CHAPTER VII

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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 numbers of 28940 applications for patents have been made during 2006-07. This figure for 2005-06 was 24505. About 81.6% of the total applications for patents received in 2006-07 were in the name of foreigners residing abroad and only 18.4% were in the name of Indian nationals (Ref. Table 32).

Table 7.1 provides information on the country-wise number of applications filed for patents in India for a few selected countries during 2005-06 and 2006-07. The numbers of applications for patents received from abroad during 2006-07 were 23626 as against 19984 during the year 2005-06.

Table 7.1

COUNTRY WISE NUMBER OF APPLICATIONS FILED FOR PATENTS IN INDIA

(Number)

Name of the Country	Number of application filed	
	2005-06	2006-07
U.S.A.	8048	8389
Germany	1736	2329
Japan	1555	1887
Switzerland	927	1330
France	1022	1226
Netherlands	837	1108
U.K.	796	933
Italy	377	576
Russia	34	45
Other Countries	4652	5803
Total of Foreign Countries	19984	23626
India	4521	5314
Total Applications	**24505**	**28940**

It may be seen from Table 7.1 that USA accounted for 35.5% of the total applications received from foreign nationals during 2006-07. USA together with Germany, Japan, Switzerland, France and Netherlands accounted for about 68.9% of total applications received from foreigners during 2006-07 (Ref. Table 33).

During the year 2006-07, 5314 applications for patents were filed by Indian nationals. Out of these, 54.9% originated from the states of Delhi and Maharashtra. Together with the States of Karnataka (11.2%) and Andhra Pradesh (7.2%), these four states accounted for 73.3% 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 2006-07 was 7539 out of this 74.7% were in the name of the foreign citizens and 25.3% 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 2003-04 onwards except for the year 2004-05.

Table 7.2

PATENTS GRANTED IN INDIA

(Number)

Year	Indians	Foreigners	Total
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	945	1524	2469
2004-05	764	1147	1911
2005-06	1396	2924	4320
2006-07	1907	5632	7539

During the year 2006-07, 17066 patents were in force. Out of these, 79.6% were in the name of foreign nationals. The share of foreign patents in force has declined from 87.8% in 1976-77 to 79.6% in 2006-07. (Ref. Table 35).

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 case of consultancy services rendered where 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.

Table 7.3

R&D OUTPUT BY SECTOR, 2004-05

(Number)

R&D Output	Institutional Sector		Industrial Sector		Total
	Central Sector	State Sector	Public Sector	Private Sector	
Products Developed	457	178	468	8681	9784
Processes Developed	298	243	183	2733	3457
Import Substitutes Developed	37	38	2240	2921	5236
Design Prototypes Developed	4226	49	264	5915	10454
Consultancy Services Rendered	6786	16729	222	1916	25653
Patents Filed	706	11	175	2308	3200
Patents Sealed	322	3	74	599	998

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.

The number of research papers published by India indicated in the above table is incomplete due to reasons mentioned earlier in this chapter. 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 numbers of papers listed in that database with an Indian address were counted as the number of peer-reviewed publications. Database

Table 7.4

PAPER/BOOKS PUBLISHED BY SECTOR, 2004-05

(Number)

Publications	Institutional Sector	Industrial Sector	Total
Papers published	13463	4616	18079
Books published	711	603	1314
Technical Reports Published	4440	2455	6895

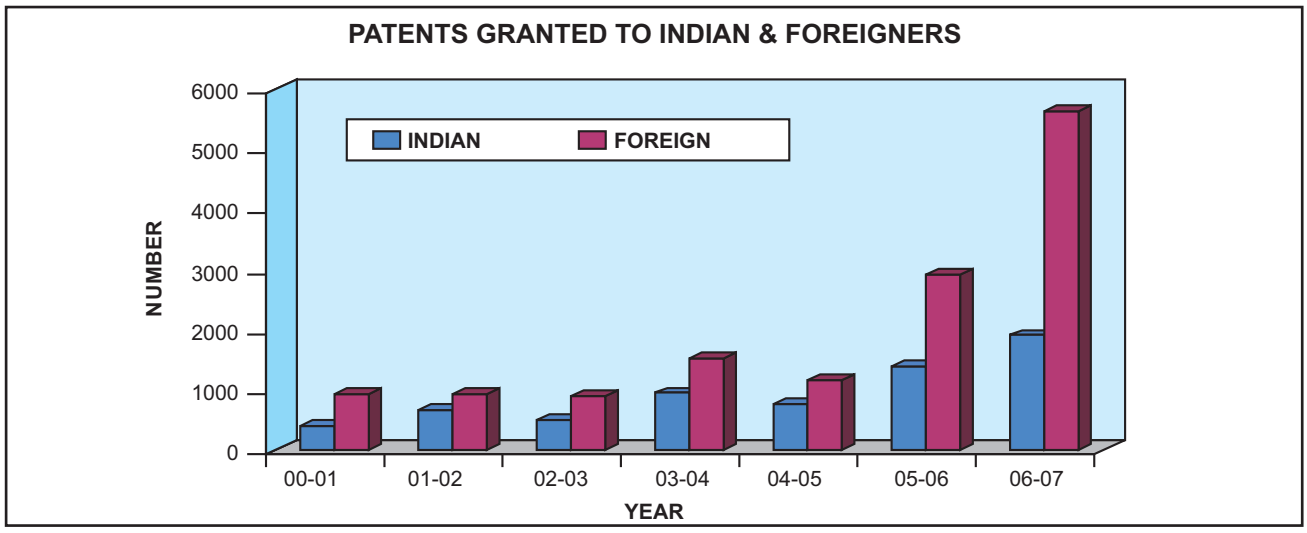

Table 7.5

RESEARCH PAPERS PUBLISHED FROM INDIA DURING 1995-2005

(Number)

Subject Area	Year											Total
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
Agriculture	11064	11204	11205	12667	12585	13222	13520	14516	14576	14323	16526	145408
Biological Sciences	10340	9664	9479	9735	9766	9700	9581	10451	10918	10635	12491	112760
Chemical Sciences	12717	13611	13807	14534	14047	14829	15512	16724	18389	21186	23668	179024
Earth Sciences	1577	1277	1124	1336	1274	1600	1656	1094	1168	1121	1212	14439
Engineering	3664	4579	4721	3813	4495	4578	4899	6079	8656	10405	11945	67834
Mathematics	1853	2294	2286	2173	1464	1563	1594	1865	1776	1672	1739	20279
Medical Sciences	3988	4151	4517	4654	5647	6011	6391	7942	10141	10604	12142	76188
Physical Sciences	5709	5655	5647	5732	5746	6019	6162	7783	7571	8408	9574	74006
Grand Total	**50912**	**52435**	**52786**	**54644**	**55024**	**57522**	**59315**	**66454**	**73195**	**78354**	**89297**	**689938**

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 Corporate Source (CS) field of respective databases. Accordingly, on-line searches were made in respect of these databases for the period 1995 to 2005 and the data thus obtained is given in Table 7.5. The output of each search also provides 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 2005. Table 7.6 shows that out of total papers published by the world, Indian contribution in Agriculture is 7.46% followed by Mathematics with 2.24% and Chemical Sciences with 2.06% during the period 1995-2005.

The percentage contribution in the areas of Earth Sciences and Engineering were 2.03% and 1.94% respectively. Indian contribution to Physical Sciences, Biological Sciences and Medical Sciences were of the order of 1.87%, 1.82% and 1.53% respectively during the period of 1995 to 2005.

Table 7.6

SUBJECT AREA - WISE NUMBER OF PAPERS PUBLISHED FROM INDIA AND WORLD DURING 1995 - 2005

Subject Area	Number of Papers from		India's Contribution to World Papers (%)
	India	World	
Agricultural Sciences	145408	1948153	7.46%
Biological Sciences	112760	6200085	1.82%
Chemical Sciences	179024	8676142	2.06%
Earth Sciences	14439	712176	2.03%
Engineering	67834	3500503	1.94%
Mathematics	20279	904931	2.24%
Medical Sciences	76188	4984064	1.53%
Physical Sciences	74006	3954958	1.87%
Total	**689938**	**30881012**	**2.23%**

To sum up, the salient features are as under:

- Out of 28940 applications filed for patents 5314 applications were filed by Indians during 2006-07. Among these, more than 50% patents were from the States of Maharashtra and Delhi. This was followed by Karnataka and Andhra Pradesh with 11.2% and 7.2% respectively.
- USA alone accounted for 35.5% of the total applications filed for patents by foreign nationals during 2006-07.
- The number of foreign patents in force has declined from 19,780 in 1976-77 to 13593 in 2006-07.
- Based on the core databases in various areas of science & technology during 1995 to 2005 India's contribution to world publications were of the order of 2.23%.
- Out of total research papers published from India in the respective fields of science, Agriculture contributed 7.46% of the world total.