

Science & Technology Profile of Publications Output of India and Germany during 1996-2006: A Comparative Study

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ABSTRACT

The paper analyses the publication share and growth of India and Germany in terms of S&T publications output. It compares the similarities in their research profile with the 15 top 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 collaborative research activity between India 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.

Keywords: S&T publications, India, Germany

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 per cent of the Gross Domestic Product, which is likely to increase to 2 per cent in the next five years. As for Germany, its position in G-7 is clearly reflected in its S&T potential and research output. A few studies have been conducted in the past on the profile of Indian science, using publications output from Web of Science database, and recently based on Scopus database¹⁻⁷.

2. OBJECTIVES

The main objectives of this paper are to: (i) analyse the publication share and growth of India and Germany in terms of world publications output in S&T during 1996-2006, (ii) compare the similarities in the research profiles of India and Germany with the top 15 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) analyse the collaborative research activity between India 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 AND DATABASES USED

The publications data on India and Germany and the other select countries leading in S&T derived from Scopus database forms the basis of this study. Scopus is an international multidisciplinary database indexing over 15,000 international peer-reviewed journals in S&T. The paper analyses 11 years of publications data from 1996 to 2006 of 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 publications, citations 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 proceedings. 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, editorials, etc., and articles presented in conference/seminar proceedings.

4. ANALYSES

4.1 Publication Share, Rank, and Growth Rate

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

Germany and India contributed 6.36 per cent and 2.04 per cent global publication share, with 4th and 12th world publication ranks during 1996-06. Amongst these two countries, the Germany's global publication share and rank has decreased from 6.32 per cent (with 4th world rank) in 1996 to 5.85 per cent (with 5th global rank) in 2006.

India's global publication share and rank on the other hand has increased from 1.84 per cent (with 13th world rank) in 1996 to 2.37 per cent (with 10th 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 per cent (compared to 3.69 per cent in Germany) during 1996-2006, rising to 10.94 per cent (compared to 4.69 per cent in Germany) during 2002-2006 (Table 2).

4.2 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, and life and health sciences during 1996-2006 (Table 3). 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 per cent) in physical sciences followed by life sciences (30.34 per cent), engineering sciences (29.52 per cent) and health sciences (21.6 per cent). In contrast, Germany's national publication share by subject in its total output has been the highest (37.36 per cent) in physical sciences followed by health sciences (30.13 per cent), life sciences (29.98 per cent), and engineering sciences (23.72 per cent) (Table 3).

In the world context, India's national publication share in physical sciences, life sciences, and engineering

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	1996-2006
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

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 Korea	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

Table 3. Subject priorities of top 15 productive countries as reflected in their cumulative publications output during 1996-2006

Country	Broad subject category				
	Life Sciences	Health Sciences	Physical Sciences	Engineering Sciences	Total output
USA	33.61	33.97	25.4	20.65	3710023
UK	32.06	36.27	26.22	19.52	1071426
Japan	31.08	26.85	18.56	31.65	1042620
China	14.85	10.98	39.07	50.54	825819
Germany	29.98	30.13	37.36	23.72	931289
France	31.41	29.52	37.15	24.08	672389
Canada	33.97	29.26	29.09	23.71	503399
Italy	32.39	34.99	33.97	21.63	487310
Russia	17.62	3.62	62.96	35.51	355949
Spain	33.76	32.4	35.93	20.7	347900
Australia	35.14	33.92	28.18	18.34	316505
India	30.34	21.6	41.23	29.52	299042
Netherlands	34.73	37.34	28.12	19.59	279458
South Korea	24.24	14.07	38.74	50.16	228177
Sweden	36.62	34.73	29.2	21.18	206173

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 in 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. To understand similarities in research profiles of top 15 productive countries, the research profiles of these top 15 countries were categorised 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 following select broad subjects 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 per cent or more;

(ii) **Moderately strong countries** having national publication share in the broad subject above the world average by 0.1 per cent to 4.99 per cent;

(iii) **Moderately weak countries** having national publication share in the broad subject below the world average below the world average by 0.1 per cent to 4.99 per cent;

(iv) **Weak countries** having national publication share in the broad subject below the world average by 5.0 per cent.

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

Table 4. Countries sharing strong-to-moderately strong research profiles

Country	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

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

Five countries—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 categorised into three sub-groups depending upon similarities in their research profiles under the select subjects (Table 6).

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 per cent), followed by life sciences (30.34 per cent), engineering sciences (29.52 per cent), and health sciences (21.6 per cent). For Germany, physical sciences is the also top priority area of research (37.36

per cent), but unlike India it accords second priority to health sciences (30.13 per cent), followed by life sciences (29.98 per cent), and engineering sciences (23.72 per cent).

4.3.1 Physical Sciences

Both India and Germany accord top priority to physical sciences but individually, differ in terms of their strengths in individual subject areas under physical sciences (Table 7).

Physics and chemistry are the leading areas of research in both India and Germany. 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 the subject areas under physical sciences—chemistry, physics, environmental sciences, earth and planetary sciences, and mathematics. Also, international collaborative research activity of Germany in all disciplines of physical sciences is growing at faster pace than India’s.

Table 5. Countries sharing strong-to-moderately strong research profiles in physical sciences and life sciences

Country	Strong	Moderately strong	Moderately 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	

Table 6. Countries sharing strong-to-moderately strong research profiles in physical sciences and engineering sciences

Country	Strong	Moderately strong	Moderately 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

Table 7. India, Germany subject profile in physical sciences (1996-2006)

Country	Share type	Chemistry	Physics	Environmental Science	Earth and Planetary 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.

4.3.2 Life Sciences

While India accords second priority to research in life sciences, 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).

Biochemistry, and genetics and molecular biology are the leading areas of research in both India and Germany in life sciences. In addition to biochemistry, genetics and molecular biology, agricultural and biological sciences are another leading area of research in India and Germany. The national share 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 and biological sciences, biochemistry, genetics and molecular biology, pharmacy, toxicology and pharmaceuticals, immunology and microbiology, and neurology. Also, international collaborative research activity of Germany in all the disciplines of life sciences is growing at a faster pace than India's.

4.3.3 Engineering Sciences

While India accords third priority to research in engineering sciences, 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).

Table 8. India, Germany subject profiles in life sciences (1996-2006)

Country	Share type	Ag. & Bio Sci.	Biochem. Gen. & Mol Biol.	Pharmacy, Toxic., & Pharmaceuticals	Immun. and 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)

Table 9. India, Germany subject profiles in engineering sciences (1996-2006)

Country	Share type	Engineering	Materials Science	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)

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. Also, international collaborative research activity of Germany in all engineering sciences disciplines is growing at a faster pace than India's.

4.3.4 Health Sciences

While India accords fourth and last priority to research in health sciences, 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).

Medicine is the largest area of research in both India and Germany in health sciences. India's 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 and

molecular biology, engineering, and materials science. In addition, agricultural and biological sciences are an area of strength in India but not of Germany.

4.4 India and Germany: Strength and Weakness

Although the raw number of papers provide a potent indicator of scientific strength, it is often insightful to analyse the country's degree of specialisation in different fields. Specialisation index was used to indicate that when a 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 11 presents the specialisation index for India and Germany by field.

The important fields in which India has shown higher specialisation are veterinary sciences (259.42), chemistry (215.71), agricultural, and biological Sciences (193.84 per cent), materials science (162.19 per cent), environmental sciences (154.93 per cent), pharmacy, toxicology and pharmaceuticals (152.32 per cent), physics (130.29 per cent), chemical engineering (130.01 per cent), mathematics (115.08 per cent), earth and planetary science (110.87 per cent) and immunology and microbiology (100.75 per cent). The important fields in which Germany has shown higher specialisation are physics (164.74 per cent), mathematics (126.55 per cent), chemistry (129.52 per cent), biochemistry, genetics and molecular biology (122.34 per cent), materials science (120.51 per cent), earth and planetary science (120.20 per cent), immunology and microbiology (119.55 per cent), public health (109.24 per cent) and medicine (105.54 per cent). If one looks at both countries specialisation, 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 specialised (Table 11).

Table 10. India, Germany subject profile in health sciences (1996-2006)

Country	Share type	Medicine	Veterinary Science	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.

Table 11. India and Germany research output and specialisation index

Broad Subjects	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 and 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 and Biological Sciences	59893	40423	1021590	92.22	193.84
Earth and 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 and 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 Science	8621	8090	152769	88.77	259.42
Immunology and 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 12. The average annual growth rate in international collaborative papers between India and Germany is 10.75 per cent. 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 11 year period (1996-06) 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 and biological sciences (521 papers), etc. If we normalise the collaborative research output data for 1996-98 and 2004-06 period, we find that the collaborative output between India and Germany has increased to maximum in medicine, followed by materials science, chemical engineering, environmental sciences, biochemistry, genetics and molecular biology, mathematics, chemistry, and engineering. As against this, there was a decrease in collaboration activity in public health, energy, earth and planetary science, computer science, agricultural and biological sciences, and physics (Table 12).

5. RESULTS AND CONCLUSIONS

As seen from publications data on India and Germany in the global context, both India and Germany rank among top 15 productive countries in the world in

Table 12. Activity index of collaborative research papers between India and Germany (1996-2006)

Broad Subjects	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 and 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 and 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		

S&T. However, Germany leads India in terms of global publications share even though India was able to achieve faster publications growth rate of 7.2 per cent compared to 3.96 per cent 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 a faster pace in Germany than India.

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 science 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, 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 and molecular biology, engineering, and materials science. In addition, agricultural and biological science is another area of strength in India but not Germany.

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

REFERENCES

1. Garg, K.C. & Dutt, B. Bibliometrics of Indian science as reflected through *Science Citation Index. J. Scienti. Indus. Res.*, 1992, **51**, 329-40.
2. Arunachalam, S.; Srinivasan, S. & Raman, V. Science in India: A profile based on India's publications as covered by *Science Citation Index*, 1989-1992. *Current Science*, 1998, **74**(5), 433-41.
3. King, David. The scientific impact of nations. *Nature*, 2004, **430**, 311-16.
4. Kedamani, B.S.; Sagar, A; Vijay Kumar & Gupta, B.M. Mapping of Indian publications in S&T: A scientometric analysis of publications in *Science Citation Index. DESIDOC Bull. Inform. Technol.*, 2007, **27**(1), 17-35.

5. Gupta, B.M. & Garg, K.C. Is science in India on the decline? A rejoinder. *Current Science*, 2002, **83**(12), 1431-32.
6. Gupta, B.M. & 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>