Is science in India on the decline? A rejoinder

S. Arunachalam[1] points out that in 1980 India accounted for 14,983 papers in *Science Citation Index* (*SCI*) and by 2000 this number has fallen to 12,127. During the same period China moved up from 924 papers to 22,061 papers, and the scientific output of South Korea, Brazil and Israel also increased significantly. India's rank in world output of papers covered in *SCI* slid down from 8th in 1980 to 15th, while the reverse happened in case of China. This indicates that the scientific output of India as reflected by its coverage in *SCI* has stagnated, while the output for the other four countries is on the rise. The present correspondence aims to look at the declining Indian scientific output in a wider perspective, which may provide gainful insight to those who are concerned with the improvement of Indian science and the concerned science policy-makers.

It will be worth mentioning here that the number of Indian scientific journals included in *SCI* as source journals has declined from 36 in 1980 to 10 in 2000. Thus, the Indian output for 14,983 papers in 1980, was based on the inclusion of 36 Indian scientific journals (with contribution of 3933 papers) in *SCI*, while the output of 12,127 papers for the year 2000 is based on 10 Indian journals (with contribution of 1650 papers) only. This suggests that besides other factors, the number of domestic Indian journals covered in *SCI* has also a bearing on the decline of Indian scientific output in *SCI* in the year 2000.

Now the question as to why the Chinese publication output has increased so significantly. Two possible reasons could be attributed to the sudden increase in the Chinese output in *SCI*, particularly in the year 2000: (i) The increase in the coverage of domestic Chinese journals in the *SCI* database, and (ii) merger of Hong Kong's output into the total output of China in the year 2000.

In 1980 there were only nine domestic Chinese journals contributing 564 papers to the total output of 924 papers in the *SCI* database, while in 2000, the number of domestic Chinese journals has gone up to 14, contributing 3055 papers to the total output of 22,061 papers. The increase in coverage of domestic Chinese journals as well as the increase in their output played a significant role in the increase of Chinese scientific output in *SCI*. Chinese output has further increased by the inclusion of 4,307 papers from Hong Kong for 2000. Similarly, it is true for South Korea. In 1980 no domestic journal published from South Korea found place in *SCI*, but in 2000 four domestic journals from South Korea were included as source items in *SCI*. These four domestic journals have added 981 articles to its publication output. However, one cannot deny the fact that Chinese, South Korean, Brazilian and Israel's output in international journals have also gone up compared to their output in domestic journals. In case of India, the output in both domestic and foreign journals has either declined or remained static over the years.

It is noteworthy that Chinese growth in publication output may be linked to the all-round growth in its economy, and also to its larger inputs in terms of financial, physical infrastructure and human resources in R&D. On the other hand, India's static output over the years may be attributed to its ageing and declining scientific population, lack of motivation, and incentives for scientists to perform, a feudal work culture, absence of dynamic and inspiring leadership, besides a lack of sufficient encouragement and incentives to bright students to take up science as a career at young age[2,3]. This is also reflected in a study by Kumar *et al.*[4], where the authors point out that the interest of fresh graduates in the pursuit of doctoral/post-doctoral studies (a potential source of output in mainstream journals) in science has decreased in India in recent years, while the same has gone up considerably for China[5]. Among the various sectors contributing to Indian science, the major decline has come in the academic sector, which used to contribute substantially in the past[3,6].

Another way of looking at the output is by normalizing the publication data of 16 countries for 1998 and 2000 (Table 1) and for India, China, South Korea, Brazil and Israel from 1980 to 2000 (Table 2) using the activity index (AI). AI was first proposed by Frame[7] and later elaborated by Schubert and Braun[8]. It characterizes the relative research effort a country devotes to a given subject field. The same methodology can be used to normalize the publication data of different countries for different years. Here AI = {(Country's output in a particular year)/(Country's output for all years)/(World output for that particular year)/(World output for all years)} × 100.

A glance at normalized publication data for 16 countries (Table 1) for the years 1998 and 2000 indicates that except for China and South Korea, the publication activity for the other 14 countries including India has not changed significantly. However, in case of China and South Korea, the increase in publication activity is about 47% and 25%, respectively. When the normalized publication data for five countries (India, China, South Korea, Brazil, and Israel) from 1980 to 2000 are considered, we get a slightly different picture (Table 2). A higher growth in publication activity was observed for South Korea, followed by China and Brazil. However, a declining trend in the publication activity was observed for both India and Israel.

Table 1. Activity index of publication output of different countries for 1998 and 2000*

Country	Activity index 1998	Activity index 2000
USA	101	99
Japan	101	99
UK	100	100
Germany	102	98
France	102	98
Canada	100	100
Italy	100	100
Russia	101	99
China	81	119
Spain	99	101
Australia	99	101
Netherlands	100	100
Sweden	101	99
Switzerland	100	100
India	101	100
South Korea	89	111

*AI has been rounded off to the nearest whole number.
AI = {(Country's output in a particular year)/(Country's output for all years)/(World output for that particular year)/(World output for all years)} × 100.

Table 2. Activity index of publication output for 1980–2000 for different countries*

	Activity index				
Year	India	China	Israel	South Korea	Brazil
1980	183	17	112	7	74
1981	169	31	114	11	83
1982	152	50	121	14	79
1983	148	56	122	18	75
1984	148	55	124	21	73
1985	135	60	130	27	82
1986	128	67	126	31	95
1987	120	73	130	37	92
1988	116	93	124	41	77
1989	117	95	112	50	83
1990	109	108	107	53	87
1991	108	105	102	63	97
1992	103	109	100	70	100
1993	92	105	101	122	93
1994	94	105	103	103	99
1995	83	112	97	129	108
1996	79	110	93	147	113
1997	69	121	88	161	118
1998	67	123	83	174	118
1999	63	132	73	183	124
2000	55	154	67	183	118

*AI has been rounded off to the nearest whole number.

Arunachalam[1] is also silent on the quality of research output. When impact of papers is considered in terms of citation rate (number of citations per paper) for 1980–84 and 1989–93, it has been observed that citation rate for India is higher than China for both the blocks[9,10]. However, citation rate for both countries has declined, from 2.47 to 1.09 for India and from 1.44 to 0.97 for China for the same period. Dhawan[11], Garg[12], and Arunachalam[13] in their studies on physics, laser, and diabetes research in India and China also point out that Indian papers have better citation rate than those from China.

If India is concerned about the decline in its scientific output in *SCI* database, she needs to improve the overall quality of the domestic journals to meet the criteria for their inclusion in the *SCI* database. Besides, Indian scientists should be encouraged to publish their quality work in domestic journals. This would certainly go a long way in gaining lost ground and enhancing the India's visibility in the scientific arena.

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B. M. GUPTA
K. C. GARG

National Institute of Science, Technology and Development Studies, Pusa Gate, K. S. Krishnan Marg, New Delhi 110 012, India

The menace of acronyms

It is a well-known fact that diverse scientific disciplines have advanced at a strikingly rapid pace in recent years. Even a scientist who is highly specialized in a very narrow area of study finds it difficult to keep track of what is happening in his own field of specialization because of the rapid advances being made. Just as people have resorted to the 'Fast Food' culture in the very busy world, scientists too have also been forced to adapt themselves to a 'Fast Science' culture. Science communication has not only become on-line, but has also tended to become highly shortened. One of the hallmarks of such a growing tendency is the phenomenal increase in the use of acronyms for just about anything and everything. A rough estimate made by this author has indicated that less than 600 acronyms only were in use in biology two decades back, but now the number has increased to more than 6000.

Too many acronyms have necessitated the creation of separate dictionaries for acronyms. It is often taken for granted that a person reading a scientific communication should know the expansions for all acronyms used, which, however, is not true. A simple test was given by me to a group of postgraduate biology students, where I had asked them to write the expansion for DNA. Although all of them knew about DNA, surprisingly only 10% of the students correctly wrote the expansion. This leads to the question: Do acronyms tend to totally replace the original expanded version? And do students, researchers and teachers feel that expanded versions for acronyms are no longer necessary? In this connection, I shall narrate an incident that happened recently. In a public viva-voce examination of a Ph D scholar who had worked on genetic transformation and who had