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# South Asia S&T Output during 2001-10: A Comparative Analysis of Pakistan with Bangladesh, Sri Lanka, and Nepal

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## **Abstract**

This study analyses the research output of four South Asia countries, namely Pakistan, Bangladesh, Sri Lanka and Nepal in S&T during 2001-10 on several parameters including its growth and country publications share in the world's research output, country publications share in various subjects in the national and global context, geographical distribution of publications, share of international collaborative publications at the national level as well as across subjects and characteristics of high productivity institutions and cited papers. The Scopus Citation Database has been used to retrieve the publication data for 10 years. Concludes that all the four South Asian countries needs to increase their output and bring about improvement in the quality of its research efforts. This can be done by investing much more in R&D expenditure, increase in the deployment of more qualified manpower and in increasing international collaboration and by modernizing and strengthening its research infrastructure.

## **Introduction**

South Asia's average growth was 6-7% in the past decade. South Asian countries continue to suffer from low human development, gender discrimination and the social inequalities. Historical, geographical and demographic factors have partly contributed to this disparity and the fact remains that the massive income and productive gap between South Asia countries and other developed countries can primarily be attributed to the lack of technological progress in these countries. The current global recession have inevitably slowed growth rates and foreign capital inflows, which resulting in increase of people living below the poverty line<sup>1</sup>

It is a fact that S&T capabilities are essential for meeting the challenging of development. S&T can provide solutions for eliminating poverty, hunger and disease for combating natural disasters and preserving the environment. The wide technology and innovation technology gap of the South Asian countries with other countries will widen further if timely action is not taken to increase investment in human development, develop infrastructure for scientific research and information technology, introduce incentives to build the absorptive capacity of firms through contract research and promote entrepreneurship<sup>1</sup>.

A few scientometric studies have been carried on South Asia. Mehbuba and Rousseau<sup>2</sup> has compared Bangladesh, Pakistan and Sri Lanka research output with India using three indicators, such as percentage of uncited articles, number of citations per document and h-indices. Gupta, Munshi and Mishra<sup>3</sup> analysed India's collaboration with South Asian countries during 1992-99 using SCI database. Mehbuba, Rousseau and Srivastava<sup>4</sup> made a scientometric comparison between two health and population research organization namely the International Centre for Diarrhoeal Disease Research (ICDDR,B), Dhaka, Bangladesh and the National Institute of Cholera and Enteric Diseases (NICED), Kolkata, India during 1979-2008 in terms of various indicators. Naim<sup>5</sup> mapped scientific research in OIC countries (including Pakistan and Bangladesh), using the indicators such as human resources in R&D, R&D expenditure, high technology exports, patents and publications. Under publications, trends in publications and relative impact of research in terms of citations during 1998-2007 have been undertaken

## **Objectives**

The objectives of the present study is to analyze the comparative performance of Pakistan, Bangladesh, Sri Lanka and Nepal science and technology as reflected in their S&T publications output during 2001-10. In particular, it analyses: (i) publications growth rate and global publication share; (ii) similarities in their research profile, (iii) most productive, medium productive, low productive and least productive areas of research; (iv) share of international collaborative papers and identification of major collaborative partners, (v) publication productive of geographical reasons, and (vi) characteristics of its high productive institutions and most cited papers.

## **Methodology and Data Source**

The publications data on Pakistan, Bangladesh, Sri Lanka and Nepal, derived from the Scopus database, forms the basis of this study. Scopus is the international multidisciplinary database indexing 18000 peer-reviewed journals (including 1800 open access journals), besides more than 500 international seminar/conference proceedings, 400 trade publications and 300 book series. In this analysis, all types of items covered in the database are covered. A three-year citation window has been used for counting the citations received and to access the impact of the research output. 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. The physical sciences include subjects such as physics, chemistry, mathematics, earth & planetary sciences and environmental sciences. Life sciences subjects such as agricultural & biological sciences, biochemistry, genetics & molecular biology, pharmacology, toxicology and pharmaceuticals, immunology & microbiology and neurosciences. Engineering sciences include subjects such as engineering, materials science, computer science, chemical engineering and energy. Health sciences include subjects such as medicine, veterinary science, public health, dentistry and nursing.. The Scopus database classifies each item on the basis of source subject title.

## **Analysis**

### **S&T Publications Output**

Pakistan has published 34088 papers during the last ten years (2001-10), compared to 11637 by Bangladesh, 5299 by Sri Lanka and 4439 by Nepal. The annual average growth rate of Pakistan publications during 2001-10 was 20.74%, compared to 16.37% by Bangladesh, 14.68% by Sri Lanka and 15.12% by Nepal. In terms of cumulative publications growth, Pakistan experienced a growth rate of

178.68% in its cumulative publications output from 2001-05 to 2006-10, followed by 129.19% growth by Bangladesh, 91.78% by Sri Lanka and 48.12% by Nepal during the same period (Table 1). The highest global share (0.196%) for its total publications during 2001-10 was achieved by Pakistan, followed by Bangladesh (0.067%), Sri Lanka (0.030%) and Nepal (0.025) during 2001-10. In terms of citation impact per paper on a three year citation window, the highest (3.06) was achieved by Sri Lanka, followed by Nepal (2.76), Bangladesh (2.71) and Pakistan (2.19) during 2001-10. In terms of h-index of total publications during 2001-10, the highest (85) is achieved by Pakistan, followed by Bangladesh (71), Sri Lanka (59) and Nepal (53). In terms of highly-cited papers in total publications during 2001-10, the highest number (63) is achieved by Pakistan, followed by Bangladesh (39), Sri Lanka (17) and Nepal (16). In terms of publications per capita (in million), the highest (214.76) was achieved by Nepal, followed by Pakistan (192.89), Sri Lanka (185.41) and Bangladesh (7.71). In terms of publications per GDP (PPP) (\$Million), the highest (12.39) was achieved by Nepal, followed by Pakistan (7.33), Sri Lanka (4.98) and Bangladesh (4.50) (Table 2).

**Table 1. Annual Publication Output of Pakistan, Bangladesh, Sri Lanka, and Nepal from 2001-10**

Year	Number of Papers			
	Pakistan	Bangladesh	Sri Lanka	Nepal
2001	1318	586	240	194
2002	1464	542	271	199
2003	1582	731	396	327
2004	1975	774	417	338
2005	2639	902	492	431
2006	3288	1059	582	545
2007	3920	1438	667	585
2008	4910	1619	702	551
2009	5920	1815	746	637
2010	7072	2171	786	632
2001-05	8978	3535	1816	1489
2006-10	25110	8102	3483	2950
2001-10	34088	11637	5299	4439

**Table 2. Relationship of Population and GDP with Publications in Four South Asian Countries, 2001-10**

Country	Publications 2001-10	Population (In Million)	GDP(PPP) \$Million IMF, 2010	Publications per Capita	Publications per GDP
Pakistan	34088	176.72	464897	192.89	7.33
Bangladesh	11637	1509.96	258608	7.71	4.50
Sri Lanka	5299	28.58	106502	185.41	4.98
Nepal	4439	20.67	35813	214.76	12.39

**Subject Priorities of Pakistan along with three other South Asian Countries as reflected in Cumulative Publication Output during 2001-10**

In this section, the subject profile in terms of physical, engineering, life and health sciences of the four South Asia countries have been studied and compared vis-à-vis the world average as shown in data presented in Table 3. The countries are classified as *strong* (having national publication share in the broad subject above the world average by 5% or more), *moderately strong* (having national publication share in the broad subject above the world average by 0.1% to 4.99%), *moderately weak* (having national publication share in the broad subject below the world average by 0.1% to 4.99%) and *weak* (having national publication share in the broad subject below the world average by 5% or more), as reflected in Table 3. Based on this table, it was observed that there is some similarity among Pakistan, Sri Lanka and Nepal in terms of national subject profile when compared with world average. The three countries have strong and moderately strong profile in life and health sciences, but moderately weak and weak profile in physical sciences and engineering sciences. In contrast, Bangladesh is strong in life sciences, but moderately weak in physical, engineering and health sciences (Table 4).

**Table 3. National Cumulative Publications Share of Pakistan, Bangladesh, Sri Lanka, and Nepal by Broad Disciplines, 2001-10**

Country	Number of Publications				Share of Publications			
	Phys Science	Engr Science	Life Science	Health Science	Phys Science	Engr Science	Life Science	Health Science
Pakistan	10266	8854	9171	10975	30.12	25.97	26.90	32.20
Bangladesh	3179	3731	3706	3233	27.32	32.06	31.85	27.78
Sri Lanka	1365	1215	1772	1810	25.76	22.93	33.44	34.16
Nepal	733	283	1187	2717	16.51	6.38	26.74	61.21
World	4958979	5674557	4196999	5121319	28.38	32.48	24.02	29.31

**Table 4. Subject Profile of the Four South Asian Countries, 2001-10**

Countries	Strong	Moderately Strong	Moderately Weak	Weak
Pakistan		Health Sciences Physical Sciences Life Sciences		Engineering Sciences
Bangladesh	Life Sciences		Health Sciences Physical Sciences Engineering Sciences	
Sri Lanka	Life Sciences	Health Sciences	Physical Sciences	Engineering Sciences
Nepal	Health Sciences	Life Sciences		Engineering Sciences Physical Sciences

### Subject Profile in Science & Technology

As per the publications data for 2001-10, Pakistan's research profile by broad disciplines emerges as follows. Health sciences subjects together contributed the highest publications share (32.20%), followed by physical sciences (30.12%), life sciences (26.90%) and engineering sciences (25.97%). Similar to Pakistan, Nepal and Sri Lanka also contributed the highest publication share (61.21% and 34.16%) to health sciences, followed by life sciences (26.74% and 33.44%), physical sciences (16.51% and 25.76%) and engineering sciences (6.38% and 22.93%) during 2001-10. In contrast, Bangladesh contributed the highest publications share (32.06%) to engineering sciences, followed by life sciences (31.85%), health sciences (27.78%) and physical sciences (27.32%).

### High Productivity Subject Areas of Research

Medicine, agricultural & biological sciences, engineering, chemistry and physics are considered the high priority areas of Pakistan in S&T, each contributing publication share between 11.05% and 30.94% in the cumulative national publication output of Pakistan during 2001-10. The national publication share, global publication share and international collaborative publication share of Pakistan, Bangladesh, Sri Lanka and Nepal in these five subject areas during 2001-10 are shown in Tables 5-6.

The national publication share of Pakistan in medicine was 30.94%, compared to 59.27% for Nepal, 31.50% for Sri Lanka and 26.18% for Bangladesh during 2001-10. The world publication share of Pakistan in medicine was 0.22%, compared to 0.06% for Bangladesh, 0.055% for Nepal and 0.04% for Sri Lanka during 2001-10. The average citation impact of all papers in medicine during 2001-10 was highest (4.02) for Bangladesh, followed by Sri Lanka (3.34), Nepal (2.40) and Pakistan (2.09). The international collaborative publications share of Pakistan in its total publications output in medicine was 18.72%, compared to 48.05% for Bangladesh, 43.73% for Sri Lanka and 28.73% in Nepal during 2001-10. The h-index of Pakistan publications in medicine during 2001-10 was 56, compared to 52 for Bangladesh and 38 each for Sri Lanka and Nepal. The number of highly-cited papers published from

Pakistan in medicine during 2001-10 was 20, compared to 16 for Bangladesh and 9 each for Sri Lanka and Nepal.

The national publication share of Pakistan in agricultural & biological sciences was 16.88%, compared to 19.85% for Sri Lanka, 18.91% for Bangladesh and 14.08% for Nepal during 2001-10. The world publication share of Pakistan in agricultural & biological sciences was 0.49%, compared to 0.19% for Bangladesh, 0.09% for Sri Lanka and 0.053% for Nepal during 2001-10. The average citation impact of all papers in agricultural & biological sciences during 2001-10 was highest (3.26) for Nepal, followed by Sri Lanka (3.08), Bangladesh (2.05) and Pakistan (2.04). The international collaborative publications share of Pakistan in its total publications output in agricultural & biological sciences was 24.78%, compared to 74.40% for Nepal, 61.03% for Sri Lanka and 54.79% for Bangladesh in during 2001-10. The h-index of Pakistan publications in agricultural & biological sciences during 2001-10 was 38, compared to 32.5 for Bangladesh, 29 for Sri Lanka and 28 for Nepal. The number of highly-cited papers published from Pakistan in agricultural & biological sciences during 2001-10 was 7, compared to 3 for Bangladesh, 1 for Sri Lanka and 0 for Nepal.

The national publication share of Pakistan in engineering was 12.70%, compared to 16.48% for Bangladesh, 13.96% for Sri Lanka and 3.0% for Nepal during 2001-10. The world publication share of Pakistan in engineering was 0.14%, compared to 0.06% for Bangladesh, 0.02% for Sri Lanka and 0.004% for Nepal during 2001-10. The average citation impact of all papers in engineering during 2001-10 was highest (1.72) for Pakistan, followed by Sri Lanka (1.11), Bangladesh (1.06) and Nepal (0.56). The international collaborative publications share of Pakistan in its total publications output in engineering was 31.04%, compared to 46.62% for Nepal, 42.84% for Sri Lanka and 37.23% for Bangladesh in engineering during 2001-10. The h-index of Pakistan publications in engineering during 2001-10 was 38.5, compared to 24 for Bangladesh, 18.5 for Sri Lanka and 6 for Nepal. The number of highly-cited papers published from Pakistan in engineering during 2001-10 was 9, compared to 2 for Sri Lanka, 1 for Bangladesh and 0 for Nepal.

The national publication share of Pakistan in chemistry was 12.69%, compared to 6.31% for Bangladesh, 5.57% for Sri Lanka and 2.23% for Nepal during 2001-10. The world publication share of Pakistan in chemistry was 0.33%, compared to 0.06% for Bangladesh, 0.02% for Sri Lanka and 0.008% for Nepal during 2001-10. The average citation impact of all papers in chemistry during 2001-10 was highest (5.15) for Sri Lanka, followed by Bangladesh (4.43), Nepal (4.03) and Pakistan (2.44). The international collaborative publications share of Pakistan in its total publications output in chemistry was 36.45%, compared to 75.76% for Nepal, 64.03% for Bangladesh and 61.36% for Sri Lanka in chemistry during 2001-10. The h-index of Pakistan publications in chemistry during 2001-10 was 39, compared to 29 for Bangladesh, 29 for Sri Lanka and 12 for Nepal. The number of highly-cited papers published from Pakistan in chemistry during 2001-10 was 5, compared to 7 for Sri Lanka, 2 for Bangladesh and 0 for Nepal.

The national publication share of Pakistan in physics was 11.05%, compared to 8.28% for Bangladesh, 4.76% for Sri Lanka and 1.80% for Nepal during 2001-10. The world publication share of Pakistan in physics was 0.20%, compared to 0.05% for Bangladesh, 0.01 for Sri Lanka and 0.004 for Nepal during 2001-10. The average citation impact of all papers in physics during 2001-10 was highest (4.37) for Sri Lanka, followed by Nepal (3.29), Pakistan (3.09) and Bangladesh (2.13). The international collaborative publications share of Pakistan in its total publications output in physics was 49.50%, compared to 65.00% for Nepal, 58.73% for Sri Lanka and 54.88% for Bangladesh in physics during 2001-10. The h-index of Pakistan publications in physics during 2001-10 was 38, compared to 21 for Sri Lanka, 21 for Bangladesh and 13 for Nepal. The number of highly-cited papers published from Pakistan in physics during 2001-10 was 6, compared 1 for Nepal and 0 each for Sri Lanka and Bangladesh.

**Table 5. World & National Publication Share in High Productivity Subject Areas, 2001-10**

Subject	World Publication Share, 2001-10 (%)				National Publication Share, 2001-10 (%)			
	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
Medicine	0.22	0.06	0.04	0.055	30.94	26.18	31.50	59.27
Agri. & Biol. Sci.	0.49	0.19	0.09	0.053	16.88	18.91	19.85	14.08
Engineering	0.14	0.06	0.02	0.004	12.70	16.48	13.96	3.00
Chemistry	0.33	0.06	0.02	0.008	12.69	6.31	5.57	2.23
Physics	0.20	0.005	0.01	0.004	11.05	8.28	4.76	1.80

**Table 6. International Collaborative Publication Share and Citation Impact in High Productivity Subject Areas, 2001-10**

Subject	International Collaborative Publication Share, 2001-10 (%)				Average Citation per Paper, 2001-10			
	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
Medicine	18.72	48.05	43.73	28.73	2.09	4.02	3.34	2.40
Agri. & Biol. Sci.	24.78	54.79	61.03	74.40	2.04	2.05	3.08	3.26
Engineering	31.04	37.23	42.84	46.62	1.72	1.06	1.11	0.56
Chemistry	36.45	64.03	61.36	75.76	2.44	4.43	5.15	4.03
Physics	49.50	54.88	58.73	65.00	3.09	2.13	4.37	3.29

### Medium Productivity Subject Areas of Research

Computer science, biochemistry, genetics & molecular biology, materials science, mathematics, pharmacology, toxicology & pharmaceuticals and environmental science are considered as the seven medium priority areas of Pakistan in S&T, each contributing publication share between 3.80% and 9.49% in the cumulative national publication output of Pakistan during 2001-10. The national publication share, global publication share and international collaborative publication share of Pakistan, Bangladesh, Sri Lanka and Nepal in these seven subject areas during 2001-10 are shown in Tables 7-8.

The national publication share of Pakistan in computer science was 9.49%, compared to 12.33% for Bangladesh, 8.59% for Sri Lanka and 1.15% for Nepal during 2001-10. The world publication share of Pakistan in computer science was 0.23%, compared to 0.10% for Bangladesh, 0.03% for Sri Lanka and 0.004% Nepal for during 2001-10. The average citation impact of all papers in computer science during 2001-10 was highest (0.66) for Pakistan, followed by Bangladesh (0.55), Sri Lanka (0.52) and Nepal (0.27). The international collaborative publications share of Pakistan in its total publications output in computer science was 31.09%, compared to 65.0% for Nepal, 58.73% for Sri Lanka and 33.45% for Bangladesh in computer science during 2001-10. The h-index of Pakistan publications in computer science during 2001-10 was 18, compared to 25 for Sri Lanka and 13 for Nepal and 12 for Bangladesh. The number of highly-cited papers published from Pakistan in computer science during 2001-10 was 1, compared to 1 for Nepal and 0 each for Bangladesh and Sri Lanka.

The national publication share of Pakistan in biochemistry, genetics & molecular biology was 8.45%, compared to 8.43% for Bangladesh, 7.91% for Nepal and 7.70% for Sri Lanka during 2001-10. The world publication share of Pakistan in biochemistry, genetics & molecular biology was 0.14%, compared to 0.05% for Bangladesh, 0.02% for Sri Lanka and 0.017% Nepal for during 2001-10. The average citation impact of all papers in biochemistry, genetics & molecular biology during 2001-10 was highest (4.85) for Nepal, followed by Sri Lanka (4.52), Pakistan (3.99) and Bangladesh (3.71). The international collaborative publications share of Pakistan in its total publications output in biochemistry, genetics & molecular biology was 47.81%, compared to 68.50% for Bangladesh, 67.40% for Sri Lanka and 64.96% for Nepal in biochemistry, genetics & molecular biology during 2001-10. The h-index of Pakistan publications in biochemistry, genetics & molecular biology during 2001-10 was 51.5, compared to 35 for Bangladesh, 28 for Nepal and 25 for Sri Lanka. The number of highly-cited papers published from Pakistan in biochemistry, genetics & molecular biology during 2001-10 was 13, compared to 5 for Bangladesh, 1 for Nepal and 0 for and Sri Lanka.

The national publication share of Pakistan in materials science was 6.56%, compared to 7.82% for Bangladesh, 4.66% for Sri Lanka and 1.10% for Nepal during 2001-10. The world publication share of Pakistan in materials science was 0.16%, compared to 0.06% for Bangladesh, 0.02% for Sri Lanka and 0.003% Nepal for during 2001-10. The average citation impact of all papers in materials science during 2001-10 was highest (4.57) for Sri Lanka, followed by Bangladesh (2.23), Pakistan (2.18) and Nepal (1.61). The international collaborative publications share of Pakistan in its total publications output in materials science was 47.85%, compared to 64.96% for Nepal, 61.22% for Sri Lanka and 55.87% for Bangladesh in materials science during 2001-10. The h-index of Pakistan publications in materials science during 2001-10 was 25, compared to 25.5 for Sri Lanka, 24 for Bangladesh and 6 for Nepal. The number of highly-cited papers published from Pakistan in materials science during 2001-10 was 0, compared to 2 for Sri Lanka and 0 each for Bangladesh and Nepal.

The national publication share of Pakistan in mathematics was 5.39%, compared to 2.87% for Bangladesh, 1.77% for Sri Lanka and 0.54% for Nepal during 2001-10. The world publication share of Pakistan in mathematics was 0.21%, compared to 0.04% for Bangladesh, 0.01% for Sri Lanka and 0.003% Nepal for during 2001-10. The average citation impact of all papers in mathematics during 2001-10 was highest (2.61) for Pakistan, followed by Sri Lanka (2.48), Bangladesh (1.15) and Nepal (0.88). The international collaborative publications share of Pakistan in its total publications output in mathematics was 45.21%, compared to 67.37% for Sri Lanka, 66.67% for Nepal and 45.21% for Bangladesh in mathematics during 2001-10. The h-index of Pakistan publications in mathematics during 2001-10 was 30, compared to 10.5 for Bangladesh, 10 for Sri Lanka and 3 for Nepal. The number of highly-cited papers published from Pakistan in mathematics during 2001-10 was 3, compared to 0 each for Bangladesh, Sri Lanka and Nepal.

The national publication share of Pakistan in pharmacology, toxicology & pharmaceuticals was 3.80%, compared to 4.61% for Bangladesh, 3.79% for Sri Lanka and 2.88% for Nepal during 2001-10. The world publication share of Pakistan in pharmacology, toxicology & pharmaceuticals was 0.21%, compared to 0.09% for Bangladesh, 0.03% for Sri Lanka and 0.021% Nepal for during 2001-10. The average citation impact of all papers in pharmacology, toxicology & pharmaceuticals during 2001-10 was highest (3.44) for Pakistan, followed by Sri Lanka (3.42), Nepal (2.95) and Bangladesh (2.83). The international collaborative publications share of Pakistan in its total publications output in pharmacology, toxicology & pharmaceuticals was 37.24%, compared to 48.76% for Sri Lanka, 46.88% for Nepal and 45.34% for Bangladesh in pharmacology, toxicology & pharmaceuticals during 2001-10. The h-index of Pakistan publications in pharmacology, toxicology & pharmaceuticals during 2001-10 was 33, compared to 25 for Bangladesh, 20 for Sri Lanka and 13 for Nepal. The number of highly-cited papers published from Pakistan in pharmacology, toxicology & pharmaceuticals during 2001-10 was 0, compared to 1 for Bangladesh and zero each for Sri Lanka and Nepal.

The national publication share of Pakistan in environmental science was 3.81%, compared to 12.23% for Sri Lanka, 9.30% for Nepal and 9.17% for Bangladesh during 2001-10. The world publication share of Pakistan in environmental science was 0.19%, compared to 0.15% for Bangladesh, 0.09% for Sri Lanka and 0.059% Nepal for during 2001-10. The average citation impact of all papers in environmental science during 2001-10 was highest (4.13) for Bangladesh, followed by Sri Lanka (4.04), Pakistan (4.02) and Nepal (2.78) during 2001-10.. The international collaborative publications share of Pakistan in its total publications output in environmental science was 24.46%, compared to 66.34% for Nepal, 66.20% for Sri Lanka and 62.89% for Bangladesh in environmental science during 2001-10. The h-index of Pakistan publications in environmental science during 2001-10 was 32, compared to 38 for Bangladesh, 33 for Sri Lanka and 22 for Nepal. The number of highly-cited papers published from Pakistan in environmental science during 2001-10 was 3, compared to 5 for Bangladesh, 3 for Sri Lanka and 0 for Nepal.



**Table 7. World & National Publication Share in Medium Productivity Subject Areas, 2001-10**

Subject	World Publication Share, 2001-10 (%)				National Publication Share, 2001-10 (%)			
	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
Computer Science	0.23	0.10	0.03	0.004	9.49	12.33	8.59	1.15
Bioc., Genet. & Mol. Biol.	0.14	0.05	0.02	0.017	8.45	8.43	7.70	7.91
Materials Sci.	0.16	0.06	0.02	0.003	6.56	7.82	4.66	1.10
Mathematics	0.21	0.04	0.01	0.003	5.39	2.87	1.77	0.54
Phar., Toxi. & Pharmaceuticals	0.21	0.09	0.03	0.021	3.80	4.61	3.79	2.88
Envir. Science	0.19	0.15	0.09	0.059	3.81	9.17	12.23	9.30

**Table 8. International Collaborative Publication Share and Citation Impact in Medium Productivity Subject Areas, 2001-10**

Subject	International Collaborative Publication Share, 2001-10 (%)				Average Citation per Paper, 2001-10			
	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
Computer Science	31.09	33.45	58.73	65.0	0.66	0.55	0.52	0.27
Bioc., Genet. & Mol. Biol.	47.81	68.50	67.40	64.96	3.99	3.71	4.52	4.85
Materials Sci.	47.85	55.87	61.22	64.96	2.18	2.23	4.57	1.61
Mathematics	45.21	45.21	67.37	66.67	2.61	1.15	2.48	0.88
Phar., Toxi. & Pharmaceuticals	37.24	45.34	48.76	46.88	3.44	2.83	3.42	2.95
Envir. Science	24.46	62.89	66.20	66.34	4.02	4.13	4.04	2.78

### Low Productivity Subject Areas of Research

Immunology & microbiology, chemical engineering, energy, earth & planetary sciences and nursing are considered the low priority areas of Pakistan in S&T, each contributing publication share between 1.21% and 2.99% in the cumulative national publication output of Pakistan during 2001-10. The national publication share, global publication share and international collaborative publication share of Pakistan, Bangladesh, Sri Lanka and Nepal in these five subject areas during 2001-10 are shown in Tables 9-10.

The national publication share of Pakistan in immunology & microbiology was 2.99%, compared to 6.02% for Sri Lanka, 5.83% for Bangladesh and 4.91% for Nepal during 2001-10. The world publication share of Pakistan in immunology & microbiology was 0.18%, compared to 0.12% for Bangladesh, 0.06% for Sri Lanka and 0.039% Nepal for during 2001-10. The average citation impact of all papers in immunology & microbiology during 2001-10 was highest (6.81) for Bangladesh, followed by Nepal (6.58), Sri Lanka (5.01) and Pakistan (4.97). The international collaborative publications share of Pakistan in its total publications output in immunology & microbiology was 39.25%, compared to 78.79% for Bangladesh, 75.23% for Nepal and 61.76% for Sri Lanka in immunology & microbiology during 2001-10. The h-index of Pakistan publications in immunology & microbiology during 2001-10 was 34, compared to 39 for Bangladesh, 27 for Sri Lanka and 24 for Nepal. The number of highly-cited papers published from Pakistan in immunology & microbiology during 2001-10 was 8, compared to 5 for Bangladesh and 1 each for Sri Lanka and Nepal.

The national publication share of Pakistan in chemical engineering was 2.64%, compared to 3.66% for Bangladesh, 2.32% for Sri Lanka and 0.56% for Nepal during 2001-10. The world publication share of Pakistan in chemical engineering was 0.12%, compared to 0.05% for Bangladesh, 0.02% for Sri Lanka and 0.003% Nepal for during 2001-10. The average citation impact of all papers in chemical engineering during 2001-10 was highest (5.42) for Sri Lanka, followed by Pakistan (4.46), Bangladesh (2.39) and Nepal (1.84). The international collaborative publications share of Pakistan in its total publications output in chemical engineering was 35.48%, compared to 60.16% for Sri Lanka, 56.00% for Nepal and 51.41% for Bangladesh in chemical engineering during 2001-10. The h-index of Pakistan publications in chemical engineering during 2001-10 was 29.5, compared to 20.5 for Bangladesh, 18 for Nepal and 6 for Sri Lanka. The number of highly-cited papers published from Pakistan in chemical engineering during 2001-10 was 3, compared to 2 for Bangladesh, 1 for Sri Lanka and 0 for Nepal.

The national publication share of Pakistan in energy was 1.95%, compared to, 2.66% for Sri Lanka, 2.53% for Bangladesh and 1.62% for Nepal during 2001-10. The world publication share of Pakistan in energy was 0.17%, compared to 0.07% for Bangladesh, 0.04% for Sri Lanka and 0.018% Nepal for during 2001-10. The average citation impact of all papers in energy during 2001-10 was highest (4.30) for Sri Lanka, followed by Pakistan (2.36), Bangladesh (1.83) and Nepal (1.29). The international collaborative publications share of Pakistan in its total publications output in energy was 19.10%, compared to 55.56% for Nepal, 46.81% for Sri Lanka and 40.48% for Bangladesh for Bangladesh in energy during 2001-10. The h-index of Pakistan publications in energy during 2001-10 was 21, compared to 21 for Sri Lanka, 15.5 for Bangladesh and 6 for Nepal. The number of highly-cited papers published from Pakistan in energy during 2001-10 was 0, compared to 0 each for Sri Lanka, Bangladesh and Nepal.

The national publication share of Pakistan in earth & planetary sciences was 1.69%, compared 4.94% for Sri Lanka, 4.66% for Nepal and to 3.56% for Bangladesh during 2001-10. The world publication share of Pakistan in earth & planetary sciences was 0.08%, compared to 0.06% for Bangladesh, 0.03% for Sri Lanka and 0.028% Nepal for during 2001-10. The average citation impact of all papers in earth & planetary sciences during 2001-10 was highest (5.27) for Nepal, followed by Sri Lanka (3.87), Bangladesh (3.62) and Pakistan (3.06). The international collaborative publications share of Pakistan in its total publications output in earth & planetary sciences was 55.11%, compared to 78.26% for Nepal, 76.72% for Sri Lanka and 54.59% for Bangladesh in earth & planetary sciences during 2001-10. The h-index of Pakistan publications in earth & planetary sciences during 2001-10 was 26, compared to 26 for Nepal, 25 for Bangladesh and 20 for Sri Lanka. The number of highly-cited papers published from Pakistan in earth & planetary sciences during 2001-10 was 3, compared to 5 for Bangladesh, 4 for Nepal and 0 for Sri Lanka.

The national publication share of Pakistan in nursing was 1.21%, compared to 1.80% for Nepal, 1.40% for Sri Lanka and 1.29% for Bangladesh during 2001-10. The world publication share of Pakistan in nursing was 0.16%, compared to 0.06% for Bangladesh, 0.03% for Sri Lanka and 0.03% Nepal for during 2001-10. The average citation impact of all papers in nursing during 2001-10 was highest (2.96) for Bangladesh, followed by Nepal (2.34), Sri Lanka (2.24) and Pakistan (1.56). The international collaborative publications share of Pakistan in its total publications output in nursing was 22.22%, compared to 67.33% for Bangladesh, 60.00% for Nepal and 54.05% for Sri Lanka in nursing during 2001-10. The h-index of Pakistan publications in nursing during 2001-10 was 15, compared to 15 for Bangladesh, 9 for Nepal and 8 for Sri Lanka. The number of highly-cited papers published from Pakistan in nursing during 2001-10 was 0, compared to 0 each for Bangladesh, Sri Lanka and Nepal.

**Table 9. World & National Publication Share in Low Productivity Subject Areas, 2001-10**

Subject	World Publication Share, 2001-10 (%)				National Publication Share, 2001-10 (%)			
	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
Immu. & Microb.	0.18	0.12	0.06	0.039	2.99	5.83	6.02	4.91
Chem. Engn	0.12	0.05	0.02	0.003	2.64	3.66	2.32	0.56
Energy	0.17	0.007	0.04	0.018	1.95	2.53	2.66	1.62
Eart & Planet Sci	0.08	0.06	0.03	0.028	1.69	3.56	4.94	4.66
Nursing	0.16	0.06	0.03	0.03	1.21	1.29	1.40	1.80

**Table 10. International Collaborative Publication Share and Citation Impact in Low Productivity Subject Areas, 2001-10**

Subject	International Collaborative Publication Share, 2001-10 (%)				Average Citation per Paper, 2001-10			
	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
Immu. & Microb.	39.25	78.79	61.76	75.23	4.97	6.81	5.01	6.58
Chem. Engn	35.48	51.41	60.16	56.00	4.46	2.39	5.42	1.84
Energy	19.10	40.48	46.81	55.56	2.36	1.83	4.30	1.29
Eart & Planet Sci	55.11	54.59	76.72	78.26	3.06	3.62	3.87	5.27
Nursing	22.22	67.33	54.05	60.00	1.56	2.96	2.24	2.34

## Least Productivity Subject Areas of Research

Veterinary science, neurosciences, public health and dentistry are considered the least priority areas of Pakistan in S&T, each contributing publication share between 0.14% and 0.98% in the cumulative national publication output of Pakistan during 2001-10. The national publication share, global publication share and international collaborative publication share of Pakistan, Bangladesh, Sri Lanka and Nepal in these four subject areas during 2001-10 are shown in Tables 11-12.

The national publication share of Pakistan in veterinary science was 0.98%, compared to, 1.44% for Bangladesh, 1.19% for Nepal and 1.11% for Sri Lanka during 2001-10. The world publication share of Pakistan in veterinary science was 0.19%, compared to 0.10% for Bangladesh, 0.03% for Sri Lanka and 0.031% Nepal for during 2001-10. The average citation impact of all papers in veterinary science during 2001-10 was highest (3.59) for Sri Lanka, followed by Nepal (2.39), Bangladesh (2.23) and Pakistan (2.05). The international collaborative publications share of Pakistan in its total publications output in veterinary science was 22.69%, compared 77.36% for Nepal, to 61.90% for Bangladesh and 61.02% for Sri Lanka in veterinary science during 2001-10. The h-index of Pakistan publications in veterinary science during 2001-10 was 15, compared to 12 for Bangladesh, 10.5 for Sri Lanka and 7 for Nepal. The number of highly-cited papers published from Pakistan in veterinary science during 2001-10 was 0, compared to 0 each for Bangladesh, Sri Lanka and Nepal.

The national publication share of Pakistan in neurosciences was 0.53%, compared to 1.17% for Sri Lanka, 0.74% for Nepal and 0.27% for Bangladesh, during 2001-10. The world publication share of Pakistan in neurosciences was 0.04%, compared to 0.01 each for Bangladesh and Sri Lanka and 0.007% for Nepal during 2001-10. The average citation impact of all papers in neurosciences during 2001-10 was highest (4.47) for Pakistan, followed by Sri Lanka (4.15), Bangladesh (3.72) and Nepal (2.52). The international collaborative publications share of Pakistan in its total publications output in neurosciences was 57.69%, compared to 87.50% for Bangladesh, 62.90% for Sri Lanka and 57.58% for Nepal in neurosciences during 2001-10. The h-index of Pakistan publications in neurosciences during 2001-10 was 17, compared to 11.5 for Sri Lanka, 7 for Bangladesh and 5 for Nepal. The number of highly-cited papers published from Pakistan in neurosciences during 2001-10 was 0, compared to 1 for Bangladesh and 0 each for Sri Lanka and Nepal.

The national publication share of Pakistan in public health was 0.43%, compared to 1.40% for Nepal, 0.66% for Sri Lanka and 0.64% for Bangladesh during 2001-10. The world publication share of Pakistan in public health was 0.06%, compared to 0.03% for Bangladesh, 0.025 for Nepal and 0.01% for Sri Lanka during 2001-10. The highest average citation impact per paper (3.87) for its total publications during 2001-10 was recorded for Pakistan, followed by Nepal (3.62), Bangladesh (3.20) and Sri Lanka (2.14). The international collaborative publications share of Pakistan in its total publications output in public health was 43.92%, compared to 62.67% for Bangladesh, 61.29% Nepal and 45.71% for Sri Lanka in public health during 2001-10. The h-index of Pakistan publications in public health during 2001-10 was 18.5, compared to 14 for Bangladesh, 10 for Nepal and 6 for Sri Lanka. The number of highly-cited papers published from Pakistan in public health during 2001-10 was 0, compared to 0 each for Sri Lanka, Bangladesh and Nepal.

The national publication share of Pakistan in dentistry was 0.14%, compared 1.91% for Sri Lanka, 0.52% for Nepal and to 0.04% for Bangladesh during 2001-10. The world publication share of Pakistan in dentistry was 0.05%, compared to 0.11% for Sri Lanka, 0.024% for Nepal and 0.01% Bangladesh for during 2001-10. The highest average citation impact per paper (4.49) for its total publications during 2001-10 was recorded for Sri Lanka, followed by Pakistan (2.81), Nepal (2.52) and Bangladesh (1.80). The international collaborative publications share of Pakistan in its total publications output in dentistry was 60.42%, compared to 80.00% for Bangladesh, 48.51% for Sri Lanka and 21.74% for Nepal in dentistry during 2001-10. The h-index of Pakistan publications in dentistry during 2001-10 was 7.5, compared to 15 for Sri Lanka, 5 for Nepal and 2 for Bangladesh. The number of highly-cited papers published from Pakistan in dentistry during 2001-10 was 0, compared to 0 each for Bangladesh, Sri Lanka and Nepal.

**Table 11. World & National Publication Share in Least Productivity Subject Areas, 2001-10**

Subject	World Publication Share, 2001-10 (%)				National Publication Share, 2001-10			
	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
Veterinary Science	0.19	0.10	0.03	0.031	0.98	1.44	1.11	1.19
Neuroscience	0.04	0.01	0.01	0.007	0.53	0.27	1.17	0.74
Public Health	0.06	0.03	0.01	0.025	0.43	0.64	0.66	1.40
Dentistry	0.05	0.01	0.11	0.024	0.14	0.04	1.91	0.52

**Table 12. International Collaborative Publication Share and Citation Impact in Least Productivity Subject Areas, 2001-10**

Subject	International Collaborative Publication Share, 2001-10 (%)				Average Citation per Paper, 2001-10 (%)			
	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
Veterinary Science	22.69	61.90	61.02	77.36	2.05	2.23	3.59	2.39
Neuroscience	57.69	87.50	62.90	57.58	4.47	3.72	4.15	2.52
Public Health	43.92	62.67	45.71	61.29	3.87	3.20	2.14	3.62
Dentistry	60.42	80.00	48.51	21.74	2.81	1.80	4.49	2.52

### International Collaboration

The share of international collaborative papers in the country research output was highest (49.16%) in Sri Lanka during 2001-10, followed by Bangladesh (47.68%), Nepal (42.01%) and Pakistan (27.92%). The share of internationally collaborative papers has marginally increased from 48.95% to 49.73% in Sri Lanka and 23.76% to 29.41% in Pakistan, compared to decrease from 47.69% to 47.67% in Bangladesh and 43.12% to 41.46% in Nepal from 2001-10 to 2006-10 (Table 13). In terms of citation impact of international collaborative papers, Nepal had achieved the highest impact of 5.21 for all papers during 2001-10, followed by Sri Lanka (4.74), Bangladesh (4.55) and Pakistan (3.93).

**Table 13. Share of International Collaborative papers of South Asian Countries, 2001-10**

Period	ICP				ICP Share			
	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
2001	250	204	102	94	18.97	34.81	42.50	48.45
2002	277	196	94	75	18.92	36.16	34.69	37.69
2003	464	356	214	138	29.33	48.70	54.04	42.20
2004	508	429	227	144	25.72	55.43	54.44	42.60
2005	634	501	252	191	24.02	55.54	51.22	44.32
2006	876	561	293	220	26.64	52.97	50.34	40.37
2007	1138	697	353	230	29.03	48.47	52.92	39.32
2008	1426	766	349	207	29.04	47.31	49.72	37.57
2009	1703	824	362	238	28.77	45.40	48.53	37.36
2010	2243	1014	375	328	31.72	46.71	47.71	51.90
2001-05	2133	1686	889	642	23.76	47.69	48.95	43.12
2006-10	7386	3862	1732	1223	29.41	47.67	49.73	41.46
2001-10	9519	5548	2621	1865	27.92	47.68	49.46	42.01

**Table 14. Collaborative Linkages of Four South Asian Countries with 45 Different Countries, 2001-10**

Countries	Pakistan	Bangladesh	Sri Lanka	Nepal	Pakistan	Bangladesh	Sri Lanka	Nepal
<b>G-8 Countries</b>								
USA	2243	1398	567	561	23.56	25.20	21.63	30.02
UK	1922	878	671	305	20.19	15.83	25.60	16.32
Germany	926	292	126	1159	9.73	5.26	4.81	62.01
Japan	534	1486	403	355	5.61	26.78	15.38	18.99
France	328	90	83	55	3.45	1.62	3.17	2.94
Canada	636	315	164	86	6.68	5.68	6.26	4.60
Italy	328	115	39	63	3.45	2.07	1.49	3.37
Russia	139	8	9	9	1.46	0.14	0.34	0.48
Sub-Total	5941	4032	1768	1322	62.41	72.67	67.46	70.73
<b>European Countries</b>								
Turkey	283	19	11	8	2.97	0.34	0.42	0.43
Switzerland	282	132	118	106	2.96	2.38	4.50	5.67
Austria	207	61	25	46	2.17	1.10	0.95	2.46
Netherlands	168	138	98	94	1.76	2.49	3.74	5.03
Spain	152	41	19	17	1.60	0.74	0.72	0.91
Romania	131	10	5	1	1.38	0.18	0.19	0.05
Belgium	97	114	47	69	1.02	2.05	1.79	3.69
Sweden	225	294	127	28	2.36	5.30	4.85	1.50
Poland	96	22	13	14	1.01	0.40	0.50	0.75
Finland	83	27	14	15	0.87	0.49	0.53	0.80
Czech Republic	65	18	14	12	0.68	0.32	0.53	0.64
Slovenia	14	4	3	1	0.15	0.07	0.11	0.05
Ukraine	46	3	4	1	0.48	0.05	0.15	0.05
Sub-Total	1404	788	413	329	14.75	14.20	15.76	17.60
<b>Pacific Countries</b>								
Australia	364	405	422	104	3.82	7.30	16.10	5.56
New Zealand	109	43	40	35	1.15	0.78	1.53	1.87
Sub-Total	458	434	452	126	4.81	7.82	17.25	6.74
<b>Developing Countries</b>								
China	857	154	105	92	9.00	2.78	4.01	4.92
South Korea	504	305	48	116	5.29	5.50	1.83	6.21
Taiwan	82	34	26	16	0.86	0.61	0.99	0.86
Singapore	117	51	62	12	1.23	0.92	2.37	0.64
Thailand	111	186	112	93	1.17	3.35	4.27	4.98
Philippines	59	70	38	27	0.62	1.26	1.45	1.44
Malaysia	298	359	68	38	3.13	6.47	2.59	2.03
South Africa	197	66	62	12	2.07	1.19	2.37	0.64
Nigeria	51	17	15	10	0.54	0.31	0.57	0.54
Brazil	135	42	38	25	1.42	0.76	1.45	1.34
Mexico	127	32	19	38	1.33	0.58	0.72	2.03
Columbia	57	128	39	54	0.60	2.31	1.49	2.89
Argentina	41	15	5	4	0.43	0.27	0.19	0.21
Saudi Arabia	517	46	3	3	5.43	0.83	0.11	0.16
Iran	224	17	29	5	2.35	0.31	1.11	0.27
Egypt	133	33	10	9	1.40	0.59	0.38	0.48
Jordan	37	3	4	3	0.39	0.05	0.15	0.16
Kuwait	114	35	5	3	1.20	0.63	0.19	0.16
Sub-Total	2949	1341	458	429	30.98	24.17	17.47	22.95
<b>South Asia</b>								
India	386	473	269	553	4.06	8.53	10.26	29.59
Pakistan		132	76	54	0.00	2.38	2.90	2.89
Bangladesh	132		45	80	1.39	0.00	1.72	4.28
Sri Lanka	76	45		46	0.80	0.81	0.00	2.46
Nepal	54	79	46		0.57	1.42	1.76	0.00
Sub-Total	542	610	342	636	5.69	10.99	13.05	34.03
Total	9519	5548	2621	1869	100.00	100.00	100.00	100.00

Among the cumulative collaborating linkages of South Asian countries with different countries (which are grouped as G-8, European countries, Pacific countries and developing countries), it was found that

Bangladesh had the highest percentage (72.67%) of cumulative collaborative linkages with G-8 countries during 2001-10, followed by Nepal (70.73%), Sri Lanka (67.46%) and Pakistan (62.41%). Nepal had also the largest share (17.60%) of cumulative collaborating linkages with European countries, followed Sri Lanka (15.76%), Pakistan (14.75%) and Bangladesh (14.20%) during 2001-10. With Pacific countries (Australia and New Zealand), Sri Lanka had the highest share (17.25%) of cumulative collaborating linkages during 2001-10, followed by Bangladesh (7.82%), Nepal (6.74%) and Pakistan (4.81%). With developing countries, Pakistan had the highest share (30.98%) of cumulative collaborating linkages during 2001-10, followed by Bangladesh (24.17%), Nepal (22.95%) and Sri Lanka (17.47%). In case of South Asian countries, Nepal had the highest share (34.03%) of cumulative collaborative linkages during 2001-10, followed by Sri Lanka (13.05%), Bangladesh (10.99%) and Pakistan (5.69%) (Table 14).

### **Geographical Distribution of Papers**

**Pakistan:** Islamabad, Karachi and Lahore are the three most productive geographical areas in Pakistan who have individually contributed 17.52% to 26.72% share individually (together 70.81%) to the total research output of Pakistan during 2001-10. Faisalabad, Rawalpindi, Peshwar, Multan and Jamshoro are the medium productive geographical areas with their individual publication share between 2.69% and 7.98%, (together 28.36%) to the total research output of Pakistan during 2001-10. Sargodha, Bahawalpur, Abbottabad, Quetta and Topi are the low productive geographical areas with their individual publication share between 1.18% and 1.84%, (together 7.43%) to the total research output of Pakistan during 2001-10 (Table 15).

**Bangladesh:** Dhaka and Rajshahi are the two most productive geographical areas in Bangladesh who have individually contributed 10.38% to 64.20% share individually (together 74.58%) to the total research output of Bangladesh during 2001-10. Mymensing, Chittagong, Khulna, Gazipur and Sylhet are the medium productive geographical areas with their individual publication share between 3.64% and 7.70%, (together 31.45%) to the total research output of Pakistan during 2001-10 (Table 15).

**Sri Lanka:** Colombo is the only most productive geographical areas in Sri Lanka who have individually contributed 36.82% to the total research output of Sri Lanka during 2001-10. Kelaniya, Moratuwa, Kandy, and Nugegoda are the medium productive geographical areas with their individual publication share between 5.0% and 8.10%, (together 29.20%) to the total research output of Sri Lanka during 2001-10. Galle, Jaffna and Battaramulla are the low productive geographical areas with their individual publication share between 1.06% and 2.60%, (together 5.43%) to the total research output of Sri Lanka during 2001-10 (Table 15).

**Nepal:** Kathmandu, Dharan and Pokhara are the three most productive geographical areas in Pakistan who have individually contributed 11.29% to 58.46% share individually (together 85.07%) to the total research output of Nepal during 2001-10. Lalitpur is the only medium productive geographical areas with its individual contribution of 4.69% in the total research output of Nepal during 2001-10. Dhulikhel, Bharatpur and Rampur are the low productive geographical areas with their individual publication share between 1.37% and 2.55%, (together 5.54%) to the total research output of Nepal during 2001-10 (Table 15).

**Table 15. Geographical Distribution of Papers, 2001-10**

Pakistan			Bangladesh		
Cities	Papers	% Share of Papers	Cities	Papers	% Share of Papers
Islamabad	9109	26.72	Dhaka	7471	64.20
Karachi	9056	26.57	Rajshahi	1208	10.38
Lahore	5971	17.52	Mymensingh	896	7.70
Faisalabad	2721	7.98	Chittagong	812	6.98
Rawalpindi	2540	7.45	Khulna	561	4.82
Peshwar	2390	7.01	Gazipur	502	4.31
Multan	1101	3.23	Sylhet	424	3.64
Jamshoro	916	2.69			
Sargodha	626	1.84			
Bahawalpur	599	1.76			
Abbottabad	453	1.33			
Quetta	451	1.32			
Topi	402	1.18			
Sri Lanka			Nepal		
Cities	Papers	% Share of Papers	Cities	Papers	% Share of Papers
Colombo	1951	36.82	Kathmandu	2595	58.46
Kelaniya	429	8.10	Dharan	680	15.32
Moratuwa	428	8.08	Pokhara	501	11.29
Kandy	425	8.02	Lalitpur	208	4.69
Nugegoda	265	5.00	Dhulikhel	113	2.55
Galle	138	2.60	Bharatpur	72	1.62
Jaffna	94	1.77	Rampur	61	1.37
Battaramulla	56	1.06			

## High Productivity Institutions

### Pakistan

Based on the analysis of the publications data during 2001-10, 20 organizations (including 13 universities, 6 research institutes and 1 hospital) were identified as most productive in S&T in Pakistan as shown in their research profile shown in Table 16. Individually, these organizations published from 428 to 3355 papers during 2001-10, with an average productivity of 1137 papers per organization. Together, they contributed 22741 papers, accounting for 66.71% share in Pakistan's total research output in S&T during 2001-10. Only 7 institutions published output above the average productivity of all institutions. These are Quaid-i-Azam University, Islamabad with 3355 papers, followed by University of Karachi (2792 papers), The Aga Khan University, Karachi (1751 papers), University of Punjab, Lahore (1747 papers), The Aga Khan University Hospital, Karachi (1575 papers), National University of Science and Technology, Rawalpindi (1327 papers) and COMSATS Institute of Information Technology, Islamabad (1229 papers). The average h-index registered by these 20 Pakistan organizations was 23.5 and only 7 institutions have scored h-index above the average h-index of all 20 organizations. These are The Aga Khan University, Karachi with h-index of 44, followed by Quaid-i-Azam University, Islamabad (43), Pakistan Institute of Nuclear Science & Technology, Islamabad (32), University of Punjab, Lahore (29), The Aga Khan University Hospital, Karachi (28) and COMSATS Institute of Information Technology, Islamabad (27). The average share of highly-cited papers (HCP) of these 20 Pakistan organizations was 2.1. Only 6 Pakistan's organizations published highly-cited papers above the average highly-cited papers of all 20 organizations. These are Quaid-i-Azam University, Islamabad with HCP of 12, followed by The Aga Khan University, Karachi (12), University of Punjab, Lahore (3), COMSATS Institute of Information Technology, Islamabad (3), Pakistan Institute of Nuclear Science & Technology, Islamabad (3) and University of Peshawar (3). The average share of international collaborative papers (ICP) of these top 20 Pakistan's organizations was 27.42%. Only 10 organizations have scored average share of ICP above the average of all organizations. These are Pakistan Institute of Nuclear Science & Technology, Islamabad with ICP share of 46.62%, followed by Quaid-i-Azam University, Islamabad (39.17%), University of Engineering & Technology, Lahore (34.76%), University of Peshawar (32.25%), COMSATS Institute of Information Technology, Islamabad (31.73%), University of Punjab, Lahore (31.70%), PCSIR Laboratories, Peshawar

(29.23%), Pakistan Institute of Engineering & Applied Sciences, Islamabad (29.0%), The Aga Khan University Hospital, Karachi (28.62%) and Bahauddin Zakariya University, Multan (27.83%).

**Table 16. Pakistan: Profile of Top 20 Most Productive Institutions, 2001-10**

S.No	Name	TP	H-Index	HCP	ICP	%ICP
1	Quaid-i-Azam University, Islamabad	3355	43	12	1314	39.17
2	University of Karachi	2792	31	0	772	27.65
3	The Aga Khan University, Karachi	1751	44	12	555	31.70
4	University of Punjab, Lahore	1747	29	3	500	31.70
5	The Aga Khan University Hospital, Karachi	1575	28	1	163	28.62
6	National University of Science and Technology, Rawalpindi	1327	18	1	421	10.35
7	COMSATS Institute of Information Technology, Islamabad	1229	27	3	573	31.73
8	Pakistan Institute of Nuclear Science & Technology, Islamabad	1137	32	3	241	46.62
9	Government College University, Lahore	1096	23	0	381	21.20
10	University of Engineering & Technology, Lahore	865	13	0	279	34.76
11	University of Peshawar	805	21	3	224	32.25
12	Bahauddin Zakariya University, Multan	715	24	1	209	27.83
13	PCSIR Laboratories, Peshawar	823	19	2	83	29.23
14	University of Sindh, Jamshoro	581	23	0	108	10.09
15	University of Sargodha	562	13	0	163	18.59
16	Pakistan Institute of Engineering & Applied Sciences, Islamabad	559	17	0	140	29.00
17	National Agricultural Research Center, Islamabad	511	18	1	127	25.04
18	Islamia University, Bahawalpur	445	20	0	114	24.85
19	University of Arid Agriculture, Rawalpindi	438	14	0	98	25.62
20	Nuclear Institute for Agriculture & Biology, Peshawar	428	13	0	80	22.37
	Total/Average	22741	23.5	2.1	6545	27.42
	Total of the Country	34088				
	% Share of Top 20 Institutions in Total Country Output	66.71%				

## Bangladesh

Based on the analysis of the publications data during 2001-10, 20 organizations (including 12 universities, 5 research institutes and 3 medical colleges & hospitals) were identified as most productive in S&T in Bangladesh as shown in their research profile shown in Table 17. Individually, these organizations published from 199 to 1646 papers during 2001-10, with an average productivity of 475.05 papers per organization. Together, they contributed 9501 papers, accounting for 81.64% share in Bangladesh's total research output in S&T during 2001-10. Only 6 institutions published output above the average productivity of all institutions. These are University of Dhaka with 1646 papers, followed by Bangladesh University of Engineering & Technology (1519 papers), Rajshahi University (1013 papers), International Center for Diarrhoeal Disease Research (1124 papers), Bangladesh Agricultural University (696 papers) and Jahangirnagar University (638 papers). The average h-index registered by these 20 Bangladesh organizations was 16.90 and only 6 institutions have scored h-index above the average h-index of all 20 organizations. These are International Center for Diarrhoeal Disease Research with h-index of 54, followed by University of Dhaka (39), Bangladesh University of Engineering & Technology (31), Jahangirnagar University (22), Rajshahi University (22) and Bangladesh Agricultural University (21). The average share of highly-cited papers (HCP) of these 20 Bangladesh organizations was 1.8. Only 4 Bangladesh's organizations published highly-cited papers above the average highly-cited papers of all 20 organizations. These are International Center for Diarrhoeal Disease Research with HCP of 15, followed by University of Dhaka (13), Bangladesh University of Engineering & Technology (3) and Jahangirnagar University (2). The average share of international collaborative papers (ICP) of these top 20 Bangladesh's



organizations was 41.70%. Only 10 organizations have scored average share of ICP above the average of all organizations. These are International Center for Diarrhoeal Disease Research with ICP share of 83.54%, followed by Bangladesh Agricultural University (64.08%), Rajshahi University (47.46%), Khulna University of Engineering & Technology (47.40%), Institute of Nuclear Science & Technology (46.90%), University of Chittagong (45.77%), Bangladesh Agricultural Research Institute (44.85%), Shahjalal University of Science & Technology (44.23%) and University of Dhaka (43.13%).

**Table 17. Bangladesh: Profile of Top 20 Most Productive Institutions, 2001-10**

S.No	Name	TP	H-Index	HCP	ICP	ICP%
1	University of Dhaka	1646	39	13	710	43.13
2	Bangladesh University of Engineering & Technology	1519	31	3	550	36.21
3	Rajshahi University	1013	22	0	415	40.97
4	International Center for Diarrhoeal Disease Research	1124	54	15	939	83.54
5	Bangladesh Agricultural University	696	21	0	446	64.08
6	Jahangirnagar University	638	22	2	360	56.43
7	Banglabandu Sheikh Mujib Medical University	445	14	1	58	13.03
8	University of Chittagong	426	15	0	195	45.77
9	Shahjalal University of Science & Technology	364	15	0	161	44.23
10	Khulna University	245	12	1	98	40.00
11	Khulna University of Engineering & Technology	192	6	0	91	47.40
12	Dhaka Medical College & Hospital	140	11	0	54	38.57
13	Bangladesh Agricultural Research Institute	136	12	0	61	44.85
14	Mymensingh Medical College	126	6	0	10	7.94
15	United International University	125	5	0	40	32.00
16	North South University	121	9	0	43	35.54
17	Rajshahi University of Engineering & Technology	118	9	1	56	47.46
18	Atomic Energy Center	115	12	0	40	34.78
19	Institute of Nuclear Science & Technology	113	8	0	53	46.90
20	Bangladesh Atomic Energy Commission, Dhaka	199	15	0	62	31.16
	Total/Average	9501	16.9	1.8	222.1	41.70
	Total of the Country	11637				
	% Share of Top 20 Institutions in Total Country Output	81.64				

## Sri Lanka

Based on the analysis of the publications data during 2001-10, 20 organizations (including 9 universities, 9 research institutes and 2 medical colleges & hospitals) were identified as most productive in S&T in Sri Lanka as shown in their research profile shown in Table 18. Individually, these organizations published from 24 to 1198 papers during 2001-10, with an average productivity of 243 papers per organization. Together, they contributed 4860 papers, accounting for 91.72% share in Sri Lanka's total research output in S&T during 2001-10. Only 7 organizations published output above the average productivity of all organizations. These are University of Peradeniya with 1198 papers, followed by University of Colombo (948 papers), University of Kelaniya (426 papers), University of Moratuwa (420 papers), International Water Management Institute, Colombo (401 papers), Institute of Fundamental Studies, Kandy (325 papers) and University of Ruhuna (267 papers). The average h-index registered by these 20 Sri Lanka organizations was 15 and only 7 organizations have scored h-index above the average h-index of all 20 organizations. These are University of Peradeniya with h-index of 36, followed by University of Colombo (33), International Water Management Institute, Colombo (31), Institute of Fundamental Studies, Kandy (28), University of Kelaniya (22), University of Ruhuna (19) and University of Sri Jayewardenepura, Nugegoda (16). The average share of highly-cited papers (HCP) of these 20 Sri Lankan organizations was 2.85. Only 3 Sri Lanka's organizations published highly-cited papers above the average highly-cited papers of all 20 organizations. These are University of Peradeniya with HCP of 41, followed by University of Colombo (6) and University of Jaffna (3). The average share of international collaborative papers (ICP) of these top 20 Sri Lanka's organizations was 43.78%. Only 9 organizations have scored average share of ICP above the average of all organizations. These are Ministry of Health, Colombo, Colombo with ICP share of 75.86%, followed by Sabaragamuwa University of Sri Lanka, Belihuloya (75.00%), International Water Management Institute, Colombo (74.56%), Coconut Research Institute of Sri Lanka, Lunuwila

(57.69%), University of Peradeniya, Kandy (57.10%), Institute of Fundamental Studies, Kandy (55.69%), Open University of Sri Lanka, Nugegoda (52.70%), University of Ruhuna, Galle (51.31%) and University of Jaffna (50.56%).

**Table 18. Sri Lanka: Profile of Top 20 Most Productive Institutions, 2001-10**

S.No	Name	TP	H-Index	HCP	ICP	% Share of ICP
1	University of Peradeniya, Kandy	1198	36	4	684	57.10
2	University of Colombo	948	33	6	410	43.25
3	University of Kelaniya	426	22	1	15	3.52
4	University of Moratuwa	420	13	1	136	32.38
5	International Water Management Institute (IWMI), Colombo	401	31	2	299	74.56
6	Institute of Fundamental Studies, Kandy	325	28	1	181	55.69
7	University of Ruhuna, Galle	267	19	0	137	51.31
8	University of Sri Jayewardenepura, Nugegoda	230	16	0	89	38.70
9	National Hospital of Sri Lanka, Colombo	129	11	1	24	18.60
10	University of Jaffna	89	13	3	45	50.56
11	Open University of Sri Lanka, Nugegoda	74	7	0	39	52.70
12	Industrial Technology Institute, Colombo	73	13	0	21	28.77
13	Ministry of Health, Colombo	58	8	0	44	75.86
14	Medical Research Institute, Colombo	45	9	1	18	40.00
15	Rubber Research Institute of Sri Lanka, Agalawatta	41	9	0	8	19.51
16	Tea Research Institute of Sri Lanka, Talawakelle	33	6	0	8	24.24
17	Coconut Research Institute of Sri Lanka, Lunuwila	26	7	0	15	57.69
18	Sabaragamuwa University of Sri Lanka, Belihuloya	24	5	0	18	75.00
19	Lady Ridgeway Hospital for Children, Colombo	29	6	0	10	34.48
20	Veterinary Research Institute, Peradeniya	24	8	0	10	41.67
	Total/Average	4860	15	2.85	110.55	43.78
	Total of the Country	5299				
	% Share of Top 20 Institutions in Total Country Output	91.72				

## Nepal

Based on the analysis of the publications data during 2001-10, 20 organizations (including 2 universities, 8 research institutes and 10 medical colleges & hospitals) were identified as most productive in S&T in Nepal as shown in their research profile shown in Table 19. Individually, these organizations published from 44 to 615 papers during 2001-10, with an average productivity of 142.15 papers per organization. Together, they contributed 2843 papers, accounting for 64.05% share in Nepal's total research output in S&T during 2001-10. Only 5 organizations published output above the average productivity of all organizations. These are Tribhuvan University, Kathmandu with 615 papers, followed by B P Koirala Institute of Health Sciences, Dharan (470 papers), Manipal College of Medical Sciences, Pokhara (249 papers), Kathmandu Medical College (175 papers) and Kathmandu University (169 papers). The average h-index registered by these 20 Nepal organizations was 10.85 and only 6 organizations have scored h-index above the average h-index of all 20 organizations. These are Tribhuvan University, Kathmandu with h-index of 29, followed by Research Laboratory for Agricultural Biotechnology & Biochemistry, Kathmandu (24), B P Koirala Institute of Health Sciences, Dharan (17), Friends of Patan Hospital, Kathmandu (12), Manipal College of Medical Sciences, Pokhara (11) and Tribhuvan University Teaching Hospital (11). The average share of highly-cited papers (HCP) of these 20 Nepal organizations was 0.75. Only 4 Nepal's organizations published highly-cited papers above the average highly-cited papers of all 20 organizations. These are Tribhuvan University, Kathmandu with HCP of 4, followed by B P Koirala Institute of Health Sciences, Dharan (1), Nepal Agricultural Research Council, Kathmandu (1) and Nepal International Clinic, Kathmandu (1). The average share of international collaborative papers (ICP) of these top 20 Sri Nepal's organizations was 42.72%. Only 10 organizations have scored average share of ICP above the average of all organizations. These are Research Laboratory for Agricultural Biotechnology & Biochemistry, Kathmandu with ICP share of 93.65%, followed by Ministry of Health & Population, Colombo (79.55%), Nepal Agricultural Research Council, Kathmandu (70.97%), Tribhuvan University Institute of Agricultural & Animal Sciences (70.59%), Institute of Engineers, Pulchowk

(68.89%), Tribhuvan University, Kathmandu (67.15%), Nepal International Clinic, Kathmandu (64.29%), International Maize and Wheat Improvement Center, Kathmandu (60.29%), International Center for Integrated Mountain Development, Kathmandu (53.33%) and Kathmandu University (49.70%).

**Table 19. Nepal: Profile of Top 20 Most Productive Institutions, 2001-10**

S.No	Name	TP	H-Index	HCP	ICP	% Share of ICP
1	Tribhuvan University, Kathmandu	615	29	4	413	67.15
2	B P Koirala Institute of Health Sciences, Dharan	470	17	1	74	15.74
3	Manipal College of Medical Sciences, Pokhara	249	11	0	25	10.04
4	Kathmandu Medical College	175	6	0	10	5.71
5	Kathmandu University	169	9	0	84	49.70
6	Manipal Teaching Hospital, Pokhara	139	9	0	17	12.23
7	Nepal Medical College, Kathmandu	129	7	0	23	17.83
8	Tribhuvan University Teaching Hospital	117	11	0	24	20.51
9	International Center for Integrated Mountain Development, Kathmandu	105	10	0	56	53.33
10	Friends of Patan Hospital, Kathmandu	72	12	0	29	40.28
11	Kathmandu Medical College Teaching Hospital	70	4	0	10	14.29
12	Tribhuvan University Institute of Agricultural & Animal Sciences	68	11	0	48	70.59
13	International Maize and Wheat Improvement Center, Kathmandu	68	15	0	41	60.29
14	Nepal Medical College Teaching Hospital	67	4	0	23	34.33
15	Research Laboratory for Agricultural Biotechnology & Biochemistry, Kathmandu	63	24	0	59	93.65
16	Nepal Agricultural Research Council, Kathmandu	62	10	1	44	70.97
17	Bir Hospital, Kathmandu	60	5	0	3	5.00
18	Nepal International Clinic, Kathmandu	56	9	1	36	64.29
19	Institute of Engineers, Pulchowk	45	5	0	31	68.89
20	Ministry of Health & Population, Colombo	44	9	0	35	79.55
	Total/Average	2843	10.85	0.75	54.25	42.72
	Total of the Country	4439				
	% Share of Top 20 Institutions in Total Country Output	64.05				

## Highly-Cited Papers

### Highly-Cited Papers of Pakistan

Pakistan has published 63 highly-cited papers in science and technology in last 10 years (2001-10) and these have received between 101 and 615 citations per paper. Of these 63 highly-cited papers, 49 were international collaborative (23 bilateral and 26 multilateral), 5 national collaborative and 9 zero collaborative. Of the international collaborative papers, Pakistan institutions were first author in only 8 papers and foreign institutions in 41 papers. Of the 63 highly-cited papers, 50 appeared as articles and 13 as review papers. In overall, Pakistan participation in these 63 papers was confined to 34 institutions, which includes 12 papers each from Quaid-i-Azam University, Islamabad and Aga Khan University, Karachi, followed by National Institute of Biotechnology & Genetic Engineering, Faisalabad (9 papers), University of Agriculture, Faisalabad (4 papers), 3 papers each from COMSATS Institute of Information Technology, Islamabad, University of Peshawar, Punjab University, Lahore and Pakistan Institute of Nuclear Science & Technology, Islamabad, 2 papers from NWFP Agricultural University, Peshawar and 1 paper each from 12 other Pakistan organizations. These 63 highly-cited papers appeared in 43 journals, including 10 papers in *Lancet*, 3 papers in *Nature*, 2 papers each in American Journal of Human Genetics, Cell, International Journal of Engineering Science, International Journal of Nonlinear Science & Numerical Simulation, Journal of Applied Microbiology, Journal of the American Chemical Society, Nature Genetics, Physics Letters, Section A and Virology and 1 paper each in 32 other journals.

### Highly-Cited Papers of Bangladesh

Bangladesh has published 39 highly-cited papers in science and technology in last 10 years (2001-10) and these have received between 100 and 415 citations per paper. Of these 39 highly-cited papers, 37 were international collaborative (28 bilateral and 9 multilateral) and 2 zero collaborative. Of the international collaborative papers, Bangladesh institutions were first author in only 7 papers and foreign

institutions in 32 papers. Of the 39 highly-cited papers, 28 appeared as articles, 10 as review papers and 1 as conference paper. In overall, Bangladesh participation in these 37 papers was confined to 12 institutions, which includes 15 papers from International Institute of Diarrhoeal Disease Research, Dhaka, 13 papers from University of Dhaka, 3 papers from Bangladesh University of Engineering & Technology, 2 papers each from Jahangirnagar University, Center for Health & Population Research, Dhaka and National Institute of Preventive & Social Medicine, Dhaka and 1 paper each from 6 other institutions. These 39 highly-cited papers appeared in 36 journals, including 5 papers each in *Journal of Physical Chemistry B* and *Lancet*, 3 papers in *Environmental Science and Technology*, 2 papers each in *Applied Geochemistry*, *Geochimica et Cosmochimica Acta* and *New England Journal of Medicine* and 1 paper each in 20 other journals.

### **Highly-Cited Papers of Sri Lanka**

Sri Lanka has published 17 highly-cited papers in science and technology in last 10 years (2001-10) and these have received between 101 and 250 citations per paper. Of these 17 highly-cited papers, all were international collaborative (10 bilateral and 7 multilateral). Of the international collaborative papers, Sri Lanka institutions were first author in only 4 papers and foreign institutions in 13 papers. Of the 17 highly-cited papers, 11 appeared as articles, 5 as review papers and 1 as editorial. In overall, Bangladesh participation in these 17 papers was confined to 13 institutions, which includes 6 papers from University of Colombo, 4 papers from University of Peradeniya, 3 papers from University of Jaffna, 2 papers from International Water Management Institute, Colombo and 1 paper each from 9 other institutions. These 17 highly-cited papers appeared in 16 journals, including 2 papers in *Lancet* and 1 paper each in 15 other journals.

### **Highly-Cited Papers of Nepal**

Nepal has published 16 highly-cited papers in science and technology in last 10 years (2001-10) and these have received between 111 and 281 citations per paper. Of these 16 highly-cited papers, all were international collaborative (6 bilateral and 10 multilateral). Of the international collaborative papers, Nepal institutions were first author in only 4 papers and foreign institutions in 12 papers. Of the 16 highly-cited papers, 14 appeared as articles, 1 as review paper and 1 as conference paper. In overall, Nepal participation in these 16 papers was confined to 15 institutions, which includes 4 papers from Tribhuvan University, Kathmandu, 2 papers each from Department of Hydrology & Meteorology, Kathmandu and Nepal Health Research Council, Kathmandu and 1 paper each from 12 other institutions. These 16 highly-cited papers appeared in 15 journals, including 3 papers in *Lancet*, 2 papers in *New England Journal of Medicine* and 1 paper each in 15 other journals.

### **Summary and Results**

Among the South Asian countries, the largest number of papers (34088) was published by Pakistan, followed by Bangladesh (11637), Sri Lanka (5299) and Nepal (4439) during the last ten years (2001-10). The highest annual average growth rate (20.74%) of publications during 2001-10 was achieved by Pakistan, followed by Bangladesh (16.37%), Nepal (15.12%) and Sri Lanka (14.68%). In terms of cumulative publications growth, Pakistan had achieved the highest growth rate of 178.68% in its cumulative publications output from 2001-05 to 2006-10, followed by 129.195% growth by Bangladesh, 91.78% by Sri Lanka and 48.12% by Nepal during the same period. In terms of publications per capita (in million), the highest (214.76) was achieved by Nepal, followed by Pakistan (192.89), Sri Lanka (185.41) and Bangladesh (7.71). In terms of publications per GDP(PPP)(\$Million), the highest (12.39) was achieved by Nepal, followed by Pakistan (7.33), Sri Lanka (4.98) and Bangladesh (4.50).

It was observed that there is some similarity among Pakistan, Sri Lanka and Nepal in terms of national subject profile when compared with world average. The three countries have strong and moderately strong profile in life and health sciences, but moderately weak and weak profile in physical sciences and engineering sciences. In contrast, Bangladesh is different and is strong in life sciences, but moderately weak in physical, engineering and health sciences.

The highest world share (0.196%) for its total publications during 2001-10 was achieved by Pakistan, followed by Bangladesh (0.067%), Sri Lanka (0.030%) and Nepal (0.025) during 2001-10. Among the twenty subjects, the world publication share of Pakistan varied from 0.038% to 0.493%, followed by Bangladesh (from 0.005% to 0.189%), Sri Lanka (from 0.024% to 0.035%) and Nepal (from 0.003% to 0.059%)

In terms of citation impact per paper on a three year citation window, the highest (3.06) was achieved by Sri Lanka, followed by Nepal (2.76), Bangladesh (2.71) and Pakistan (2.19) during 2001-10. Among the twenty subjects, the citation impact per paper varied from 0.66 to 6.81 in Bangladesh, followed by Nepal (from 0.27 to 6.58), Sri Lanka (from 0.52 to 5.42) and Pakistan (from 0.66 to 4.97) during 2001-10. Among the four South Asia countries, Pakistan leads in terms of citation impact per paper in engineering (1.72), computer science (0.66), mathematics (2.61), pharmacology, toxicology and pharmaceuticals (3.44), neurosciences (4.47) and public health (3.87), Bangladesh leads in medicine (4.02), environmental science (4.13), immunology & microbiology (6.81) and nursing (2.96), Sri Lanka leads in chemistry (5.15), physics (4.37), materials science (4.57), chemical engineering (5.42), energy (4.30), veterinary science (3.59) and dentistry (4.49) and Nepal leads in agricultural & biological sciences (3.26), biochemistry, genetics & molecular biology (4.85) and earth & planetary sciences (5.27) during 2001-10.

In terms of share of international collaborative papers during 2001-10, the highest (50.43%) was achieved by Sri Lanka, followed by Bangladesh (47.69%), Nepal (42.07%) and Pakistan (27.79%). Among the twenty subjects, the share of international collaborative papers varied from 33.29% to 87.50% in Bangladesh, followed by Nepal (from 21.74% to 78.26%), Sri Lanka (from 31.21% to 76.72%) and Pakistan (from 18.66% to 60.41%) during 2001-10. Among the four South Asia countries, Bangladesh leads in terms of share of international collaborative papers in neurosciences (87.50%), dentistry (80.00%), immunology & microbiology (78.79%), biochemistry, genetics & molecular biology (68.50%), nursing (67.33%), public health (62.67%) and medicine (48.05%), Nepal leads in earth & planetary sciences (78.26%), veterinary science (77.36%) < chemistry (75.76%), agricultural & biological sciences (74.40%), environmental science (66.34%), physics (65.00%), computer science (65.00%), materials science (64.96%), energy (55.56%) and engineering (46.62%) and Sri Lanka leads in mathematics (67.37%) and chemical engineering (60.16%) during 2001-10.

In terms of h-index of total publications during 2001-10, the highest (85) is achieved by Pakistan, followed by Bangladesh (71), Sri Lanka (59) and Nepal (53). Among the twenty subjects, the h-index varied from 7 to 55 in Pakistan, followed by Bangladesh (from 2 to 52), Sri Lanka (from 6 to 38) and Nepal (from 3 to 38) during 2001-10. Among the four South Asia countries, Pakistan leads in terms of h-index in biochemistry, genetics & molecular biology (51.5), pharmacology, toxicology & pharmaceuticals (33), mathematics (30), chemical engineering (29.5), energy (21), public health (18.5), neurosciences (17) and veterinary science (15), Sri Lanka leads in materials science (25.5), computer science (25) and dentistry (15) and Bangladesh leads in immunology & microbiology (39), environmental sciences (38) and nursing (15) during 2001-10.

In terms of highly-cited papers in total publications during 2001-10, the highest number (63) is achieved by Pakistan, followed by Bangladesh (39), Sri Lanka (17) and Nepal (16). Among the twenty subjects, the number of highly-cited papers varied from 0 to 20 in Pakistan, followed by Bangladesh (from 0 to 16), Sri Lanka (from 0 to 9) and Nepal (from 0 to 9) during 2001-10. Among the four South Asia countries, Pakistan leads in terms of number of highly-cited papers in medicine (20), biochemistry, genetics & molecular biology (13), engineering (9), immunology & microbiology (8), agricultural & biological sciences (7), physics (6), mathematics (3), chemical engineering (3) and computer science (1), Sri Lanka leads in chemistry (7) and materials science (2) and Bangladesh leads in environmental sciences (5), earth & planetary sciences (5) and pharmacology, toxicology and pharmaceuticals (1) during 2001-10.

It was observed that Bangladesh had the highest percentage (72.67%) of cumulative collaborative linkages with G-8 countries during 2001-10, followed by Nepal (70.73%), Sri Lanka (67.46%) and Pakistan (62.41%). Nepal had also the largest share (17.60%) of cumulative collaborating linkages with

European countries, followed Sri Lanka (15.76%), Pakistan (14.75%) and Bangladesh (14.20%) during 2001-10. With Pacific countries (Australia and New Zealand), Sri Lanka had the highest share (17.25%) of cumulative collaborating linkages during 2001-10, followed by Bangladesh (7.82%), Nepal (6.74%) and Pakistan (4.81%). With developing countries, Pakistan had the highest share (30.98%) of cumulative collaborating linkages during 2001-10, followed by Bangladesh (24.17%), Nepal (22.95%) and Sri Lanka (17.47%). In case of South Asian countries, Nepal had the highest share (34.03%) of cumulative collaborative linkages during 2001-10, followed by Sri Lanka (13.05%), Bangladesh (10.99%) and Pakistan (5.69%).

In terms of geographical distribution, the first top three cities in Pakistan, Bangladesh, Sri Lanka and Nepal contributed 70.81%, 82.28%, 53.00% and 85.07% share respectively in their research output during 2001-10. The next three top three cities in Pakistan, Bangladesh, Sri Lanka and Nepal contributed 22.44%, 16.11%, 15.62% and 8.86% share respectively in their research output during 2001-10.

The top 20 organizations in Pakistan, Bangladesh, Sri Lanka and Nepal during 2001-1: (i) contributed 66.71%, 81.64%, 91.72% and 64.05% share respectively in their research output, (ii) had an average productivity per organization of 1137, 475.05, 243 and 142.15 for their research output; (iii) had an international collaborative papers share of 27.42%, 41.70%, 43.78% and 42.72% respectively in their research output; (iv) had an average h-index of 23.5, 16.9, 15 and 10.85 respectively; and (v) had an average number of highly-cited papers of 2.1, 1.8, 2.85 and 0.75 respectively.

The number of highly-cited papers (with citation range) in Pakistan, Bangladesh, Sri Lanka and Nepal during 2001-10 were 63 (from 101-615 citations), 39 (from 100-415 citations), 17 (from 101-250 citations) and 16 (from 111-281 citations), respectively. Of these high citation papers in Pakistan, Bangladesh, Sri Lanka and Nepal during 2001-10, 49, 37, 17 and 16 respectively were internationally collaborative during 2001-10. The number of institutions participating in these highly-cited papers in Pakistan, Bangladesh, Sri Lanka and Nepal were 34, 12, 13 and 15 respectively during 2001-10. These highly-cited papers in Pakistan, Bangladesh, Sri Lanka and Nepal were published in 43, 36, 16 and 15 journals respectively during 2001-10.

All four South Asian countries need to increase their output and bring about improvement in the quality of research efforts. This can be done by investing much more in R&D expenditure, increase in the deployment of more qualified manpower and in increasing international collaboration and by modernizing and strengthening research infrastructure.

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