

An overview of extramural research and development funding in India

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Realizing the need to receive a substantial gain through application of science and technology (S&T) for the upliftment of economy, the Indian Government shoulders about 75% of the financial support towards national research and development (R&D) expenditure. All the major scientific agencies of central government sponsor R&D projects, better known as extramural R&D projects, to individual scientists to carry out time-bound research in the areas of their interest. Analysis of these extramural R&D projects gives a good reflection of magnitude of R&D activities in various scientific disciplines within the country. The present paper analyses the extramural R&D projects funded by major central government S&T departments/agencies during the five-year period (1990–95) in terms of pattern of funding by types of institutions and by broad subject areas. The analysis also covers year-wise and agency-wise R&D support. Regional distribution of R&D projects and their support in India is also studied.

INDIA has a very broad-based infrastructure of science and technology (S&T). The government of India is the chief patron of scientific and industrial research in the central sector, shouldering about 75% of the total financial burden of national research and development (R&D) expenditure¹. In the central sector, scientific research is carried out mainly under certain government departments and autonomous/funded agencies, both of which are specifically charged with R&D functions. In this category of R&D bodies, there are two types of departments/agencies: R&D-performing bodies and R&D-sponsoring bodies. Department of Atomic Energy (DAE), Department of Space (DOS), Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), etc. are examples of R&D-performing bodies, and departments like Department of Science and Technology (DST), Department of Biotechnology (DBT), and Department of Ocean Development (DOD) belong to the second category of R&D bodies^{2,3}.

Although the former category also supports extramural research, it is the latter which plays a major role in promotion of scientific research through time-bound R&D projects. All these scientific agencies of central government are sponsoring R&D projects to individual scientists to carry out specific time-bound research projects in the areas of their interest. Such projects are known as sponsored R&D projects or extramural R&D projects. One of the major objectives of extramural R&D project

funding is to build general research capability in the country and provide special encouragement to scientists to pursue a research career.

In this paper, an overview of the extramural R&D projects funded by major central government departments/agencies in India during the five-year period (1990–95), is presented. Such a study not only brings out funding patterns of sponsored research by major scientific agencies within the country but also gives a good reflection of the magnitude of R&D activities carried out in various scientific disciplines through extramural research support.

The data base

The National Science and Technology Management Information System (NSTMIS) scheme under the DST has been maintaining a data base on extramural R&D projects funded by various central government departments/agencies since 1985. Almost all the central S&T departments in India such as DST, DBT, DAE, DOD, Department of Electronics (DOE), Department of Education (DOED), Department of Coal (DOC), Defence Research and Development Organization (DRDO), Department of Non-Conventional Energy Sources (DNES), Department of Space (DOS), Ministry of Environment and Forests (MOEN), Ministry of Water Resources (MOWR), Ministry of Welfare (MOW), Indian Council of Agricultural Research (ICAR), Indian Council of Medical Research (ICMR), Council of Scientific and Industrial Research (CSIR), Central Board of Irrigation and Power (CBIP), and University Grants Commission

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(UGC) have specific schemes to sponsor R&D projects and are included in this data base. These agencies invite time-bound projects from individual scientists in universities/colleges, institutes of national importance, national laboratories, public sector undertakings and other registered bodies. This data base of DST was undertaken for the detailed analysis of extramural projects.

Methodology

The expenditure on R&D incurred by any S&T agency and the research projects sponsored by it to various academic and other institutions can give an idea of the magnitude of R&D activities carried out by that scientific agency. If the same is studied for all the major central S&T departments/agencies, it can throw some light on extramural research support within the country⁴.

Keeping this in view, the extramural R&D projects funded by major S&T departments/agencies in India during the period 1990–95, are analysed in terms of pattern of funding by types of institutions and by broad subject areas. The analysis also covers year-wise and agency-wise funding patterns during this period. Regional distribution of R&D projects and their support in India is also studied.

Results and discussions

The project cost referred to here means the total approved cost of the project for the initial approved duration of the project. The information pertaining to Department of Mines, Ministry of Non-Conventional Energy Sources and Ministry of Urban Affairs & Employment is not covered fully. The information pertaining to the Ministry of Environment & Forests for the year 1994–95 is not included⁵. These limitations have to be kept in view while drawing any inferences from this analysis.

A total of 6791 R&D projects costing Rs 547.64 crores were approved by 22 central government departments/agencies of India during the period 1990–95. In all, 1095 institutions received R&D (extramural) support from these 22 S&T departments/agencies. These institutions are comprised of 133 universities, 443 colleges, 16 deemed universities, 9 institutes of national importance, 233 national laboratories and 261 registered bodies and other state government departments etc. The average cost of an R&D project was about Rs 8.06 lakhs. Analysis of these 6791 projects approved during 1990–95 is given in the following paragraphs.

Year-wise funding

Table 1 gives year-wise R&D support by 22 funding agencies during 1990–95. It also indicates that on an

average 1358 projects were funded with an average cost of Rs 109.53 crores every year.

Funding by major scientific departments/agencies

The data on the R&D support by various funding agencies during 1990–95 show that maximum number of projects were approved by DST (1810) (Table 2). On an average, 362 new projects were sanctioned by DST, 159 by UGC and 158 by CSIR per year.

The extramural R&D support by DST was the highest with 153.32 crores (28%), followed by DBT with 133.64 crores (24%). DST and DBT's share in total R&D funding was more than 50%. Forty-six projects were high-costing projects with approved cost of Rs 1.00 crore and above. Out of these, 22 projects were funded by the DBT alone (see Figure 1).

In-depth analysis of the data on year-wise basis shows that the funding support by DST was maximum in all the five years except 1992–93 where funding by DBT reached its maximum. CSIR maintained the funding support more or less at a uniform level in all the five years.

Funding by subject areas

The projects are classified into eight major subject areas as follows: Agricultural sciences, Biological sciences, Chemical sciences, Earth sciences, Engineering & technology, Mathematics, Medical sciences and Physical sciences. The classification has been done based on the subject area indicated by the agencies and also based on the title of the projects. Some of the projects may be multi-disciplinary in nature, but have been classified into one of the above areas depending on their major bias. Table 3 shows the number of projects approved in each subject area along with financial support.

It may be seen from Table 3 that among subject areas listed, biological sciences received maximum support by way of number of projects followed by engineering, medical sciences and agricultural sciences. In other words, biological sciences, engineering, medical sciences and agricultural sciences (combined) received 70% of the total projects. One reason could be that biological sciences area is supported by many funding agencies

Table 1. Year-wise R&D support during 1990–95

Year	Number of projects	Total approved cost (Rs in crores)
1990	1225	99.47
1991	1149	85.16
1992	1420	104.51
1993	1440	127.16
1994	1557	131.34
Total	6791	547.64

Table 2. Department/agency-wise support to extramural R&D projects during 1990-95

Department/Agency	Number of projects	Total approved cost (Rs in crores)	Order*
Department of Atomic Energy (DAE)	312	15.37	10
Department of Biotechnology (DBT)	440	133.64	2
Department of Coal (DOC)	44	20.40	8
Department of Education (DOED)	261	17.21	9
Department of Electronics (DOE)	98	29.29	4
Department of Mines (DOM)	3	0.25	22
Department of Ocean Development (DOD)	54	23.28	6
Department of Science & Technology (DST)	1810	153.32	1
Ministry of Environment & Forests (MOEN)	211	11.27	14
Ministry of Non-Conventional Energy Sources (MNES)	65	8.96	15
Ministry of Urban Affairs & Employment (URBD)	7	0.34	21
Ministry of Water Resources (MOWR)	38	1.57	18
Ministry of Welfare (MOW)	26	2.72	17
Central Board of Irrigation & Power (CBIP)	226	12.67	13
Council of Scientific & Industrial Research (CSIR)	792	28.50	5
Defence Research & Development Organization (DRDO)	260	20.47	7
Indian Council of Agricultural Research (ICAR)	634	36.41	3
Indian Council of Medical Research (ICMR)	645	13.07	12
India Meteorological Department (IMD)	8	0.60	20
Indian Space Research Organization (ISRO)	52	3.39	16
University Grants Commission (UGC)	797	14.19	11
Steel Authority of India Limited (SAIL)	8	0.72	19
Total	6791	547.64	

*Order is based on total approved cost.

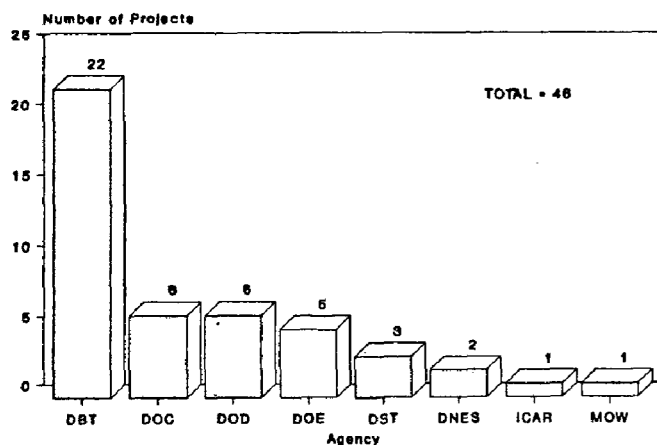


Figure 1. Agency-wise distribution of R&D projects costing Rs 1 crore and above (1990-95).

such as DST, DBT, CSIR, MOEN, DOED, etc. On the other hand, major research support for areas like agricultural sciences, medical sciences and mathematics comes through specialized agencies such as ICAR, ICMR, DAE respectively.

Maximum financial resources were received by engineering (29%) followed by biological sciences (28%). The extramural support to the mathematics area was the least (0.7%). The average per project cost of an engineering project was the highest (Rs 10.92 lakhs), while the average cost of a project in the area of mathematics was the least (Rs 3.92 lakhs) (see Figure 2).

Table 3. Subject area-wise extramural R&D support during 1990-95

Subject	Number of projects	Total approved cost (Rs in crores)
Agricultural sciences	799	64.06 (11.70%)
Biological sciences	1660	155.67 (28.43%)
Chemical sciences	789	34.52 (6.30%)
Earth sciences	532	45.70 (8.34%)
Engineering & Technology	1433	156.44 (28.57%)
Mathematics	97	3.80 (0.69%)
Medical sciences	865	40.64 (7.42%)
Physical sciences	616	46.81 (8.55%)
Total	6791	547.64 (100%)

Further analysis on the cost range (Table 4) reveals that maximum number of R&D projects approved, were costing below Rs 5 lakhs (4058 projects or 60%). Twenty-three per cent of the projects were in the cost range of Rs 5 to 10 lakhs. There were 315 projects costing Rs 25 lakhs and above. Out of these, 182 projects were in the cost range of Rs 25 to 50 lakhs and 87 in the range of Rs 50 lakhs to 1 crore. Only 46 projects (0.7%) were in the cost range of Rs 1 crore and above.

Funding by types of institutions

The institutions have been classified into five categories as follows: (i) Universities/Colleges; (ii) Deemed universities; (iii) Institutes of national importance such as Indian Institutes of Technology, All India Institute of

Medical Sciences, Post-Graduate Institute of Medical Education and Research (Chandigarh), Sree Chitra Tirunal Institute of Medical Sciences and Technology; (iv) National Research Laboratories, i.e. laboratories under CSIR, ICAR, ICMR, DRDO and autonomous institutions under central government ministries/departments, central public sector undertakings; (v) Others—Institutions which are not covered under (i), (ii), (iii), (iv) above. It may be seen that the institutions under (i), (ii), (iii) together form the academic sector.

Table 5 shows the number of projects and their approved cost by types of institutions during the period 1990–95. The data indicate that majority of the R&D projects were sanctioned to academic sector. 4174 projects (62%) went to universities/colleges/deemed universities and 908 (13%) to institutes of national importance. In other words, the academic sector received 5082 projects

(75%), amounting to Rs 307.70 crores. National laboratories received 1114 projects (16%) and the remaining 595 projects (9%) went to 'other' institutes such as registered bodies, state government organizations, etc.

Further analysis indicates that 56% of the R&D support was given to the academic sector. It varied from a minimum of 46.85% during 1990–91 to a maximum of 65.35% during 1994–95 (Figure 3).

Altogether, 1095 institutions received these 6791 projects. This included 576 universities/colleges (133 universities and 443 colleges), 16 deemed universities, 9 institutes of national importance, 233 national laboratories and 261 registered bodies and state government departments, etc. 576 universities/colleges put together received 35.6% of total support. The 133 universities received 30.35% of support. However, the total percentage of support to 443 colleges (medical, engineering

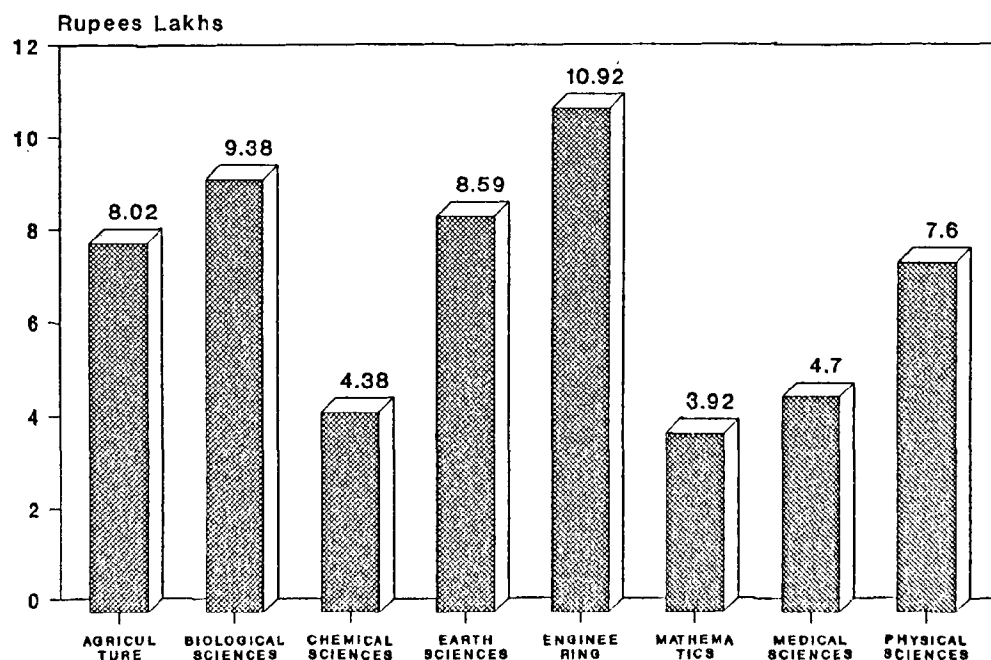


Figure 2. Subject area-wise average cost per project during 1990–95.

Table 4. Subject area-wise extramural R&D projects by approved cost range during 1990–95

Subject	Number of projects by cost range (range Rs lakhs)							Total
	< 1	1–5	5–10	10–15	15–20	20–25	≥ 25	
Agricultural sciences	16	460	226	35	19	8	35	799
Biological sciences	240	751	313	145	57	50	104	1660
Chemical sciences	69	517	140	35	18	4	6	789
Earth sciences	43	272	136	45	7	3	26	532
Engineering & Technology	53	509	518	161	57	42	93	1433
Mathematics	25	64	5	1	–	1	1	97
Medical sciences	351	330	76	47	22	14	25	865
Physical sciences	51	307	132	58	19	24	25	616
Total	848	3210	1546	527	199	146	315	6791

Table 5. Extramural R&D support by types of institutions during 1990-95

Institute	Number of projects		Total approved cost (Rs in crores)	
Universities/Colleges (i)	3772	(55.5%)	195.09	(35.6%)
Deemed universities (ii)	402	(5.9%)	45.92	(8.4%)
Institutes of national importance (iii)	908	(13.4%)	66.69	(12.2%)
National laboratories (iv)	1114	(16.4%)	184.94	(33.8%)
Others (v)	595	(8.8%)	55.00	(10.0%)
Total	6791	(100%)	547.64	(100%)

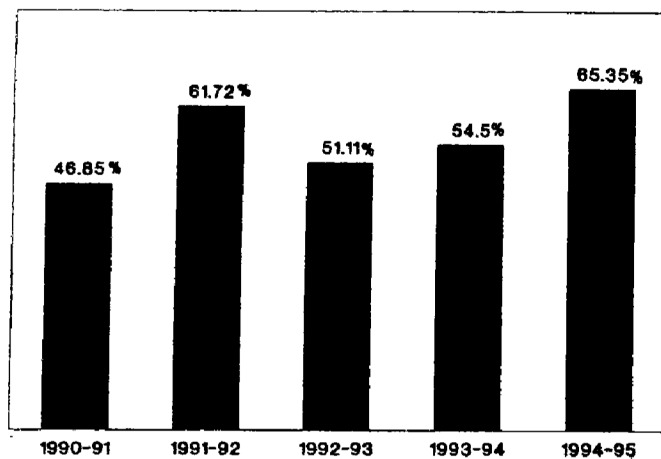


Figure 3. Percentage of R&D support to academic sector during 1990-95

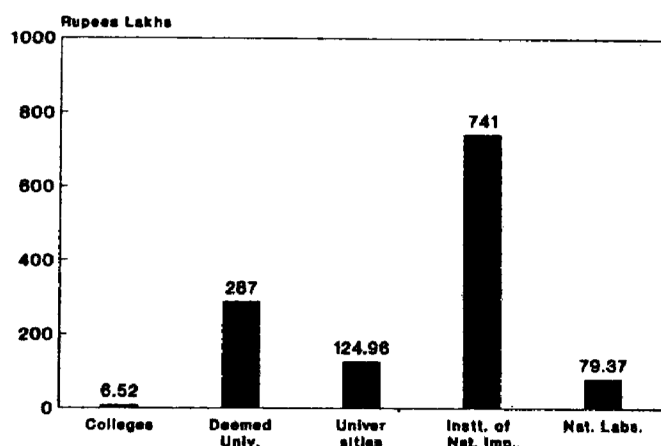


Figure 4. Average support per institute (category-wise) during 1990-95.

and sciences) was only 5.28% (Rs 28.89 crores). Three universities (Banaras Hindu University, Delhi University and Madurai Kamaraj University) alone received 25.82 crores, amounting to 15.5% of the support given to universities. This may be because R&D atmosphere is already existing in these universities, and the faculty are aware of the various R&D funding programmes at the national level. Therefore, a concerted effort is required

Table 6. Distribution of R&D projects by cities during 1990-95

City	Number of projects	Total approved cost (Rs in crores)
Delhi (88)	760	69.15
Bangalore (48)	505	49.65
Calcutta (53)	375	29.52
Chennai (51)	355	28.04
Mumbai (44)	328	29.40
Hyderabad (39)	310	35.15
Pune (40)	231	20.51
Varanasi (6)	181	9.72
Chandigarh (7)	174	14.60
Lucknow (22)	155	11.18
Kanpur (10)	152	11.17
Thiruvananthapuram (14)	115	7.82
Roorkee (5)	99	5.99
Kharagpur (1)	98	7.09
Coimbatore (17)	93	8.25
Bhubaneswar (13)	83	8.58
Jaipur (8)	74	3.49
Waltair (5)	66	3.85
Madurai (10)	66	8.12
Ludhiana (3)	64	2.96
Vadodara (12)	59	3.45
Tiruchirapalli (7)	57	2.80
Mysore (8)	55	3.49
Bhopal (11)	51	9.30
Nagpur (14)	50	5.33
Indore (11)	50	3.53

Based on selected cities having 50 or more approved projects. Number of institutions in each city is given in parentheses.

to bring in more universities to participate in the R&D activities, and form a part of its promotional programmes. Support given to 233 national laboratories was 33.8% of the total R&D support.

It is worth mentioning that six institutions alone (5 IITs and IISc, Bangalore) received 15% (Rs 82.18 crores) of the total R&D support. The average support per institute (category-wise) during the entire period 1990-95, is shown in Figure 4.

Analysis by region

It is perhaps interesting to analyse the regional distribution of R&D projects in India. An analysis of concentration of projects in various cities of India shows that the institutions in Delhi received the highest number of projects (11.2%) followed by Bangalore (7.4%). Table 6

Table 7. State-wise distribution of R&D projects during 1990–95

State	Number of projects	Total approved cost (Rs in lakhs)
Andaman & Nicobar (1)	3	21.20
Andhra Pradesh (85)	502	4637.18
Arunachal Pradesh (3)	5	51.67
Assam (23)	56	306.59
Bihar (45)	137	1484.52
Chandigarh (7)	174	1460.10
Daman & Diu (1)	1	0.15
Delhi (88)	761	6921.44
Goa (5)	36	510.33
Gujarat (45)	177	1721.27
Haryana (19)	107	745.89
Himachal Pradesh (16)	69	314.64
Jammu & Kashmir (8)	32	168.59
Karnataka (85)	683	5859.25
Kerala (44)	260	2335.66
Madhya Pradesh (52)	240	2050.51
Maharashtra (134)	742	6094.89
Manipur (4)	24	109.25
Meghalaya (4)	43	377.11
Mizoram (5)	7	27.17
Orissa (31)	145	1123.06
Pondicherry (7)	23	88.22
Punjab (13)	127	720.92
Rajasthan (41)	176	1058.90
Sikkim (1)	1	3.15
Tamil Nadu (127)	718	5828.21
Tripura (1)	10	39.30
Uttar Pradesh (125)	930	5986.78
West Bengal (75)	602	4718.72
Total	6791	54764.67

Number of institutions in each state is given in parentheses.

gives the distribution of projects in twenty-six cities of India.

Table 7 gives information on state-wise support to extramural R&D projects. During 1990–95, 6791 projects were approved. Out of these, 56% of the projects were received by the institutes located in five states, viz. Uttar Pradesh, Delhi, Maharashtra, Tamil Nadu and Karnataka.

During 1990–95, 1095 institutions were provided R&D (extramural) support. Maximum number of institutions (134) receiving the support were in Maharashtra followed by Tamil Nadu (127) and Uttar Pradesh (125).

Delhi, Karnataka and Andhra Pradesh have more or less equal number of R&D institutes (about 85 each). 81% of the total R&D support was shared by institutions based in 9 states such as Delhi, Maharashtra, Uttar Pradesh, Karnataka, Tamil Nadu, West Bengal, Andhra Pradesh, Kerala and Madhya Pradesh. The reason could be that major R&D institutions like Indian Institutes of Technology (IITs), Indian Institute of Science (IISc), All India Institute

of Medical Sciences (AIIMS) and Banaras Hindu University (BHU) are located in these states.

Summary and conclusion

During the period 1990–95, 6791 projects worth Rs 547.64 crores were sanctioned by 22 central government departments/agencies of India. The extramural R&D support increased from Rs 99.47 crores in 1990–91 to Rs 131.34 crores in 1994–95. The average cost per project works out to Rs 8.06 lakhs. In all, 1095 institutions were provided R&D support by these 22 departments/agencies. These institutions are comprised of 133 universities, 443 colleges, 16 deemed universities, 9 institutes of national importance, 233 national laboratories and 261 registered bodies and state government departments. DST (28%) and the DBT (24%) were the two departments playing a major role in extramural R&D funding. Engineering sciences received the highest support (28.57%) very closely followed by biological sciences (28.43%). The average cost per project in the area of engineering sciences was the highest (Rs 10.92 lakhs) and the least in the area of mathematics (Rs 3.92 lakhs). Academic sector received 56% of the total extramural R&D support during 1990–95, while national laboratories received 34% support. The 133 universities put together received 30% of the total support. The five IITs and IISc, Bangalore, received 15% of the total R&D support. Eighty-one per cent of the total R&D support was shared by institutions based in Delhi, Maharashtra, Uttar Pradesh, Karnataka, Tamil Nadu, West Bengal, Andhra Pradesh, Kerala and Madhya Pradesh.

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