health sciences has been above the global average, but its national publication share in engineering sciences has been below the global average.

In order to understand similarities in research profile of top 15 productive countries, the research profile of these top countries were categorized into the following four groups. The select

countries were later grouped and sub-grouped based on the degree of similarity between their national publication share in the select broad subject and the world average publications share in the same broad subject

- (i) **Strong Countries** having national publication share in the broad subject above the world average by 5% or more;
- (ii) **Moderately Strong Countries** having national publication share in the broad subject above the world average by 0.1% to 4.99%;
- (iii) **Moderately Weak Countries** having national publication share in the broad subject below the world average by 0.1% to 4.99%;
- (iv) **Weak Countries** having national publication share in the broad subject below the world average by 5.0%.

Seven countries such as United States, United Kingdom, Italy, Spain, Canada, Australia, and Netherlands share strong to moderately strong similarities in life sciences and health sciences, but they are weak in engineering sciences. These countries were further categorized into five sub-groups depending upon similarities in their research profiles under the select subjects (Table 4).

**Table 4 : Countries Sharing Strong to Moderate Strong Research Profile in Life Sciences and Health Sciences**

Countries	Strong	Moderately Strong	Moderately Weak	Weak
United States	Life Sciences	Health Sciences	Physical Science	Engineering Sciences
Australia, Canada, Sweden	Life Sciences	Health Sciences, Physical Sciences		Engineering Sciences
Netherlands	Life Sciences, Health Sciences	Physical Sciences		Engineering Sciences
United Kingdom	Life Sciences, Health Sciences		Physical Science	Engineering Sciences
Italy, Spain	Life Sciences, Physical Sciences	Health Sciences		Engineering Sciences

**Table 5: Countries Sharing Strong to Moderate Strong Research Profile in Physical Sciences and Life Sciences**

Countries	Strong	Moderate Strong	Moderate Weak	Weak
Germany	Physical Sciences	Life Sciences	Health Sciences	Engineering Sciences
Japan	Physical Sciences	Life Sciences, Engineering	Health Sciences	
France	Physical Sciences, Life Sciences		Health Sciences, Engineering	

Three countries such as Japan, Germany and France share strong to moderately strong similarities in life sciences and physical sciences, but they are weak in engineering sciences. These countries were further categorized into four sub-groups depending upon similarities in their research profiles under the select subjects (Table 5).

Five countries such as Russia, China, India, South Korea and Taiwan share strong to moderately strong similarities in physical sciences and engineering sciences, but they are weak in health sciences. These countries were further categorized into three sub-groups depending upon similarities in their research profiles under the select subjects (Table 6):

**Table 6: Countries Sharing Strong to Moderate Strong Research Profile in Physical Sciences and Engineering Sciences**

Countries	Strong	Moderate Strong	Moderate Weak	Weak
China, South Korea	Engineering Sciences	Physical Sciences	Life Sciences	Health Sciences
Russia	Physical Sciences	Engineering Sciences	Life Sciences	Health Sciences
India	Physical Sciences	Engineering Sciences, Life Sciences		Health Sciences

### 4.3. Subject-Wise Profile of India and Germany

India and Germany differ in their subject priorities for research as seen from national share of each in broad disciplines - life sciences, health sciences, physical sciences, and engineering sciences. For India, physical science is the top priority area of research (41.23%), followed by life sciences (30.34%), engineering sciences (29.52%), and health sciences (21.6%). For Germany, physical sciences is the also top priority area of research (37.36%), but unlike India it accords second priority to health sciences (30.13%), followed by life sciences (29.98%), and engineering sciences (23.72)

**Physical Sciences** – Both India and Germany accord top priority to physical sciences but individually they differ in terms of their strengths in individual subject areas under physical sciences.

**Table 7: India Germany Subject Profile in Physical Sciences, 1996-2006**

Country	Share Type	Chemistry	Physics	Environ.. Science	Earth & Plana. Science.	Mathematics
India	National Share (Rise)	16.05 (-0.24)	14.34 (-1.68)	6.31 (0.29)	5.07 (-1.76)	4.21 (-0.34)
Germany.	National Share Rise)	9.63 (0.08)	18.13 (1.11)	4.03 (0.30)	5.50 (0.57)	4.63 (0.62)
India	World Share (Rise)	5.31 (1.28)	3.14 (0.39)	3.66 (1.29)	2.49 (0.03)	2.02 (0.49)
Germany.	World Share (Rise)	7.37 (-1.85)	9.48 (-1.44)	5.37 (0.35%)	7.88 (1.66)	7.11 (-1.65)
India	Int. Coll (Rise)	13.26 (2.25)	27.36 (2.96)	10.36 (0.78)	21.58 (6.15)	27.52 (3.05)
Germany.	Int. Coll (Rise)	32.87(11.01)	48.78 (7.96)	29.53 (12.93)	52.51(11.15)	41.34 (5.23)

*\*National share is computed on cumulative output of the country during 1996-2006 and rise in national share is computed in 8 years between 1996-98 and 2004-2006; World share is computed on publications output in 2006 and rise in world share is computed in 8 years between 1996 and 2004; \*National share of international collaborative papers is computed on cumulative output of the country during 1996-2006 and rise in international collaborative papers is computed in 8 years between 1996*

Physics and chemistry are the leading areas of research in both India and Germany in physical sciences. The national shares of India and Germany in these two leading subject areas individually is two to three times greater than the output in the other disciplines under physical sciences. However, Germany is stronger compared to India in terms of global publications share, international publications share and in the national publication share, and this applies to all subject areas under physical sciences – chemistry, physics, environmental sciences, earth & planetary sciences and mathematics. Secondly, international collaborative research activity of Germany in all physical sciences disciplines is growing at faster pace than India's.

**Life Sciences** – India accords second priority to research in life sciences and Germany accords it the third priority. Individually India and Germany differ in terms of their strengths in individual subject areas under life sciences.

**Table 8: India Germany Subject Profile in Life Sciences, 1996-2006**

Country	Share Type	Ag. & Bio Sci.	Biochem. Gen. & Mol Biol.	Pharmacy, Toxic., & Pharmaceutics	Immun. & Microbiology	Neurology
India	National Share (Rise)	13.52 (-2.09)	12.36 (1.84)	6.05 (0.31)	3.73 (0.54)	1.29 (0.20)
Germany.	National Share (Rise)	6.43 (0.45)	15.71(1.08)	3.88 (0.12)	4.42 (0.15)	4.20 (0.42)
India	World Share (Rise)	4.09 (0.68)	2.57 (1.02)	4.57 (2.35)	2.80 (1.18)	1.08 (0.54)
Germany.	World Share (Rise)	5.67 (0.17)	7.61(0.16)	5.98 (-0.39)	7.30 (0.02)	9.04 (1.56)
India	Int. Coll (Rise)	11.33 (2.19)	19.06 (1.97)	8.79 (3.14)	18.84 (-0.06)	16.05 (5.02)
Germany.	Int. Coll (Rise)	36.56 (14.84)	37.55 (7.53)	24.52 (8.58)	38.41 (12.93)	35.23 (9.42)

*\*National share is computed on cumulative output of the country during 1996-2006 and rise in national share is computed in 8 years between 1996-98 and 2004-2006; World share is computed on publications output in 2006 and rise in world share is computed in 8 years between 1996 and 2004; \*National share of international collaborative papers is computed on cumulative output of the country during 1996-2006 and rise in international collaborative papers is computed in 8 years between 1996-98 and 2004-2006*

Biochemistry, genetics & molecular biology is the leading area of research in both India and Germany in life sciences. In addition to biochemistry, genetics & molecular biology, agricultural & biological sciences is another leading area of research in India and Germany. The national share individually of India and Germany in these disciplines is at least two to three times greater than in the other disciplines under life sciences. However, Germany is stronger compared to India in terms of global publications share, international publications share and in the national publication share, and it applies to all subject areas in life sciences – Agriculture & biological sciences, biochemistry, genetics, & molecular biology, pharmacy, toxicology & pharmaceutics, immunology & microbiology, and neurology. Secondly, international collaborative research activity of Germany in all life sciences disciplines is growing at faster pace than India's.

**Engineering Sciences** – India accords third priority to research in engineering sciences and Germany accords it the fourth and last priority. Individually India and Germany differ in terms of their strengths in individual subject areas under engineering sciences.

**Table 9: India Germany Subject Profile in Engineering Sciences, 1996-2006**

Country	Share Type	Engineering	Materials Sc	Chemical Engineering	Computer Science	Energy
India	National Share (Rise)	13.16 (0.91)	11.95 (-0.03)	5.74 (-0.05)	3.18 (0.36)	1.82 (-0.62)
Germany.	National Share (Rise)	10.62 (1.46)	8.88 (0.13)	3.39 (0.17)	3.79 (0.68)	1.38 (0.10)
India	World Share (Rise)	1.88 (0.17)	3.95 (0.51)	3.29 (0.19)	1.08 (-0.54)	2.42 (-0.67)
Germany.	World Share (Rise)	3.72 (-0.68)	6.09 (-2.83)	4.39 (-2.0)	4.93 (-0.34)	4.28 (-1.69)
India	Int Coll (Rise)	14.59 (0.00)	17.04 (5.66)	13.27 (2.23)	25.83 (-8.88)	16.13 (-1.28)
Germany.	Int Coll (Rise)	25.56(16.47)	36.19 (12.01)	25.06 (9.24)	28.18(13.10)	26.83 (9.69)

*\*National share is computed on cumulative output of the country during 1996-2006 and rise in national share is computed in 8 years between 1996-98 and 2004-2006; World share is computed on publications output in 2006 and rise in world share is computed in 8 years between 1996 and 2004; \*National share of international collaborative papers is computed on cumulative output of the country during 1996-2006 and rise in international collaborative papers is computed in 8 years between 1996-98 and 2004-2006*

Engineering and materials science are the leading areas of research in both India and Germany in engineering sciences. The national share of India and Germany individually in these disciplines is at least two to three times greater than in the other disciplines under engineering sciences. However, Germany is stronger compared to India in terms of global publications share, international publications share and in the national publication share, and it applies to all subject areas in engineering – engineering, materials science, chemical engineering, computer science, and energy. Secondly, international collaborative research activity of Germany in all engineering sciences disciplines is growing at faster pace than India's.

**Health Sciences** – India accords fourth and last priority to research in health sciences and Germany accords it the second priority. Individually India and Germany differ in terms of their strengths in individual subject areas under engineering sciences.

**Table 10: India Germany Subject Profile in Health Sciences, 1996-2006**

Country	Share Type	Medicine	Veterinary Sc	Public Health	Dentistry	Nursing
India	National Share (Rise)	18.67 (4.83)	2.71 (-0.79)	0.52 (0.22)	0.30 (0.22)	0.16 (0.14)
Germany.	National Share (Rise)	28.79 (2.56)	0.93 (0.10)	1.72 (0.22)	0.40 (0.10)	0.39 (0.08)
India	World Share (Rise)	1.74 (0.83)	4.88 (0.57)	1.01 (0.53)	2.58 (1.96)	0.42 (0.29)
Germany.	World Share (Rise)	6.11 (0.10)	5.64 (0.83)	6.66 (0.88)	6.27 (3.47)	1.76 (0.32)
India	Int Coll (Rise)	10.59 (3.88)	3.92 (1.55)	15.44 (2.73)	6.34 (-3.83)	22.86 (7.33)
Germany.	Int Coll (Rise)	19.26 (9.51)	21.58 (6.92)	19.84 (11.92)	24.44 (4.92)	24.45 (15.11)

*\*National share is computed on cumulative output of the country during 1996-2006 and rise in national share is computed in 8 years between 1996-98 and 2004-2006; World share is computed on publications output in 2006 and rise in world share is computed in 8 years between 1996 and 2004; \*National share of international collaborative papers is computed on cumulative output of the country during 1996-2006 and rise in international collaborative papers is computed in 8 years between 1996-98 and 2004-2006*

Medicine is the largest area of research in both India and Germany in health sciences. Its national share in this subject area is at least nine times greater than in the other disciplines under health sciences. However, Germany is stronger compared to India in terms of global publications share, international publications share and in the national publication share and this applies to all subject areas in health sciences – medicine, veterinary science, health science, dentistry, and nursing. Secondly, international collaborative research activity of Germany in all engineering sciences disciplines is growing at faster pace than India's.

From the above analysis, it is clear that major fields of national priority in India and Germany are medicine, chemistry, physics, biochemistry, genetics & molecular biology, engineering, and materials science. In addition, agricultural & biological sciences is an area of strength in India but not of Germany.

#### **4.4 India and Germany Strength and Weakness**

Although the raw number of papers provides a potent indicator of scientific strength, it is often insightful to analyse the country's degree of specialization in different fields. Here we use the specialization index, which indicates when country has a more important share of the world scientific production in one field relative to its overall share of world scientific production. The Table 7 presents the specialization index for India and Germany by field.

The important fields in which India has shown higher specialization are veterinary sciences (259.42), chemistry (215.71), agricultural & biological Science (193.84), materials science (162.19), environmental sciences (154.93), pharmacy, toxicology & pharmaceuticals (152.32), physics (130.29), chemical engineering (130.01), mathematics (115.08), earth & planetary science (110.87) and immunology & microbiology (100.75). The important fields in which Germany has shown higher specialization are physics (164.74), mathematics (126.55), chemistry (129.52), biochemistry, genetics & molecular biology (122.34), materials science (120.51), earth & planetary science (120.20), immunology & microbiology (119.55), public health (109.24) and medicine (105.54). If one looks at both countries specialization, it is possible to immediately see that there is a potential for collaboration between India and Germany in physics, chemistry,

materials sciences, earth and planetary sciences and mathematics - all fields where both countries are specialized (Table 11).

**Table 11. India and Germany Research Output & Specialization Index**

Broad Subject	Cumulative Number of Publications, 1996-2006			Activity Index	
	Germany	India	World	Germany	India
Medicine	268109	55838	3996279	105.54	68.45
Physics	168835	42879	1612194	164.74	130.29
Biochemistry, Genetics & Molecular Biology	146279	36953	1880807	122.34	96.25
Engineering	98926	39365	2374196	65.55	81.23
Chemistry	89728	47987	1089811	129.52	215.71
Materials Science	82669	35727	1079110	120.51	162.19
Agricultural & Biological Sciences	59893	40423	1021590	92.22	193.84
Earth & Planetary Sciences	51194	15163	669992	120.20	110.87
Mathematics	43153	12600	536386	126.55	115.08
Neurology	39089	3845	454311	135.35	41.46
Environmental Science	37570	18873	596759	99.03	154.93
Pharmacy, Toxicology & Pharmaceutics	36097	18103	582222	97.53	152.32
Computer Science	35305	9507	672662	82.56	69.24
Chemical Engineering	31540	17176	647198	76.66	130.01
Public Health	16062	1548	231298	109.24	32.79
Energy	12817	5455	272138	74.09	98.20
Veterinary	8621	8090	152769	88.77	259.42
Immunology & Microbiology	41205	11151	542194	119.55	100.75
Dentistry	3728	899	79368	73.89	55.49
Nursery	3636	468	181291	31.55	12.65
Total Papers	931289	299042	14649750		

#### 4.5 Scientific Collaboration between India and Germany

Germany and India have a growing number of scientific collaborations, which is reflected in the Table 8. The average annual growth rate in international collaborative papers between India and Germany was 10.75%. The overall quality of the collaborative papers was measured in terms of citation received in the first three years after the publication. It was observed that the overall quality of the collaborative papers between India and Germany has increased from 4.49 during 1996-98 to 6.59 during 2004-06. Over the 11 years (1996-06) period covered by this study, the largest field of collaborations between India and Germany was physics (with 2660 papers), followed by materials science (1061 papers), chemistry (1005 papers), biochemistry, genetics and molecular biology (818 papers), engineering (571 papers), agricultural & biological sciences (521 papers) etc. If we normalize the collaborative research output data for 1996-98 and 2004-06 period, we find that the collaborative output between India and Germany has increased the largest in medicine, followed by materials science, chemical engineering, environmental sciences, biochemistry, genetics & molecular biology, mathematics, chemistry and engineering. As against this, there was a decrease in collaboration activity in public health, energy, earth & planetary science, computer science, agricultural & biological sciences and physics (Table 12).



**Table 12. Activity Index of Collaborative Research Papers between India and Germany during 1996-2006**

Broad Subject	Collaborative Number of Papers between India and Germany			Activity Index	
	1996-98	2004-06	1996-06	1996-98	2004-06
Physics	520	1007	2660	104.57	90.90
Material Sciences	152	447	1061	76.63	101.16
Mathematics	84	192	452	99.41	101.99
Chemistry	184	436	1005	97.94	104.17
Biochemistry	144	379	818	94.17	111.25
Engineering	113	269	571	105.86	113.12
Earth & Planetary Sciences	122	176	477	136.82	88.60
Energy	33	37	122	144.69	72.82
Computer Sciences	47	69	180	139.67	92.04
Chemical Engineering	49	152	320	81.91	114.05
Medicine	37	165	317	62.44	124.98
Agricultural & Biological Sciences	102	208	521	104.73	95.86
Environment	37	100	214	92.49	112.20
Health	2	3	7	152.84	102.91
Total	1194	2660	6387		

## 5. Results & Conclusions

As seen from publications data on India and Germany in global context, both India and Germany rank among top 15 productive countries in the world in science and technology. However, Germany leads India in terms of global publications share even though India was able to achieve faster publications growth rate of 7.2% compared to 3.96% by Germany. Germany is stronger compared to India in terms of global publications share in all subject areas under physical sciences, life sciences, engineering sciences, and health sciences. Germany also leads India in its share of international publications in all subject areas of science and technology. In addition, international collaborative research activity is growing at faster pace in Germany than India's.

Both India and Germany differ in terms of the subject priorities for research except in physical sciences. India accords top priority to physical sciences, followed by life sciences, engineering sciences, and health sciences. For Germany, physical sciences is also top priority area of research, but unlike India it accords second priority to health sciences, life sciences, and engineering sciences.

India has close similarity with countries such as Russia, China, India, South Korea and Taiwan and they share strong to moderately strong similarities in physical sciences and engineering sciences, but they are weak in health sciences.

From the data analysed, it is clear that major fields of interest common to both India and Germany are medicine, chemistry, physics, biochemistry, genetics & molecular biology, engineering, and materials science. In addition, agricultural & biological sciences is another area of strength in India but not of Germany.

Both countries can plan fresh collaborative programmes to strengthening research and development in particular in the subject areas of their strength and even in other areas of mutual interest.

## References

1. Garg, K.C. and Dutt, B. Bibliometrics of Indian science as reflected through *Science Citation Index*. *Journal of Scientific & Industrial Research* 1992, 51, 329-40.
2. Arunachalam, S.; Srinivasan, S. and Raman, V. Science in India: A profile based on India's publications as covered by *Science Citation Index*, 1989-1992. *Current Science* 10 March 1998, 74(5), 433-441.
3. King, David. The scientific impact of nations. *Nature* 15 July 2004, 430, 311-316
4. Kedamani, B.S.; Sagar, A; Kumar, Vijay and Gupta, B.M. Mapping of Indian publications in S&T: A scientometric analysis of publications in Science Citation Index. *DESIDOC Bulletin of Information Technology* January 2007, 27(1), 17-35.
5. Gupta, B.M. and Garg, K.C. Is science in India on the decline? A rejoinder. *Current Science* 25 December 2002, 83(12), 1431-32.
6. Gupta, B.M. and Dhawan, S.M. *Measures of progress of science in India; An analysis of publications output in science and technology*. New Delhi; Office of the Principal Scientific Advisor to the Government of India, November 2006 (<http://psa.gov.in>)
7. Gupta, B.M. and Dhawan, S.M. (2008). Status of India in science and technology as reflected in its publications output in Scopus international database, 1996-2006. Submitted for publication in *Scientometrics* (February 2008)