

CHAPTER VII

RESEARCH AND DEVELOPMENT OUTPUT INDICATORS

Indicators are tools to assist in the assessment of some activity, action or consequence. Research and Development (R&D) is a systematic and creative work undertaken in order to increase the stock of knowledge and use of this knowledge to devise new application for increasing productivity, decreasing production costs, develop new products and processes etc. In an R&D environment it is generally easy to measure input than output, as outputs are partly intangible in nature and cannot be quantified readily. Besides, there are certain conceptual difficulties in defining the output of R&D in clear and unambiguous terms. For example, while it is easy to count the number of scientists employed, it is difficult to describe the quality distribution within such scientific manpower. However, one can make an attempt to collect data on output parameters like patents and know-how developed and utilized, royalties and fees received from the processes sold out, research papers and other publications which might directly or indirectly measure the outcome of R&D.

A variety of patent indicators have been of late used as a measure of inventiveness and output from R&D, particularly with regard to the industrial sector. The patent provides protection to avoid unauthorized duplication (or copying) of the invention. Data on patents registered in a particular year and comparison with data of similar nature of the previous years indicate the direction in which the research efforts of the country are progressing. Annual reports of Controller General of Patents, Designs and Trade Marks contain time-series data on patents covering various facets. As is known, patents can be registered not only in one's own country but in other countries too. Tables containing detailed information on applications for patents from persons in India and abroad, applications for patents filed in India by foreign countries, patents filed and granted are given at the end. Though data is available regarding the number of applications filed for patents by foreign nationals in India, information on Indian applying for patents in other countries is not readily available from these Annual Reports. To that extent, the data presented in the ensuing paragraphs is incomplete.

The data for the last decade shows that the highest number of 12613 applications have been made during 2003-04. This figure for 2002-03 was 11466. About 74.5% of the total applications for patents received in 2003-04 were in the name of foreigners residing abroad and only 25.5% were in the name of Indian nationals. (Ref. Table 29)

Table 7.1 provides information on the country-wise number of applications filed for patents in India for

a few selected countries during 2002-03 and 2003-04. The number of applications for patents received from abroad during 2003-04 were 9395 as against 8773 during the year 2002-03.

Table 7.1

COUNTRY WISE NUMBER OF APPLICATIONS FILED FOR PATENTS IN INDIA

Name of the country	(Number)	
	No. of applications filed	
	2002-03	2003-04
U.S.A.	2416	3128
Germany	857	939
Japan	731	484
France	299	436
U.K.	391	418
Switzerland	418	341
Netherlands	391	264
Italy	118	167
Russia	11	20
Other Countries	3141	3198
Total of Foreign Countries	8773	9395
India	2693	3218
Total Applications	11466	12613

It may be seen from Table 7.1 that USA accounted for 33.3% of the total applications received from foreign nationals during 2003-04. USA together with Germany, Japan, UK, and France accounted for about 57.5% of total applications received from foreigners during 2003-04. (Ref. Table 32)

During the year 2003-04, 3218 applications for patents were filed by Indian nationals. Out of these, 53.3% originated from the states of Delhi and Maharashtra. Together with the States of Tamil Nadu (10.3%) and Andhra Pradesh (6.9%), these four states accounted for 70.5% of total number of applications filed in the country by Indian Nationals.

Table 7.2 gives information on the number of patents granted in the name of Indians and Foreigners during the last ten years period. The number of patents granted during the year 2003-04 was 2469, out of this 56.3% were in the name of the foreign citizens and 43.7% in the name of Indian citizens. It may be observed from Table 7.2 that the share of patents granted to Indians has shown an increasing trend from 2000-01 onwards except for the year 2002-03.

Table 7.2**PATENTS GRANTED IN INDIA**

Year	(Number)		
	Indians	Foreigners	Total
1994-95	476	1283	1759
1995-96	415	1118	1533
1996-97	293	614	907
1997-98	619	1225	1844
1998-99	645	1155	1800
1999-00	557	1324	1881
2000-01	399	919	1318
2001-02	654	937	1591
2002-03	494	885	1379
2003-04	1078	1391	2469

During the year 2003-04, 6,406 patents were in force. Out of these, 67.6% were in the name of foreign nationals. The share of foreign patents in force has declined from 87.8% in 1976-77 to 67.6% in 2003-04. (Ref. Table 32).

The data on a number of parameters like products developed, processes developed, import substitutes developed, design prototypes developed and consultancy services rendered by R&D institutions in different sectors were collected from the primary source through the national survey. Table 7.3 presents the data.

It may be kept in mind while making use of these data that the response for questions related to R&D output was low and not always complete. Besides, it is also possible that the data provided by the responding units may be cumulative rather than for each year separately. No quantitative evaluation of the output reported has been done. It may be seen from Table 7.3 that in most of the cases private sector has a major share except in cases of import substitutes developed and consultancy services rendered where public sector industry and institutional sector dominates the other sectors.

The measurement of the number of scientific publications by field and countries is an indicator of the status of scientific research in that area. The results of scientific research can be disseminated through publication of papers in research journals and also through presentation of papers in national and international seminars/workshops. Information on the number of papers published or the technical reports published has been compiled based on the DST survey separately for institutional and industrial sector and is presented in Table 7.4.

Ideally, academic institutions and also individual researchers not assigned to organized laboratories should also have been included in the National Survey but due to limitations of resources, this survey has been restricted to research laboratories under the central and state governments and in-house R&D units of public and private sector industries. Therefore, the data given in Table 7.4 should be used as indicative rather than exact. The reservations about data in Table 7.3 expressed earlier also hold good for the data in Table 7.4.

Table 7.3**R&D OUTPUT BY SECTOR, 1999-2000**

R&D Output	(Number)				Total
	Institutional Sector		Industrial Sector		
	Central Sector	State Sector	Public Sector	Private Sector	
Products developed	758	339	376	4583	6056
Processes developed	282	112	156	1683	2233
Import substitutes developed	97	43	1344	1183	2667
Design prototypes developed	2954	56	169	1014	4193
Consultancy services rendered	10050	18798	210	6510	35568

Table 7.4

PAPERS/BOOKS PUBLISHED BY SECTOR, 1999-2000

(Number)

Publications	Institutional Sector	Industrial Sector	Total
Papers published	15168	1805	16973
Books published	653	103	756
Technical Reports Published	3272	2017	5289

The number of research papers published by India indicated in the above table is incomplete due to reasons mentioned above. However, one can get an idea of the total number of S&T publications originated from India by searching the representative International Databases.

A core database for each subject has been selected and the number of papers listed in that database

with an Indian address were counted as the number of peer-reviewed publications. Database covered were CAB Abstracts (Agriculture), BIOSIS Previews (Life Sciences), CA Search (Chemical Sciences), GEOREF (Earth Sciences), Ei Compendex Plus (Engineering), Mathsci (Mathematics), EMBASE (Medical Sciences) and INSPEC (Physical Sciences). The search strategy adopted was to look for an Indian address in the

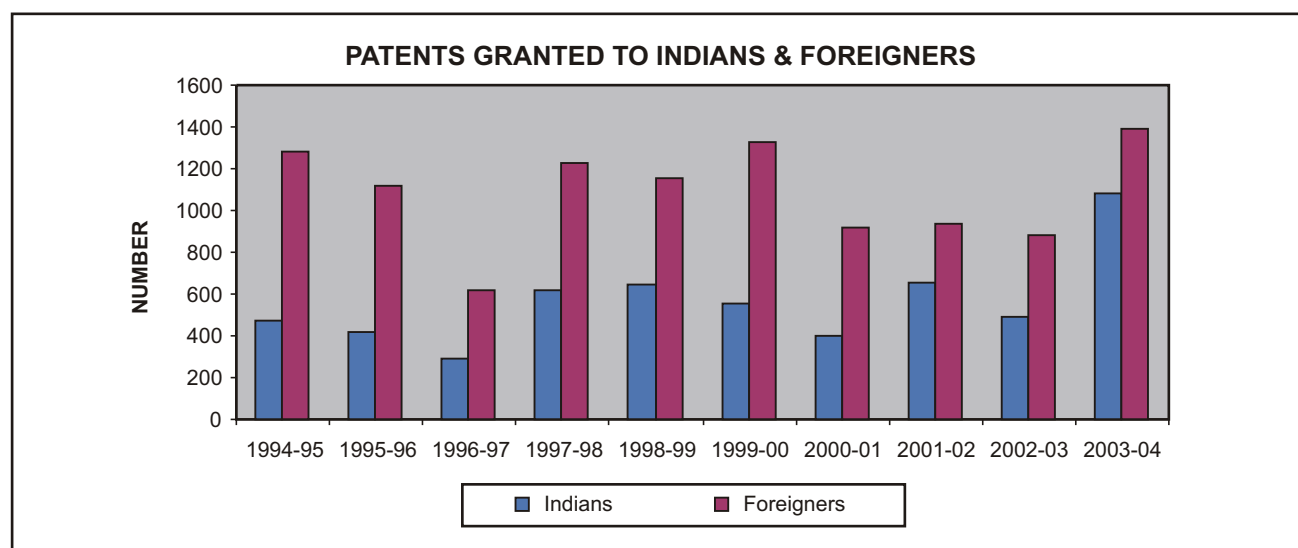


Table 7.5

RESEARCH PAPERS PUBLISHED FROM INDIA DURING 1994-2003

Subject Area\Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total
Agriculture	10756	11064	11204	11205	12667	12585	13052	13215	13984	13637	123369
Biological Sciences	10386	10340	9664	9479	9735	9766	9700	9560	10257	10765	99652
Chemical Sciences	13218	12717	13611	13807	14534	14047	14786	15461	16479	17502	146162
Earth Sciences	985	1577	1277	1124	1336	1274	1540	1465	900	794	12272
Engineering	4295	3664	4579	4721	3813	4495	4573	4890	5794	8248	49072
Mathematics	1495	1853	2294	2286	2173	1464	1549	1575	1777	1587	18053
Medical Sciences	4215	3988	4151	4517	4654	5647	5602	6161	7415	9094	55444
Physical Sciences	5652	5709	5655	5647	5732	5746	6019	6141	7746	7203	61250
Grand Total	51002	50912	52435	52786	54644	55024	56821	58468	64352	68830	565274

Corporate Source (CS) field of respective databases. Accordingly, on-line searches were made in respect of these databases for the period 1994 to 2003 and the data thus obtained is given in Table 7.5. The output of each search also provide the total publications from world by which one can get an idea of India's contribution to world publications. The information based on these databases is given in Table 7.5.

It may be seen from Table 7.5 that the number of papers published in the areas of Chemical Sciences, Agriculture and Biological Sciences were more as

compared to other subjects during 2003. Table 7.6 shows that out of total papers published by the world, Indian contribution in Agriculture is 7.4% followed by Mathematics with 2.2% and Chemical Sciences with 1.99% during the period 1994-2003.

The percentage contribution in the areas of Earth Sciences and Engineering were 1.97% and 1.93% respectively. Indian contribution to Physical Sciences, Biological Sciences and Medical Sciences were of the order of 1.83%, 1.77% and 1.32% respectively during the period of 1994 to 2003.

Table 7.6

SUBJECT AREA-WISE NUMBER OF PAPERS PUBLISHED FROM INDIA AND WORLD DURING 1994-2003

	Number of Papers from		India's Contribution to World Papers (Percentage)
	India	World	
Agricultural Sciences	123369	1654127	7.4%
Biological Sciences	99652	5632833	1.77%
Chemical Sciences	146162	7326840	1.99%
Earth Sciences	12272	621149	1.97%
Engineering	49072	2541754	1.93%
Mathematics	18053	815761	2.21%
Medical Sciences	55444	4206720	1.32%
Physical Sciences	61250	3347694	1.83%
Total	565274	26146878	2.16%

To sum up, the salient features are as under:

- Out of 12613 applications filed for patents 3218 applications were filed by Indians during 2003-04. Among these, more than 50% patents were from the States of Maharashtra and Delhi. This was followed by Tamil Nadu and Andhra Pradesh with 10.3% and 6.9% respectively.
- USA alone accounted for 33.3% of the total applications filed for patents by foreign nationals during 2003-04.
- The number of foreign patents in force has declined from 19,780 in 1976-77 to 4,331 in 2003-04.
- Based on the core databases in various areas of science & technology during 1994 to 2003 India's contribution to world publications were of the order of 2.16%.
- Out of total research papers published from India in the respective fields of science, Agriculture contributed 7.4% of the world total.