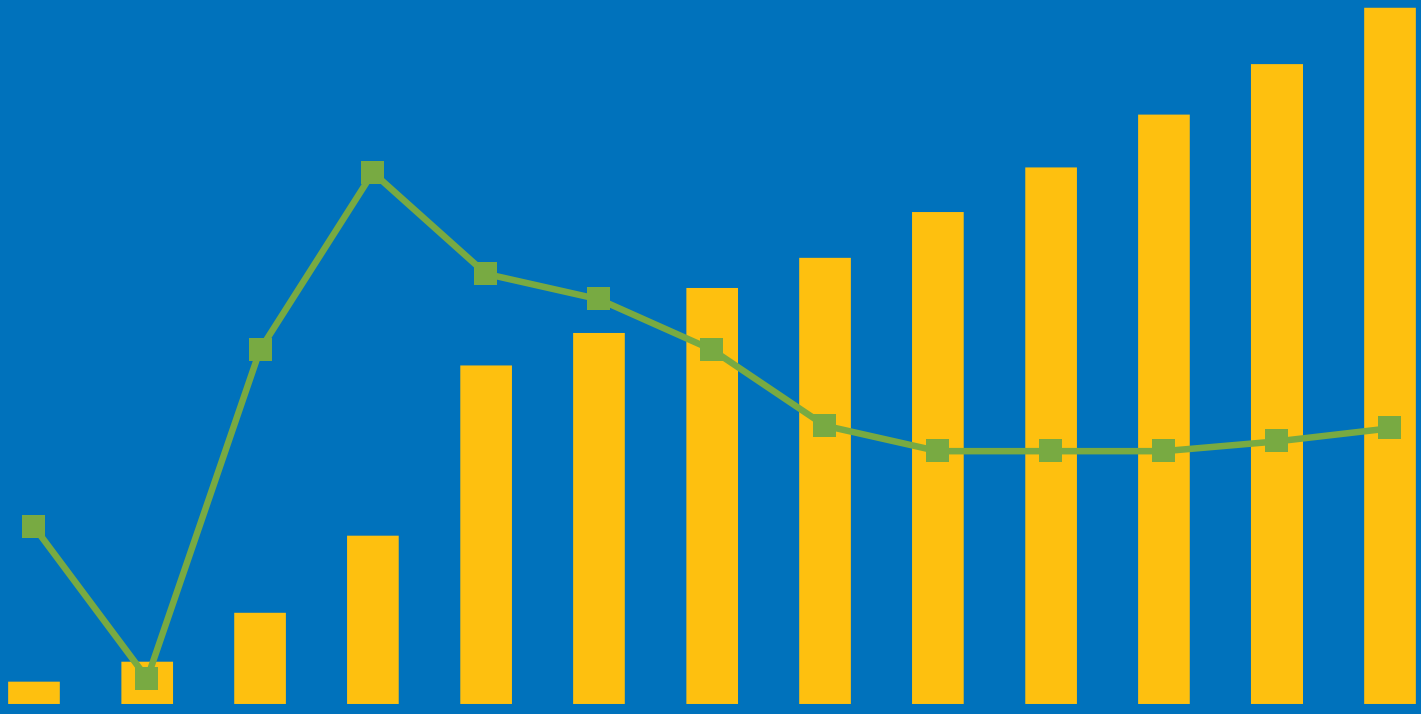
RESEARCH AND DEVELOPMENT STATISTICS

2019-20



सत्यमेव जयते

GOVERNMENT OF INDIA
MINISTRY OF SCIENCE & TECHNOLOGY
DEPARTMENT OF SCIENCE & TECHNOLOGY
NEW DELHI-110016 (INDIA)
December 2020

Cover figure represents:
National R&D expenditure and its percentage to GDP over the years.

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Note: **1 Crore = 10^7 = 10.0 million**
1 Lakh = 10^5 = 0.1 million

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Due to recent nomenclature, Ministry of Human Resource Development referred to in this report may be read as Ministry of Education.

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SECRETARY

भारत सरकार
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FOREWORD

Financial and human resources directed towards Research and Development (R&D) represent principal "Inputs" to R&D and are used as indicators of the status of R&D effort in any country. The Department of Science & Technology (DST) has been undertaking biennial National Surveys since 1973-74 to collect valuable statistics on these resources deployed on R&D activities in India. Based on the data thus collected, a number of analytical reports are being published by the Department. While collecting the data, the UNESCO recommendations on science and technology are adopted so that the data are comparable with other countries.

The present publication "**Research and Development Statistics, 2019-20**" is based on the survey conducted during 2018-19. DST has strived together data from a large number of scientific agencies, research laboratories, socio-economic ministries/departments, public and private sector industries including multi-national companies. The report presents analysis on a number of parameters based on data drawn from the primary and secondary sources such as higher education in S&T, patents, etc. including bibliometric analysis of scientific publications. The report includes several cross tabulations on financial and manpower resources deployed for R&D by sector/objectives/fields of science/industry groups/qualification/nature of activity/gender/emoluments, etc. Data mining and data reduction have considerable challenges. There are some inescapable situations in which data estimations are unavoidable. Under such circumstances proven statistical methods of estimations have been used to bridge the gap.

The planning and execution of the National Survey, data compilation, data analysis and preparation of this exhaustive publication has been completely done in-house by the team comprising Dr. Parveen Arora, Dr. A.N. Rai and Mr. P.K. Arya.

The Department is thankful to all the scientific agencies/departments and in-house R&D labs for their cooperation in providing valuable data without which this publication would not have been possible at all. The present publication is useful for evidence-based policy planning for Indian Science Sector. We would welcome constructive suggestions/comments for enrichment of this publication.

(Prof. Ashutosh Sharma)
Secretary
Department of Science & Technology
Government of India

December, 2020

सत्यमेव जयते

Dr. Parveen Arora
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PREFACE

The National Science and Technology Management Information System (NSTMIS), Department of Science and Technology (DST), Government of India, has been conducting periodically national surveys to collect data on resources devoted to S&T activities (mainly R&D) in the country. Based on survey data, a number of national S&T indicators reports are published which serves as an evidence-base for S&T assessment and policy formulation in the country.

The national S&T survey 2018-19 captured the information from around 5000 R&D organizations viz., public sector, private sector, MNCs, higher education, SIROs and NGOs spread across the country. A structured questionnaire utilising international standardization of S&T resources was designed for seeking information primarily on financial and human resources in S&T.

In view of the digital era, the national S&T survey was conducted on a web-based platform to minimize the time lag and to ensure smooth accomplishment of such a mammoth task. Though both the off-line and on-line modes were followed to collect survey response, interestingly more than 75% of the respondent preferred submitting response in on-line mode.

The publication is widely used by professionals engaged in policy making, planning, science, administration, industry, teaching and research apart from other stakeholders active in S&T sector in the country.

The Department acknowledges the effort of professional team from TERI, New Delhi towards the automation and execution of the national survey exercise and ICAR-NAARM, Hyderabad for the execution of state sector survey under the overall supervision and guidance of NSTMIS, DST. The cooperation and response received from various central government scientific departments/ agencies, research institutions both public and private and other stakeholders for providing valuable information for the publication is also greatly acknowledged.

The Department welcomes any comments/suggestions to further enrich this publication, available at www.dst.gov.in and www.nstmis-dst.org for the users.

(Dr. Parveen Arora)
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December, 2020

RESEARCH AND DEVELOPMENT STATISTICS 2019-20

HIGHLIGHTS

- The national investment on R&D activities attained a level of Rs. 1,13,825.03 crore in 2017-18. The same is estimated to be Rs. 1,23,847.71 crore in 2018-19.
- 0.7% of Gross National Product was devoted to R&D during 2017-18 and 2018-19 respectively.
- The percentage share of Private Sector in National R&D expenditure has increased from 32.1% in 2010-11 to 36.8% in 2017-18.
- The percentage share of Central Government, State Governments, Higher Education and Public Sector Industries in national R&D expenditure during 2017-18 was 45.4%, 6.4%. 6.8%, 4.6% respectively.
- In the Institutional Sector, excluding Higher Education Sector, about 23.9% of the total expenditure was spent on basic research, 36.9% on applied research, 32.4% on experimental development and rest 6.8% on supporting activities.
- 63.2% of the total R&D expenditure was met from government sources and 36.8% came from private sources during 2017-18.
- 84.4% of the R&D expenditure incurred by Central Government sources came from 12 major scientific agencies - CSIR, DRDO, DAE, DBT, DST, DOS, MES, ICAR, ICMR, MEITY, MNRE, MOEFCC. Amongst the major scientific agencies, DRDO accounted for 31.6% alone.
- State Sector spent Rs. 7,264.81 crore on R&D activities during 2017-18. Around 88% of the total investment on R&D activities by State Sector was on development of agriculture and allied areas.
- Industrial Sector spent Rs. 47,109.13 crore on R&D activities and accounted for 41.4% of National R&D expenditure during 2017-18.
- India's per capita R&D expenditure has increased to PPP $ 47.2 in 2017-18 from PPP $ 29.2 in 2007-08.
- The R&D manpower has increased to 3.42 lakh in 2018 from 2.83 lakh in 2015.
- During 2018, nearly 5.52 lakh personnel were employed in the R&D establishments in the country. Out of this 61.1% were performing R&D activities, 17.9% were performing auxiliary activities and 20.3% were providing administrative and non-technical support.
- There were 56,747 women directly engaged in R&D activities which constitute 16.6% of the total R&D manpower.
- India's researchers per million population has increased to 255 in 2017 from 218 in 2015.
- India's significant increase in research output is reflected in publication databases: by 50% from 90,864 in 2011 to 1,36,238 in 2016 in SCOPUS; by 36.5% from 47,081 in 2011 to 64,267 in 2016 in SCI; and by 83.1% from 74,143 in 2011 to 1,35,788 in 2018 in NSF.
- India's growth rate of scientific publication during 2011–2016 as per the SCOPUS and SCI database was 8.4% and 6.4% as against the world average of 1.9% and 3.7% respectively. It was 12.9% as against the world average of 4.9% as per the NSF database.
- India was ranked at 3rd, 5th and 9th in scientific publication output during 2018 as per the NSF, SCOPUS and SCI database respectively. India is ranked ahead of many developed and developing countries including BRICS except China.
- 13,045 patents were sealed in the year 2017-18. Out of which 1,937 patents were sealed by Indians.
- Out of 15,550 patents filed by Indians at Indian Patent Office during 2017-18, 65% of them were filed from the States of Maharashtra, Karnataka, Tamil Nadu and Delhi.
- Out of the total 32,304 Patents filed by foreigners in India during 2017-18, United States of America topped the list with a share of 56.3%.
- There were 993 Universities/Deemed Universities, 127 institutes of national importance and 39,931 colleges during 2018-19 imparting higher education in the country.

CHAPTER I

CHAPTER I

NATIONAL RESOURCES FOR RESEARCH AND DEVELOPMENT

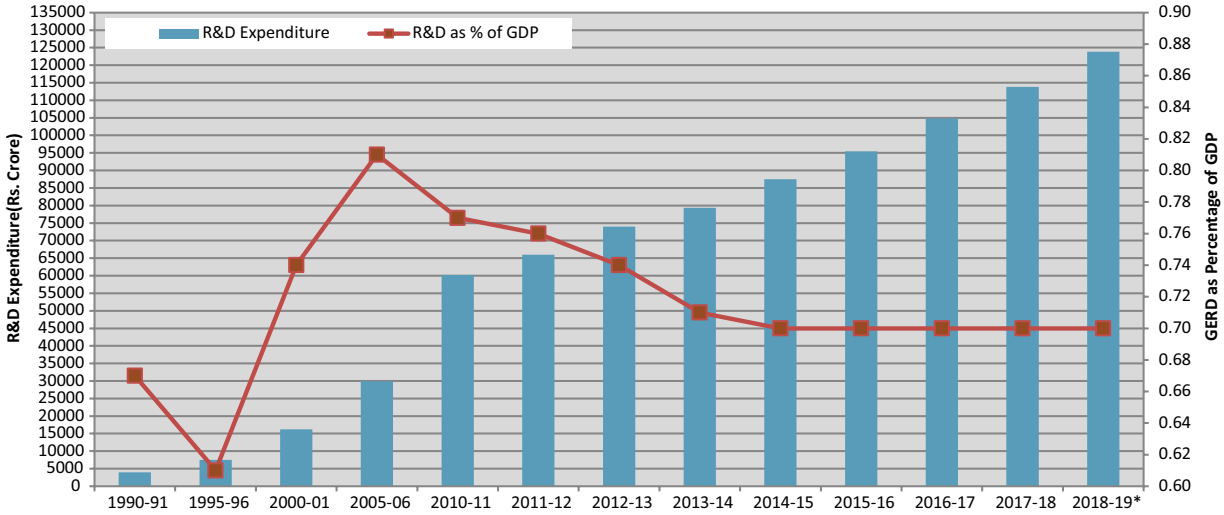
The Indian Research and Development (R&D) System can be grouped by way of a variety of performers and funding sources. The performers include the national laboratories, universities, in-house R&D laboratories and non-profit organisations. The funding sources include the Central Government, State Governments and the industry. In the Central Government, scientific research is carried out under both these groups. R&D performing bodies inter alia included Department of Atomic Energy (DAE), Department of Space (DOS), Defence Research and Development Organisation (DRDO), Council of Scientific and Industrial Research (CSIR) and Indian Council of Agricultural Research (ICAR). In the R&D funding group fall the Department of Science and Technology (DST), Department of Biotechnology (DBT), Ministry of Earth Sciences (MES) etc among others.

Although the primary role of R&D performing group is to undertake R&D, they also sponsor some amount of extramural research in the areas of their interest. On the other hand, the R&D funding group is primarily engaged in its major role of promoting scientific research in extramural or sponsored mode. Research carried out by the Public Sector, Private Sector and Non-Governmental Organization is supported mainly with their own sources. Academic Sector performs R&D through both intramural as well as extramural sources.

It may not be out of place to mention that under this survey the scope and coverage of the R&D activities has been revised and substantially enlarged by including R&D expenditure incurred by multinational companies or enterprises, small-scale industries and companies not covered by the Department of Scientific and Industrial Research (DSIR) under its recognition Scheme.

The national expenditure on R&D has increased from Rs. 95,452.44 crore in 2015–16 to Rs. 1,03,099.26 crore in 2016–17 and to Rs. 1,13,825.03 crore in 2017–18. By applying the rates of growth for five years from 2012–13 to 2017–18 for central, state

Figure 1.1: NATIONAL R&D EXPENDITURE AND ITS PERCENTAGE WITH GDP



* Estimated

and private sectors and from 2010–11 to 2015–16 for higher education sector, the projected R&D expenditure would attain a level of Rs. 1,23,847.71 crore in 2018–19 (Fig. 1.1). The compound annual rate of growth of R&D expenditure at current prices for the period 2012–13 to 2017–18 works out to be 9.0% and the rate of growth of R&D expenditure at constant prices for the same period was 5.1%. R&D expenditure at constant prices (base: 2011–12) has increased from Rs. 78,801.61 crore in 2015–16 to Rs. 82,535.91 crore in 2016–17 and further to Rs. 87,756.49 crore in 2017–18. R&D expenditure at constant prices has been worked out by using GDP price deflators as per Economic Survey 2018–19.

The share of the various sectors in the total R&D expenditure for the year 2017–18 was—central government including the public sector industry 50.0%, private sector 36.8%, the state governments 6.4% and the higher education 6.8% (Fig. 1.2).

It would be appropriate to mention here about the sector-wise growth of R&D Institutions in the country. In 2018, out of a total of 6,862 R&D Institutions, 63% of the R&D institutions were in the private sector industry followed by state sector 15%, higher education sector 10% while other sectors occupied a share of less than 10%. A consistent increase in share of R&D Institutions was witnessed during the survey years 2018 and 2010 for both private sector industry and higher education sector by 10% and 3% respectively. In contrast, a consistent decline in share of R&D Institutions was observed for other sectors during the aforementioned survey years (Fig. 1.3).

It is interesting to observe from the figure below that the share of the private sector investment in National R&D has increased significantly by 94% during the years 2001–02 to 2017–18 (Fig. 1.4).

In absolute terms, the private sector investment in national R&D has increased by seven times from Rs. 6038.96 crore in 2004–05 to Rs. 41,855.88 crore in 2017–18 whereas the government sector increased by four times during the same period from Rs. 18,078.28 crore in 2004–05 to Rs. 71,969.15 crore in 2017–18 respectively (Fig. 1.5).

If one considers industrial sector (or Business Enterprises Sector) as a whole comprising both public and private sector, the share of Industrial sector in the total national R&D expenditure increased from 34.2% in 2009–10 to 41.4% in 2017–18. The increase in the share of R&D expenditure

Figure 1.2: NATIONAL R&D EXPENDITURE BY SECTOR, 2017-18

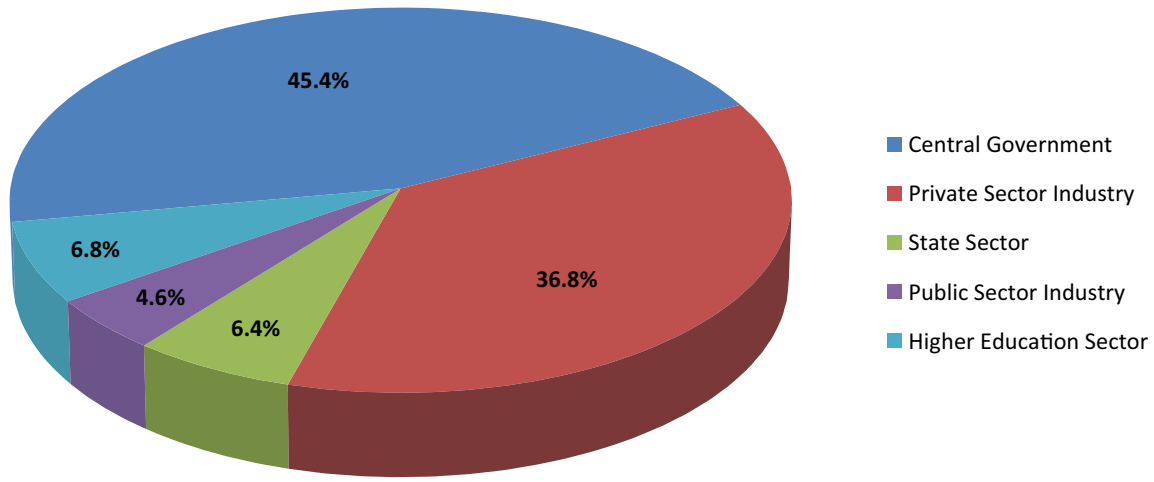


Figure 1.3: DISTRIBUTION OF R&D INSTITUTIONS BY SECTOR

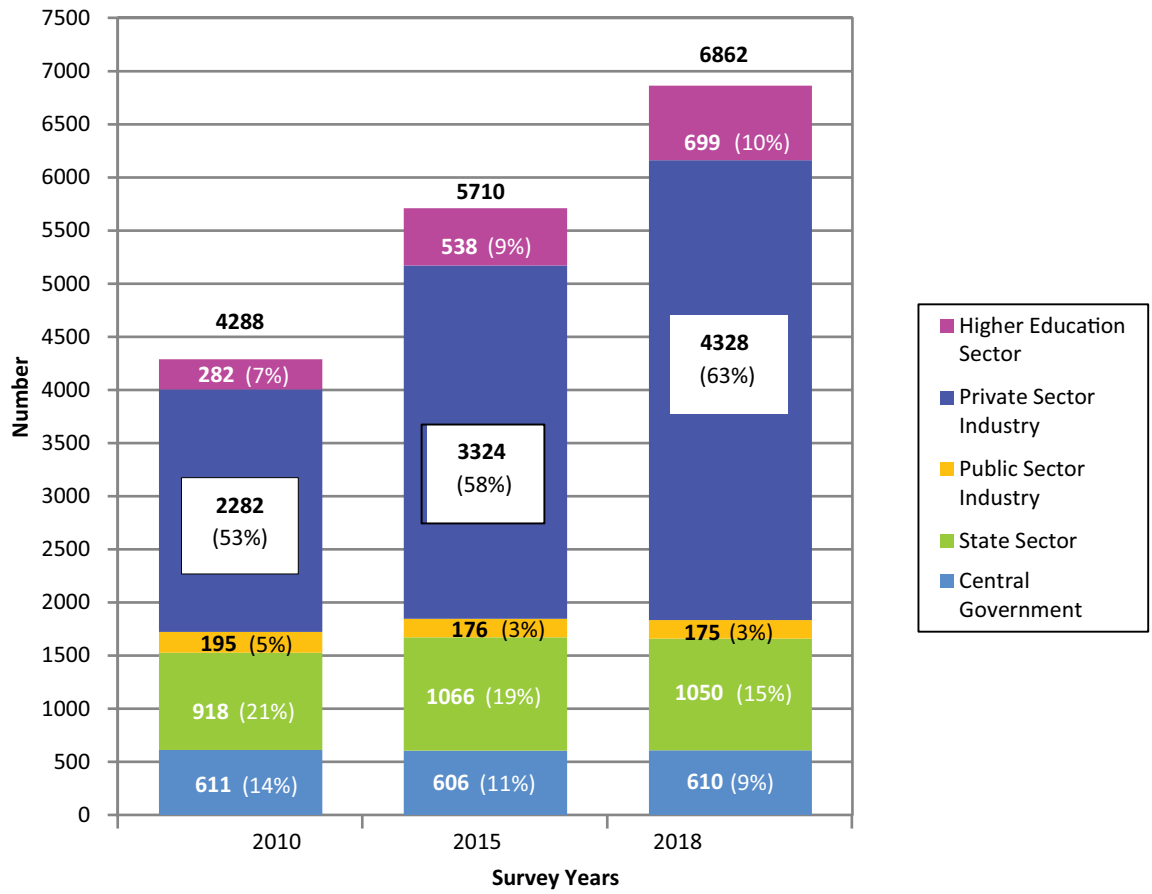
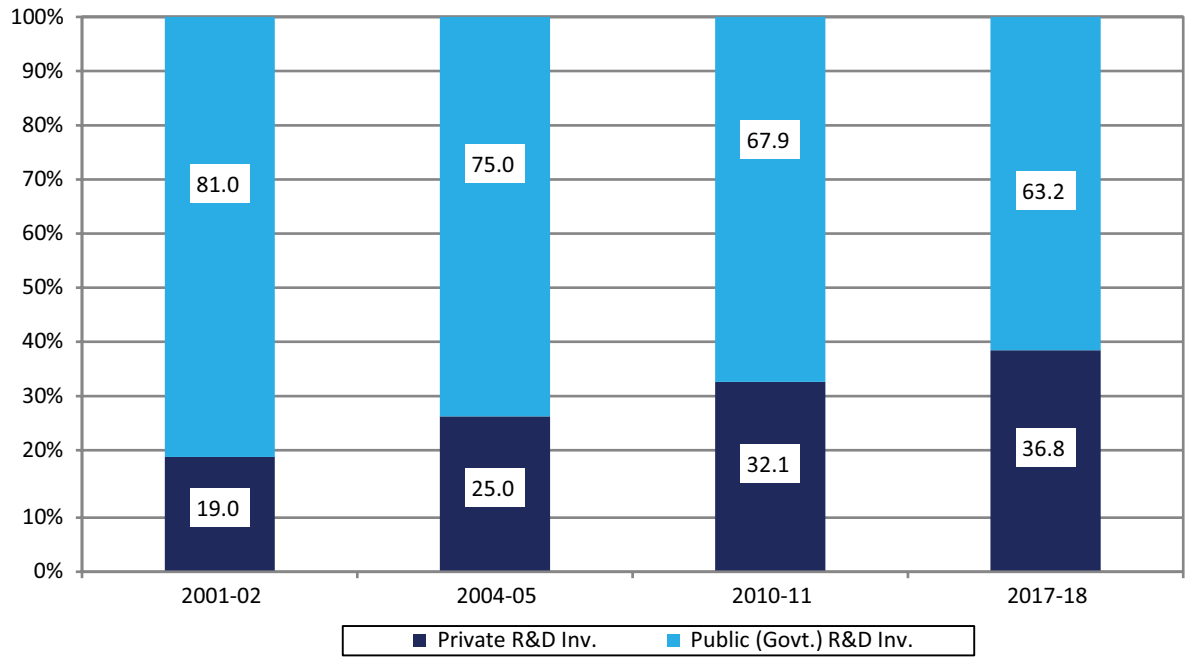
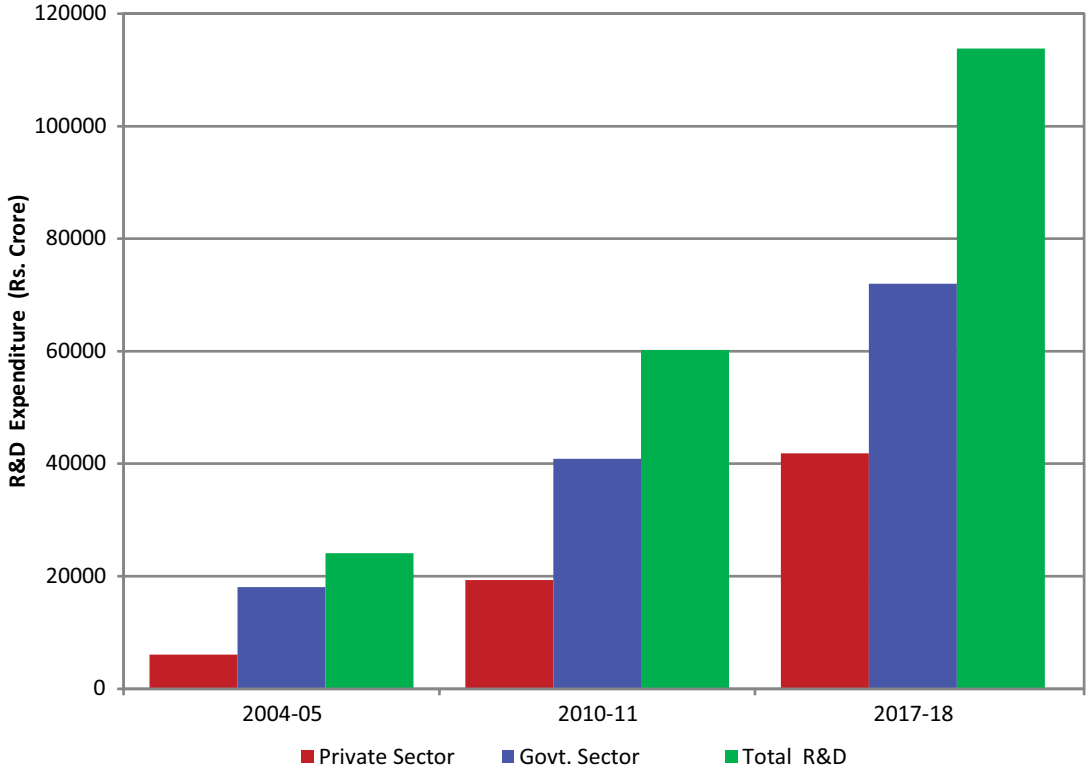


Figure 1.4: PERCENTAGE SHARE OF PRIVATE AND PUBLIC (GOVT.) INVESTMENT IN NATIONAL R&D



Note : Inv. = Investment
Public (Govt.) Investments in R&D = Central Government Ministries/Department + Public Sector/joint sector + State Governments + Higher Education

Figure 1.5: NATIONAL R&D EXPENDITURE BY SOURCE OF FUNDS



Note : Govt. Sector = Central Government Ministries/Department + Public Sector/joint sector + State Governments + Higher Education

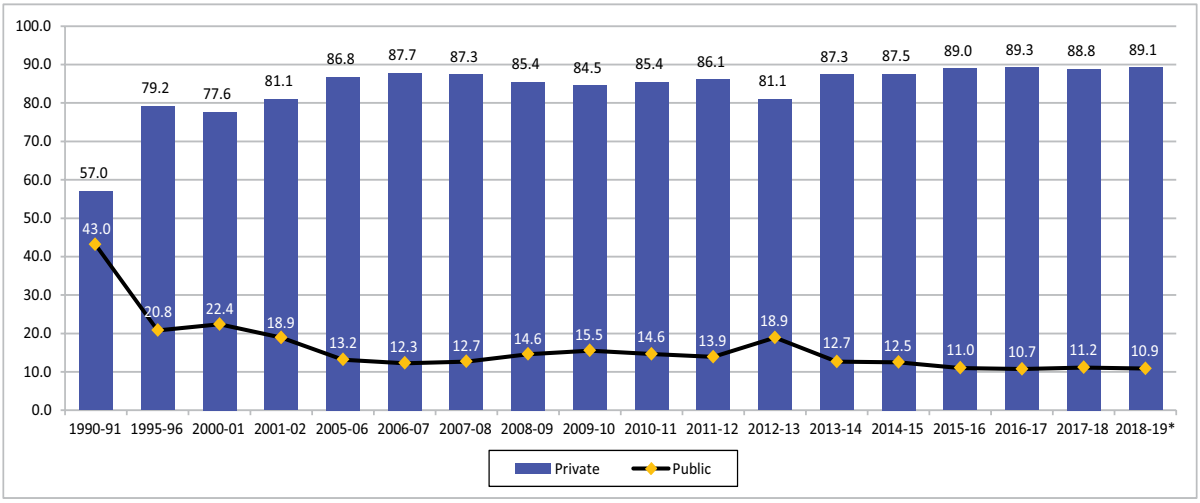
of industrial sector (or Business Enterprises Sector) in the national R&D expenditure is mainly due to significant increase in the share of private sector R&D expenditure by more than 25% from 28.9% in 2009–10 to 38.6% in 2017–18. Whereas, the share of public sector R&D declined by 13% from 5.3% to 4.6% during the same period. In this context, it would be equally interesting to examine the intra share percentage distribution of public and private sector R&D in Industrial R&D. It may be seen that the private sector has dominated Industrial R&D with a share of more than 80% since 2001–02 onwards. In 2017–18, the share of private and public sector in Industrial R&D was 88.8% and 11.2%, respectively (Fig. 1.6). The number of R&D units in each of the sector varies in terms of size of the firm. The public sector R&D units are larger in size when compared to private sector.

Analyses have shown that 58.6% of the R&D expenditure was incurred by the institutional sector comprising of central, state and academic sector and 41.4% was incurred by the industrial or business enterprise sector (public and private) industries during the year 2017–18. This is contrary to what one observes in the developed countries where the share of industrial sector in the national R&D expenditure is usually more than 50%. In fact, it is more than 70% for the countries such as China, Japan, Korea and USA.

National R&D expenditure as percentage of GDP was 0.7% during 2017–18, which has consistently remained the same since 2012–13. Though, in absolute terms, the R&D expenditure has shown a consistent rising trend over the years. A similar rising trend is also being observed in case of GDP as well. Thus, it would be interesting to examine and compare the trend in annual growth rate of both R&D expenditure and GDP together.

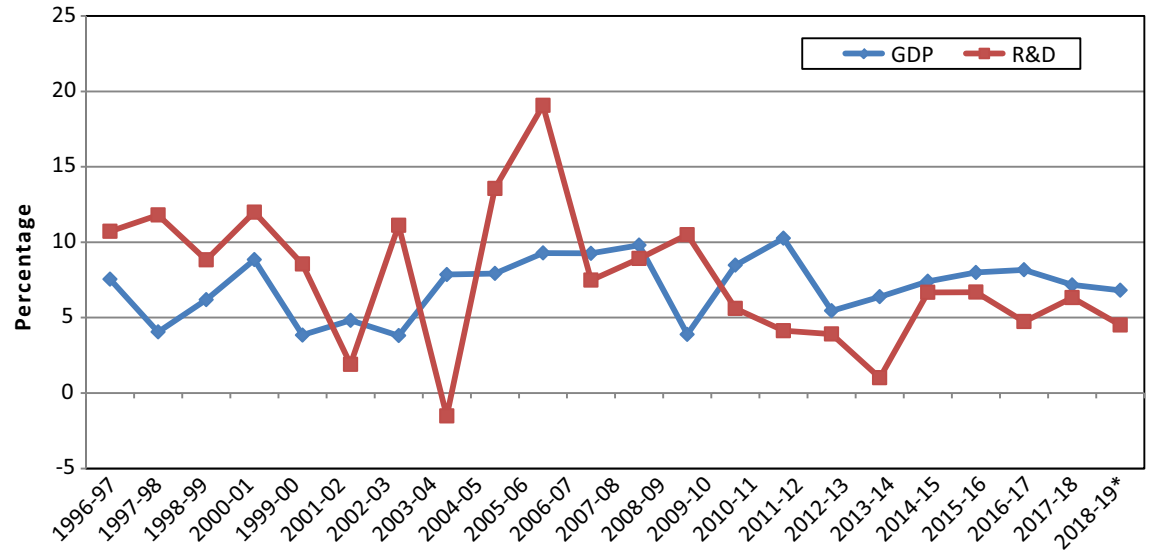
It may be seen that (Fig. 1.7 and Fig. 1.8) the annual growth rate of R&D expenditure (both at current and constant prices) remained higher than that of GDP during 1996–97 to 2000–01 while fluctuating

Figure 1.6: PERCENTAGE SHARE OF PUBLIC AND PRIVATE SECTOR ENTERPRISE IN INDUSTRIAL R&D



* Estimated

Figure 1.7: R&D EXPENDITURE AND GDP ANNUAL GROWTH RATE AT CURRENT PRICES



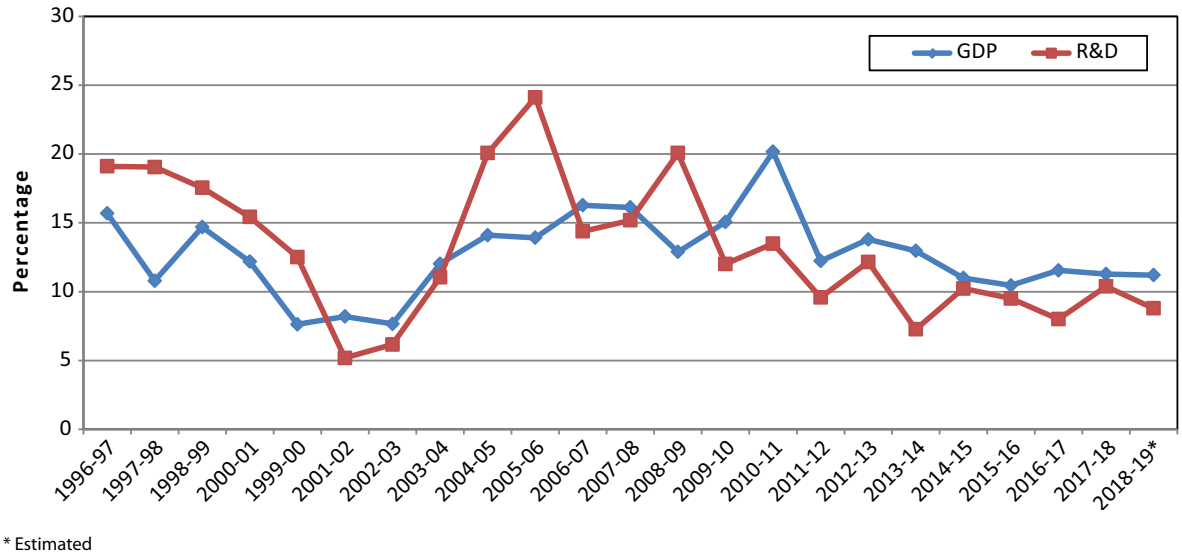
* Estimated

thereafter. Further, since 2009–10 onwards, the annual growth rate of GDP (both at current and constant price) surpassed that of R&D. One of the reasons could be the revision of the GDP series with a new base year 2011–12 involving a comprehensive coverage of industrial and service sectors, thus leading to higher GDP and its annual growth rate.

R&D expenditure has been classified into 13 objectives based on UNESCO classification. Ideally, the R&D expenditure should be apportioned amongst the 13 objectives based on project-wise expenditure. Such an exercise being not feasible, each R&D institution has been assigned to a specific objective depending upon its predominant activity. On this basis, the share of R&D expenditure by different objectives is given in Table 1.1 (Ref. Table 12)

Nearly, 76% of total R&D expenditure was accounted for by the objectives—Health, Defence, Development of Agriculture, Forestry and Fishing, Industrial Production and Technology, Exploration and Exploitation of Space and Transport, Telecommunication and other Infrastructure (Fig. 1.9).

Figure 1.8: R&D EXPENDITURE AND GDP ANNUAL GROWTH RATE AT CONSTANT PRICES



* Estimated

Table 1.1: PERCENTAGE SHARE OF NATIONAL RESEARCH AND DEVELOPMENT EXPENDITURE BY OBJECTIVES, 2017–18

Objective	Percentage
Health	18.6
Defence	17.1
Development of Agriculture, Forestry and Fishing	12.6
Industrial Production and Technology	9.8
Exploration and Exploitation of Space	8.8
Transport, Telecommunication and other Infrastructure	8.7
Energy	7.3
General Advancement of Knowledge	7.2
Other Aims	5.5
Education	2.0
Exploration and Exploitation of the Earth	1.8
Environment	0.5
Political & Social Systems, Structures & Processes (including socio-economic services)	0.04
Total	**100.0**

The expenditure for S&T activities has been classified by type of work based on the estimates provided by the R&D institutions in the central and state governments and scientific and industrial research organisations (SIROs) excluding higher education. Such a classification of expenditure by type of work is not available for the industrial sector in general except SIROs. During the year 2017–18, the percentage share of Basic Research was 23.9%, Applied Research 36.9%, Experimental Development 32.4% and the related supporting activities was 6.8%. Table 1.2 gives the breakup of S&T expenditure by type of work for the year 2017–18 (Ref. Table 11).

Central government including public sector has accounted for 50% of the total national R&D expenditure during 2017–18. Major scientific agencies have, in fact, accounted for a share of 84.4% of the total central government R&D expenditure including public sector in-house R&D units. At the national level, major scientific agencies have shared 42.2% of the total R&D expenditure. The share of R&D expenditure in decreasing order among the major scientific agencies is presented in Table 1.3 (Ref. Table 7).

It may be seen from Table 1.3 that five major scientific agencies viz., DRDO, DOS, ICAR, DAE, and CSIR account for 82.2% of the total R&D expenditure under the central government major scientific agencies with DRDO alone accounting for a share of 31.6%.

The analyses on personnel employed in R&D establishments show that as on 1st April 2018, there were 552,969 personnel employed in the R&D sector. Around 59% of them were employed by the institutional sector and 41% by the industrial sector. Out of the total, 61.8% of the personnel were engaged primarily on R&D work, 17.9% were performing auxiliary (technical support) activities and 20.3% were doing administrative and other non-technical activities. The information regarding the deployment of personnel in institutional sector and industrial sector of R&D establishment, is provided in Table 1.4.

Figure 1.9: NATIONAL R&D EXPENDITURE BY OBJECTIVES, 2017-18

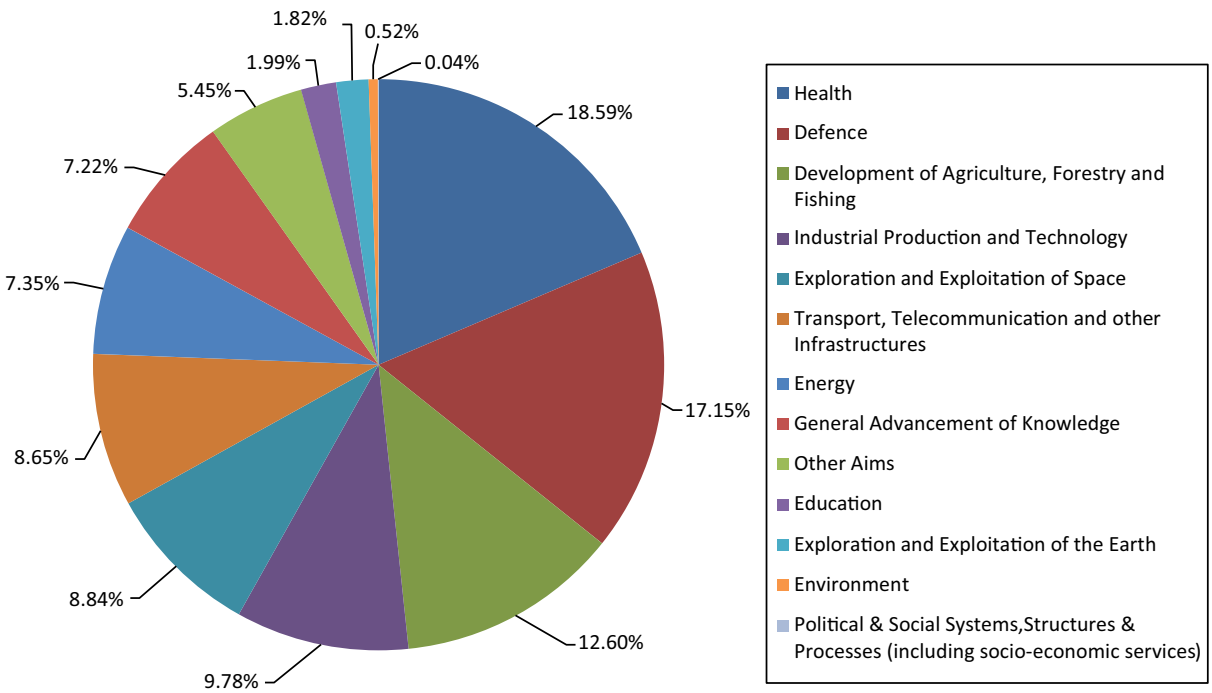


Table 1.2: PERCENTAGE SHARE OF NATIONAL S&T EXPENDITURE BY TYPE OF WORK, 2017–18

Type	Percentage
Basic Research	23.9
Applied Research	36.9
Experimental Development	32.4
Other Activities	6.8

Table 1.3: PERCENTAGE SHARE OF R&D EXPENDITURE BY MAJOR SCIENTIFIC AGENCIES, 2017–18

Scientific Agency	2017–18
Defence Research & Development Organisation (DRDO)	31.6
Department of Space (DOS)	19.0
Indian Council of Agricultural Research (ICAR)	11.1
Department of Atomic Energy (DAE)	10.8
Council of Scientific & Industrial Research (CSIR)	9.5
Department of Science & Technology (DST)	7.3
Department of Biotechnology (DBT)	3.7
Indian Council of Medical Research (ICMR)	3.1
Ministry of Earth Sciences (MES) +	2.3
Ministry of Electronics and Information Technology (MEITY) ++	0.8
Ministry of Environment, Forest and Climate Change (MoEFCC)	0.5
Ministry of New and Renewable Energy (MNRE)	0.1
Total	**100.0**

\+ Formerly Department of Ocean Development

++ Formerly Ministry of Communications & information Technology

It may be noted that there is no uniformity in the deployment pattern in both sectors, in case of R&D and administrative personnel, there is a large divergence. Industrial sector has comparatively higher proportion of personnel engaged in R&D activities and low proportion of personnel engaged in administrative activities compared to the institutional sector. This may be on account of the fact that the administrative procedural requirements in the institutional sector need more manpower or the number of persons providing administrative support in industrial sector is not fully reflected. In case of some of the industrial units, administrative facilities are common to R&D as well as other non-R&D activities and therefore, data on administrative personnel were not maintained separately.

An attempt has been made to find out the number of auxiliary and administrative personnel for each R&D person employed for a few selected departments in the Institutional sector and also for public and private sector industries in the Industrial sector as given in Table 1.5. It may be seen that the average number of auxiliary personnel per R&D person was 0.46 though it varied from 0.19 to 1.46 in the institutional sector. The figures for public and private sectors industry were 0.16 and 0.33 respectively.

The number of administrative personnel per R&D personnel varied from 0.35 to 1.38 in the institutional

Table 1.4: PERCENTAGE DISTRIBUTION OF PERSONNEL BY TYPE OF EMPLOYER ACTIVITY AS ON 1ST APRIL, 2018*

Employer/Activity	R&D	Auxiliary	Administrative	Total
Institutional Sector	39.3	27.5	33.2	100
Industrial Sector	60.9	19.1	20.0	100
Total	**50.7**	**23.1**	**26.2**	**100**

*Based on response; excludes Higher Education Sector

sector and the same for public and private sector industry was 0.14 and 0.34, respectively. It is interesting to observe that both the number of auxiliary personnel per R&D personnel and the number of administrative personnel per R&D personnel employed in Department of Atomic Energy (DAE), Indian Council of Agricultural Research (ICAR), Indian Council of Medical Research (ICMR) and State Governments were relatively high as compared to other organisations/sectors.

It can be assumed that those directly engaged in R&D activities and those extending technical support (that is auxiliary personnel) are by and large qualified in S&T. With this assumption, it may be estimated that 5,52,969 S&T personnel were deployed in R&D sector as on April 1, 2018. Out of this number, 3,41,818 were employed directly in R&D or creating new knowledge. There were 56,747 females directly engaged in R&D activities (female R&D personnel) which accounted for only 16.6% of the total R&D personnel engaged in R&D work.

International comparison of R&D efforts provides an opportunity to understand the country's position in relation to other countries. Most of the developed countries spend over 2% of their GDP on R&D but developing countries spend less than 1.0% with a few exceptions. R&D spending of 0.7% of GDP in India was, though no doubt higher than a number of developing countries, the country needs to substantially enhance its R&D expenditure in fostering S&T led growth in the present global context.

It is observed that in countries where R&D investment is about 2% or more of their GDP, major contribution (>50%) comes from the private sector. In the Indian context, the contribution of private sector is 37% and the rest 63% of national R&D expenditure comes from Government. This calls for stimulating the private sector R&D investments through policy measures, incentives, research collaboration with public research innovation system, promotion of Start-ups etc.

India has 255 researchers per million population as compared to 8,342 in Israel 7,899 in Denmark; 7,597 in Sweden; 7,498 in Korea; 6,722 in Finland; 6,636 in Singapore; 6,489 in Norway and 5,304 in Japan. However, the total numbers of researchers in India are 3.42 lakh as compared to 17.40 lakh in China, 13.71 lakh in USA, 6.76 lakh in Japan, 4.13 lakh in Germany and 3.83 lakh in Korea. While countries such as Denmark,

Table 1.5: NUMBER OF AUXILIARY AND ADMINISTRATIVE PERSONNEL PER R&D PERSON AS ON 1ST APRIL, 2018*

Number of Supporting personnel per R&D personnel*		
Institutional Sector	**Auxiliary**	**Administrative**
Department of Atomic Energy (DAE)	1.46	0.94
Council of Scientific and Industrial Research (CSIR)	0.93	0.62
Defence Research and Development Organisation (DRDO)	0.21	0.38
Indian Council of Agricultural Research (ICAR)	1.07	0.92
Indian Council of Medical Research (ICMR)	0.38	1.38
Department of Space (DOS)	0.19	0.35
Other Ministries/Depts.	0.48	0.77
State Governments	0.60	1.38
Industrial Sector		
Public Sector Industry	0.16	0.14
Private Sector Industries (including SIROs)	0.33	0.34
Overall R&D Sector	**0.46**	**0.52**

* Based on response; excludes Higher Education Sector

Finland, Israel, Sweden, Singapore, etc., have relatively far less number of researchers than India.

Questions are often asked whether the output of R&D is commensurate with the level of investment made by the country. No precise model has so far been evolved, to evaluate the output of R&D. In the absence of such rigorous indicators, an attempt is made to look at some of the parameters even if they are only indirect efficiency indicators. Scientific publications and Patents are two such globally accepted output indicators.

In terms of scientific publication output, the country has witnessed a rising trend during the last decade as reflected in varied publication databases. India's research publication output increased by 50% from 90,864 to 1,36,238 in 2011 and 2016 as per SCOPUS database; by 36.5% from 47,081 to 64,267 in 2011 and 2016 as per SCI database; and by 83.1% from 74,143 to 1,35,788 in 2011 and 2018 as per NSF (USA) database. India has grown faster than many developed and developing countries such as USA, UK, Germany, France, Japan, Korea, Brazil, etc and is ranked at 3rd, 5th and 9th position globally as per the NSF, SCOPUS and SCI publication database.

If one looks at the Patent data for the period 1976 to 2017, the number of applications for patents made every year varied between 2870 and 47,854. It was highest for the year 2017–18. The number of patents granted during the period varied from 780 to 16,061 and it was highest in 2008–09. The number of patents in force as of 2017–18 was 56,764. The state-wise distribution of number of patent applications filed by Indians during 2017–18 shows that more than 75% were from the states of Maharashtra, Tamil Nadu, Karnataka, Delhi, Telangana, Uttar Pradesh and Gujarat. As is well known, many foreign nationals take patents in countries other than their own with a view to tap the potential of their products there.

The number of patents sealed in the name of foreigners was almost five to six times those sealed in the name of Indians. So, it may be seen that the number of foreign patents in force during the year 2017–18 was 84.4%. Amongst the foreign patent applications, those from the USA accounted for 18,179 out of 32,304 total foreign applications made during 2017–18.

To sum up, the salient features are as follows:

- The national expenditure on Research and Development (R&D) has increased from Rs. 95,452.44 crore in 2015–16 to Rs. 1,03,099.26 crore in 2016–17 and to Rs. 1,13,825.03 crore in 2017–18.
- The share of R&D expenditure of the central government including public sector industry was 50% during 2017–18.
- R&D expenditure by institutional sector was 58.6% of the total national R&D expenditure and the rest 41.4% was incurred by industrial sector comprising both public and private sector industry during 2017–18.
- India spent 0.7% of GDP on R&D during 2017–18; it has consistently remained the same since 2012–13.
- Major scientific agencies accounted for 84.4% of the total R&D expenditure of the central government including public sector in-house R&D units. At national level, major scientific agencies have shared 42.2% of the total R&D expenditure.
- 82.2% of total R&D expenditure of the major scientific agencies under the central government including public sector was accounted for by five agencies—DRDO, DOS, ICAR, DAE, CSIR and in that order with DRDO accounting for a major share of 31.6%.
- As on 1st April, 2018, there were 5,52,969 personnel employed in the R&D sector. Out of these, 3,41,818 personnel (61.8%) were employed directly on R&D work.

CHAPTER II

CHAPTER II

RESEARCH AND DEVELOPMENT IN THE CENTRAL SECTOR

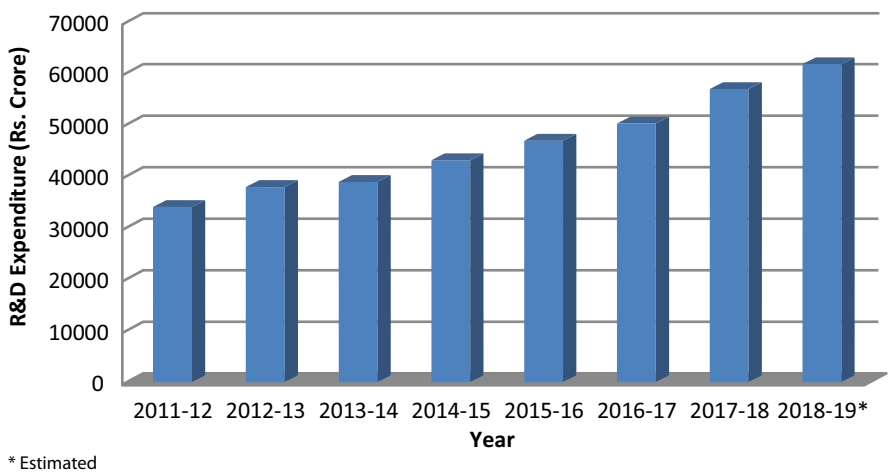
Realising the need to receive a substantial gain through the application of Science & Technology for the upliftment of the economy, Central (or Federal) Government continued to shoulder the major share of the financial resources devoted to Research and Development (R&D) activities. The share of Central Government including Public Sector R&D units and Higher Education Sector was 56.8% in 2017–18. The Higher Education Sector constitutes 6.8% of National R&D expenditure in 2017–18. In absolute terms, the total R&D expenditure of the Central Government inclusive of Public Sector industry (called as Central Sector) has increased from Rs. 37,894.46 crore in 2012–13 to Rs. 56,920.02 crore in 2017–18. By applying the appropriate growth as observed over a period of time starting from 2012–13 to 2017–18 the R&D expenditure for Central Sector is estimated to reach a level of Rs. 61,745.16 crore in 2018–19 (Fig. 2.1) (Ref. Table 1).

With the present trend of share in R&D expenditure by Central Government, the rate of growth for the years 2015–16, 2016–17 and 2017–18 over the previous year was 8.8%, 7.1% and 13.3% respectively. It may be seen from Table 2.1 that the annual (year to year) growth rates of R&D expenditure at constant prices (Base 2011–12) during the period 2012–13 to 2018–19 attained growth rate of 9.2% in the year 2017–18 from 3.9% in preceding year and then it suddenly fell to 4.2% in 2018–19 (Ref Table 4).

R&D expenditure at constant prices has been worked using GDP price deflators. The annual growth rate of Central Government R&D expenditure at current prices has a similar trend. The lowest growth rate was recorded both at current and constant prices for the year 2013–14.The growth rates in real terms for R&D expenditure in some of the years were quite small. There was not much increase in the R&D expenditure after adjusting for inflation except in the year 2017–18 practically and thereafter it again moved downwards in 2018–19.

The Central Government R&D expenditure inclusive of Public Sector Industry (Central sector) is classified by 13 socio-economic objectives as laid down by the UNESCO (Ref. Table 12). Ideally, this exercise ought to be done on project to project basis, but due to operational problems, it has not been possible to do so. Hence, each R&D institution has been assigned to a specific objective based upon its predominant activity. The percentage share of total R&D expenditure of

Figure 2.1: GROWTH OF R&D EXPENDITURE IN CENTRAL SECTOR



* Estimated

Table 2.1: GROWTH IN CENTRAL SECTOR R&D EXPENDITURE

Year	Annual Rate of Growth in Percentage	
	At Current Prices	At Constant Prices
	Base Year 2011–12	
2012–13	11.4	3.2
2013–14	2.6	-3.4
2014–15	10.8	7.3
2015–16	8.8	6.4
2016–17	7.1	3.9
2017–18	13.3	9.2
2018–19*	8.5	4.2

* Estimated

Central Sector for some of the objectives for the year 2017–18 is given in Table 2.2.

It may be seen from Table 2.2 that R&D institutions under Central Government spent 78.6% of Central Sector R&D expenditure on five objectives such as Defence, Exploration and Exploitation of Space, General Advancement of Knowledge, Development of Agriculture, Forestry and Fishing and Energy during 2017–18. The maximum R&D expenditure was on Defence, which accounted for 31.4%. This was followed by Exploration and Exploitation of Space with 16.4%. More or less, a similar trend was observed in the past

Table 2.2: PERCENTAGE SHARE OF CENTRAL SECTOR R&D EXPENDITURE BY OBJECTIVE, 2017–18

Objective	Percentage
Defense	31.4
Exploration and Exploitation of Space	16.4
General Advancement of Knowledge	12.4
Development of Agriculture, Forestry and Fishing	9.5
Energy	8.9
Health	7.8
Industrial Production and Technology	3.4
Exploration and Exploitation of the Earth	3.3
Transport, Telecommunication and other Infrastructures	1.3
Education	1.1
Environment	0.6
Other Aims	3.7
Political & Social Systems, Structures & Processes (including socio-economic services)	0.0
Total	**100.0**

also with variations in inter-se percentage of the above objectives. The objectives have also been revised by UNESCO.

The percentage share of Central Sector including Public Sector industries in National R&D expenditure by objectives for the year 2017–18 is shown in Table 2.3. Almost all of the R&D expenditure in Strategic areas like Space and Defence were borne by Federal Government. The similar trend was observed in the case of Exploration and Exploitation of the Earth. Even in the case of General Advancement of Knowledge more than 92.4% was spent by Central (Federal) Government.

For the purpose of statistical analysis, S&T institutions under central government are grouped as follows:

a. R&D organisations under Major Scientific Agencies i.e. organisations which have R&D or promotion of S&T as their predominant activity.

b. R&D organisations under Other Central Ministries/ Departments i.e. organisations which undertake R&D work occasionally in connection with their day-to-day problems.

c. In-house R&D units of Public Sector Industry.

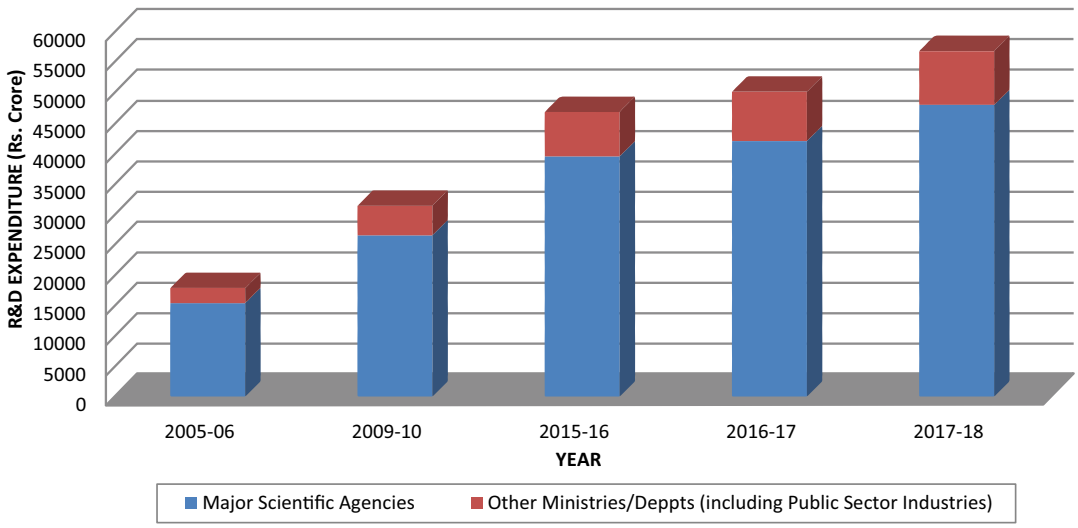
The share of R&D expenditure during 2017–18 by the 12 Major Scientific Agencies including Public Sector R&D units in the total Central Sector R&D expenditure was 84.4%. This forms 42.2% of the National R&D expenditure. It has risen from Rs. 26,559.46 crore in 2009–10 to Rs. 39,566.71 crore in 2015–16 to Rs. 48,044.63 crore in 2017–18 for these agencies. Similarly, R&D expenditure for other Ministries/Departments including Public Sector R&D units increased from Rs. 4,874.17 crore in 2009–10 to Rs. 7,320.45 crore in 2015–16 to Rs. 8,875.40 crore in 2017–18. The shares of R&D expenditure by Major Scientific Agencies, Other Central Ministries/ Departments and Public Sector in total Central Sector R&D expenditure for 2017–18 were 84.4%, 6.4%, and 9.2% respectively (Fig. 2.2).

Table 2.4 shows the percentage share of R&D expenditure among Major Scientific Agencies. The table indicates that about 89.5% of total R&D expenditure of major scientific agencies was shared by six agencies, viz., Defence Research and Development Organisation (DRDO), Department of Space (DOS), Indian Council of

Table 2.3: PERCENTAGE SHARE OF CENTRAL GOVERNMENT (INCLUDING PUBLIC SECTOR) OUT OF NATIONAL R&D EXPENDITURE BY OBJECTIVE, 2017–18

Objective	Percentage
Exploration and Exploitation of Space	100.0
Defense	98.7
Exploration and Exploitation of the Earth	98.0
General Advancement of Knowledge	92.4
Energy	65.4
Environment	67.1
Development of Agriculture, Forestry and Fishing	40.6
Education	30.3
Health	22.7
Industrial Production and Technology	18.9
Transport, Telecommunication and other Infrastructures	8.1
Political & Social Systems, Structures & Processes (including socio-economic services)	0.0
Other Aims	36.8
Percentage Share in National R&D Expenditure	**53.9**

Figure 2.2: CENTRAL GOVERNMENT R&D EXPENDITURE BY MAJOR SCIENTIFIC AGENCIES AND OTHER MINISTRIES/DEPARTMENTS



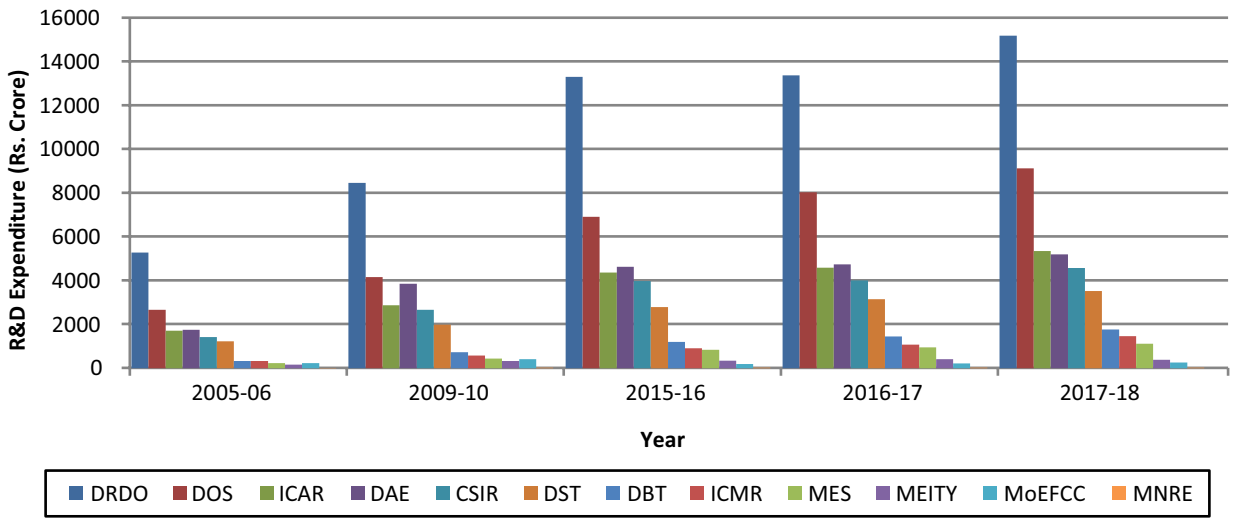
Agricultural Research (ICAR), Department of Atomic Energy (DAE), Council of Scientific and Industrial Research (CSIR), and Department of Science and Technology (DST). Defence Research and Development Organisation (DRDO) alone accounts for a share of 31.6% (Fig. 2.3).

The R&D expenditure of the central sector can be divided into institutional R&D and industrial R&D (Ref. Table 2). The industrial R&D expenditure in the central sector is expenditure incurred by the in-house R&D units of the Public Sector industry. For 2017–18, the share of Public Sector Industry

Table 2.4: INTER-SE PERCENTAGE SHARE OF R&D EXPENDITURE BY MAJOR SCIENTIFIC AGENCIES 2017–18

Agency	Percentage
Defence Research & Development Organisation (DRDO)	31.6
Department of Space (DOS)	19.0
Indian Council of Agricultural Research (ICAR)	11.2
Department of Atomic Energy (DAE)	10.8
Council of Scientific & Industrial Research (CSIR)	9.5
Department of Science & Technology (DST)	7.3
Department of Biotechnology (DBT)	3.7
Indian Council of Medical Research (ICMR)	3.1
Others	3.8
Total	**100**

Figure 2.3: R&D EXPENDITURE BY SELECT CENTRAL GOVERNMENT SCIENTIFIC AGENCIES



R&D expenditure in the total central sector R&D expenditure was 9.2% and the remaining 90.8% was incurred by R&D institutions in the central sector.

In all, there are 14 Cooperative Research Associations representing different industries such as textiles, plywood, rubber, automotive, electrical, tea and cement. These Cooperative Research Associations are financed jointly by the Government and the members of the concerned industry. The R&D expenditure incurred by these Associations had increased from Rs. 349.51 crore in 2015–16 to Rs. 403.06 crore in 2017–18 (Ref. Table 10).

With regard to the Manpower employed in R&D establishments, as on April 1, 2018, there were 1,64,629 personnel employed in the central sector R&D units. This was 29.8% of total national manpower employed in all R&D units in the country. The above figure is inclusive of 12,035 personnel employed in R&D units of Public Sector Undertakings (Ref. Table 21).

Out of the total 1,64,629 personnel employed in R&D establishments under Central Government inclusive of Public Sector Industry (Central sector), 71,972 personnel were primarily engaged in R&D activities comprising 62,681 R&D personnel in Central Government institutional sector and 9,291 R&D personnel in the in-house R&D units of Public Sector Industry. The manpower employed in R&D establishments of Central Sector were either engaged in R&D work or were extending technical support for R&D (termed as auxiliary personnel) or provided administrative support for research activities. The percentage break up of total manpower employed in Central Government inclusive of Public sector industry (Central sector) according to three types of activities was 43.7% in R&D, 28.6% in auxiliary and 27.7% in administrative activities.

As on April 1, 2018, total number of 1,04,311 women were employed in R&D establishments in the country. Out of this 33,073 (31.7%) were employed in the Central Sector including Public Sector R&D units. Out of 56,747 women S&T personnel directly engaged on R&D activities at the national level, the share of Central Sector inclusive of Public sector was 24.2%. It is seen that for every 100 R&D employees in Central Sector including public sector about 19.1% were women R&D employees (Ref. Table 22).

Out of every 100 women employed in Central Sector, 41.5% were engaged directly in R&D activities, 29.0% were performing auxiliary activities and 29.4% were providing administrative support. The percentage of women working for R&D activities is high as compared to working for Auxiliary and Administrative activities.

To sum up, the salient features are as under:

- Central Government including Public Sector industry and Higher Education Sector continued to shoulder a major share of national Government which was 56.8% during 2017–18.
- In absolute terms, Central Government incurred Rs. 64,704.35 crore on R&D during 2017–18.
- Annual rate of growth for R&D expenditure at current prices for 2017–18 over the previous year was 13.3%. The same in constant prices (Base 2011–12) was 9.2%.
- By socio-economic objectives as defined by UNESCO, the Defence R&D accounted for 31.4% of Federal R&D expenditure during 2017–18.
- Nearly 100% of R&D expenditure on Defence and Space was borne by Central Government including Public Sector R&D units during 2017–18.
- Major share (84.4%) of Central Government R&D expenditure was accounted for by 12 Major Scientific Agencies.
- About 1.65 lakh personnel were engaged in R&D units of the institutional and Public sector industries under Central Government and out of this 43.7% were primarily engaged in R&D, 28.6% in auxiliary activities and 27.7% were providing administrative support.
- For every 100 R&D employees in Central Sector 20.1% were women R&D employees during 2017–18.

CHAPTER III

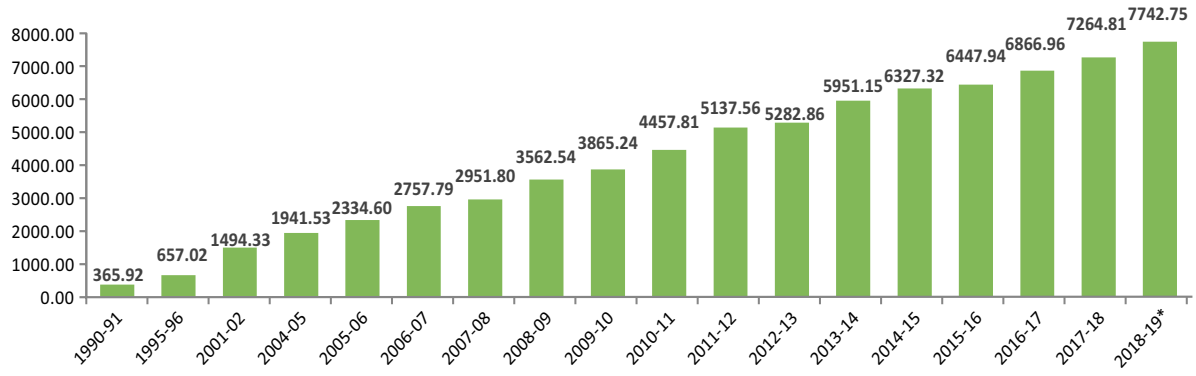
CHAPTER III

RESEARCH AND DEVELOPMENT IN THE STATE SECTOR

The Research and Development (R&D) expenditure incurred by the states has increased from Rs. 365.92 crore in 1990–91 to Rs. 3,865.24 crore in 2009–10 and further to Rs. 7,264.81 crore in 2017–18 (Fig. 3.1). The annual growth rate of the R&D expenditure of the states in 2017–18 over 2009–10 was 8.2%. It is expected to be of the order of Rs. 7,742.75 crore in 2018–19. The R&D expenditure by the states accounted for 6.4% of the national R&D expenditure during 2017–18. The R&D expenditure in the states constituted only 0.04% of the GDP at current prices during 2017–18.

Out of the total State S&T expenditure of Rs. 8,380.06 crore, by type of work, incurred by state governments during 2017–18, R&D activities comprising of Basic Research, Applied Research and Experimental Development accounted for 86.7% (Ref Table 11). The total R&D expenditure incurred by states by type of work for some recent years are presented in Table 3.1.

Figure 3.1: GROWTH OF R&D EXPENDITURE IN STATE SECTOR



*Estimated

Table 3.1: STATE GOVERNMENTS' R&D EXPENDITURE BY TYPE OF WORK

(Rs. Crore)

Year	Basic Research	Applied Research	Experimental Development	Other Related & S&T Activity	Total S&T
2015-16	1254.04	3381.05	1812.85	1001.54	7449.58
2016-17	1344.43	3582.53	1940.00	1054.06	7921.02
2017-18	1400.86	3859.36	2004.59	1115.25	8380.06

Basic Research remained between 12% and 19%, Experimental Development varied from 28% to 35% and the rest accounted by Applied Research which varied from 52% to 59% for the various years. Fig. 3.2 shows R&D expenditure by type of research during 2017-18.

Having dealt with the state sector as a whole, it is perhaps useful to analyse the intensity of R&D activities in different states measured in terms of resources deployed. The state-wise percentage distribution of R&D expenditure for the year 2017–18, arranged in descending order is given in Table 3.2

Figure 3.2: R&D EXPENDITURE BY TYPE OF RESEARCH IN STATE SECTOR, 2017-18

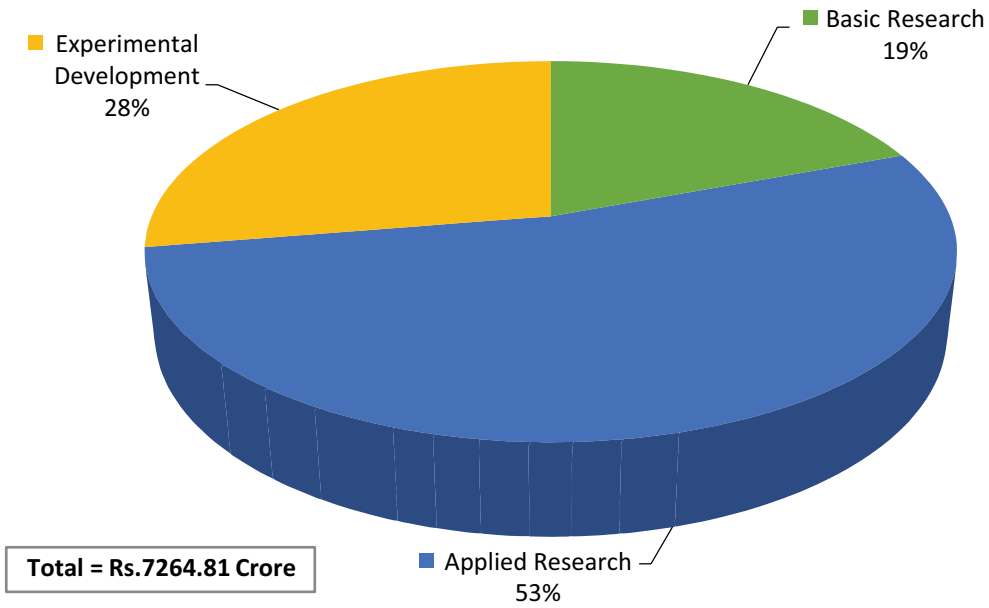


Table 3.2: PERCENTAGE DISTRIBUTION OF R&D EXPENDITURE BY VARIOUS STATES, 2017–18

Sl No.	State	Percentage
1	Gujarat	10.9
2	Tamil Nadu	9.5
3	Punjab	7.6
4	Andhra Pradesh	7.5
5	Madhya Pradesh	6.7
6	Uttar Pradesh	6.5
7	Assam	6.3
8	Haryana	5.2
9	Karnataka	5.1
10	Jammu & Kashmir	4.0
11	Uttarakhand	3.9
12	West Bengal	3.8
13	Telangana	3.8
14	Chhattisgarh	3.6
15	Maharashtra	3.1
16	Rajasthan	2.7
17	Kerala	2.2
18	Himachal Pradesh	2.2
19	Odisha	2.1
20	Manipur	1.4
21	Jharkhand	1.3
22	Bihar	0.7
23	Meghalaya	0.1
	Total	**100**

A few states accounted for a major share of the total R&D expenditure of the state sector as a whole. More than 55% of the total R&D expenditure of the states was accounted by Gujarat, Tamil Nadu, Punjab, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh and Assam in that order.

The expenditure incurred by the state governments on R&D has been apportioned into 12 objectives as defined by the UNESCO (Ref Table 12). Accordingly, the data on R&D expenditure by major objectives for the year 2017–18 is presented in Table 3.3.

Table 3.3: PERCENTAGE DISTRIBUTION OF R&D EXPENDITURE BY OBJECTIVES, 2017–18

Objective	Percentage
Development of Agriculture, Forestry, and Fishing	88.0
Education	11.1
Political & Social Systems, Structures & Processes (including socio-economic services)	0.4
Others	0.5
Total	**100.0**

Development of Agriculture, Forestry and Fishing is the major objective in the state sector incurring 88% of the total R&D expenditure during 2017–18.

Manpower employed is one of the major resources deployed for R&D activities. The total personnel employed in the R&D institutions in the states were 48,794 as on April 1, 2018. Out of this, about 33.6% (or 16,376 personnel) were employed directly on R&D activities called as R&D personnel. Besides, 20.1% (or 9,828 personnel) of the total were supporting R&D activities called auxiliary personnel and the rest 46.3% (or 22,590 personnel) were administrative staff. It was noticed that there were 12,279 women personnel employed in the state R&D institutions and out of them 3,957 women were engaged primarily (or directly) on R&D activities.

The salient features of the R&D scenario in the State sector are as under:

- State Sector spent Rs. 7,264.81 crore on R&D activities during 2017–18.
- There were about 16,376 personnel engaged directly in R&D activities in State Sector, out of them 3,957 were women.
- State Sector accounted for only 6.4% of National R&D expenditure and 0.04% of Gross Domestic Product during 2017–18.
- Women personnel engaged in R&D activities in the states continued to be very small in number as compared to men and they constitute only about 24.2% of the total R&D personnel in the state R&D establishments.
- R&D activities were concentrated in few States only.
- Agriculture was the major field of research in the States.

CHAPTER IV

CHAPTER IV

RESEARCH AND DEVELOPMENT IN INDUSTRIAL SECTOR

Research and Development (R&D) is an essential facet of any industrial activity especially, in the wake of growing global competition. Financial and human resources represent the principal inputs to R&D and can be used as indicators of the commitment of industry to innovation. It is a well-known fact that the R&D in industries is essential for generating know-how necessary for production of quality products, promoting efficiency, promoting exports and technological self-reliance needed in the country as well as absorption, adaptation and upgradation of imported know-how. R&D in Industrial Sector is also essential for solving day-to-day production problems and for exploring the potential for future industrial expansion. The Government of India has been encouraging industrial units to take up R&D activities by paying special attention for promotion and support to R&D.

A scheme for granting recognition to in-house R&D units in industrial sector to both private and public funded R&D laboratories was initiated by the Department of Science and Technology (DST) in 1973. This activity is being dealt by the Department of Scientific and Industrial Research (DSIR) since 1984. One of the objectives of this scheme is to provide liberalized import facilities to recognized R&D units for purchase of equipment, components, raw materials, etc., necessary for carrying out R&D work in order to update the technology and effecting improvements in the manufacturing process, introducing new products, processes, developing import substitutes. These incentives have encouraged industry to establish their in-house R&D centres (or units).

Industries in India comprise public sector industries (both central and state) and private sector industries. The private sector industries include in-house R&D units and Scientific and Industrial Research Organisations (SIROs) recognized by DSIR. The scope and coverage of data on R&D expenditure and human resources for Private Sector has been enlarged this time by including multinational companies and companies not covered by the DSIR under its recognition scheme. Public sector together with private sector is known as industrial sector for convenience.

Table 4.1: RESPONSE PROFILE OF INDUSTRIAL SECTOR

(Number)

R&D Units	Private Sector			Public Sector (4)	Industrial Sector (5)=(3)+(4)
	In-house R&D (1)	SIRO (2)	Total Private Sector R&D (3)=(1)+(2)		
1. Surveyed	3267	612	3879	164	4043
2. Responded	1556	428	1984	93	2077
3. Estimated*	451	69	520	10	530
4. 'NIL' R&D	255	24	279	20	299
5. Not Responded	1005	91	1096	41	1137

Note : 1. *Projected for total R&D expenditure only
2. Industrial Sector = Private Sector + Public Sector.

For 2017–18 survey, 4,043 industrial R&D units were contacted through mail card enquiry. This comprised of 1,841 DSIR recognised in-house R&D units of Private Sector, 1,426 companies performing R&D activities and registered with Ministry of Company Law Affairs (out of total private sector companies/ units, 472 are Multi-national Companies), 612 Scientific and Industrial Research Organisations (SIRO non-commercial) and 164 in-house R&D units of the Public/ Joint Sector. Requisite information for the survey in the Questionnaires specially designed for this sector has been received from 1,227 DSIR-recognised companies, 329 R&D units not covered by DSIR recognition scheme including Multi-national Companies, 428 SIRO units and 93 Public/Joint Sector R&D units and the R&D expenditure for 451 R&D units of Private Sector and 69 SIRO units have been estimated to arrive at the total Private Sector R&D expenditure of 2,504 R&D units. It may be mentioned here that 279 R&D units in Private Sector and 20 units in Public/Joint Sector reported 'NIL' R&D activities. Detailed analysis of data in respect of R&D expenditure and human resources is based on the actual data received from 2,077 in-house R&D units of Industrial Sector. Table 4.1 gives the response profile of Industrial Sector.

Table 4.2 gives the investment on R&D and number of in-house R&D units for public sector, private sector and industrial sector as a whole for three years' duration.

Investment on R&D activities by 2607 Industrial Sector R&D units attained a level of Rs. 47,109.13 crore at current prices for the year 2017–18. For the Private and Public Sector industries separately, the R&D expenditure was Rs. 41,855.88 crore and Rs. 5,253.25 crore respectively. Industrial Sector R&D expenditure constitutes 41.4% of the national R&D expenditure of Rs. 1,13,875.03 crore in the year 2017–18 (Fig. 4.1). For Private and Public Sector separately the share was 36.8% and 4.6% respectively. The Industrial Sector

Figure 4.1: GROWTH OF INDUSTRIAL R&D EXPENDITURE

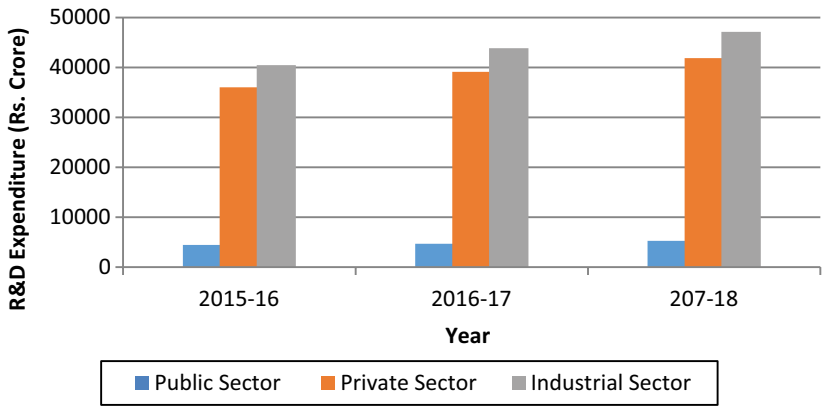


Table 4.2: R&D EXPENDITURE BY INDUSTRIAL SECTOR

Sector	Period	Public Sector	Private Sector	Industrial Sector
No. of R&D Units	2015-16 to 2017-18	103	2504	2607
R&D expenditure (Rs. Crore)	2015-16	4453.88	36022.15	40476.03
	2016-17	4706.29	39124.71	43831.00
	2017-18	5253.25	41855.88	47109.13

investment on R&D for the year 2017–18 worked out to be 0.28% of the Gross Domestic Product (GDP) at current prices.The R&D expenditure as percentage of Sales Turnover (STO) for Industrial Sector (including SIROs) worked out to be 1.11% for the year 2017–18. Industrial R&D expenditure increased from Rs. 40,476.03 crore in 2015–16 to Rs. 47,109.13 crore in 2017–18.

It may be seen from Table 4.2 that 88.8% of the total Industrial Sector investment on R&D was by 96.0% of Private Sector in-house R&D units whereas rest 11.2% was invested by 4.0% of Public/Joint Sector R&D units during 2017–18. It may be interesting to note that though the number of R&D units for public and private sectors were kept constant for the duration of three years, the share of public sector R&D investment has decreased from 23.6% in 2002–03 to 11.1% in 2017–18. It may not be out of place to mention here that the Private Sector R&D expenditure during this period has increased significantly at the faster pace than Public Sector R&D expenditure.

It may also be seen from Table 4.2 that per unit R&D expenditure for Private and Public Sector were quite variant which were Rs. 16.7 crore and Rs. 51.0 crore respectively during 2017–18. The variation between the two set of figures may be attributed to the big size of the companies in public sector and their need for complex and sophisticated technology calling for higher investment on R&D whereas private sector R&D units were heterogeneous in size which even included small-scale industries and voluntary organizations operating on non-commercial basis spending very little on R&D.

It is known that industries are profit oriented and the investment by industries is to a large extent conditioned by the financial benefits accruing to them by way of increase in production, sales, reduction in the cost of production etc. The investment on advertisement also aims at increasing sales. Therefore, the information on R&D expenditure as percentage of STO, advertising expenditure as percentage of STO and expenditure on purchase of new plant and equipment and its percentage share in STO were compiled to assess the relative importance given by the industries to R&D, advertising and purchase of new plant and equipment. The R&D expenditure as percentage of STO for Industrial Sector (excluding SIROs) worked out to be 0.98% for the year 2017–18 while for the Private and Public Sector separately, the figures were 1.48% and 0.29% respectively. The investment on advertisement as percentage of STO was 0.40% for Industrial Sector during 2017–18 and for the Private and Public Sector separately the figures were 0.67% and 0.04% respectively during 2017–18. The investment on purchase of new plant and machinery as percentage of STO was 3.02% for Industrial Sector during 2017–18. For the Private and Public Sector separately the figures were 2.88% and 3.22% respectively during 2017–18. It appears from the data and analysis that industry as a whole has higher priority for investment on advertising and purchase of new plant and equipment compared to R&D. It may be mentioned here that the R&D expenditure as percentage of STO for a number of developed countries of the world varies between 3.0% and 4.0%.

The total R&D expenditure of Industrial Sector, Private Sector (excluding non-commercial 497 SIRO units) and Public Sector were apportioned into 25 and 40 industrial groups, respectively on the basis of the products manufactured by them. Out of these industrial groups identified, 14 leading industry groups, arranged in descending order of their R&D expenditure, spent 88.8% of total Industrial Sector R&D expenditure in 2017–18. Table 4.3 gives information on the number of R&D units and total R&D expenditure in each industry group separately for public, private and industrial sector during 2017–18.

It may be seen from Table 4.3 that Drugs & Pharmaceuticals group with 316 units occupy the first place in terms of R&D expenditure with Rs. 10,162.26 crore (24.3%). This was followed by Transportation and Information Technology with 16.4% and 8.7% respectively during 2017–18. In the same manner, if one looks at the Public/Private Sector industries data separately, the trend changes. In Public Sector, Defence Industries alone accounted for 51.6% followed by Fuel groups with 22.2%. In case of Private Sector, the R&D expenditure of Drugs & Pharmaceuticals group was the highest accounting for 27.8% followed by Transportation with 18.8%. At the same time, Drugs & Pharmaceuticals remained the largest with 15.0% as

Table 4.3: INDUSTRIAL EXPENDITURE CLASSIFIED BY LEADING INDUSTRY GROUPS DURING 2017–18

Industries Groups	Public Sector		Private Sector		Industrial Sector		%
	R&D Units	R&D Exp (Rs. Crore)	R&D Units	R&D Exp (Rs. Crore)	R&D Units	R&D Exp (Rs. Crore)	
Drugs & Pharmaceuticals	3	3.15	313	10159.11	316	10162.26	24.34
Transportation	2	0.85	100	6848.96	102	6849.81	16.41
Information Technology	–	–	34	3625.17	34	3625.17	8.68
Misc. Mechanical Engg Industries	–	–	76	3122.67	76	3122.67	7.48
Chemicals (other than fertilizers)	9	15.64	224	3004.56	233	3020.20	7.23
Defence Industries	18	2712.22	23	140.25	41	2852.47	6.83
Electricals & Electronics	10	102.3	215	1935.47	225	2037.77	4.88
Medical & Surgical Appliances	2	6.57	35	1277.97	37	1284.54	3.08
Fuels	13	1163.99	10	51.32	23	1215.31	2.91
Biotechnology	1	0.07	163	1071.3	164	1071.37	2.57
Industrial Machinery	1	646.64	63	201.52	64	848.16	2.03
Metallurgical Industries	10	208.64	58	263.9	68	472.54	1.13
Soaps, Cosmetics, Toilet Preparations	1	0.65	13	283.26	14	283.91	0.68
Telecommunications	1	22.76	13	202.9	14	225.66	0.54
Others	32	369.77	667	4312.38	699	4682.15	11.21
Total	**103**	**5253.25**	**2007**	**36500.74**	**2110**	**41753.99**	**100.00**

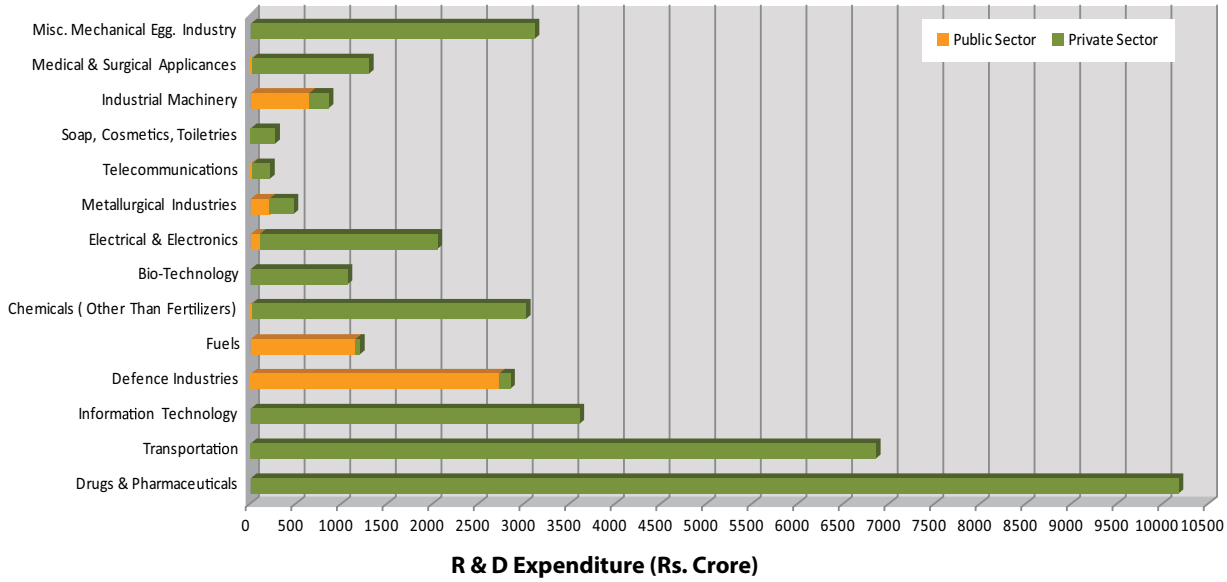
Source : Data collected and compiled by NSTMIS, DST, GoI

- represents 'NIL'

far as the number of units was concerned, followed by Chemicals (other than Fertilizers) 11.0% in the Industrial Sector as a whole. It may be safely concluded from the above discussion that R&D expenditure in industry was concentrated in some industry groups only (Fig. 4.2).

The heterogeneity in the size of R&D expenditure for different industry groups between Private and Public Sector in-house R&D units was quite significant. Table 4.4 may be seen for details. According to the data given in Table 4.4, per unit R&D expenditure for Industrial Sector as a whole was maximum for Information Technology, i.e. Rs. 106.6 crore and all of these industries were under Private Sector. Similarly, the per unit R&D expenditure for the industry group Defence Industries was Rs. 69.6 crore next to Information Technology followed by the group Transportation with Rs. 67.2 crore. When the per unit R&D expenditure of Public Sector was separately looked into, Industrial Machinery ranked first followed by Defence Industries, Fuels and Telecommunications. Among the Private Sector industry groups, this was maximum for Information Technology, i.e. Rs. 106.62 crore succeeded by Defence Industries, Transportation and Fuels. The per unit R&D expenditure of Public and Private Sector, when all units taken, was Rs. 51.0 crore and Rs. 18.2 crore respectively. This may be mainly due to the existence of a large number of R&D units of small-scale industrial category and also Private Sector R&D units are heterogeneous in size in terms of R&D resources input. It may be interesting to note from this table that variation in size of R&D investment

Figure 4.2: R&D EXPENDITURE BY LEADING INDUSTRIES GROUPS, 2017-18



Source : Data collected and compiled by NSTMIS, DST, GoI

Table 4.4: PER UNIT INDUSTRIAL R&D EXPENDITURE CLASSIFIED BY SECTOR AND BY INDUSTRY GROUP, 2017–18

Industry Group	Public Sector		Private Sector		Industrial Sector	
	R&D Units	R&D Exp (Rs. Crore)	R&D Units	R&D Exp (Rs. Crore)	R&D Units	R&D Exp (Rs. Crore)
Information Technology	–	–	34	106.62	34	106.62
Defence Industries	18	150.68	23	6.10	41	69.57
Transportation	2	0.43	100	68.49	102	67.16
Fuels	13	89.54	10	5.13	23	52.84
Misc. Mechanical Engineering Industries	0	0	76	41.09	76	41.09
Medical & Surgical Appliances	2	3.29	35	36.51	37	34.72
Drugs & Pharmaceuticals	3	1.05	313	32.46	316	32.16
Soaps, Cosmetics, Toilet Preparations	1	0.65	13	21.79	14	20.28
Telecommunications	1	22.76	13	15.61	14	16.12
Industrial Machinery	1	646.64	63	3.20	64	13.25
Chemicals (other than fertilizers)	9	1.74	224	13.41	233	12.96
Electricals & Electronics	10	10.23	215	9.00	225	9.06
Metallurgical Industries	10	20.86	58	4.55	68	6.95
Biotechnology	1	0.07	163	6.57	164	6.53
Others	32	11.56	667	6.47	699	6.70
Total	**103**	**51.00**	**2007**	**18.19**	**2110**	**19.79**

- represents 'NIL'

was quite high between different industry groups. It may further be observed that heterogeneity in the size of R&D expenditure for different industry groups between public and private sector was also quite significant.

The quantum of manpower employed in R&D units is another major indicator of country's R&D effort. As on April 1, 2018, there were 2,26,879 full-time equivalent personnel employed in 2,607 units of Industrial Sector in-house R&D units including 497 SIRO units which worked out to be 41.0% of total personnel employed in all the R&D establishments in the country. Out of the total manpower employed in industrial R&D units 2,14,844 were employed in 2,504 Private Sector industries and rest 12,035 were employed in 103 Public/Joint Sector industries. In terms of percentage this works out to be 94.7% and 5.3% in Private and Public Sector respectively.

The personnel employed in the in-house R&D units of Industrial Sector were either engaged in research and development work (called R&D personnel) or were extending technical support for research and development (called auxiliary personnel) or were providing administrative support (called the administrative personnel) for research activities. It may be safely assumed that R&D personnel and auxiliary personnel were mostly S&T qualified. Information in this context may be seen from Table 4.5 which gives the number of personnel by type of work for Public, Private and Industrial Sector separately. It may be indicated here that the classification of all personnel into the three categories is not easy for many R&D units and therefore, this data may be considered only as order of magnitude.

It may be seen from Table 4.5 that for every 100 personnel employed in Industrial Sector R&D units, 60.9 were engaged in R&D, 19.0 extended technical support for performing the R&D work and 20.1 provided administrative support. In Private Sector including SIRO, out of every 100 personnel, 59.9 were engaged in R&D, 19.5 provided technical support and 20.6 provided administrative support and for Public Sector employment, the share of these categories was 77.2, 12.3 and 10.5 respectively.

As on April 1, 2018, the total number of R&D personnel employed in 2,607 Industrial Sector R&D units were 1,38,059 which work out to be 40.4% of total R&D personnel at national level. For Private Sector this figure was 1,28,768 and for Public Sector it was 9,291. About 44,705 female personnel were employed in Industrial Sector R&D establishments in the country. Out of this, 54.5% (24,368) were employed in Industrial Sector R&D work given at the end (Ref. Table 22).

Table 4.5: CLASSIFICATION OF PERSONNEL BY TYPE OF WORK AS ON 01.04.2018

(Number)

Category	Public Sector	Private Sector	Industrial Sector
No. of R&D Units	103	2504	2607
R&D	9291	128768	138059
Auxiliary	1480	41872	43352
Administrative	1264	44204	45668
Total	**12035**	**214844**	**226879**

To sum up, the salient features are as under:

- Industrial Sector investment on R&D at current prices during 2017–18 attained a level of Rs. 47,109.13 crore. Out of this, 11.2% was spent by Public Sector and 88.8% was spent by Private Sector.
- Industrial Sector accounted for 41.4% of National R&D expenditure during 2017–18.
- Industry spent 0.28% of Gross Domestic Product (GDP) on R&D in 2017–18.
- The R&D expenditure as percentage of Sales Turnover (STO) for Industrial Sector (including SIROs) was 1.11% for the year 2017–18 while for Private and Public Sector separately the figures were 1.48% and 0.29% respectively.
- Per unit R&D expenditure for Private and Public Sector industries were Rs. 18.19 crore and Rs. 51.0 crore respectively during 2017–18.
- Drugs and Pharmaceuticals industry group topped the R&D expenditure followed by Transportation and Information Technology during 2017–18.
- As on April 1, 2018; there were 2,26,879 personnel employed in 2,607 Industrial Sector R&D units out of which 1,38,059 were engaged directly on R&D activities. This was 41.0% of total R&D establishments in the country.
- Out of the total R&D personnel in Industrial Sector, 5.3% were employed in Public Sector and 94.7% were employed in Private Sector.
- Out of every 100 personnel employed in Industrial Sector, 60.9 were primarily engaged in R&D, 19.0 extended technical support and 20.1 provided administrative support.

CHAPTER V

CHAPTER V

HIGHER EDUCATION AND SCIENTIFIC RESEARCH

University Grants Commission (UGC), which was established in 1956, under an Act of Parliament, is expected to coordinate the major responsibility of regulating the standard in higher education sector of the country. It has been monitoring the growth of higher education as well as the establishment of new universities and colleges, so as to ensure that higher education grows in response to the needs of society for trained manpower with appropriate levels of professional training, skills and specializations or general educational attainments.

The National Policy on Education (NPE) in 1986 and its revised policy known as Programme of Action of 1992 has made the Commission to direct its efforts towards an overall improvement in higher education through appropriate emphasis on: Autonomous Colleges, Redesigning of Courses, State Councils of Higher Education Accreditation and Assessment Councils, Alternative Models of Management in Universities, National Qualifying Test for recruitment of teachers, making Research and Development broad-based, Training Orientation of teachers, Improvement of Efficiency, Youth and Sports, and Education for the Minorities, Scheduled Castes/Scheduled Tribes, Handicapped and Women.

To gear education sector towards the demands of the 21st century and the needs of the people, Government has brought out after more than three decades since previous policy, new National Education Policy (NEP) 2020. The NEP 2020 envisions an India-centred education system that contributes directly to transforming our nation sustainably into an equitable and vibrant knowledge society, by providing high quality education to all. It further aims at providing autonomy to all higher education institutions with a substantial increase in the overall public expenditure on education.

The Expenditure on Education by Central and State Governments increased from Rs. 114.4 crore in 1950–51 to Rs. 9,211.86 crore in 1985–86 and further to Rs. 1,14,388.82 crore in 2005–06 and to Rs. 2,97,311.17 crore in 2010–11 and to Rs. 5,99,555.26 crore in 2015–16. The State Governments accounted for 76.8% of the expenditure during 2015–16 (see Table 5.1).The expenditure on university and the higher education (Revenue account) has increased in absolute terms from Rs. 1,106.59 crore in 1985–86 to Rs. 29,169.41 crore in 2010–11 to further Rs. 52,402.05 crore in 2015–16, but its percentage share in the total education expenditure declined from 14.7% in 1985–86 to 12.5% in 2010–11 and further to 13.0% in 2015–16 (see Table 5.2).

Table 5.1: EXPENDITURE ON EDUCATION BY CENTRE AND STATE GOVERNMENTS

(Rs. Crore)

Government	1985–86+	2005–06	2010–11	2015–16 (RE)	2016–17 (BE)
Central Government	942.1	23211.13	80660.74	138964.49	163834.59
State Government	8269.76	91177.69	216650.43	460590.77	518937.18
TOTAL	**9211.86**	**114388.82**	**297311.17**	**599555.26**	**682771.77**
% Share of State Govt in Total	89.8	79.7	72.9	76.8	76.0

Source : Analysis of Budgeted Expenditure on Education (various issues), Department of Education, MHRD.

Note :
1. The Centre and State Education Department budget is total of the Revenue, Capital, Loans and advances and other Departments for the respective years.
2. Total Expenditure on Education includes Expenditure by the Education Department and other Departments, Where Other Departments, Expenditure also includes Expenditure for training (formal/informal).
3. RE=Revised Estimates and BE=Budget Estimates

Table 5.2: PLAN & NON-PLAN ACTUAL EXPENDITURE OF EDUCATION DEPARTMENT OF STATES/UNION TERRITORIES & CENTRE (REVENUE ACCOUNT)

(Rs. Crore)

Sector	1985-86+	2005-06	2010-11	2015-16 (RE)	2016-17 (BE)
University Education/DL/Scholarship	1106.59	11013.34	29169.41	52402.05	58923.52
Total Education	**7533.83**	**94483.70**	**233510.12**	**402811.71**	**462398.25**
%Share in total Education	14.7	11.7	12.5	13.0	12.7

Source : Analysis of Budgeted Expenditure on Education (various issues), Department of Education, MHRD.
Note : RE=Revised Estimates and BE=Budget Estimates

The Higher Education Sector is one of the major performers of research. There is no reliable data available on R&D in Higher Education Sector in the country. The Department of Science and Technology had made efforts during 1998 for quantification of manpower and financial resources devoted to R&D in Science and Technology of Higher Education Sector by launching a National Survey executed through 4 zonal centres through sponsored project mode. In 1998–99 for the first time intramural R&D expenditure of Higher Education Sector was quantified from 106 universities and 27 Post Graduate Colleges having R&D to the tune of Rs. 378.56 crore constituting 2.9% of the national R&D expenditure. Further, the data from 131 universities and 46 colleges has been collected and analysed and the R&D expenditure has gone up to Rs. 1,254.81 crore in 2005–06 constituting 4.1% of national R&D expenditure. During the last decade, the R&D expenditure in higher education has gone up to Rs. 3,306.74 crore in 2010–11, Rs. 6,095.18 crore in 2015–16 and Rs. 7,784.33 crore in 2017–18 constituting 5.5%, 6.4% and 6.8%, respectively of national R&D expenditure. It is estimated at Rs. 8,797.08 crore in 2018–19 constituting 7.1% of national R&D expenditure. This amount does not include the expenditure incurred by the State Agricultural Universities and also the Extramural projects funded by Central Departments/Agencies. Such an expenditure has been included under State Sector and Central Sector respectively.

Data on enrolment of students in institutions of higher education can be used as one of the parameters to assess the growth of qualified manpower in the country. The data shown in Table 5.3 reveals that as against the enrolment of 36.05 lakh students in all faculties in 153 Universities/deemed universities with 5,816 colleges in the year 1985–86, there were 274.99 lakh students enrolled in as many as 621 universities/ deemed universities in 32,974 colleges in 2010–11 and 373.99 lakh students enrolled in 993 universities/ deemed universities in 39,931 colleges in 2018–19. Fig. 5.1 shows growth of enrollment in higher education over the years. The number of universities including institutions of national importance, which enjoy university status in 2018–19 were 993.

Table 5.4 shows the growth of enrolment faculty wise in higher education from 2001–02 to 2018–19. In absolute terms, overall student enrolment has gone up to 3.7 times from 89.64 lakh in 2001–02 to 327.71 lakh in 2018–19. It is interesting to observe that the overall percentage share of Science and Technology discipline increased from 30.6% in 2001–02 to 33.0% in 2010–11 and further to 36.8% in 2018–19. *Inter se* the share of pure Science discipline enrolment decreased from 19.4% in 2001–02 to 11.1% in 2010–11 to 16.3% in 2018–19 while, Engineering and Technology discipline enrolment increased from 6.9% in 2001–02 to 18.7% in 2010–11 to 15.3% in 2018–19.

Table 5.5 shows the growth of women enrolment faculty wise in higher education from 2001–02 to 2018–19. In absolute terms, their number in S&T faculties increased from 9.67 lakh in 2001–02 to 20.20 lakh in 2010–11 and further to 53.27 lakh in 2018–19. Among the women enrolled in S&T faculties 52.7% belonged to pure science, 30.0% to engineering and technology, 15.5% to medicine, 1.7% to agriculture and 0.2% to veterinary sciences during 2018–19 (Ref. Table-26).

The data in Table 5.6 reveals that the out-turn of S&T personnel has increased from 2,35,792

Table 5.3: GROWTH OF UNIVERSITIES/DEEMED UNIVERSITIES/COLLEGES AND ENROLMENT

(Number)

Year	Universities	Institutions/ Deemed to be Universities	Colleges	Total Enrolment
1976-77	105	9	4317	2431563
1980-81	116	12	4722	2752437
1985-86	136	17	5816	3605029
1990-91	150	29	7346	4924868
1991-92	155	31	7761	5265886
1992-93	159	31	7993	5534966
1993-94	163	34	8441	5817249
1994-95	168	36	9019	6113929
1995-96	171	37	9252	6574005
2000-01	193	47	12806	8399443
2005-06	241	101	19327	12043050
2010-11	621	131	32974	27499749
2011-12	642	128	34852	29184331
2012-13	667	127	35525	30152417
2013-14	723	127	36634	32336234
2014-15	760	122	38498	34211637
2015-16	799	122	39071	34584781
2016-17	864	122	40026	35705905
2017-18	903	123	39050	36642378
2018-19	993	124	39931	37399388

Source : UGC Annual Reports and AISHE, MHRD Survey Reports.

Note : 1. Series revised from 2010–11 as per the various AISHE, MHRD survey reports.

2. The number of Universities since 2010–11 onwards also include Instt/deemed to be universities and Institutions of National Importance. The figures on enrolment include all faculties including arts, commerce, humanities, etc. (Ref. Table-24)

Figure 5.1: GROWTH OF ENROLMENT IN HIGHER EDUCATION

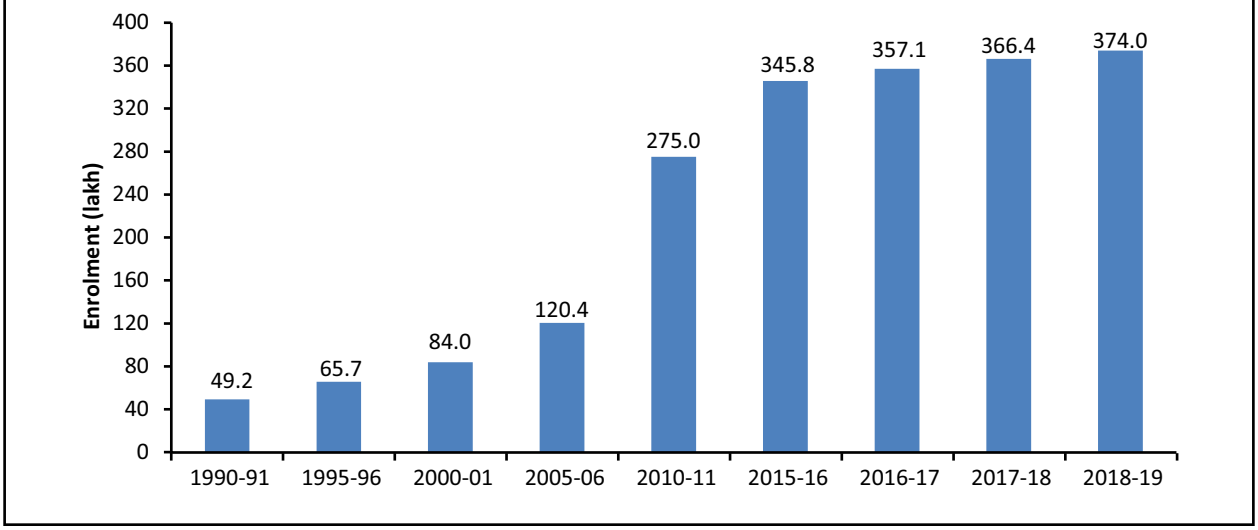


Table 5.4: GROWTH OF ENROLMENT IN S&T HIGHER EDUCATION BY VARIOUS FACULTIES

(Thousand)

Course of Study/ Discipline	2001-02		2005-06		2010-11		2015-16		2017-18		2018-19	
	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total
A. Science and Technology												
Science	1739.1	19.4	2255.2	20.5	1801.0	11.1	4930.7	15.7	5509.3	16.8	5357.3	16.3
Engineering/ Technology	618.6	6.9	795.1	7.2	3024.0	18.7	5472.0	17.4	5194.5	15.9	5024.7	15.3
Medicine	277.9	3.1	348.5	3.2	433.3	2.7	1035.3	3.3	1251.8	3.8	1363.9	4.2
Agriculture	89.6	1.0	64.0	0.6	95.0	0.6	215.3	0.7	270.7	0.8	290.3	0.9
Veterinary Science	17.9	0.2	16.5	0.2	1.1	0.0	16.1	0.1	22.5	0.1	23.8	0.1
Total (A)	**2743.2**	**30.6**	**3479.3**	**31.5**	**5354.4**	**33.0**	**11669.3**	**37.2**	**12248.8**	**37.5**	**12059.8**	**36.8**
B. Other Discipline	6221.5	69.4	7548.7	68.5	10856.8	67.0	19695.1	62.8	20447.3	62.5	20712.1	63.2
Total (A+B)	**8964.7**	**100.0**	**11028.0**	**100.0**	**16211.2**	**100.0**	**31364.4**	**100.0**	**32696.1**	**100.0**	**32771.9**	**100.0**

Source : University Grants Commission (UGC), Annual Reports and AISHE,MHRD Survey reports

Note : Figures for 2010-11 onwards are taken from AISHE, MHRD Survey Reports and pertains only to UG, PG, M.Phil and Ph.D disciplines based on the actual survey response which also excludes courses conducted by standalone institutions. Hence, the total of faculty- wise figures will not match with the overall enrolment figures(Ref.Table-25).

Table 5.5: FACULTY WISE GROWTH OF WOMEN ENROLMENT IN S&T HIGHER EDUCATION

(Thousand)

S&T Discipline	2001-02	% of Overall Enrolment	2005-06	% of Overall Enrolment	2010-11	% of Overall Enrolment	2015-16	% of Overall Enrolment	2017-18	% of Overall Enrolment	2018-19	% of Overall Enrolment
A. Science and Technology												
Science	699.4	7.8	901.3	8.2	853.0	5.3	2388.0	7.6	2757.0	8.4	2804.8	8.6
Engg. & Tech	131.8	1.5	185.9	1.7	916.4	5.7	1718.0	5.5	1642.2	5.0	1600.7	4.9
Medicine	123.0	1.4	162.6	1.5	225.6	1.4	619.3	2.0	758.0	2.3	823.1	2.5
Agriculture	9.1	0.1	10.8	0.1	24.9	0.2	59.3	0.2	78.9	0.2	89.1	0.3
Vet. Science	3.2	0.0	3.6	0.0	0.5	0.0	5.8	0.0	8.4	0.0	9.2	0.0
Total (S&T) (A)	**966.5**	**10.8**	**1264.2**	**11.5**	**2020.4**	**12.5**	**4790.4**	**15.3**	**5244.6**	**16.0**	**5327.0**	**16.3**
B. Other Discipline	2547.9	28.4	3202.6	29.0	5051.3	31.2	10119.3	32.3	10617.9	32.5	10933.3	33.4
Total Women (A+B)	3514.4	39.2	4466.8	40.5	7071.7	43.6	14909.8	47.5	15862.4	48.5	16260.3	49.6
Overall Enrolment (Men+ Women)	8964.7	100.0	11028.0	100.0	16211.2	100.0	31364.4	100.0	32696.1	100.0	32771.9	100.0

Source : University Grants Commission (UGC), Annual Reports and AISHE,MHRD Survey reports

Note :
1. Figures for 2010-11 onwards are taken from AISHE, MHRD Survey Reports and pertains only to UG, PG, M.Phil and Ph.D disciplines based on the actual survey response which also excludes courses conducted by standalone institutions. Hence, the total of faculty- wise figures will not match with the overall enrolment figures.
2. The percentages are calculated based on total enrolment(men+Women) of the respective years. (Ref.Table-26)

in 1995 to 11,33,581 in 2010 and further to 27,84,150 in 2018.

The percentage share of out-turn in Pure Science, Medicine, Agriculture and Veterinary Science in total S&T out-turn has declined during the period 1995 to 2015 but thereafter slightly increased in 2018, whereas during the same period the share of out-turn in engineering and technology has increased but declined during 2015 to 2018. However, in absolute terms, there is an increase in the out-turn in all the disciplines and levels of qualification during 1995–2018. Graduate degree holders formed the single largest group with 83.4% of the total out-turn of S&T personnel. Out of them 45.4% were pure science graduates during the year 2018.

Table 5.6: OUT-TURN OF S&T PERSONNEL FROM UNIVERSITIES BY FIELD OF SCIENCE AND LEVEL OF QUALIFICATION LEVEL OF QUALIFICATION

Subject Area	Graduate				Post Graduate				Doctorate				Total			
	1995	2010	2015	2018	1995	2010	2015	2018	1995	2010	2015	2018	1995	2010	2015	2018
Science	139257	425531	876127	1054627	23807	111876	172611	231470	3155	5872	9012	10055	166219	543279	1057750	1296152
													(70.5)	(47.9)	(41.3)	(46.6)
Engg. & Tech.	32250	421660	1026993	991604	3667	27609	198406	145233	546	1682	4340	7659	36463	450951	1229739	1144496
													(15.5)	(39.8)	(48.0)	(41.1)
Medicine*	19613	103197	181735	226234	4634	18304	42012	48246	-	-	-	1606	24247	121501	223747	276086
													(10.3)	(10.7)	(8.7)	(9.9)
Agri. & Vet. Sc.	5752	12633	35382	48787	2284	4469	10513	13454	827	748	1894	5154	8863	17850	47789	67395
													(3.8)	(1.6)	(1.9)	(2.4)
Total	**196872**	**963021**	**2120237**	**2321252**	**34392**	**162258**	**423542**	**438403**	**4528**	**8302**	**15246**	**24474**	**235792**	**1133581**	**2559025**	**2784129**
	(83.5)	**(85.0)**	**(82.9)**	**(83.4)**	**(14.6)**	**(14.3)**	**(16.6)**	**(15.7)**	**(1.9)**	**(0.7)**	**(0.6)**	**(0.9)**	**(100.0)**	**(100.0)**	**(100.0)**	**(100.0)**

Note :
1. Figures pertain to UG, PG and Ph.D disciplines only and figures in brackets are percentage calculated on total out-turn of the respective years.
2. Figures for 2015 onwards are taken from AISHE, MHRD Survey Reports (based on actual response)for UG, PG and forPh.D, figures are taken from UGC Annual Reports. Hence, the total of level -wise out-turn may not match figures from Annual reports figures.
3. Figures for Engineering and Technology Degree Holders include IITs also.
4. Doctorates in Medicine have been included in Doctorate of Science and Doctorate in Veterinary Science have been merged with Doctorate of Agricultural Science.
5. Medicine includes degrees awarded in Indian Systems of Medicine, Pharmacy, Dentistry and Nursing.
6. Science include Criminology & Forensic Science, Marine Science/Oceanography; Agriculture include Fisheries; Engineering includes IT & Computer.

Doctorate degree holders are highly qualified personnel of education system. From Table 5.7, analysis of data of Ph.D. degree recipients during 2017–18 reveals that 60% of them were from S&T faculties and the rest 40% from other non S&T faculties. Pure science alone shared 41.1% followed by Engineering and Technology, which shared 31.3% of total S&T doctorates degrees awarded during 2017–18 (Fig. 5.2).

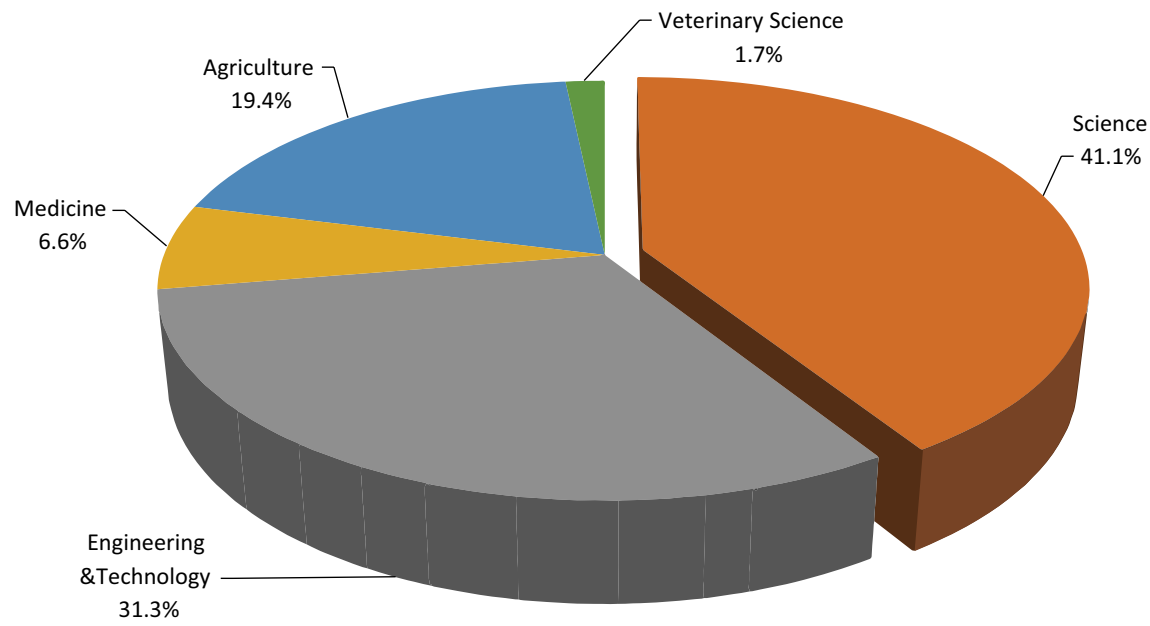
Teaching staff in higher education plays a vital role for training better manpower. UGC is making all efforts to keep the standard of teaching staff up-to-date in knowledge, technical know-how, and skill by providing requisite facilities and incentives through Faculty Improvement Programme and other schemes. As given in Table 5.8 out of the total 12.50 lakh of teaching staff serving in higher education sector, 15.1%

Table 5.7: FACULTY-WISE NUMBER OF DOCTORATE DEGREES AWARDED, 2017–18

Faculty	2017–18	% share of total
A. Science and Technology		
Science	10055	24.6
Engineering/Technology	7659	18.8
Medicine	1606	3.9
Agriculture	4748	11.6
Veterinary Science	406	1.0
Total S&T (A)	**24474**	**60.0**
B. Others*	**16339**	**40.0**
Total (A+B)	**40813**	**100.0**

*Others include Arts, Commerce, Law, Education, Library & Information Science; Music, Performing/Visual Arts, Journalism & Mass Communication, Physical Education & Social Work etc.

Figure 5.2: FACULTY WISE DOCTORATE DEGREE AWARDED IN S&T DISCIPLINES, 2017-18



were in university departments/colleges and 84.9% in affiliated colleges. Percentage share of Professors in the total strength of teaching staff was only 9.5% and that of Readers/Associate Prof., Lecturers/ Assistant Professor, Tutors/Demonstrators and Temporary Teachers were 12.0%, 68.9%, 3.8% and 5.8% respectively.

Table 5.8: TEACHING STAFF POSITIONED IN HIGHER EDUCATION SECTOR, 2018–19

(Number)

Designation	University Teaching Departments/ Constituents Units/Off-Campus Centres	Affiliated Colleges and Constituent College	Grand Total
Professor & *Equivalent	35221	83235	118456
Reader/Associate Professor	27697	122460	150157
Lecturer/Assistant Professor	109667	752434	862101
Tutor/Demonstrator	7412	39489	46901
Temporary Teachers	7720	65074	72,794
Grand Total	**187717**	**1062692**	**1250409**

* Includes Directors, Principals and Senior Teachers who are equivalent to Professors. Excludes Visiting Teachers. (Source: UGC Annual Report (AISHE Report: 2018–19 based on actual response)

To sum up, the salient features are as under:

- There were 993 universities/deemed universities and 39,931 colleges during 2018–19 to impart higher education in the country.
- Expenditure on University and other Higher Education (Revenue account) was Rs. 4,02,811.71 crore during 2015–16. 327.72 lakh students were enrolled for higher education out of which 36.8% were in S&T faculties during 2018–19.
- Higher Education sector spent Rs. 7,784.33 crore on R&D activities with a share of 6.8% in the national R&D expenditure for the year 2017–18.
- Out turn of S&T personnel increased from 2,35,792 in 1995 to 11,33,581 in 2010 and further to 27,84,150 in 2018.
- Out of 40,813 Ph.D. degrees awarded 10,055 were from pure science during 2017–18.
- During 2018–19 there were 12.50 lakh teaching staff in all faculties in higher education sector, 9.5% of them were in the grade of professor.

CHAPTER VI

CHAPTER VI

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 such as 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.

The data for the last decade shows that the highest number of 47,854 applications for patents was made during 2017–18. The figure for 2016–17 was 45,444. About 67.5% of the total applications for patents received in 2017–18 were in the name of foreigners residing abroad and only 32.5% were in the name of Indian nationals (Ref. Table 40).

Table 6.1 provides information on the country-wise number of applications filed for patents in India for a few selected countries during 2016–17 and 2017–18. The number of applications for patents received from abroad during 2017–18 was 32,304 as against 32,226 during the year 2016–17 (Ref. Table 41).

Table 6.1: COUNTRY-WISE NUMBER OF APPLICATIONS FILED FOR PATENTS IN INDIA

S. No.	Country	Number of applications filed	
		2016–17	2017–18
1.	USA	10883	18179
2.	Japan	4275	4487
3.	Germany	2818	2773
4.	Switzerland	1467	1268
5.	The Netherlands	1359	1387
6.	France	1214	1184
7.	UK	1008	1138
8.	Italy	551	577
9.	Russia	67	93
10.	Other Countries	8583	1218
11.	India (A)	13219	15550
12.	Total Foreign Countries (B)	32225	32304
	Total (A+B)	**45444**	**47854**

Source : Annual Reports of Controller General of Patents, Design and Trade Marks

It may be seen from Table 6.1 that the USA accounted for 56.3% of the total applications received from foreign nationals during 2017–18. The USA together with Japan and Germany accounted for about 78.8% of total applications received from foreigners during 2017–18.

During the year 2017–18, there were 15,550 applications for patents filed by Indian nationals. Out of these, 64.4% originated from the states of Maharashtra (24.6%), Tamil Nadu (17.6%), Karnataka (13.0%) and Delhi (9.2%). Together with the States of Telangana (5.3%) and Uttar Pradesh (4.6%), these six states accounted for 74.3% of total number of applications filed in the country by Indian Nationals (Ref. Table 42). Table 6.2 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 2017–18 was 13,045. Out of this, 85.2% were in the name of the foreign citizens and 14.8% in the name of Indian citizens. It may be

Table 6.2: PATENTS GRANTED IN INDIA

(Number)

Year	Indians	Foreigners	Total
2008–09	2541	13520	16061
2009–10	1725	4443	6168
2010–11	1273	6236	7509
2011–12	699	3682	4381
2012–13	716	3410	4126
2013–14	634	3592	4226
2014–15	684	5294	5978
2015–16	918	5408	6326
2016–17	1315	8532	9847
2017–18	1937	11108	13045

Source: Annual Reports of Controller General of Patents, Design and Trade Marks

observed that during the decade the share of patents granted to Indians was highest in 2008–09 and then it started declining from 2009–10 to 2013–14 except the year 2012–13. It started increasing again during 2013–14 to 2017–18 (Fig. 6.1) (Ref. Table 43).

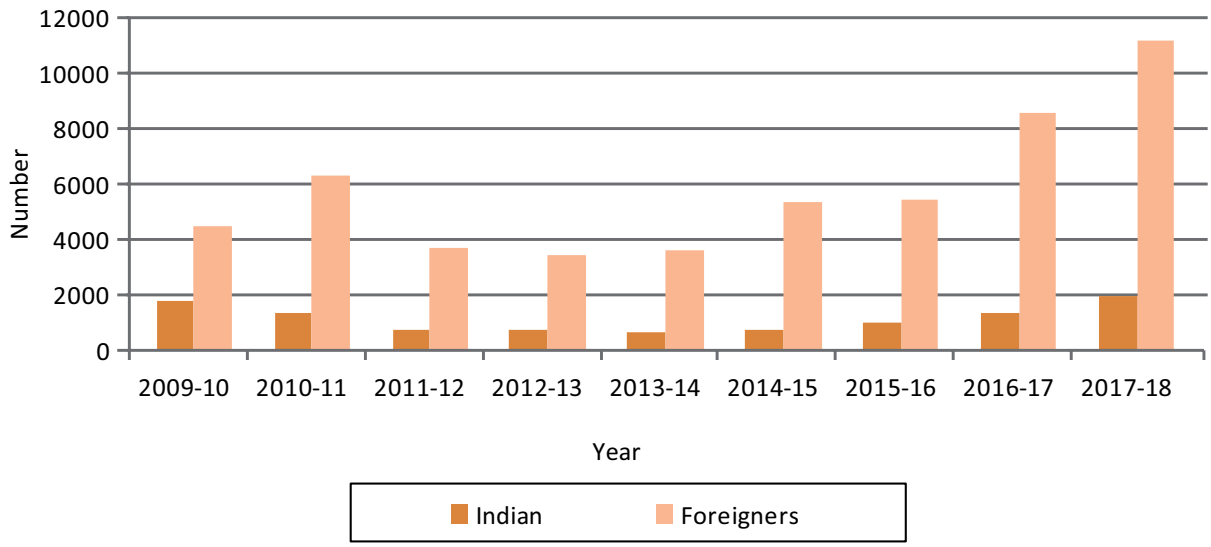
During the year 2017–18, 56,764 patents were in force. Out of these, 84.4% were in the name of foreign nationals. During the last decade, the share of foreign patents in force has shown an increasing trend. The share of foreign patents in force increased from 80.0% in 2008–09 to 84.4% in 2017–18 (Ref. Table 43).

Table 6.3 gives information on patent applications filed at different patent offices across the world during the years 2016, 2017 and 2018. It may be seen from the table that China filed and received the highest number of patent applications during 2018 as per the World Intellectual Property Indicators (*as per WIPO website accessed on April 2020*). Chinese patent office received the highest number of patent applications (15,42,002) followed by the USA, Japan and Republic of Korea with 5,97,141; 3,13,567 and 2,09,992 patent applications respectively from across the world. The Indian patent office received 50,055 patent applications during 2018 which included 16,289 applications from residents and the rest 33,766 applications from non-residents as compared to 45,057 applications including 13,199 resident applications and 31,858 non-resident applications received during 2016. It indicates that patent filing at Indian patent office is showing an increasing trend over the years. According to WIPO, India's Patent Office stands at the 7th position among the top 10 Patent Filing Offices in the world.

Table 6.3 further shows that during 2018, patent applications filed by residents dominated in various patent offices across the world such as China (90.4%), Japan (80.9%), South Korea (77.4%), Germany (68.7%) and Russian Federation (65.7%) in contrast to countries like India (32.5%), Brazil (20.0%) and Canada (12.0%) where patent applications filed by non-residents dominated. It is interesting to note that the USA had nearly equal share of patent applications filed by residents as well as non-residents. The overall world total also shows dominance of residents with 2,378,400 patent applications (71.5%) over non-residents with 32,26,300 patent applications (28.5%) filed.

The measurement of the number of scientific publications by field and countries is an indicator of the status of the outcome of scientific research efforts or R&D. 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 etc. These are now professionally captured across the countries and S&T disciplines and documented in the global publication

Figure 6.1: PATENTS GRANTED TO INDIANS & FOREIGNERS



Source : Annual Reports of Controller General of Patents, Design and Trade Marks

Table 6.3: PATENT APPLICATIONS FILED AT SELECT PATENT OFFICES ACROSS THE WORLD DURING THE YEARS 2015 TO 2018

(Number)

Office	2016			2017			2018		
	Resident	Non-Resident	Total	Resident	Non-Resident	Total	Resident	Non-Resident	Total
China	1204981	133522	1338503	1245709	135885	1381594	1393815	148187	1542002
USA	295327	310244	605571	293904	313052	606956	285095	312046	597141
Japan	260244	58137	318381	260292	58189	318481	253630	59937	313567
Republic of Korea	163424	45406	208830	159084	45691	204775	162561	47431	209992
European Patent Office	76082	83276	159358	78555	88030	166585	81565	92832	174397
Germany	48480	19419	67899	47785	19927	67712	46617	21281	67898
India	13199	31858	45057	14961	31621	46582	16289	33766	50055
Russian Federation	26795	14792	41587	22777	14106	36883	24926	13031	37957
Canada	4078	30667	34745	4053	30969	35022	4349	31812	36161
Australia	2620	25774	28394	2503	26403	28906	2757	27200	29957
Brazil	5200	22810	28010	5480	20178	25658	4980	19877	24857
World	**2206900**	**910600**	**3117500**	**2243100**	**919200**	**3162300**	**2378400**	**947900**	**3326300**

Source : World Intellectual Property Indicators (WIPO); website accessed in April 2020.

or bibliometric databases. Bibliometric indicators viz., total number of S&T publications originating from a country coupled with other related dimensions during a specified time period are made available by searching the representative international bibliometric databases.

To bring forth new and updated set of bibliometric indicators for the S&T sector in the country, the National Science and Technology Management Information System (NSTMIS), Department of Science and Technology (DST) has commissioned since early 2010, bibliometric studies at regular intervals on India's research output, collaboration and comparative performance based on the popular global databases Science Citation Index (SCI) and SCOPUS. These studies/reports serve as an evidence base leading to evaluation and monitoring of scientific research for policy planning.

The information on India's research publication trend during 2011–16 based on the SCOPUS and SCI databases along with advanced trend for the years 2017 and 2018 is given in Table 6.4. India's scientific publication output has shown a rising trend during the last decade. As per the SCOPUS database, research output has increased by 49.9% from 90,864 in 2011 to

Table 6.4: INDIA'S RESEARCH PUBLICATION TREND, 2011–2018

(Number)

Database	2011	2012	2013	2014	2015	2016	2017	2018
SCOPUS	90,864	99,974	1,06,957	1,21,516	1,28,021	1,36,238	1,54,306#	1,71,879#
SCI	47,081	49,607	54,529	59,311	61,825	64,267	73,529#	73,813#
NSF(US)	74,143	80,493	86,348	96,426	1,01,813	1,12,167	1,21,631	1,35,788

Source : 1. NSTMIS, DST Commissioned Study (SCOPUS; SCI Database), 2019
2. NSF Database- Science and Engineering Indicators 2020, NSF (USA)

Note : #- Advanced Trends

1,36,238 in 2016. Similarly, it increased by 36.5% from 47,081 in 2011 to 64,267 in 2016 as per the SCI database. During 2011–2016, India's growth rate of scientific research publication was 8.4% and 6.4% as per the SCOPUS and SCI database as against the world average of 1.9% and 3.7%, respectively (Ref. Table 34 and Table 37). NSF (USA) database has further corroborated India's rising trend in science and engineering research publications. As per the NSF database, India's research output increased by 53.1% from 74,143 in 2011 to 112,167 in 2016 with a growth rate of 12.9% as against the world average of 4.9%. During 2018, India's scientific publication output increased to 171,879 and 73,813 as per advanced trends in SCOPUS and SCI database respectively. Whereas in case of NSF database, India's scientific publication output was 135,788 in 2018.

For international comparisons, searches were made in respect of SCI database for the period 2011 to 2016 for select countries and world, this shall further enable us to get an idea of India's contribution to world in terms of scientific publications, the data thus obtained is given in Table 6.5.

Table 6.5: RESEARCH PAPERS PUBLISHED FROM INDIA AND SELECT COUNTRIES IN S&T DURING 2011–2016

(Number)

S. No.	Country	2011	2012	2013	2014	2015	2016
1.	USA	3,67,493	3,80,423	3,94,642	4,01,761	4,07,638	4,11,363
2.	China	1,62,968	1,88,460	2,22,401	2,56,655	2,87,702	3,12,983
3.	United Kingdom	1,01,502	1,06,209	1,12,833	1,13,058	1,18,878	1,22,764
4.	Germany	96,501	1,00,733	1,04,714	1,05,658	1,08,863	1,10,928
5.	Japan	77,777	78,548	80,171	78,648	77,943	79,010
6.	France	67,878	70,195	73,171	73,166	75,272	76,197
7.	Canada	59,477	62,406	65,372	66,713	68,503	69,374
8.	Italy	55,823	59,312	64,075	65,541	67,672	69,332
9.	Australia	45,645	49,691	55,139	58,764	62,713	64,904
10.	India	47,081	49,607	54,529	59,311	61,825	64,267
11.	Spain	50,886	54,493	57,056	57,982	58,856	59,425
12.	South Korea	45,723	49,898	52,340	55,210	58,260	58,930
13.	Brazil	36,019	38,523	40,127	41,622	43,517	45,781
14.	The Netherlands	34,068	36,734	38,643	39,238	40,274	41,343
15.	Russia	29,193	28,562	29,906	31,030	35,309	35,505
16.	Switzerland	24,805	26,588	28,179	29,138	30,256	31,559
17.	Turkey	24,047	25,695	26,888	27,518	29,056	30,710
18.	Sweden	21,691	23,507	25,177	26,210	27,298	28,479
19.	Taiwan	27,335	27,756	28,274	27,764	26,650	25,979
20.	Saudi Arabia	5,885	7,701	9,546	11,910	13,704	14,699
21.	Mexico	10,572	11,414	12,200	12,789	13,749	14,457
22.	South Africa	9,521	10,287	11,030	12,184	13,057	13,932
23.	Argentina	8,176	8,555	8,831	8,868	9,265	9,170
24.	Indonesia	1,218	1,422	1,651	1,776	1,966	2,258
	World	**13,08,375**	**13,76,849**	**14,53,771**	**14,98,240**	**15,46,276**	**15,68,706**

Source : NSTMIS, DST Commissioned Study 2019, Clarivate, Web of Science-SCI database.

It may be seen that India's volume of scientific publication remained far ahead of many developed and developing countries including BRICS except China during the last decade as per SCI database. Similar trend for India was observed in case of NSF and SCOPUS databases as well (Ref. Table 33 and 34) In fact, India (2018) was ranked at 3rd, 5th and 9th in scientific publication output as per the NSF, Scopus and SCI database respectively (see Fig. 6.2).

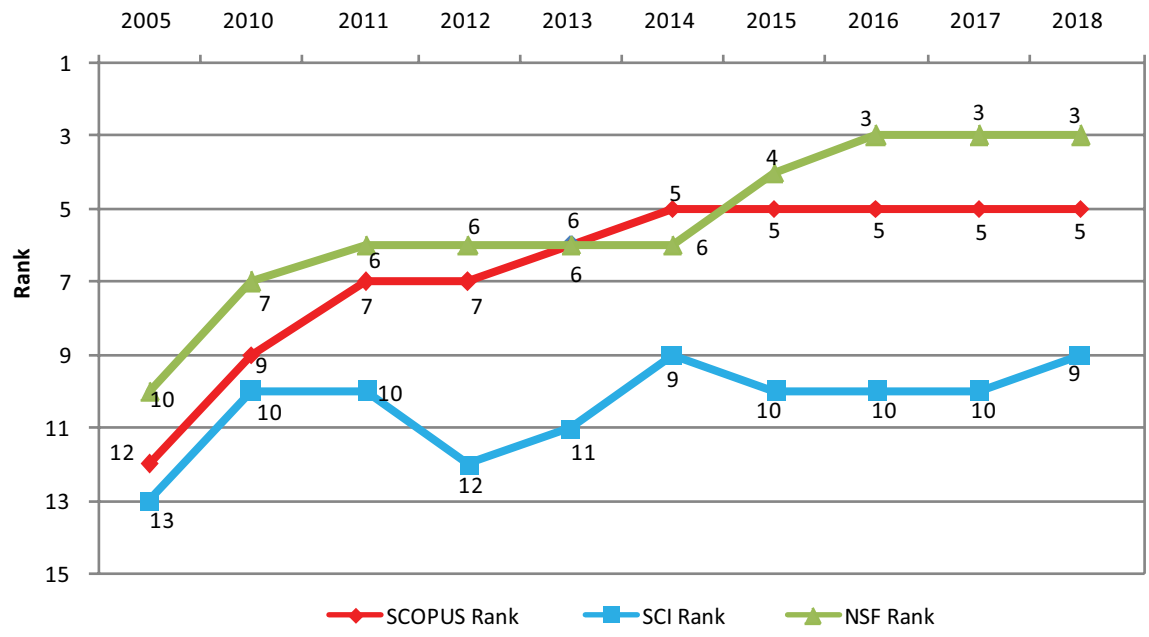
An important aspect which attracts attention both globally and nationally and requires mention is the quality of scientific research papers published. As per the Department of Science and Technology (DST) Commissioned Study 2019 based on SCOPUS database, India received 8,80,733 scholarly citations in 2011 and 2,62,677 in 2016. This accounted for 3.0% and 4.1% of the world's total citations in the year 2011 and 2016 respectively as given in Table 6.6.

Thus, it would be interesting here to observe the ranking for India both in terms of publication and citation among the groups of nations as given in Table 6.7.

It is seen that in terms of scholarly publications, India ranks 1st among SAARC countries, 2nd among BRICS countries and 5th among G20 and Top 20 countries. India, also accounted for nearly all of the citations to the SAARC region's scholarly output.

Further, as reveled from the SCOPUS database, India's growth is quite aggressive at the very top end of the excellence scale. India held 4.3% of world share

Figure 6.2: INDIA'S RANKING IN SCIENTIFIC PUBLICATION IN SCOPUS, SCI AND NSF DATABASE



Source: NSTMIS, DST Commissioned Study (SCI ; SCOPUS Database), 2019 ; NSF database, Science and Engineering Indicators, 2020

Table 6.6: SCHOLARLY CITATIONS FOR INDIA AND OTHER GROUPS OF NATIONS DURING 2011 AND 2016

(Number)

Year	India	SAARC	BRICS	EU28	G8	G20	World
2011	880733 (3.0%)	987478 (3.4%)	5229291 (17.8%)	11321919 (38.5%)	19279279 (65.5%)	24513632 (83.3%)	29422393 (100%)
2016	262677 (4.1%)	307936 (4.9%)	1830409 (28.9%)	2377425 (37.5%)	3717522 (58.7%)	5350193 (84.5%)	6333593 (100%)

Source : NSTMIS, DST Commissioned Study (SCOPUS Database), 2019

Table 6.7: PUBLICATION AND CITATION RANKING FOR INDIA IN SELECT GROUPS OF NATIONS, 2016

Rank	SAARC	BRICS	G20	TOP 20
Publication	1	2	5	5
Citation	1	2	10	11

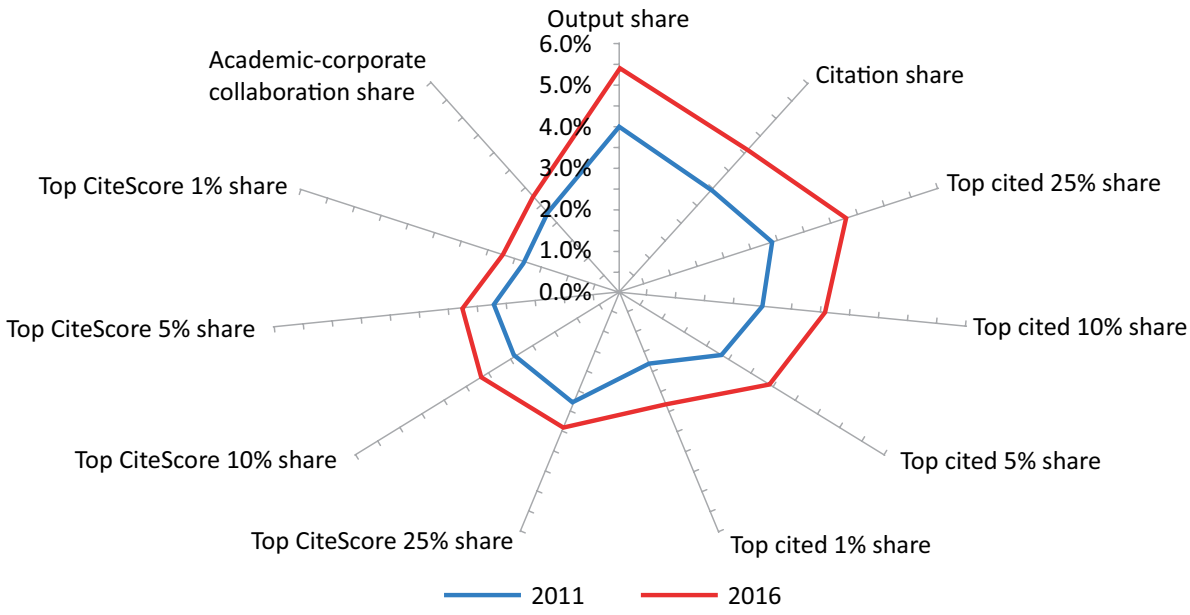
Source : NSTMIS, DST Commissioned Study (SCOPUS Database), 2019

in top 25%, 3.6% in top 10%, 3.4% in top 5% and 2.8% in top 1% of highly cited publications during 2016. The highly cited publications were mainly concentrated in the fields such as Engineering, Physics & Astronomy, Computer Science and Materials Science. In terms of total research output, 16.4% of India's research publications came from international collaboration and 2.7% came from academic-corporate collaboration in 2016 (see Fig. 6.3).

It is evident from Table 6.8 based on the Web of Science (SCI database), that the number of papers published in the areas of Chemistry, Engineering, and Physics were more as compared to other subjects during 2011–16. It also shows that out of total papers published by the world, Indian contribution in Chemistry is 7.2% followed by Agriculture with 6.6% and Pharmacology & Toxicology with 6.3% during the period 2011–16.

The percentage contribution in the areas of Materials Science and Physics were 6.2% and 5.2% respectively. Indian contribution to Biology & Biochemistry, Engineering and Space Science were of the order of 4.9%, 4.7% and 4.6% respectively during the period 2011 to 2016.

Figure 6.3: INDIA'S OUTPUT, IMPACT AND KNOWLEDGE TRANSFER, 2011–16



Source: NSTMIS, DST Commissioned Study (SCOPUS Database), 2019

Table 6.8: FIELD-WISE NUMBER OF PAPERS PUBLISHED FROM INDIA AND WORLD DURING 2011–2016

S. No.	Fields	2011–2016		
		India	World	India's Contribution to World (%)
1.	Agricultural Sciences	15,941	2,41,321	6.6
2.	Biology & Biochemistry	21,130	4,28,325	4.9
3.	Chemistry	71,493	9,97,167	7.2
4.	Clinical Medicine	32,251	15,89,211	2.0
5.	Computer Science	7,929	2,13,756	3.7
6.	Engineering	34,092	7,19,308	4.7
7.	Environment/Ecology	10,041	2,76,180	3.6
8.	Geosciences	10,080	2,60,977	3.9
9.	Immunology	4,251	1,49,583	2.8
10.	Materials Science	29,677	4,75,887	6.2
11.	Mathematics	7,061	2,47,761	2.8
12.	Microbiology	5,692	1,22,461	4.6
13.	Molecular Biology & Genetics	6,747	2,74,568	2.5
14.	Neuroscience & Behavior	4,327	3,00,772	1.4
15.	Pharmacology & Toxicology	14,533	2,28,905	6.3
16.	Physics	32,942	6,38,020	5.2
17.	Plant & Animal Science	14,626	4,22,353	3.5
18.	Psychiatry/Psychology	1,431	2,37,399	0.6
19.	Space Science	3,969	85,559	4.6
20.	Others	7,508	2,50,838	3.0
	Total	**3,36,620**	**87,52,217**	**3.8**

Source : NSTMIS, DST Commissioned Study 2019, Clarivate, Web of Science-SCI database.

To sum up, the salient features are as under:

- Out of 47,854 applications filed for patents 15,550 (32%) applications were filed by Indians during 2017–18. Among these, nearly 65.0% patents were from the States of Maharashtra, Karnataka, Tamil Nadu and Delhi. This was followed by Telangana and Uttar Pradesh with 5.3% and 4.6% respectively.
- The USA alone accounted for 56.3% of the total applications filed for patents by foreign nationals during 2017–18.
- The number of foreign patents in force has declined from 19,780 in 1976–77 to 4,331 in 2003–04 but rose to 47,934 in 2017–18.
- According to WIPO, India is ranked at 7th position among the top 10 Patent Filing Offices in the world.
- India's significant increase in research output is reflected in publication databases: by 50% from 90,864 in 2011 to 1,36,238 in 2016 in SCOPUS; by 36.5% from 47,081 in 2011 to 64,267 in 2016 in SCI; and by 83.1% from 74,143 in 2011 to 1,35,788 in 2018 in NSF.
- India's growth rate of scientific publication during 2011–2016 as per the SCOPUS and SCI database was 8.4% and 6.4% as against the world average of 1.9% and 3.7% respectively. It was 12.9% as against the world average of 4.9% as per the NSF database.
- India was ranked at 3rd , 5th and 9th in scientific publication output during 2018 as per the NSF, Scopus and SCI database respectively. India is ranked ahead of many developed and devloping countries including BRICS except China.
- Based on the SCI database during 2011–16, India's largest share of global research publications were in Chemistry (7.2%), Agricultural Sciences (6.6%), Pharmacology and Toxicology (6.3%), Materials Science (6.2%), Physics (5.2%), Biology and Bio-chemistry (4.9%), Engineering (4.7%) and Microbiology (4.6%).
- Based on the SCOPUS database, India held 4.3% of world share in top 25%, 3.6% in top 10%, 3.4 % in top 5% and 2.8% in top 1% of highly cited publications during 2016. The highly cited publications were mainly concentrated in the fields such as Engineering, Physics & Astronomy, Computer Science and Materials Science.
- As per the SCOPUS database, 16.4% of India's research publications came from international collaboration and 2.7% came from academic-corporate collaboration in 2016.

CHAPTER VII

CHAPTER VII

INTERNATIONAL COMPARISON OF RESEARCH AND DEVELOPMENT

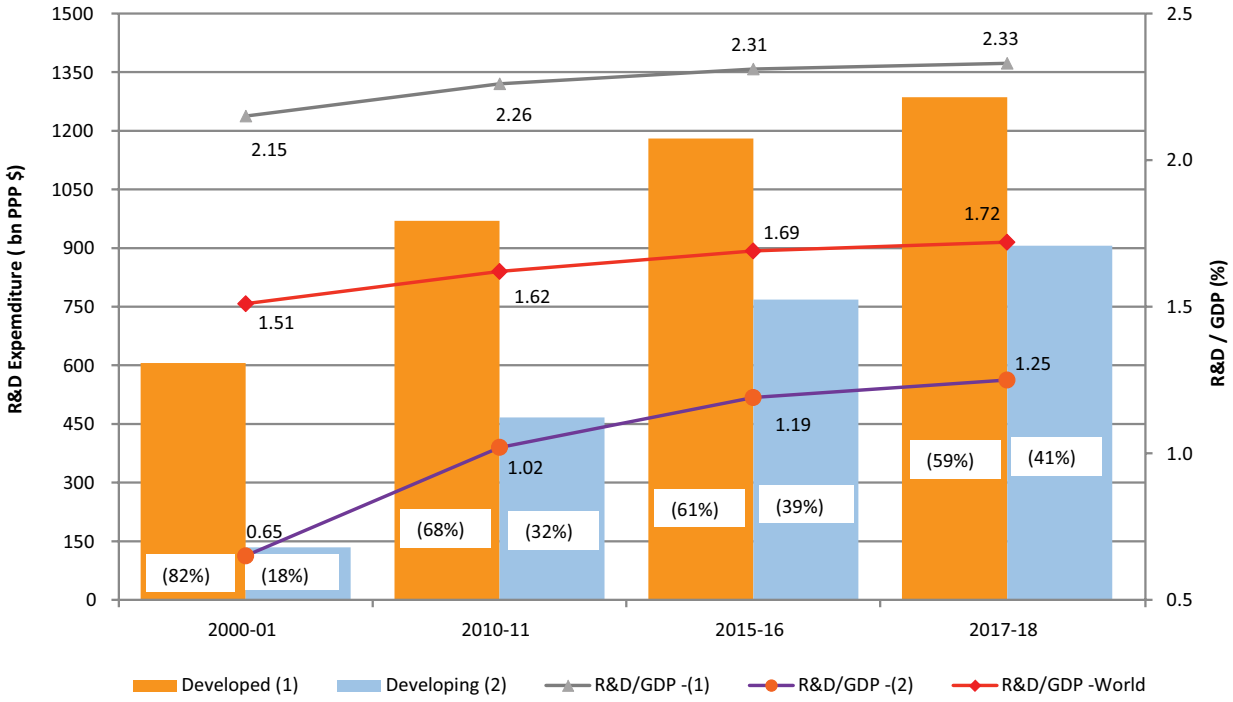
In the preceding chapters, an analysis has been attempted on the national research and development (R&D) efforts and its components in various sectors. This chapter has been devoted to assess the relative progress in scientific and technological (mainly R&D) activities achieved by India in comparison to other developing and developed countries. This primarily involves examining global investments in R&D and its concentration or spread across regions, continents and countries. Such a comparison, though prima facie appears to be simple and straightforward, entails a number of difficulties, both conceptual and operational. Though most of the developed countries and a few of the developing countries have a well-organised data collection system, yet the concepts vary from country to country. So, it is difficult to compare these data because of the varying concepts and definitions used. A complete data system or recent data are also often lacking for most of the developing countries and even for some of the developed countries. Keeping in view, the constraints given above, an attempt has been made in the ensuing paragraphs to throw light on the S&T parameters related with socio-economic parameters for select developing and developed countries.

According to the UNESCO S&T Statistics (Table 7.1), the total investment on R&D in the world during 2000–01 was of the order of 740.78 billion PPP $. This increased to 1,435.89 billion PPP $ in 2010–11 and to 1,947.77 billion PPP $ in 2015–16 and was 2,192.38 billion PPP $ during 2017–18. The investment on R&D by the developed countries during 2000–01 was 606.14 billion PPP $ and the rest 134.64 billion PPP $ was by the developing countries. In terms of percentage, it works out to be 82% and 18% respectively. In 2010–11, the share of developed and developing countries in world R&D was 68% and 32% while during 2017–18 this was 59% and 41% respectively (Fig. 7.1).

Table 7.1: ESTIMATED WORLD R&D EXPENDITURE BY REGIONS

Region	R&D Expenditure (PPP $ billion)				R&D Expenditure as % of GDP			
	2000-01	2010-11	2015-16	2017-18	2000-01	2010-11	2015-16	2017-18
World	740.78	1435.89	1947.77	2192.38	1.51	1.62	1.69	1.72
	(100%)	(100%)	(100%)	(100%)				
Developed	606.14	969.32	1179.83	1286.09	2.15	2.26	2.31	2.33
	(82%)	(68%)	(61%)	(59%)				
Developing	134.64	466.57	767.94	906.29	0.65	1.02	1.19	1.25
	(18%)	(32%)	(39%)	(41%)				

Figure 7.1: WORLD R&D EXPENDITURE AND ITS PERCENTAGE WITH GDP



Note : Figure in brackets indicate % share in World R&D by region.

This clearly shows a consistently increasing percentage share of developing countries in the world R&D expenditure. In fact, the developing countries region share has risen by more than 100% from 18% to 41% while the developed countries region share has declined by around 75% from 82% to 59% during the last two decades.

One of the most commonly used indicators for international comparison of S&T efforts is the proportion of Gross Domestic Product (GDP) devoted to R&D activities. It may be seen from Table 7.1, that the expenditure on R&D as percentage of GDP for the world in 2017–18 was 1.72%. For the developed countries, this percentage has remained a little over 2.0% during 2000–01 to 2017–18 whereas in the case of developing countries, the percentage has increased from 0.65% in 2000–01 to 1.02% in 2010–11 and further to 1.25% in 2017–18.

In nutshell, the R&D expenditure to world GDP ratio during the last two decades has remained the same for developed countries while it has nearly doubled for the developing countries. Thus, it would be interesting to examine information regarding expenditure on R&D by continents under the developed/developing regions in the world as given in Table 7.2.

Table 7.2: SHARE OF WORLD R&D EXPENDITURE BY CONTINENTS

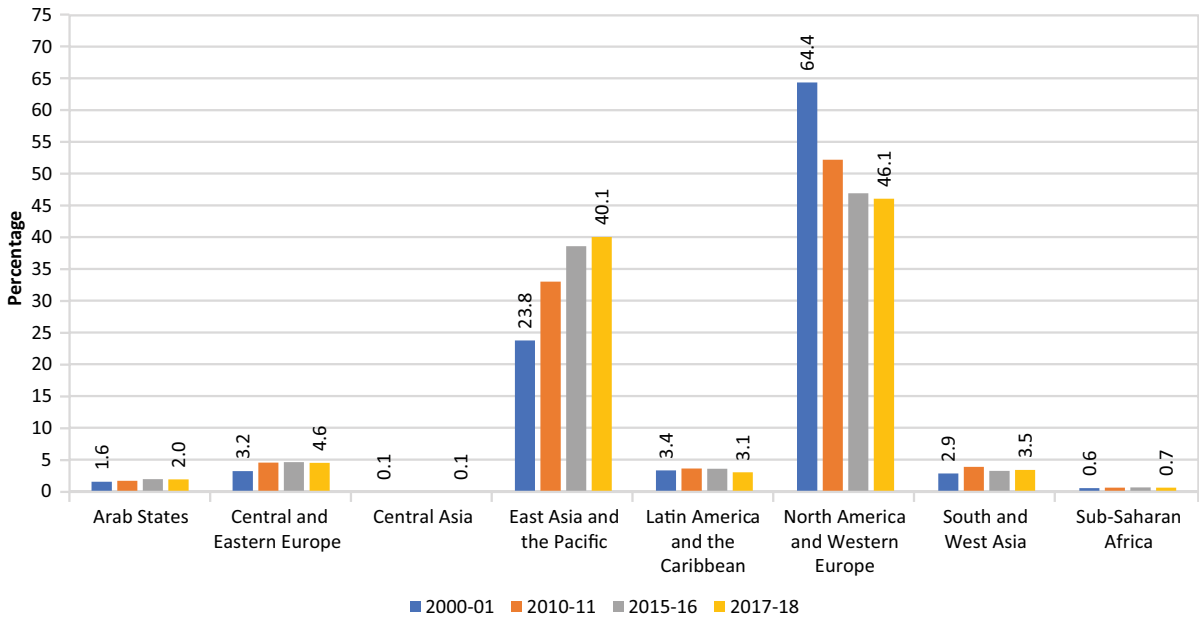
Continent	Expenditure on R&D (billion PPP $) and % Share in World R&D								R&D Expenditure as % GDP			
	2000-01		2010-11		2015-16		2017-18		2000-01	2010-11	2015-16	2017-18
Africa	7.20	(0.97)	18.06	(1.26)	27.32	(1.40)	30.03	(1.37)	0.32	0.40	0.46	0.47
Asia	207.50	(28.01)	545.03	(37.96)	850.88	(43.68)	995.45	(45.41)	1.19	1.43	1.57	1.61
Europe	205.99	(27.81)	362.83	(25.27)	453.23	(23.27)	503.28	(22.96)	1.60	1.74	1.84	1.86
Latin America and the Caribbean	25.01	(3.38)	52.69	(3.67)	70.92	(3.64)	67.07	(3.06)	0.54	0.66	0.73	0.67
Northern America	286.26	(38.64)	434.99	(30.29)	522.11	(26.81)	570.42	(26.02)	2.57	2.66	2.63	2.69
Oceania	8.81	(1.19)	22.29	(1.55)	23.30	(1.20)	26.12	(1.19)	1.46	2.16	1.77	1.78
World	**740.78**	**(100)**	**1435.89**	**(100)**	**1947.77**	**(100)**	**2192.38**	**(100)**	**1.51**	**1.62**	**1.69**	**1.72**

Note : Northern America includes Canada & United States.

It may be seen that during the last two decades a major share, that is, 94.4% of the world R&D expenditure has been concentrated in three continents, viz., Asia, Europe and Northern America. However, the inter se percentage share among the continents varied significantly. The percentage share of world R&D expenditure by Asia increased from 28% to 45% while it decreased both in case of Europe from 28% to 23% and Northern America from 39% to 26% during 2000–01 to 2017–18.

The regional grouping of the world continents by R&D expenditure shows that a large pie, (Fig. 7.2) that is, 86% share of world R&D expenditure is concentrated in mainly two regions comprising: i) North America and Western Europe and ii) East Asia and the Pacific. Other regions such as Central and Eastern Europe, Latin America and the Caribbean, South and West Asia, etc., together contribute towards 14% share of world R&D expenditure. Interestingly, during the last two decades, the percentage share of the world R&D expenditure has consistently increased from 23% to 40% for the East Asia and the Pacific region in contrast to the consistent decline from 64% to 46% for the North America and Western Europe region.

Figure 7.2: SHARE OF WORLD R&D EXPENDITURE BY REGIONS

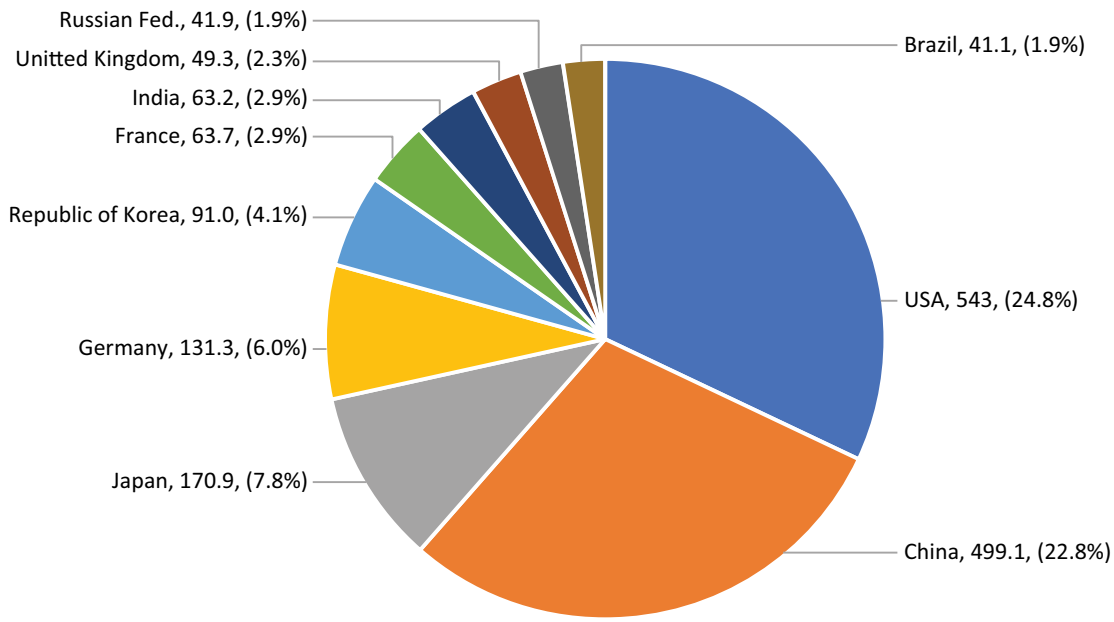


Note : Continents of the world are grouped as per UNESCO Insititute of Statistics(UIS) regions.

Further, 77.3% of share of the world R&D investment in 2017 was contributed by top ten countries comprising both developed and developing regions and continents in the world (Fig. 7.3). The top four countries contributed just over 60% towards the share in world R&D. The details of these countries along with their share in world R&D are: USA (24.8%), China (22.8%), Japan (7.8%) and Germany (6.0%). During the last two decades, the top four countries have played a lead role in world R&D, and grouped under the select regions/continents of the world, viz., Northern America (USA), Asia (China and Japan) and Europe (Germany) or as per UIS regions classification under North America and Western Europe (USA and Germany) and East Asia and Pacific (China and Japan). Other prominent top 10 countries include Korea, France, India, UK, Russian Federation and Brazil which falls mainly under Asia and Europe except Brazil falling under Latin America and the Caribbean. India occupies 7th place globally in R&D investment (bn PPP $) and is grouped under Asia having a 2.9% of share in world R&D.

Table 7.3 gives data for R&D expenditure as percentage of GDP in respect of selected countries comprising both developing and developed world, grouped in classes ranging from 0.0–1.0%, 1.1–2.0% and above 2.0%.

Figure 7.3: WORLDS'S TOP 10 COUNTRIES AND PERCENTAGE SHARE IN R&D INVESTMENT, 2017



Source : UNESCO and World Bank website, accessed March, 2020.

Note : R&D Expenditure in bn PPP $; Figure in parenthesis represent % Share in global R&D.

Table 7.3: EXPENDITURE ON R&D AS PERCENTAGE OF GDP FOR SELECTED COUNTRIES, 2017

R&D Expenditure as percentage of GDP					
0.0–1.0 (%)		**1.1–2.0 (%)**		**Above 2.0 (%)**	
South Africa	0.8	Netherlands	2.0	Republic of Korea	4.6
India	0.7	Australia	1.9	Israel	4.5
Mexico	0.5	United Kingdom	1.7	Sweden	3.3
Venezuela	0.3	Canada	1.6	Japan	3.2
Pakistan	0.2	Malaysia	1.4	Denmark	3.1
Philippines	0.2	Italy	1.4	Germany	3.0
Sri Lanka	0.1	Hungary	1.3	USA	2.8
		Brazil	1.3	Finland	2.8
		New Zealand	1.2	France	2.2
		Spain	1.2	Singapore	2.2
		Russian Fed.	1.1	China	2.1
				Norway	2.1

Source : UIS, UNESCO (Website accessed March, 2020)

Note : R&D Exp/GDP(%) : 2016- Malaysia, Mexico, Singapore, South Africa; 2015- Sri Lanka; 2014- Venezuela

It may be seen from Table 7.3 that most of the developed countries spent, more than 2% of their GDP on R&D. Among the developing nations, Brazil and China spent 1.3% and 2.1% of GDP on their R&D while India spent 0.7% of its GDP on R&D.

It might further be useful to examine whether the countries having high Per Capita GDP also invest more on R&D. For this purpose Per Capita GDP has been broken down into four groups as shown in Table 7.4.

It may be noted from Table 7.4 that amongst the developed countries having a per capita GDP of 45,000 PPP $ and above, the per capita R&D expenditure varied from 747.6 PPP $ for Canada to 1,965.0 PPP $ for Singapore (exception being a developing country) while for the countries having per capita GDP of 26,000 PPP $ to 45,000 PPP $, the per capita R&D expenditure varied from 390.7 PPP $ for Hungary to 1,867.0 PPP $ for Israel.

The developing countries whose per capita GDP was less than 13,000 PPP $ spent per capita R&D expenditure up to 61.0 PPP $. In case of India, this figure was 47.2 PPP $. On the other hand, the developing countries whose per capita GDP was between 13,000 PPP $ to 26,000 PPP $ had per capita R&D expenditure varying from 91.3 PPP $ for Mexico to 351.2 PPP $ for China.

Table 7.4: PER CAPITA R&D EXPENDITURE FOR SELECTED COUNTERIES GROUPED BY PER CAPITA GDP 2017 (IN PPP $)

Per Capita GDP below 13000 PPP $		Per Capita GDP between 13000–26000 PPP $		Per Capita GDP between 26000–45000 PPP $		Per Capita GDP above 45000 PPP $	
Venezuela	61.0	China	351.2	Israel	1867.0	Singapore	1965.0
India	47.2	Russian Fed.	287.7	Republic of Korea	1780.5	Sweden	1736.7
Sri Lanka	12.9	Brazil	197.9	Japan	1340.4	USA	1671.1
Pakistan	12.4	South Africa	108.5	France	997.4	Denmark	1670.5
Philippines	12.0	Mexico	91.3	United Kingdom	739.5	Germany	1588.9
				Italy	552.8	Norway	1307.1
				Spain	469.8	Finland	1277.1
				New Zealand	460.2	Netherlands	1090.6
				Malaysia	404.9	Australia	883.8
				Hungary	390.7	Canada	746.7

Source : UNESCO and World Bank (website accessed March, 2020).

Scientists and Engineers carrying out the research and development activities constitute another important input for research. In order to iron out inter-country differences due to varying population size, their number is usually expressed per million people. It may be seen from (Ref. Table 31, S&T Indicators Tables) that Israel tops the list with 8,342 researchers per million people. For Denmark, Sweden, Korea Republic, Singapore, Japan, Germany, United Kingdom and USA these figures are 7,899; 7,597; 7,498; 6,636; 5,304; 5,003; 4,341 and 4,245 respectively. For India, the number of researchers per million people is 255.

However, in terms of total researchers China has the highest number of 17,40,442 researchers followed by USA (13,71,290), Japan (6,76,292), Germany (4,13,542) and Russian Federation (4,10,617), respectively. For India, the total number of researchers is 3,41,818.

To sum up, the salient features of international R&D scene are:

- Global Investment in R&D during last two decades has been concentrated in select continents/regions/countries: 94% in three continents Asia, Europe, and North America; 86% of it in two regions North America and Western Europe, and East Asia and the Pacific; and 77% of it in 10 countries.
- Most of the developed countries spent more than 2% of their GDP on R&D while India spent 0.7% of GDP on R&D.
- India's per capita R&D expenditure was 47.2 PPP $ whereas this was between 390.7 PPP $ and 1965.0 PPP $ *(exception being Singapore)* for most of the developed countries.
- India has 255 researchers per million people as compared to 8,342 in Israel, 7899 in Denmark, 7,597 in Sweden, 5,304 in Japan and 5,003 in Germany. However, the total number of researchers in India are 3,41,818 as compared to 17,40,442 in China, 13,71,290 in USA, and 6,76,292 in Japan.

CHAPTER VIII

CHAPTER VIII

EXTRAMURAL SUPPORT FOR RESEARCH AND DEVELOPMENT PROJECTS BY CENTRAL GOVERNMENT DEPARTMENTS/AGENCIES

The purpose of the extramural research and development (R&D) project funding is to build general research capability in the country and provide special encouragement to scientists to pursue a research career. The National Science and Technology Management Information System (NSTMIS) division of the Department of Science and Technology has been maintaining a database on all extramural R&D projects funded by various Central Government Departments/ Agencies as a part of the Management Information System since 1990. The division also brings out annually a directory of extramural R&D projects approved by various agencies during each financial year.

Almost all the Central S&T Departments such as the Department of Atomic Energy (DAE), Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha & Homeopathy (AYUSH), Department of Biotechnology (DBT), Department of Science & Technology (DST), Department of Scientific and Industrial Research, Ministry of Electronics and Information Technology (MEITY) Ministry of Earth Sciences (MOES) formerly DOD, Ministry of Environment, Forest & Climate Change (MOEFCC), Ministry of New & Renewable Energy (MNRE), Ministry of Power (MOP), Ministry of Steel (MOS), All India Council for Technical Education (AICTE), Council of Scientific and Industrial Research (CSIR), Defence Research and Development Organisation (DRDO), Indian Council of Agricultural Research (ICAR), Indian Council of Medical Research (ICMR), Indian Space Research Organisation (ISRO) under Department of Space, Petroleum Conservation Research Association (PCRA) have specified schemes to sponsor R&D projects. The All India Council of Technical Education (AICTE), Department of Coal (DOC), Ministry of Social Justice and Empowerment (MOSJE) and University Grants Commission (UGC) have not funded any extramural research (EMR) projects during 2016–17.

Central Government Departments/Agencies operate a number of EMR Schemes under which they invite time bound projects from individual scientists in Universities/Colleges, Institutes of National Importance, National Laboratories, state level institutions, Public Sector Undertakings and other registered bodies.

The extramural R&D funding by Central S&T departments/agencies has increased at a compound annual growth rate of 9.42% during the period 2012–13 to 2016–17 (Fig. 8.1). Total 4,711 new projects costing Rs. 2,454.02 crore were approved for funding by 17 funding agencies during the year 2016–17, as shown in Table 8.1. This table provides agency-wise information on number of extramural R&D projects approved and their cost during the years 2013–14, 2014–15, 2015–16 and 2016–17. It may be noted that the approved cost given in the tables in this chapter is the cost of the newly approved projects for the entire duration of the project period and not the actual expenditure during the year.

It may be worth mentioning here that the Department of Science & Technology provided the highest extramural funding of Rs. 1,535.74 crore (62.6%) followed by the Department of Biotechnology with Rs. 347.40 crore (14.2%) during 2016–17. These two departments together played major role in extramural R&D funding in the country by contributing more than 75% of the total extramural R&D support at national level. The Defence Research and Development Organisation was the third highest extramural supporter with a funding of Rs. 232.73 (9.5%) during 2016–17. The lowest support of Rs. 0.81 crore for extramural R&D projects was by the Petroleum Conservation Research Association (PCRA). The share of number of projects supported by the Department of Science & Technology was also highest (67.0%) when compared to other sponsoring agencies.

Figure 8.1: GROWTH IN EXTRAMURAL R&D SUPPORT BY CENTRAL GOVERNMENT DEPARTMENTS/AGENCIES

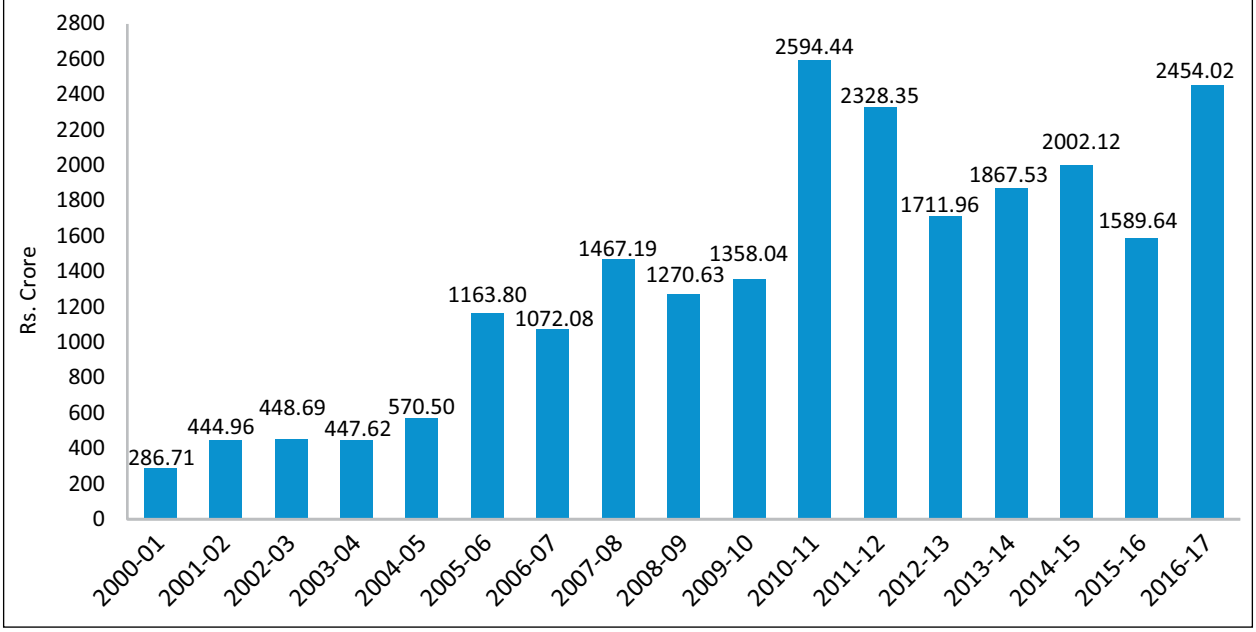


Table 8.1: AGENCY-WISE SUPPORT TO EXTRAMURAL R&D PROJECTS

(Rs. Crore)

Funding Agency	2013-14		2014-15		2015-16		2016-17	
	No. of Projects	Approved Cost	No. of Projects	Approved Cost	No. of Projects	Approved Cost	No. of Projects	Approved Cost
AICTE	406	43.65	97	13.75	0	0.00	0	0.00
AYUSH	11	2.05	14	3.43	23	10.83	16	7.60
CSIR	358	64.90	265	38.79	145	24.86	231	45.25
DAE	230	76.01	291	101.63	150	38.04	208	58.86
DBT	577	505.51	531	569.59	470	487.68	578	347.40
DOC	2	29.19	3	8.73	7	38.36	0	0.00
DRDO	113	48.95	138	77.78	103	60.06	120	232.73
DSIR	0	0.00	39	41.61	14	1.81	32	13.47
DST	2337	736.82	2166	759.89	1626	577.57	3156	1535.74
ICAR	0	0.00	0	0.00	197	55.96	41	6.34
ICMR	261	116.61	252	90.50	76	21.60	121	37.08
ISRO	18	2.77	27	4.99	50	10.72	96	18.02
MEITY*	40	167.94	62	231.32	28	74.99	11	26.08
MNRE	8	31.67	4	2.26	15	30.86	34	90.35
MOEFCC	11	2.76	15	3.74	16	7.28	30	16.03
MOES	2	2.03	16	6.58	83	56.73	25	9.71
MOP	6	1.92	9	2.54	18	6.05	8	2.71
MOS	1	6.45	0	0.00	0	0.00	1	5.82
MOSJE	10	0.67	8	0.99	0	0.00	0	0.00
PCRA	0	0.00	1	0.20	4	0.79	3	0.81
UGC	1134	27.64	1482	43.80	1278	85.45	0	0.00
Total	**5525**	**1867.53**	**5420**	**2002.12**	**4303**	**1589.64**	**4711**	**2454.02**

Source : NSTMIS, DST, GoI.
Note : *MOCIT prior to 2015–16

Subject area-wise number of projects and approved cost during 2013–14, 2014–15, 2015–16 and 2016–17 are given in Table 8.2. Amongst the eight subject areas, Engineering & Technology, Biological Sciences, Chemical Sciences and Physical Sciences were the main recipients of R&D support in terms of number of projects during 2016–17. In terms of total funding, Engineering & Technology received maximum support (42.0%) followed by Biological Sciences (20.3%), Physical Sciences (10.3%) and Medical Sciences (9.9%). The extramural support to Mathematics was the lowest (0.5%).

The institutions receiving support from the funding agencies have been classified into 5 categories for convenience of analysis: Universities/Colleges, Deemed Universities, Institutes of National Importance, National Laboratories and other Institutions under State Governments, Voluntary Agencies, Registered Societies, Individual Scientists, etc. (which are not covered in any of the above types).

The pattern of extramural R&D funding during 2013–14, 2014–15, 2015–16 and 2016–17 based on the above classification is given in Table 8.3. The number of R&D projects supported to academic sector (comprising Universities/Colleges, Deemed Universities and Institutes of National Importance) has hovered around 70% of the total projects during 2016–17. The national laboratories and the institutions in the 'Others' category accounted for about 6.4% and 23.4% of the projects respectively during the same period. The extramural R&D funding support to the Academic Sector was accounted for 68.7% of the total funding during 2016–17 (Fig. 8.2).

Table 8.4 gives information on state-wise support to extramural R&D projects. During 2016-17, a number of 4,711 projects were approved for funding by various sponsoring agencies.

Nearly, 70% of the projects were received by the Institutes located in ten states, viz., Tamil Nadu, Delhi, Maharashtra, Karnataka, West Bengal, Uttar Pradesh, Telangana, Assam, Kerala and Gujarat accounted for about 79.5% of total EMR funding.

In addition to extramural mode, R&D projects are also carried out by the National Laboratories,

Table 8.2: SUBJECT AREA-WISE DISTRIBUTION OF EXTRAMURAL R&D PROJECTS

(Rs. Crore)

Subject	2013-14		2014-15		2015-16		2016-17	
	No. of Projects	Approved Cost	No. of Projects	Approved Cost	No. of Projects	Approved Cost	No. of Projects	Approved Cost
Agricultural Sciences	67	30.20	95	44.04	340	112.67	166	58.19
Biological Sciences	1830	715.78	1701	786.52	1016	561.82	1121	498.56
Chemical Sciences	979	213.03	1039	215.51	700	152.76	566	223.05
Earth Sciences	209	62.68	255	97.71	252	125.19	231	134.95
Engineering and Technology	1128	464.82	994	559.87	1112	388.42	1511	1031.07
Mathematics	286	27.01	284	15.84	177	11.83	70	11.75
Medical Sciences	475	222.22	481	155.92	357	114.71	511	243.90
Physical Sciences	551	131.78	571	126.72	349	122.24	535	252.54
Total	**5525**	**1867.53**	**5420**	**2002.12**	**4303**	**1589.64**	**4711**	**2454.02**

Source : NSTMIS, DST, GoI

Figure 8.2: DISTRIBUTION OF EXTRAMURAL R&D PROJECTS BY TYPES OF INSTITUTES DURING 2016–17

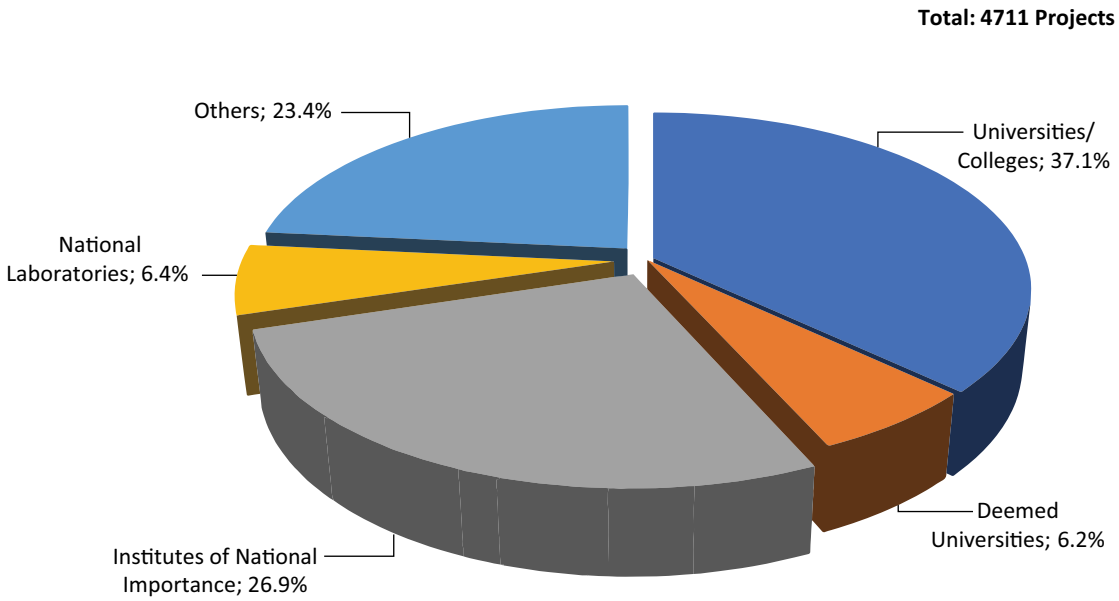


Table 8.3: DISTRIBUTION OF EXTRAMURAL R&D PROJECTS BY TYPES OF INSTITUTES

(Rs. Crore)

Institute Type	2013-14		2014-15		2015-16		2016-17	
	No. of Projects	Approved Cost	No. of Projects	Approved Cost	No. of Projects	Approved Cost	No. of Projects	Approved Cost
Universities/ Colleges	3222	621.33	3186	647.81	2212	468.93	1746	703.09
Deemed Universities	258	149.99	323	130.53	188	87.49	293	258.72
Institutes of National Importance	914	418.09	885	369.57	669	402.33	1268	724.91
National Laboratories	259	103.65	277	223.90	239	101.32	300	149.88
Others	872	574.47	749	630.31	995	529.57	1104	617.41
Total	**5525**	**1867.53**	**5420**	**2002.12**	**4303**	**1589.64**	**4711**	**2454.02**

Source : NSTMIS, DST, GoI

Table 8.4: STATE-WISE SUPPORT TO EXTRAMURAL R&D PROJECTS

State	2013-14		2014-15		2015-16		2016-17	
	No. of Projects	Approved Cost	No. of Projects	Approved Cost	No. of Projects	Approved Cost	No. of Projects	Approved Cost
Andaman & Nicobar	5	2.66	5	1.63	7	1.56	6	2.79
Andhra Pradesh	530	108.90	221	43.20	227	26.46	101	29.93
Arunachal Pradesh	10	6.62	3	0.90	8	1.03	21	5.62
Assam	234	103.17	227	34.45	93	29.79	185	67.94
Bihar	32	10.84	26	7.08	31	3.20	50	13.01
Chandigarh	67	28.17	56	18.71	56	17.74	67	22.08
Chhattisgarh	54	15.94	40	4.42	30	3.79	19	7.11
Delhi	404	219.33	403	245.58	320	182.44	440	274.11
Goa	27	8.61	31	6.73	14	5.88	56	16.70
Gujarat	113	41.28	140	37.11	101	34.60	150	60.36
Haryana	62	113.09	64	74.27	52	17.79	69	30.80
Himachal Pradesh	53	12.21	47	45.18	45	13.32	70	20.19
Jammu & Kashmir	49	17.43	61	31.58	65	16.38	54	19.14
Jharkhand	57	27.71	41	16.97	32	36.17	58	22.92
Karnataka	623	240.48	443	278.04	413	265.85	396	269.47
Kerala	454	58.57	345	94.17	189	63.90	154	75.32
Madhya Pradesh	130	27.35	144	15.99	94	16.16	108	44.64
Maharashtra	429	183.65	697	331.41	347	180.53	425	289.88
Manipur	45	5.46	79	9.56	21	5.76	40	12.31
Meghalaya	22	9.76	34	6.28	15	6.91	42	13.14
Mizoram	12	1.84	16	4.49	12	1.52	22	6.38
Nagaland	7	5.12	6	4.96	14	3.01	13	7.64
Odisha	139	40.11	115	34.60	128	44.06	150	52.29
Puducherry	43	20.15	19	4.19	43	12.28	30	14.42
Punjab	122	35.38	112	38.89	134	46.47	147	55.92
Rajasthan	134	22.76	145	26.73	68	17.04	125	34.61
Sikkim	13	3.55	8	5.49	7	1.52	16	6.00
Tamil Nadu	839	229.00	796	179.94	763	224.90	604	331.86
Telangana	0	0.00	323	93.90	268	83.43	268	265.76
Tripura	21	2.89	31	6.50	9	2.39	17	7.07
Uttar Pradesh	340	110.32	301	109.64	251	79.65	313	137.10
Uttarakhand	87	19.93	94	45.79	111	50.43	125	58.27
West Bengal	368	135.24	347	143.74	335	93.70	370	179.24
Total	**5525**	**1867.53**	**5420**	**2002.12**	**4303**	**1589.64**	**4711**	**2454.02**

Source : NSTMIS, DST, GoI.
Note : States and Union Territories not receiving EMR support are not mentioned.

Universities/Colleges, Public and Private Sector Industries and other research organisations out of the annual grants received by them. This is known as in-house or intramural R&D.

The expenditure on intramural projects constitutes the major component of the national R&D expenditure. The total national R&D expenditure reported in this document comprises both intramural and extramural R&D projects. Share of extramural R&D expenditure in national R&D expenditure for 2016–17 was 2.4%.

To sum up, the salient features are as under:

- The extramural R&D support has shown an increasing trend over the past five years with a compound annual growth rate of 9.42%. It has reached a level of Rs. 2,454.02 crore in 2016–17 from Rs. 1,711.96 crore in 2012–13.
- R&D support to the academic sector (comprising of Universities/Colleges, Deemed Universities and Institutes of National Importance) through extramural projects was 68.7% during 2016–17.
- Support to national laboratories was of the order of 6.1% during 2016–17.
- The Department of Science & Technology (DST) (62.6%) and the Department of Biotechnology (DBT) (14.2%) were the two departments playing a major role in extramural R&D funding.
- The share of extramural R&D funding in total National R&D expenditure for 2016–17 was 2.4%.

S&T INDICATORS TABLES

Table 1

NATIONAL EXPENDITURE ON RESEARCH AND DEVELOPMENT BY SECTOR

(Rs. Crore)

Sector	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2005-06	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19*
Central Sector	112.47	287.63	580.49	1654.06	3058.27	5199.79	17872.02	33095.18	34021.44	37894.46	38879.89	43094.90	46887.17	50219.42	56920.02	61745.16
State Sector	12.58	26.73	59.34	162.78	365.92	657.02	2334.60	4457.81	5137.56	5282.86	5951.15	6327.32	6447.94	6866.96	7264.81	7742.75
Private Sector	14.59	42.35	120.69	251.94	549.98	1627.07	8471.95	19337.02	23295.71	27096.51	30514.80	32538.39	36022.15	39124.71	41855.88	45562.72
Higher Education Sector							1254.01	3306.74	3506.62	3708.96	4010.05	5512.83	6095.18	6888.17	7784.33	8797.08
Total	**139.64**	**356.71**	**760.52**	**2068.78**	**3974.17**	**7483.88**	**29932.58**	**60196.75**	**65961.33**	**73982.79**	**79355.89**	**87473.44**	**95452.44**	**103099.26**	**113825.03**	**123847.71**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note :
1. *Estimated
2. Central Sector data includes 103 R&D units of Public Sector/Joint Sector companies.
3. State Sector includes R&D expenditure of State Agricultural Universities and other State Departments/Organisations.
4. The number of R&D units in the Private Sector varies from year to year as per the DSIR recognition and estimation from other sources.
5. Private Sector industries data for the year 2005-06 onwards comprised of R&D units/firms recognised by DSIR and industries/multinational companies from CMIE database not registered with DSIR.
6. Private Sector data for the period 2015-16 to 2017-18 refers to 2504 in-house Private Sector R&D units which include 497 SIRO units.
7. Data for the year 2018-19 has been estimated by applying the rate of growth for the five-year period 2012-13 to 2017-18, sector-wise. In case of Higher Education Sector, growth rate is based on the period 2010-11 to 2015-16.
8. Higher Education Sector data is based on the DST sponsored study on quantification of resources in higher education in India (derived from AISHE database, MHRD) carried out by BHU (2018-19). Higher Education survey started since 2001-02 by DST.
9. Central Sector = Central Government Ministries/Department + Public Sector/Joint Sector industries.

Table 2

NATIONAL EXPENDITURE ON RESEARCH AND DEVELOPMENT BY INSTITUTIONAL AND INDUSTRIAL SECTORS

(Rs. Crore)

S. No.	Sector	2015-16	2016-17	2017-18
A	**INSTITUTIONAL SECTOR**			
1	Institutions under Central Government	42433.33	45513.2	51666.82
2	Institutions under State Government	6447.94	6866.96	7264.81
3	Higher Education	6095.18	6888.17	7784.33
	Total (A)	**54976.45**	**59268.33**	**66715.96**
B	**INDUSTRY SECTOR**			
4	Industry (Public)	4453.84	4706.22	5253.20
5	Industry (Private)	31709.04	34522.99	36873.49
6	Scientific and Industrial Research Organisation (SIRO)	4313.11	4601.72	4982.39
	Total (B)	**40475.99**	**43830.93**	**47109.08**
	GRAND TOTAL (A+B)	**95452.44**	**103099.26**	**113825.03**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note :
1. State Sector includes R&D expenditure of State Agricultural Universities and other State Departments / Organisations.
2. Private Sector data for the period 2015-16 to 2017-18 refers to 2504 in-house Private Sector R&D units which include 497 SIRO units.
3. Higher Education Sector data is based on the DST sponsored study on quantification of resources in higher education in India (derived from AISHE database, MHRD) carried out by BHU (2018-19).

Table 3

NATIONAL EXPENDITURE ON RESEARCH AND DEVELOPMENT IN RELATION TO GDP

Year	R&D Expenditure current prices (Rs. Crore)	GDP current prices (Rs. Crore)	R&D % of GDP
Series: 2004-05			
1995-96	7483.88	1226725	0.6
1996-97	8913.61	1419277	0.6
1997-98	10611.34	1572394	0.7
1998-99	12473.17	1803378	0.7
1999-00	14397.60	2023130	0.7
2000-01	16198.80	2177413	0.7
2001-02	17038.15	2355845	0.7
2002-03	18088.16	2536327	0.7
2003-04	20086.34	2841503	0.7
2004-05	24117.24	3242209	0.7
2005-06	29932.58	3693369	0.8
2006-07	34238.39	4294706	0.8
2007-08	39437.77	4987090	0.8
2008-09	47353.38	5630063	0.8
2009-10	53041.30	6477827	0.8
2010-11	60196.75	7784115	0.8
Series: 2011-12			
2011-12	65961.33	8736329	0.8
2012-13	73982.79	9944013	0.7
2013-14	79355.89	11233522	0.7
2014-15	87473.44	12467959	0.7
2015-16	95452.44	13771874	0.7
2016-17	103099.26	15362386	0.7
2017-18	113825.03	17095005	0.7
2018-19*	123847.71	19010164	0.7

Source : (i) Data on R&D expenditure collected and compiled by NSTMIS, DST, GoI.
(ii) Data on GDP- Economic Survey 2018-19.

Note : 1. GDP : Gross Domestic Product.
2. R&D : Research & Development.
3. R&D/GDP ratio have been revised as per the new GDP figures.
4. * Estimated

Table 4

NATIONAL EXPENDITURE ON RESEARCH & DEVELOPMENT AT CURRENT AND CONSTANT PRICES

(Rs. Crore)

Year	National Expenditure on Research and Development	
	Current Prices	Constant Prices
Base Year: 2004-05		
1985-86	2068.78	7960.98
1990-91	3974.17	10085.15
1995-96	7483.88	11627.32
1996-97	8913.61	12873.45
1997-98	10611.34	14393.25
1998-99	12473.17	15663.93
1999-00	14397.60	17542.37
2000-01	16198.80	19042.89
2001-02	17038.15	19405.60
2002-03	18088.16	21563.84
2003-04	20086.34	21236.36
2004-05	24117.24	24117.24
2005-06	29932.58	28715.90
2006-07	34238.39	30864.41
2007-08	39437.77	33616.38
2008-09	47353.38	37145.07
2009-10	53041.30	39228.08
2010-11	60196.75	40850.18
Base Year: 2011-12		
2011-12	65961.33	65961.33
2012-13	73982.79	68544.23
2013-14	79355.89	69238.88
2014-15	87473.44	73860.67
2015-16	95452.44	78801.61
2016-17	103099.26	82535.91
2017-18	113825.03	87756.49
2018-19*	123847.71	91712.87

Source : 1. Data collected and compiled by NSTMIS, DST, GoI.
2. Economic Survey 2018-19

Table 5

PUBLIC AND PRIVATE INVESTMENT IN NATIONAL R&D AND % SHARE IN GDP

(Rs. Crore)

Year	Public Investment in R&D	% share of Public Investment in total R&D	Private Investment in R&D	% share of Private Investment in total R&D	Total Investment in R&D
2004-05	18078.28(0.5)	75.0	6038.96(0.2)	25.0	24117.24(0.7)
2005-06	21460.63(0.6)	71.7	8471.95(0.2)	28.3	29932.58(0.8)
2006-07	23752.81(0.6)	69.4	10485.58(0.2)	30.6	34238.39(0.8)
2007-08	26511.64(0.5)	67.2	12926.14(0.3)	32.8	39437.77(0.8)
2008-09	32987.98(0.5)	69.7	14365.40(0.3)	30.3	47353.38(0.8)
2009-10	37735.75(0.6)	71.1	15305.55(0.2)	28.9	53041.30(0.8)
2010-11	40859.73(0.6)	67.9	19337.02(0.2)	32.1	60196.75(0.8)
2011-12	42665.62(0.5)	64.7	23295.71(0.3)	35.3	65961.33(0.8)
2012-13	46886.28(0.5)	63.4	27096.51(0.3)	36.6	73982.79(0.7)
2013-14	48841.09(0.4)	61.5	30514.80(0.3)	38.5	79355.89(0.7)
2014-15	54935.05(0.4)	62.8	32538.39(0.3)	37.2	87473.44(0.7)
2015-16	59430.29(0.4)	62.3	36022.15(0.3)	37.7	95452.44(0.7)
2016-17	63974.55(0.4)	62.1	39124.71(0.3)	37.9	103099.26(0.7)
2017-18	71969.15(0.5)	63.2	41855.88(0.2)	36.8	113825.03(0.7)
2018-19*	78284.99(0.5)	63.2	45562.72(0.2)	36.8	123847.71(0.7)

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. *Estimated

2. Public Investments in R&D = Central Government Ministries/Department + Public Sector/joint sector industries+ State Government + Higher Education

3. Number in paranthesis indicate percentage share in GDP.

Table 6

GOVERNMENT AND BUSINESS ENTERPRISE INVESTMENT IN NATIONAL R&D AND % SHARE IN GDP

(Rs. Crore)

Year	Investment in R&D by Goverment	%	Investment in R&D by Business Enterprises	%	Total GERD
2004-05	16820.40(0.5)	69.7	7296.84(0.2)	30.3	24117.24(0.7)
2005-06	20173.43(0.5)	67.4	9759.15(0.3)	32.6	29932.58(0.8)
2006-07	22287.40(0.5)	65.1	11950.99(0.3)	34.9	34238.39(0.8)
2007-08	24634.39(0.5)	62.5	14803.39(0.3)	37.5	39437.78(0.8)
2008-09	30530.96(0.5)	64.5	16822.42(0.3)	35.5	47353.38(0.8)
2009-10	34921.19(0.5)	65.8	18120.11(0.3)	34.2	53041.30(0.8)
2010-11	37547.92(0.5)	62.4	22648.83(0.3)	37.6	60196.75(0.8)
2011-12	38903.05(0.4)	59.0	27058.28(0.3)	41.0	65961.33(0.8)
2012-13	40568.09(0.4)	54.8	33414.70(0.3)	45.2	73982.79(0.7)
2013-14	44419.34(0.4)	56.0	34936.55(0.3)	44.0	79355.89(0.7)
2014-15	50285.41(0.4)	57.5	37188.03(0.3)	42.5	87473.44(0.7)
2015-16	54976.45(0.4)	57.6	40475.99(0.3)	42.4	95452.44(0.7)
2016-17	59268.33(0.4)	57.5	43830.93(0.3)	42.5	103099.26(0.7)
2017-18	66715.95(0.4)	58.6	47109.08(0.3)	41.4	113825.03(0.7)
2018-19*	72732.36(0.4)	58.7	51115.35(0.3)	41.3	123847.71(0.7)

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. *Estimated

2. Government Investment in R&D = Central Government Ministries/Department + State Goverment+ Higher Education
3. Business Enterprise/ Industry Investment in R&D= Public sector industry + Private sector industry
4. Number in paranthesis indicate percentage share in GDP.

Table 7

EXPENDITURE ON RESEARCH & DEVELOPMENT BY SELECT MAJOR SCIENTIFIC AGENCIES

(Rs. Crore)

S. No.	Agency\ Year	1970-71	1980-81	1990-91	2000-01	2005-06	2009-10	2015-16	2016-17	2017-18
1	Council of Scientific & Industrial Research (CSIR)	21.56	69.00	249.19	864.12	1427.04	2666.44	3988.14	4013.06	4582.12
2	Defence Research & Development Organisation (DRDO)	17.55	79.70	681.00	3359.32	5283.35	8475.38	13317.12	13382.05	15195.87
3	Department of Atomic Energy (DAE)	28.72	73.48	275.54	1005.52	1752.50	3858.21	4635.95	4750.39	5208.01
4	Department of Biotechnology (DBT)	–	–	41.37	120.58	325.85	727.38	1210.25	1446.71	1771.65
5	Ministry of Electronics and Information Technology (MEITY) +	–	5.41	33.03	51.07	167.85	327.96	351.51	409.85	386.55
6	Ministry of New and Renewable Energy (MNRE)	–	4.00	16.02	12.27	9.62	26.51	23.11	32.35	34.50
7	Ministry of Earth Sciences (MES) ++	–	–	27.80	84.23	235.48	448.24	839.25	951.24	1123.58
8	Department of Science & Technology (DST)	0.84	40.64	119.82	311.46	1237.05	1986.01	2800.76	3161.54	3526.64
9	Department of Space (DOS)	–	56.02	386.22	1905.40	2667.60	4162.96	6920.01	8040.00	9130.57
10	Indian Council of Agricultural Research (ICAR)	18.37	97.45	276.25	1161.74	1717.27	2881.30	4369.75	4592.95	5355.57
11	Indian Council of Medical Research (ICMR)	2.18	9.00	44.54	149.12	331.00	583.50	918.02	1073.83	1468.70
12	Ministry of Environment, Forest and Climate Change (MoEFCC)	–	3.74	162.09	272.86	235.31	415.57	192.84	220.21	260.87
	Total	**89.22**	**438.44**	**2312.87**	**9297.69**	**15389.92**	**26559.46**	**39566.71**	**42074.18**	**48044.63**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. Not including Public Sector Research and Development Expenditure.
2. – Department does not exist during this period.
3. + Formerly Ministry of Communications & Information Technology
4. ++ Formerly Department of Ocean Development
5. Data includes both Plan & Non-Plan R&D Expenditure.

Table 8

EXPENDITURE ON RESEARCH AND DEVELOPMENT BY CENTRAL MINISTRIES/DEPARTMENTS OTHER THAN MAJOR SCIENTIFIC AGENCIES

(Rs. Crore)

S. No.	Ministry/Departments	Research and Development Expenditure		
		2015-16	2016-17	2017-18
1	Agriculture, Cooperation and Farmers' Welfare	2.92	3.26	3.79
2	Animal Husbandry, Dairying and Fisheries	24.02	27.79	23.73
3	AYUSH	260.85	350.31	510.59
4	Chemicals and Petrochemicals	3.11	0.18	4.68
5	Civil Aviation	9.32	6.42	0.65
6	Coal	62.73	65.57	159.65
7	Commerce	113.13	110.95	110.56
8	Consumer Affairs	11.36	11.71	12.91
9	Culture	53.66	59.78	61.25
10	Defence Production	2088.11	2277.07	2814.25
11	Empowerment of Persons with Disabilities	1.46	1.31	1.18
12	Fertilizers	22.85	20.40	17.94
13	Finance	0.79	0.94	1.38
14	Food and Public Distribution	10.43	10.30	8.86
15	Food Processing Industries	58.92	45.93	67.31
16	Health and Family Welfare	317.59	323.00	346.58
17	Health Research	0.50	0.51	0.66
18	Heavy Industry	918.02	997.03	869.4
19	Home Affairs	45.53	13.83	19.70
20	Housing and Urban Affairs	6.65	5.94	5.89
21	Human Resource Development	434.80	552.41	632.94
22	Industrial Policy and Promotion	39.03	50.04	59.84
23	Information and Broadcasting	11.75	11.98	12.22
24	Labor and Employment	8.44	9.20	7.34
25	Micro, Small and Medium Enterprises	20.86	28.84	31.57

Table 8 Contd...

Table 8 (Contd.)
EXPENDITURE ON RESEARCH AND DEVELOPMENT BY CENTRAL MINISTRIES/DEPARTMENTS OTHER THAN MAJOR SCIENTIFIC AGENCIES

(Rs. Crore)

S. No.	Ministry/Departments	Research and Development Expenditure		
		2015-16	2016-17	2017-18
26	Mines	92.87	126.14	110.12
27	Petroleum and Natural Gas	968.06	1072.23	1061.39
28	Pharmaceuticals	32.29	28.00	28.59
29	Power	336.25	453.69	456.15
30	Public Enterprises	0.60	0.33	0.36
31	Rural Development	60.88	56.03	63.80
32	Social Justice and Empowerment	0.09	0.08	0.05
33	Telecommunications	365.53	427.50	361.69
34	Railways	136.94	167.09	174.08
35	Road Transport and Highways	6.04	6.34	7.30
36	Shipping	3.14	1.05	1.53
37	Skill Development and Entrepreneurship	0.31	0.40	0.09
38	Statistics and Programme Implementation	177.67	189.62	206.29
39	Steel	179.97	198.13	184.83
40	Textiles	235.68	235.22	246.82
41	Water Resources, River Development and Ganga Rejuvenation	80.62	86.16	91.72
42	Public Sector under Major Scientific Agencies	92.39	86.58	70.44
43	Joint Sector including State Undertaking	24.29	25.97	25.28
	Total	**7320.45**	**8145.26**	**8875.40**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. Data includes both Plan & Non-Plan R&D expenditure.

2. Departments/Ministries with no R&D expenditure are not shown in this Table.

Table 9

EXPENDITURE ON RESEARCH AND DEVELOPMENT BY STATE GOVERNMENTS

(Rs. Crore)

S. No.	State	Research and Development Expenditure		
		2015-16	2016-17	2017-18
1	Andhra Pradesh	493.69	533.43	543.49
2	Assam	276.59	289.58	455.13
3	Bihar	132.79	129.71	53.68
4	Chhattisgarh	169.99	208.57	257.99
5	Gujarat	728.01	755.44	789.52
6	Haryana	285.62	313.30	374.58
7	Himachal Pradesh	140.16	141.15	158.97
8	Jammu & Kashmir	238.17	260.58	290.68
9	Jharkhand	70.88	106.20	91.54
10	Karnataka	369.17	344.57	373.48
11	Kerala	138.90	123.82	160.41
12	Madhya Pradesh	417.93	466.98	488.51
13	Maharashtra	190.09	234.10	221.77
14	Manipur	200.19	113.19	102.00
15	Meghalaya	8.76	8.58	9.01
16	Odisha	130.97	147.26	154.85
17	Punjab	513.68	534.38	551.44
18	Rajasthan	203.55	233.11	192.56
19	Tamil Nadu	589.14	670.51	688.34
20	Telangana	269.89	284.07	276.02
21	Uttar Pradesh	371.87	448.39	471.02
22	Uttarakhand	255.53	253.98	281.41
23	West Bengal	252.36	266.10	278.41
	Total	**6447.93**	**6867.00**	**7264.81**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. Research & Development Expenditure figures are based on survey response.

2. States/Union Territories with no R&D Expenditure or R&D Units are not shown in this Table.

Table 10

EXPENDITURE ON RESEARCH & DEVELOPMENT BY COOPERATIVE RESEARCH ASSOCIATIONS

(Rs. Crore)

S. No.	Name	2015-16	2016-17	2017-18
1	Ahmedabad Textile Industry's Research Association	18.44	15.05	13.21
2	Electrical Research & Development Association	64.78	73.29	72.81
3	Indian Jute Industries Research Association	5.18	6.63	7.07
4	Indian Rubber Manufacturers Research Association	11.24	12.51	14.84
5	Man Made Textiles Research Association	3.30	3.96	4.50
6	Northern India Textile Research Association	9.81	10.28	11.20
7	Petroleum Conservation Research Association +	2.51	2.56	3.04
8	The Automotive Research Association of India	153.73	331.13	206.26
9	The Bombay Textile Research Association	7.53	6.29	5.96
10	The Sima Cotton Development & Research Association	0.18	0.16	0.14
11	The South India Textile Research Association	21.30	11.49	12.02
12	The Synthetic & Art Silk Mills' Research Association	16.88	27.77	22.82
13	Tea Research Association ++	28.78	25.37	22.89
14	Wool Research Association	5.85	6.76	6.30
	Total	**349.51**	**533.25**	**403.06**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. + Extramural research supported by PCRA.

2. ++ Includes data for all Tea Research Institutes

Table 11

SCIENCE & TECHNOLOGY EXPENDITURE BY TYPE OF WORK BY CENTRAL AND STATE GOVERNMENTS & SIROs

(Rs. Crore)

Year	Central Government					State Government					Scientific and Industrial Research Organisation					Total				
	Basic Research	Applied Research	Experimental Development	Other Related S&T Activities	Total S&T	Basic Research	Applied Research	Experimental Development	Other Related S&T Activities	Total S&T	Basic Research	Applied Research	Experimental Development	Other Related S&T Activities	Total S&T	Basic Research	Applied Research	Experimental Development	Other Related S&T Activities	Total S&T
2015-16	10753.86	15461.18	16218.29	2083.38	44516.71	1254.04	3381.05	1812.85	1001.64	7449.58	1379.13	2094.11	839.86	792.15	5105.25	13387.03	20936.34	18871.00	3877.17	57071.54
2016-17	11730.44	16817.11	16965.65	2389.47	47902.67	1344.43	3582.53	1940.00	1054.06	7921.02	1420.33	2272.58	908.82	862.87	5464.60	14495.20	22672.22	19814.47	4306.40	61288.29
2017-18	13440.85	18991.71	19234.26	2640.10	54306.92	1400.86	3859.36	2004.59	1115.25	8380.06	1545.79	2440.57	996.03	872.45	5854.84	16387.50	25291.64	22234.88	4627.80	68541.82

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. R&D : Research and Development = Basic Research + Applied Research + Experimental Development.

2. S&T : Science and Technology = R&D + Other related S&T activities.

Table 12

EXPENDITURE ON RESEARCH AND DEVELOPMENT BY OBJECTIVES

(Rs. Crore)

S. No.	OBJECTIVE	Central Government			State Government			Private Sector			Public Sector			Total		
		2015-16	2016-17	2017-18	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
1	Defence	13317.12	13382.05	15195.87	–	–	–	197.55	303.68	227.46	1998.92	2186.89	2698.48	15513.59	15872.62	18121.81
2	Development of Agriculture, Forestry and Fishing	4401.11	4631.34	5390.82	5659.56	6002.88	6395.32	1346.87	1486.60	1515.50	10.82	7.12	10.12	11418.36	12127.94	13311.76
3	Education	559.01	575.33	636.89	729.10	798.90	808.27	552.97	596.36	654.51	-	-	-	1841.08	1970.59	2099.67
4	Energy	3273.37	3412.31	3640.02	–	–	–	2291.88	2437.38	2687.88	1398.00	1362.33	1438.26	6963.25	7212.02	7766.16
5	Environment	325.90	331.28	367.86	–	–	–	177.77	164.63	181.36	0.89	1.41	1.50	504.56	497.32	550.72
6	Exploration and Exploitation of Space	7143.97	8256.55	9340.46	–	–	–	0.65	0.37	0.35	-	-	-	7144.62	8256.92	9340.81
7	Exploration and Exploitation of the Earth	1012.20	1078.58	1207.36	–	–	–	25.73	33.45	39.28	625.66	695.44	679.31	1663.59	1807.47	1925.95
8	General Advancement of Knowledge	5507.75	6052.98	7045.76	–	–	–	556.90	523.63	582.57	2.87	1.53	1.04	6067.52	6578.14	7629.37
9	Health	3087.97	3559.26	4444.87	9.72	9.61	11.11	13132.74	15000.09	15175.97	13.25	11.32	9.75	16243.68	18580.28	19641.70
10	Industrial Production and Technology	1541.17	1586.70	1748.77	–	–	–	7331.05	7871.91	8386.12	211.14	245.80	200.20	9083.36	9704.41	10335.09
11	Political & Social Systems,Structures & Processes (including socio-economic services)	–	–	–	25.56	32.09	30.28	10.69	10.80	10.19	-	-	-	36.25	42.89	40.47
12	Transport, Telecommunication and other Infrastructures	539.45	651.64	599.88	6.50	7.78	6.01	6960.41	7284.84	8394.27	167.46	168.78	142.53	7673.82	8113.04	9142.69
13	Other Aims	1724.31	1995.19	2048.27	17.50	15.69	13.83	3098.76	3055.89	3627.57	24.84	25.60	72.02	4865.41	5092.37	5761.69
	Total	**42433.33**	**45513.21**	**51666.83**	**6447.94**	**6866.95**	**7264.82**	**35683.97**	**38769.63**	**41483.03**	**4453.85**	**4706.22**	**5253.21**	**89019.09**	**95856.01**	**105667.89**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. R&D expenditure on Higher Education Sector is not included.
2. Private Sector includes Scientific and Industrial Research Organisations (SIROs).
3. Objectives Standardised as per UNESCO Classification.
4. - represent `NIL'.

Table 13

RESEARCH AND DEVELOPMENT EXPENDITURE, ADVERTISING EXPENDITURE, NEW PLANT AND MACHINERY EXPENDITURE VERSUS SALES TURNOVER IN PUBLIC AND PRIVATE SECTOR INDUSTRIES

Year	Research and Development Expenditure		Advertising Expenditure		New Plant Machinery Expenditure		Sales Turnover		Research and Development Expenditure as % of Sales Turover		Advertising Expenditure as % of Sales Turover		New Plant Machinery Expenditure as % of Sales Turover	
	(Rs. Crore)		(Rs. Crore)		(Rs. Crore)		(Rs. Crore)		(%)		(%)		(%)	
	Public Sector	Private Sector	Public Sector	Private Sector	Public Sector	Private Sector	Public Sector	Private Sector	Public Sector	Private Sector	Public Sector	Private Sector	Public Sector	Private Sector
2015-16	4453.84	31370.87	492.96	17007.86	55646.06	86520.59	1490941.24	2136108.39	0.30	1.47	0.03	0.80	3.73	4.05
2016-17	4706.22	34167.91	591.86	16278.68	46821.70	113115.04	1598305.60	2272581.47	0.29	1.50	0.04	0.72	2.93	4.98
2017-18	5253.20	36500.65	728.73	16465.06	57635.67	71134.22	1788862.07	2471337.93	0.29	1.48	0.04	0.67	3.22	2.88

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. Data for Public Sector refers to 103 industrial R&D units.

2. Data for Private Sector refers to 2007 industrial R&D units exculding SIROs.

Table 14

EXPENDITURE ON RESEARCH AND DEVELOPMENT BY PUBLIC/JOINT SECTOR UNDERTAKINGS 2017-18

Ministry/Department/State	Public/Joint Sector Undertaking	R&D Expenditure (Rs. Crore)	R&D Expenditure as % of S.T.O.
Agriculture, Cooperation and Farmers' Welfare	National Seeds Corporation Ltd.	-	-
Atomic Energy	Electronics Corporation of India Ltd.	25.76	1.84
	IREL (India) Ltd.	3.87	0.67
	Nuclear Power Corporation of India Ltd.	31.06	0.25
	Uranium Corporation of India Ltd.	1.81	0.10
Biotechnology	Bharat Immunologicals & Biologicals Corporation Ltd.	0.49	1.40
Chemicals and Petrochemicals	HIL (India) Ltd. (Formerly, Hindustan Insecticides Ltd.)	4.68	1.18
Civil Aviation	Airports Authority of India	0.65	0.01
Coal	Central Coalfields Ltd.	0.38	0
	Central Mine Planning & Design Institute Ltd.	70.74	6.13
	Coal India Ltd.	70.74	0.06
	NLC India Ltd.	15.37	0.18
	The Singareni Collieries Company Ltd.	2.42	0.01
Defence Production	BEML Ltd. (Formerly Bharat Earth Movers Ltd.)	102.04	3.09
	Bharat Dynamics Ltd.	40.22	0.88
	Bharat Electronics Ltd.	1022.39	10.14
	Garden Reach Shipbuilders & Engineers Ltd.	22.40	1.67
	Goa Shipyard Ltd.	10.09	0.69
	Hindustan Aeronautics Ltd. (Consolidated)	1520.97	8.31
	Hindustan Shipyard Ltd.	5.57	0.86
	Mazagon Dock Shipbuilders Ltd.	75.11	1.71
	Mishra Dhatu Nigam Ltd.	15.46	2.32
Empowerment of Persons with Disabilities	Artificial Limbs Manufacturing Corporation of India	0.71	0.31
Fertilizers	FCI Aravali Gypsum and Minerals India Ltd.	-	-
	Gujarat State Fertilizers & Chemicals Ltd. Fertilizer Unit	9.57	0.15
	Indian Farmers Fertiliser Cooperative Ltd., Kalol	0.06	0
	National Fertilizers Ltd.	0.25	0
	Paradeep Phosphates Ltd.	0.54	0.01
	Rashtriya Chemicals & Fertilizers Ltd.	2.78	0.04
	The Fertilizers and Chemicals Travancore Ltd.	1.14	0.06
Finance	Security Printing and Minting Corporation of India Ltd.	1.38	0.03

Table 14 Contd...

Table 14 (Contd.)
EXPENDITURE ON RESEARCH AND DEVELOPMENT BY PUBLIC/JOINT SECTOR UNDERTAKINGS 2017-18

Ministry/Department/State	Public/Joint Sector Undertaking	R&D Expenditure (Rs. Crore)	R&D Expenditure as % of S.T.O.
Food and Public Distribution	Central Warehousing Corporation	0.28	0.02
Health and Family Welfare	HLL Lifecare Ltd. (HLL) (formely Hindustan Latex Ltd.)	5.87	0.55
Heavy Industry	Andrew Yule & Co. Ltd.	0.17	0.05
	Bharat Heavy Electricals Ltd.	646.66	2.32
	Bridge and Roof Company (India) Ltd.	0.10	0.50
	Heavy Engineering Corporation Ltd.	0.94	0.24
	HMT Machine Tools Ltd.	1.73	0.93
	NEPA Ltd.	1.48	1.29
	Rajasthan Electronics & Instruments Ltd.	2.36	0.97
	Sambhar Salts Ltd.	0.06	0.31
	Scooters India Ltd.	0.20	0.39
Housing and Urban Affairs	Housing and Urban Development Corporation Ltd.	1.04	0.03
Mines	Hindustan Copper Ltd.	1.58	0.10
	Mineral Exploration Corporation Ltd.	0.61	0.16
	National Aluminium Company Ltd.	27.96	0.29
Petroleum and Natural Gas	Balmer Lawrie & Company Ltd.	7.58	0.41
	Bharat Petroleum Corporation Ltd.	95.66	0.03
	Chennai Petroleum Corporation Ltd. (Madras Refineries Ltd.)	11.51	0.03
	Engineers India Ltd.	14.35	0.80
	Gail (India) Ltd.	28.88	0.05
	Hindustan Petroleum Corporation Ltd.	232.78	0.10
	Indian Oil Corporation Ltd.	3.09	0
	Oil & Natural Gas Corporation Ltd.	605.87	0.71
	Oil India Ltd.	58.63	0.55
Pharmaceuticals	Hindustan Antibiotics Ltd.	1.40	4.44
	Karnataka Antibiotics & Pharmaceuticals Ltd.	1.27	0.36
Power	National Thermal Power Corporation Ltd.	129.68	0.16
	NHPC Ltd.	5.52	0.08
	North Eastern Electric Power Corporation Ltd.	0.27	0.02
	Power Grid Corporation Ltd.	59.76	0.19
	THDC India Ltd.	4.82	0.22
Public Enterprises	Hindustan Newsprint Ltd.	0.36	0.14
Scientific and Industrial Research	Central Electronics Ltd.	7.45	3.37

Table 14 Contd...

Table 14 (Contd.)
EXPENDITURE ON RESEARCH AND DEVELOPMENT BY PUBLIC/JOINT SECTOR UNDERTAKINGS 2017-18

Ministry/Department/State	Public/Joint Sector Undertaking	R&D Expenditure (Rs. Crore)	R&D Expenditure as % of S.T.O.
Shipping	Cochin Shipyard Ltd.	0.22	0.01
	Kamarajar Port Ltd.	1.30	0.21
Steel	KIOCL Ltd.	0.31	0.02
	MECON Ltd.	0.71	0.16
	MOIL Ltd. (Formely Manganese Ore India Ltd.)	9.64	0.73
	NMDC (Formerly National Mineral Development Corporation)	25.67	0.22
	Rashtriya Ispat Nigam Ltd.	20.06	0.12
	Research & Development Centre for Iron & Steel (RDCIS), SAIL	118.93	0.20
	Steel Authority of India Ltd. Alloy Steel Plant	9.52	1.47
Telecommunications	Indian Telephone Industries	22.76	1.34
Textiles	National Textile Corporation (Tamil Nadu and Pondicherry) Ltd.	0.28	0.05
Gujarat	Gujarat Alkalies & Chemicals Ltd.	2.15	0.09
	Gujarat Insecticides Ltd.	1.50	0.55
	Gujarat Narmada Valley Fertilizers and Chemicals Ltd.	1.72	0.03
Haryana	Haryana Leather Chemicals Ltd.	0.61	1.73
	Haryana State Electronics Development Corporation Ltd.	3.74	6.44
Karnataka	Hutti Gold Mines Co. Ltd.	0.04	0.01
	Karnataka Soaps & Detergents Ltd.	0.65	0.13
Kerala	Keltron Component Complex Ltd.	0.11	0.18
	Kerala Electrical & Allied Engg. Co. Ltd.	0.04	0.04
	Kerala Minerals & Metals Ltd.	1.40	0.19
	Travancore Titanium Products Ltd	1.70	0.98
Maharashtra	Haffkine Bio-Pharmaceutical Corporation Ltd.	0.07	0.04
	Maharashtra State Seeds Corporation Ltd.	0.59	0.11
Tamil Nadu	Tamil Nadu Co-Operative Sugar Federation Ltd.	0.58	74.44
	Tamil Nadu Newsprint & Papers Ltd.	9.31	0.28
Uttar Pradesh	Pradeshik Cooperative Dairy Federation Ltd.	0.05	0
West Bengal	Webel Mediatronics Ltd.	0.19	1.33
	Webfil Ltd.	0.83	1.99
	Total	**5253.25**	**0.29**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. R&D : Research and Development.
2. S.T.O. : Sales Turnover.
3. - represents 'NIL'.

Table 15

EXPENDITURE ON RESEARCH AND DEVELOPMENT BY INDUSTRY GROUPS FOR PUBLIC SECTOR

S. No.	Industry Group	No.of R&D Units	R&D Expenditure					
			(Rs. Crore)			as % of S.T.O.		
			2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
1	Agricultural Machinery	2	0.76	1.23	0.59	0.06	0.08	0.04
2	Bio-technology	1	0.12	0.12	0.07	0.05	0.05	0.04
3	Boilers & Steam Generating Plants	1	129.68	162.28	129.68	0.18	0.21	0.16
4	Chemicals (other than fertilizers)	9	17.54	13.15	15.64	0.19	0.13	0.13
5	Consultancy Services	4	42.97	41.66	90.52	0.86	0.86	1.64
6	Defence Industries	18	2021.49	2199.00	2712.22	9.05	9.15	9.99
7	Drugs & Pharmaceuticals	3	2.09	2.85	3.15	0.44	0.55	0.75
8	Earth Moving Machinery	1	66.61	78.07	102.05	1.95	2.75	3.09
9	Electricals & Electronics	10	95.66	94.97	102.30	0.30	0.25	0.25
10	Fertilizers	7	19.86	17.13	14.34	0.03	0.04	0.03
11	Food Processing Industries	1	0.05	0.05	0.05	0.00	0.00	0.00
12	Fuels	13	1023.25	1123.63	1163.99	0.09	0.09	0.08
13	Industrial Equipment	3	2.09	1.23	2.41	0.15	0.09	0.17
14	Industrial Machinery	1	749.10	648.86	646.64	2.99	2.62	2.32
15	Machine Tools	1	1.65	1.93	1.73	0.74	0.95	0.93
16	Medical & Surgical Appliances	2	11.69	9.02	6.57	0.95	0.70	0.50
17	Metallurgical Industries	10	198.04	246.81	208.64	0.27	0.30	0.21
18	Paper & Pulp	3	9.72	10.94	11.15	0.30	0.29	0.30
19	Scientific Instruments	1	4.21	3.57	3.74	8.72	6.91	6.44
20	Soaps, Cosmetics, Toilet Preparations	1	0.54	0.48	0.65	0.15	0.12	0.13
21	Sugar	1	0.68	0.67	0.57	57.63	64.42	74.03
22	Telecommunications	1	33.61	33.25	22.76	2.68	2.06	1.34
23	Textiles (Dyed, Printed, Processed)	1	0.39	0.46	0.28	0.06	0.07	0.05
24	Transportation	2	9.59	6.65	0.85	0.09	0.06	0.01
25	Miscellaneous Industries	6	12.49	8.28	12.66	0.10	0.06	0.09
	Total	**103**	**4453.88**	**4706.29**	**5253.25**	**0.30**	**0.29**	**0.29**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. S.T.O : Sales Turnover.
2. R&D : Research and Development.
3. R&D intensity in Sugar industry is very high due to low Sales Turnover

Table 16

EXPENDITURE ON RESEARCH AND DEVELOPMENT BY INDUSTRY GROUPS FOR PRIVATE SECTOR

S. No.	Industry Group	No.of R&D Units	R&D Expenditure					
			(Rs. Crore)			as % of S.T.O.		
			2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
1	Agricultural Machinery	98	697.03	777.57	831.69	1.66	1.73	1.73
2	Bio-technology	163	1052.67	1075.28	1071.30	4.52	5.57	5.55
3	Boilers & Steam Generating Plants	6	50.66	51.07	68.21	0.84	0.94	1.24
4	Cement & Gypsum Products	18	77.74	74.71	94.44	0.11	0.10	0.11
5	Ceramics	16	36.39	38.23	48.19	0.28	0.29	0.36
6	Chemicals (other than fertilizers)	224	2437.86	2813.85	3004.56	1.50	1.67	1.60
7	Commercial, Office, Household Equipment	13	132.75	152.74	170.46	0.52	0.55	0.59
8	Consultancy Services	9	27.66	28.74	26.35	5.04	4.65	3.79
9	Defence Industries	23	112.58	117.86	140.25	3.43	2.91	3.66
10	Drugs & Pharmaceuticals	313	8832.96	10294.44	10159.11	4.59	5.21	4.96
11	Dyestuffs	14	14.07	15.30	30.11	0.25	0.25	0.49
12	Earth Moving Machinery	12	53.13	94.30	149.41	0.51	0.48	0.69
13	Electricals & Electronics	215	1737.60	1768.45	1935.47	0.62	0.60	0.61
14	Fermentation Industries	5	12.37	11.42	13.04	0.05	0.04	0.05
15	Fertilizers	16	37.79	38.38	44.03	0.18	0.20	0.20
16	Food Processing Industries	90	248.00	280.92	245.86	0.31	0.35	0.32
17	Fuels	10	39.91	45.10	51.32	0.27	0.30	0.28
18	Glass	2	0.11	0.13	0.21	0.05	0.06	0.08
19	Glue & Gelatine	2	18.14	5.28	5.83	3.36	0.93	0.93
20	Industrial Equipment	66	362.82	402.92	470.49	0.93	1.00	1.14
21	Industrial Machinery	63	186.27	171.39	201.52	1.34	1.37	1.49
22	Information Technology	34	3209.52	3210.62	3625.17	2.75	2.45	2.58
23	Leather, Leather goods & Pickers	8	18.30	18.85	18.03	0.30	0.31	0.27
24	Machine Tools	24	121.41	125.68	142.16	0.97	0.93	0.93
25	Math Surveying & Drawing Instruments	1	1.57	1.60	2.07	5.55	5.15	6.47
26	Medical & Surgical Appliances	35	983.20	1176.57	1277.97	16.71	18.97	19.89
27	Metallurgical Industries	58	173.00	216.09	263.90	0.08	0.08	0.08
28	Miscellaneous Mechanical Engineering Industries	76	2599.43	2766.83	3122.67	3.02	2.97	3.11

Table 16 Contd...

Table 16 (Contd.)
EXPENDITURE ON RESEARCH AND DEVELOPMENT BY INDUSTRY GROUPS FOR PRIVATE SECTOR

S. No.	Industry Group	No.of R&D Units	R&D Expenditure					
			(Rs. Crore)			as % of S.T.O.		
			2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
29	Paper & Pulp	16	21.25	32.22	51.57	0.16	0.27	0.39
30	Prime Movers	4	106.38	153.70	151.10	2.00	2.74	2.66
31	Rubber Goods	37	472.95	707.26	647.50	0.75	1.27	1.11
32	Scientific Instruments	13	13.13	13.77	16.15	3.03	2.85	3.35
33	Soaps, Cosmetics, Toilet Preparations	13	278.17	308.91	283.26	0.39	0.41	0.32
34	Sugar	11	93.63	87.58	97.99	0.69	0.63	0.68
35	Telecommunications	13	179.13	187.76	202.90	7.65	7.68	9.33
36	Textiles (Dyed, Printed, Processed)	51	228.43	242.80	262.20	0.38	0.41	0.42
37	Timber Products	1	0.21	0.37	0.53	0.23	0.42	0.59
38	Transportation	100	6096.48	6061.18	6848.96	1.87	1.72	1.79
39	Vegetable Oil & Vanaspati	2	1.62	1.41	2.27	0.08	0.07	0.10
40	Miscellaneous Industries	132	604.68	596.79	722.49	0.66	0.61	0.68
	Total	**2007**	**31371.00**	**34168.07**	**36500.74**	**1.47**	**1.50**	**1.48**

Source : Data collected and complied by NSTMIS, DST, GoI.

Note : 1. S.T.O : Sales Turnover.
2. R&D : Research and Development.

Table 17

RESEARCH AND DEVELOPMENT EXPENDITURE BY MULTINATIONAL ENTERPRISES

(Rs. Crore)

Type of Multinational Enterprises	No.of R&D Units	2015-16	2016-17	2017-18
Private Sector- India	261	11981.27	13358.2	13162.74
Private Sector- Foreign	146	5351.96	5266.52	6089.04
Public Sector	5	1063.88	1089.57	1110.84
Total	**412**	**18397.11**	**19714.29**	**20362.62**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Table 18

NATIONAL EXPENDITURE ON R&D BY ECONOMIC ACTIVITY

(Rs. Crore)

S. No.	Economic Activity	NIC Code	Research & Development Expenditure		
			2015-16	2016-17	2017-18
1	Agriculture, Forestry and Fishing	1	9158.72	9618.42	10734.75
2	Mining and Quarrying	5	194.05	212.88	279.82
3	Manufacture of Food Products	10	311.87	354.32	330.17
4	Manufacture of Beverages	11	19.44	21.24	25.65
5	Manufacture of Tobacco Products	12	20.38	18.91	17.39
6	Manufacture of Textiles	13	280.40	283.53	304.43
7	Manufacture of Wearing Apparel	14	34.79	33.95	38.51
8	Manufacture of Leather and Related Products	15	134.40	137.16	143.96
9	Manufacture of Wood and of Products of Wood & Cork, except Furniture	16	4.63	5.83	6.80
10	Manufacture of Paper and Paper Products	17	181.94	194.44	214.62
11	Manufacture of Coke and Refined Petroleum Products	19	826.50	969.29	959.09
12	Manufacture of Chemicals and Chemical Products	20	3354.15	3870.04	3970.88
13	Manufacture of Basic Pharmaceutical Products and Pharmaceutical Preparations	21	8628.65	10039.44	10105.92
14	Manufacture of Rubber and Plastic Products	22	610.88	841.73	792.11
15	Manufacture of Other Non-Metallic Mineral Products	23	41.86	43.17	47.15
16	Manufacture of Basic Metals	24	93.44	162.24	152.86
17	Manufacture of Fabricated Metal Products, except Machinery and Equipment	25	99.49	113.04	136.83
18	Manufacture of Computer, Electronic and other Optical Products	26	1633.55	1760.09	1983.94
19	Manufacture of Electrical Equipment	27	1140.80	1308.47	1358.62
20	Manufacture of Machinery and Equipment NEC	28	1895.20	1938.63	2014.05
21	Manufacture of Motor Vehicles, Trailers and Semi-Trailers	29	8083.99	8176.04	9207.98
22	Manufacture of Other Transport Equipment	30	437.62	568.62	648.28
23	Other Manufacturing	32	1773.95	1605.49	1968.27
24	Repair and Installation of Machinery and Equipment	33	2.17	2.43	19.19
25	Electricity, Gas, Steam and Air Conditioning Supply	35	139.48	87.48	131.70
26	Water Supply, Sewerage, Waste Management and Remediation activities	36	12.97	16.35	16.28
27	Construction	41	94.54	131.26	211.54

Table 18 Contd...

Table 18 (Contd.)
NATIONAL EXPENDITURE ON R&D BY ECONOMIC ACTIVITY

(Rs. Crore)

S. No.	Economic Activity	NIC Code	Research & Development Expenditure		
			2015-16	2016-17	2017-18
28	Transportation and Storage	49	157.67	91.49	122.43
29	Professional, Scientific and Technical Activities	69	35598.44	37960.86	42554.88
30	Public Administration and Defence, Compulsory Social Security	84	622.25	697.79	953.37
31	Education	85	3789.62	4102.06	4328.20
32	Human Health and Social Work Activities	86	4150.07	4682.29	5344.17
33	Service Sector	90	2740.55	2642.15	3202.29
34	Others	91	2750.65	3165.07	3341.79
	Total		**89019.11**	**95856.20**	**105667.92**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. National R&D Expenditure by Economic Activity comprises of Central Government, State Government, Private, Public Sector, Scientific and Industrial Research Organisations (SIROs).

2. Break-up of Higher Education Sector by economic activity is not available.

Table 19

GOVERNMENT EXPENDITURE ON R&D BY ECONOMIC ACTIVITY

(Rs. Crore)

S.No.	Economic Activity	NIC Code	Research & Development Expenditure			
			Units	2015-16	2016-17	2017-18
1	Agriculture, Forestry and Fishing	1	160	8279.42	8666.08	9747.76
2	Mining and Quarrying	5	4	111.95	127.97	138.81
3	Manufacture of Food Products	10	2	13.99	16.78	25.76
4	Manufacture of Textiles	13	8	126.77	111.41	123.38
5	Manufacture of Leather and Related Products	15	1	101.29	116.43	124.6
6	Manufacture of Wood and of Products of Wood & Cork, except Furniture	16	1	4.42	5.46	6.27
7	Manufacture of Paper and Paper Products	17	1	10.22	10.95	13.11
8	Manufacture of Coke and Refined Petroleum Products	19	1	2.51	2.56	3.04
9	Manufacture of Chemicals and Chemical Products	20	1	91.30	93.14	76.70
10	Manufacture of Basic Pharmaceutical Products and Pharmaceutical Preparations	21	2	0.29	0.32	0.35
11	Manufacture of Rubber and Plastic Products	22	2	42.46	43.32	48.11
12	Manufacture of Basic Metals	24	2	11.93	10.47	14.85
13	Manufacture of Electrical Equipment	27	1	158.76	249.65	256.10
14	Other Manufacturing	32	1	0.01	0.01	0.01
15	Construction	41	1	27.80	37.54	45.00
16	Transportation and Storage	49	1	5.51	6.38	3.91
17	Professional, Scientific and Technical Activities	69	103	33522.66	35800.86	40322.29
18	Education	85	49	3191.79	3453.48	3637.67
19	Human Health and Social Work Activities	86	49	1500.89	1837.84	2257.97
20	Service Sector	90	14	349.20	301.09	324.61
21	Others	91	39	1328.19	1488.62	1761.34
	Total		**443**	**48881.36**	**52380.36**	**58931.64**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : Goverment includes Major Scientific Agencies, Central Ministries/Departments and State Governments.

Table 20

INDUSTRIAL SECTOR EXPENDITURE ON R&D BY ECONOMIC ACTIVITY

(Rs. Crore)

S.No.	Economic Activity	NIC Code	No.of R&D Units	Research & Development Expenditure		
				2015-16	2016-17	2017-18
1	Agriculture, Forestry and Fishing	1	225	879.30	952.34	986.99
2	Mining and Quarrying	5	18	82.10	84.91	141.01
3	Manufacture of Food Products	10	82	297.88	337.54	304.41
4	Manufacture of Beverages	11	6	19.44	21.24	25.65
5	Manufacture of Tobacco Products	12	5	20.38	18.91	17.39
6	Manufacture of Textiles	13	51	153.63	172.12	181.05
7	Manufacture of Wearing Apparel	14	2	34.79	33.95	38.51
8	Manufacture of Leather and Related Products	15	8	33.11	20.73	19.36
9	Manufacture of Wood and of Products of Wood &Cork, except Furniture	16	1	0.21	0.37	0.53
10	Manufacture of Paper and Paper Products	17	21	171.72	183.49	201.51
11	Manufacture of Coke and Refined Petroleum Products	19	8	823.99	966.73	956.05
12	Manufacture of Chemicals and Chemical Products	20	245	3262.85	3776.90	3894.18
13	Manufacture of Basic Pharmaceutical Products and Pharmaceutical Preparations	21	298	8628.36	10039.12	10105.57
14	Manufacture of Rubber and Plastic Products	22	58	568.42	798.41	744.00
15	Manufacture of Other Non-Metallic Mineral Products	23	7	41.86	43.17	47.15
16	Manufacture of Basic Metals	24	24	81.51	151.77	138.01
17	Manufacture of Fabricated Metal Products, except Machinery and Equipment	25	34	99.49	113.04	136.83
18	Manufacture of Computer, Electronic and other Optical Products	26	63	1633.55	1760.09	1983.94
19	Manufacture of Electrical Equipment	27	135	982.04	1058.82	1102.52
20	Manufacture of Machinery and Equipment n.e.c	28	165	1895.20	1938.63	2014.05
21	Manufacture of Motor Vehicles, Trailers and Semi-Trailers	29	64	8083.99	8176.04	9207.98
22	Manufacture of Other Transport Equipment	30	41	437.62	568.62	648.28
23	Other Manufacturing	32	273	1773.94	1605.48	1968.26
24	Repair and Installation of Machinery and Equipment	33	2	2.17	2.43	19.19
25	Electricity, Gas, Steam and Air Conditioning Supply	35	12	139.48	87.48	131.70
26	Water Supply, Sewerage, Waste Management and Remediation activities	36	12	12.97	16.35	16.28

Table 20 Contd...

Table 20 (Contd.)
INDUSTRIAL SECTOR EXPENDITURE ON R&D BY ECONOMIC ACTIVITY

(Rs. Crore)

S.No.	Economic Activity	NIC Code	No.of R&D Units	Research & Development Expenditure		
				2015-16	2016-17	2017-18
27	Construction	41	20	66.74	93.72	166.54
28	Transportation and Storage	49	13	152.16	85.11	118.52
29	Professional, Scientific and Technical Activities	69	170	2075.78	2160.00	2232.59
30	Public Administration and Defence, Compulsory Social Security	84	22	622.25	697.79	953.37
31	Education	85	106	597.83	648.58	690.53
32	Human Health and Social Work Activities	86	197	2649.18	2844.45	3086.20
33	Service Sector	90	43	2391.35	2341.06	2877.68
34	Others	91	176	1422.46	1676.45	1580.45
	Total		**2607**	**40137.75**	**43475.84**	**46736.28**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : Industrial Sector comprises of Private Sector (2007), Public Sector (103) and Scientific and Industrial Research Organisations (497).

Table 21

FULL TIME EQUIVALENT OF MANPOWER EMPLOYED IN R&D ESTABLISHMENTS AS ON 01.04.2018

(Number)

	Name of Establishment	Personnel Engaged in			Total (1+2+3)
		R&D Activities (1)	Auxilliary Activities (2)	Administrative Activities (3)	
1.	**INSTITUTIONAL SECTOR**				
	A. GOVERNMENT INSTITUTIONS				
	a. Major Scientific Agencies	53891	34149	34125	122165
	b. Central Government Ministries / Departments	8790	11495	10144	30429
	c. State Governments/UT	16376	9828	22590	48794
	Total Government Institutions (A=a+b+c)	79057	55472	66859	201388
	B. HIGHER EDUCATION SECTOR	124702	–	–	124702
	TOTAL INSTITUTIONAL SECTOR (1= A+B)	**203759**	**55472**	**66859**	**326090**
2.	**INDUSTRIAL SECTOR**				
	a. Public Sector including Joint Sector	9291	1480	1264	12035
	b. Private Sector	107003	23741	24745	155489
	c. Scientific and Industrial Research Organisation (SIRO)	21765	18131	19459	59355
	Private Sector + SIRO (b+c)	128768	41872	44204	214844
	TOTAL INDUSTRIAL SECTOR (2= a+b+c)	**138059**	**43352**	**45468**	**226879**
	Total (1+2)	**341818**	**98824**	**112327**	**552969**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note :
1. Data for Industrial Sector refers to 2607 in-house R&D units including 2007 Private Sector industries, 103 Public Sector industries and 497 SIRO units.
2. R&D : Research and Development.
3. - Not available
4. Data includes Part Time (FTE) of manpower employed in R&D establishments.

Table 22

FULL TIME EQUIVALENT OF WOMEN EMPLOYED IN R&D ESTABLISHMENTS AS ON 01.04.2018

(Number)

	Name of Establishment	Personnel Engaged in			Total (1+2+3)
		R&D Activities (1)	Auxilliary Activities (2)	Administrative Activities (3)	
1	**INSTITUTIONAL SECTOR**				
	A. GOVERNMENT INSTITUTIONS				
	a. Major Scientific Agencies	10138	5789	7081	23008
	b. Central Government Ministries / Departments	2073	3659	2376	8108
	c. State Governments/UT	3957	2250	6072	12279
	Total Government Institutions (A=a+b+c)	**16168**	**11698**	**15529**	**40457**
	B. HIGHER EDUCATION SECTOR	**16211**	**–**	**–**	**16211**
	TOTAL INSTITUTIONAL SECTOR (1= A+B)				
2	**INDUSTRIAL SECTOR**				
	a. Public Sector including Joint Sector	1527	157	273	1957
	b. Private Sector	15011	2815	2525	20351
	c. Scientific and Industrial Research Organisation (SIRO)	7830	7790	6777	22397
	Private + SIRO (b+c)	22841	10605	9302	42748
	TOTAL INDUSTRIAL SECTOR (2= a+b+c)	**24368**	**10762**	**9575**	**44705**
	Total (1+2)	**56747 (16.6%)**	**22460 (22.7%)**	**25104 (22.3)**	**104311 (18.8%)**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : 1. Data for Industrial Sector refers to 2607 in-house R&D units including 2007 Private Sector industries, 103 Public Sector industries and 497 SIRO units.

2. R&D : Research and Development.

3. - Not available

Table 23

FIELD OF SPECIALIZATION OF FULL TIME PERSONNEL EMPLOYED IN R&D AS ON 01.04.2018

(Number)

Field of Specialization	Male	Female	Transgender	Total
Agricultural Sciences	20010	5823	0	25833
Engineering Technology	103944	17587	0	121531
Medical Sciences	24255	7888	0	32143
Natural Sciences	24860	7232	0	32092
Social Sciences	3510	2006	1	5517
Total	**176579**	**40536**	**1**	**217116**

Source : Data collected and compiled by NSTMIS, DST, GoI.

Note : Data analysed is based on the Survey response. Data includes all sectors except Higher Education. In case of Higher Education, field of specialization of full time personnel employed in R&D is not available.

Table 24

UNIVERSITIES/COLLEGES AND THEIR ENROLMENT FROM 1976-77 TO 2018-19

(Number)

Year	Universities	Institutions/Deemed to be Universities	Colleges	Total Enrolment
1976-77	105	9	4317	2431563
1977-78	108	9	4375	2564972
1978-79	108	10	4460	2618228
1979-80	112	10	4558	2648579
1980-81	116	12	4722	2752437
1981-82	120	12	4880	2952066
1982-83	125	14	5039	3133093
1983-84	126	14	5246	3307649
1984-85	132	16	5590	3404096
1985-86	136	17	5816	3605029
1986-87	143	21	6040	3757158
1987-88	144	22	6685	4020159
1988-89	145	27	6773	4285489
1989-90	149	28	7145	4602680
1990-91	150	29	7346	4924868
1991-92	155	31	7761	5265886
1992-93	159	31	7993	5534966
1993-94	163	34	8441	5817249
1994-95	168	36	9019	6113929
1995-96	171	37	9252	6574005
1996-97	172	38	9940	6842598
1997-98	182	39	10678	7260418
1998-99	182	40	11397	7705520
1999-00	189	42	11865	8050607
2000-01	193	47	12806	8399443
2001-02	196	52	15437	8964680
2002-03	200	81	16206	9516773
2003-04	213	89	16742	10201981
2004-05	229	96	18080	11038543
2005-06	241	101	19327	12043050

Table 24 Contd...

Table 24 (Contd.)
UNIVERSITIES/COLLEGES AND THEIR ENROLMENT FROM 1976-77 TO 2018-19

Year	Universities	Institutions/Deemed to be Universities	Colleges	Total Enrolment
2006-07	249	109	21170	13163054
2007-08	272	103	23206	14400381
2008-09	300	128	25951	15768417
2009-10	363	130	31812	17243352
2010-11	621	131	32974	27499749
2011-12	642	128	34852	29184331
2012-13	667	127	35525	30152417
2013-14	723	127	36634	32336234
2014-15	760	122	38498	34211637
2015-16	799	122	39071	34584781
2016-17	864	122	40026	35705905
2017-18	903	123	39050	36642378
2018-19	993	124	39931	37399388

Source : UGC Annual Reports and AISHE,MHRD Survey Reports.

Note : 1. Series revised from 2010-11 as per the various AISHE, MHRD survey reports.
2. The number of Universities since 2010-11 onwards also include Institutions of National Importance.
3. Figures of students enrolment pertain to regular/distance mode courses in universities and colleges including Standalone Institutions such as polytechnics, Institutes under central ministries, Nursing Institutes, Teacher training Institutes etc awarding diploma and certificate.

Table 25

FACULTY- WISE ENROLMENT IN HIGHER EDUCATION FROM 2001-02 TO 2018-19

(Thousand)

Course of Study / Discipline	2001-02		2005-06		2010-11		2014-15		2015-16		2016-17		2017-18		2018-19	
	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total	Enrolment	% of total
A. Science and Technology																
Science	1739.1	19.4	2255.2	20.5	1801.0	11.1	4608.9	15.1	4930.7	15.7	5350.1	16.5	5509.3	16.8	5357.3	16.3
Engineering/ Technology	618.6	6.9	795.1	7.2	3024.0	18.7	5515.8	18.0	5472.0	17.4	5322.1	16.4	5194.5	15.9	5024.7	15.3
Medicine	277.9	3.1	348.5	3.2	433.3	2.7	932.6	3.1	1035.3	3.3	1123.7	3.5	1251.8	3.8	1363.9	4.2
Agriculture	89.6	1.0	64.0	0.6	95.0	0.6	194.5	0.6	215.3	0.7	265.6	0.8	270.7	0.8	290.3	0.9
Veterinary Science	17.9	0.2	16.5	0.2	1.1	0.0	14.4	0.0	16.1	0.1	18.7	0.1	22.5	0.1	23.8	0.1
Total (A)	**2743.2**	**30.6**	**3479.3**	**31.5**	**5354.4**	**33.0**	**11266.3**	**36.9**	**11669.3**	**37.2**	**12080.2**	**37.3**	**12248.8**	**37.5**	**12059.8**	**36.8**
B. Other Discipline	**6221.5**	**69.4**	**7548.7**	**68.5**	**10856.8**	**67.0**	**19297.4**	**63.1**	**19695.1**	**62.8**	**20325.2**	**62.7**	**20447.3**	**62.5**	**20712.1**	**63.2**
Total (A+B)	**8964.7**	**100.0**	**11028.0**	**100.0**	**16211.2**	**100.0**	**30563.7**	**100.0**	**31364.4**	**100.0**	**32405.5**	**100.0**	**32696.1**	**100.0**	**32771.9**	**100.0**

Source : University Grants Commission (UGC), Annual Reports and AISHE,MHRD Survey reports

Note : Figures for 2010-11 onwards are taken from AISHE, MHRD Survey Reports and pertains only to UG, PG, M.Phil and Ph.D disciplines based on the actual survey response which also excludes courses conducted by standalone institutions. Hence, the total of faculty- wise figures will not match with the overall enrolmment figures.

Table 26

FACULTY-WISE ENROLMENT OF WOMEN IN HIGHER EDUCATION FROM 2001-02 TO 2018-19

(Thousand)

Year	Science &Technology Disciplines						
	Science	Engg.	Med.	Agri.	Vety. Sc.	Other Discipline	Total
	(1)	(2)	(3)	(4)	(5)	(5)	
2001-02	699.4	131.8	123.0	9.1	3.2	2547.9	3514.4
	(40.2)	(21.3)	(44.3)	(10.2)	(17.8)	(41.0)	(39.2)
2005-06	901.3	185.9	162.6	10.8	3.6	3202.6	4466.8
	(40.0)	(23.4)	(46.7)	(16.9)	(21.8)	(42.4)	(40.5)
2010-11	853.0	916.4	225.6	24.9	0.5	5051.3	7071.7
	(47.36)	(30.3)	(52.0)	(26.2)	(43.6)	(46.5)	(43.6)
2011-12	1183.7	1274.0	360.3	25.4	4.2	6126.2	8974.0
	(49.2)	(32.0)	(59.0)	(26.6)	(30.8)	(49.0)	(45.7)
2012-13	1458.0	1465.3	405.7	36.3	4.7	7484.1	10854.2
	(49.1)	(31.8)	(58.6)	(26.7)	(33.2)	(50.2)	(46.5)
2013-14	1796.8	1682.3	489.9	48.6	4.8	8687.9	12710.4
	(48.4)	(31.8)	(59.3)	(29.6)	(34.9)	(50.6)	(46.8)
2014-15	2207.2	1747.0	552.8	51.3	5.0	9865.7	14429.1
	(47.9)	(31.7)	(59.2)	(26.4)	(34.5)	(51.1)	(47.2)
2015-16	2388.0	1718.0	619.3	59.3	5.8	10119.3	14909.8
	(48.4)	(31.4)	(59.8)	(27.6)	(36.2)	(51.4)	(47.5)
2016-17	2622.1	1673.6	678.1	75.5	6.9	10563.5	15619.6
	(49.0)	(31.4)	(60.3)	(28.4)	(37.1)	(52.0)	(48.2)
2017-18	2757.0	1642.2	758.0	78.9	8.4	10617.9	15862.4
	(50.0)	(31.6)	(60.5)	(29.2)	(37.6)	(51.9)	(48.5)
2018-19	2804.8	1600.7	823.1	89.1	9.2	10933.3	16260.3
	(52.4)	(31.9)	(60.3)	(30.7)	(38.7)	(52.8)	(49.6)

Source : University Grants Commission (UGC),) Annual Reports and AISHE,MHRD Survey reports

Note :
1. Figure in paranthesis indicates % share of women enrolled against total enrolment by discipline in respective year.
2. Agri.: Agriculture; Vety. Sc.: Veterinary Sciences; Engg.: Engineering and Technology; Med.: Medicine
3. Figures for 2010-11 onwards are taken from AISHE, MHRD Survey Reports and pertains only to UG, PG, M.Phil and Ph.D disciplines based on the actual survey response which also excludes courses conducted by standalone institutions. Hence, the total of faculty- wise figures will not match with the overall enrolmment figures.

Table 27

PUBLIC EXPENDITURE ON EDUCATION AND GROSS DOMESTIC PRODUCT (GDP)

(Rs. Crore)

Year	GDP at Current price (at Factor cost)	Total Expenditure on Education by Education & other Departments	Expenditure on Education by Education & other Departments as % of GDP
1951-52	10080	64.46	0.64
1960-61	16220	239.56	1.48
1970-71	42222	892.36	2.11
1980-81	130178	3884.20	2.98
1990-91	510964	19615.85	3.84
2000-01	1991982	82486.48	4.14
2005-06	3390503	113228.71	3.34
2006-07	3953276	137383.99	3.48
2007-08	4582086	155797.27	3.40
2008-09	5303567	189068.84	3.56
2009-10	6108903	241256.02	3.95
2010-11	7248860	293478.23	4.05
2011-12	8736039	333930.38	3.82
2012-13	9946636	368132.87	3.70
2013-14(RE)	11236635	433640.59	3.86
2014-15(BE)	12433749	502929.34	4.04

Source : Education Statistics at a Glance, 2016, MHRD, GoI (website: http://mhrd.gov.in/statist)

Note : 1. RE: Revised Estimate, BE: Budget Estimate

2. GDP Base Year has been revised since 2004-05

Table 28

DOCTORATE DEGREES AWARDED FACULTY-WISE, 2010-11 TO 2017-18

(Number)

Faculty	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Science	5271	6334	6641	7018	7617	7636	8914	10055
Engineering/Technology	1682	2173	2119	2533	4340	5470	5289	7659
Medicine	601	638	756	819	1395	1021	1422	1606
Agriculture	586	677	738	871	1690	1350	4465	4748
Veterinary Science	162	189	204	241	204	283	298	406
Total S&T- (A)	8302	10011	10458	11482	15246	15760	20388	24474
Others- (B)	7791	9850	9817	11367	12081	11911	14012	16339
Total (A+B)	16093	19861	20275	22849	27327	27671	34400	40813
Faculty	**% in Science & Technology (S&T) Disciplines**							
	2010-11	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**
Science	63.5	63.3	63.5	61.1	50.0	48.5	43.7	41.1
Engineering/Technology	20.3	21.7	20.3	22.1	28.5	34.7	25.9	31.3
Medicine	7.3	6.4	7.2	7.1	9.1	6.5	7.0	6.6
Agriculture	7.1	6.8	7.1	7.6	11.1	8.6	21.9	19.4
Veterinary Science	2.0	1.9	2.0	2.1	1.3	1.8	1.5	1.7
Total (S&T) - A	**(100.0)**	**(100.0)**	**(100.0)**	**(100.0)**	**(100.0)**	**(100.0)**	**(100.0)**	**(100.0)**

Source : University Grants Commission (UGC), Annual Reports and AISHE,MHRD Survey reports

Note : Engineering/Technology includes IT & Computer; Science includes Fisheries Science, Marine Science/Oceanography; Others includes Arts, Commerce, Law, Eduction, Library & Information Science; Music, Performing/Visual Arts, Journalism & Mass Communication, Physical Education & Social Work etc.

Table 29

DOCTORAL DEGREE AWARDED BY SELECT COUNTRY AND FIELD, 2016 (OR MOST RECENT YEAR)

(Number)

S. No.	Country	All fields	All S&E	Physical/ Biological Sciences	Mathematics/ Computer Sciences	Agricultural Sciences	Engineering	Social and Behavioural Sciences	Non-S&E
		(1)=2+8	(2)=3+4+5+6+7	(3)	(4)	(5)	(6)	(7)	(8)
1	United States	69,525	39,710	16,466	1,951	1,003	10,582	9,708	29,815
2	China (2015)	53,778	34,440	10,978	0.0	2,549	18,729	2,184	19,338
3	**India (2018)**	**40,813**	**24,474**	**11,661**	**#**	**5,154**	**7,659**	**@**	**16,339**
4	Germany	29,303	15,871	8,382	1,021	898	3,710	1,860	13,432
5	United Kingdom	27,366	15,757	7,763	1,136	334	3,965	2,559	11,609
6	Russia	27,212	14,376	3,781	1,860	1,045	5,222	2,468	12,836
7	Brazil	20,605	10,469	3,143	332	2,389	3,061	1,544	10,136
8	France	13,016	9,564	5,788	630	0.0	1,757	1,389	3,452
9	Spain	14,694	8,373	4,706	775	248	1,141	1,503	6,321
10	Japan	15,804	7,391	2,316	0.0	881	3,440	754	8,413
11	South Korea	13,882	6,557	1,861	154	286	3,519	737	7,325
12	Italy	9,803	5,656	2,346	477	499	1,796	538	4,147
13	Canada	7,768	5,556	2,083	251	248	1,632	1,341	2,212
14	Australia	9,089	5,285	1,988	346	406	1,502	1,043	3,804
15	Turkey	6,052	3,004	1,207	34	210	1,088	465	3,048
16	Mexico	9,268	2,654	792	65	233	716	848	6,614
17	Switzerland	3,935	2,441	1,253	120	122	627	319	1,494
18	Sweden	3,533	2,188	745	177	81	927	258	1,345
19	Taiwan	3,623	2,128	556	51	89	1,244	188	1,495
20	South Africa	2,536	1,313	616	51	121	221	304	1,223
21	Israel	1,570	1,151	680	62	23	176	210	419
22	Romania	2,260	1,070	237	53	134	417	229	1,190

Source : 1. Science and Engineering Indicators 2020, NSF,USA
2. Data for India taken from- UGC Annual Report 2017-18 and AISHE,MHRD Survey reports

Note : 1. S&E-Science and Engineering, Non-S&E includes Arts,Commerce, Law,Education etc
2. India- Physical and Biological Sciences includes Science & Medicine; Agricultural Sciences includes Veterinary Science
3. #- Mathematics/Computer Sciences merged in physical/biological sciences ; @- merged with Non-S&E
4. Figure in bracket represent data year for China and India. For other countries data year is 2016.
5. Countries are ranked based on the Doctoral degrees in S&E field.

Table 30

TOP 15 REGIONS, COUNTRIES, OR ECONOMIES OF ORIGIN OF U.S. DOCTORATE RECIPIENTS ON TEMPORARY VISAS, BY FIELD: 2000–17

(Number)

Region, country, or economy	All fields	All S&E fields	Engineering	Agricultural sciences	Biological sciences	Computer sciences	Earth, atmospheric, and ocean sciences	Mathematics	Medical and other health sciences	Physical sciences	Psychology	Social sciences	Non-S&E
All regions, countries, or economies of origin (212 regions, countries, or economies)[a]	246,126(100)	210,053	72,416	7,886	34,142	13,785	4,732	11,889	7,750	28,671	4,186	24,596	36,073
Top 15 regions, countries, or economies of origin	186,134(76)	161,769	59,915	5,201	26,962	10,701	3,395	8,896	5,688	21,678	2,955	16,378	24,365
China[b]	71,864(29)	66,690	24,714	1,748	11,879	4,962	1,623	4,874	1,492	10,923	598	3,877	5,174
India	**31,069(13)**	**29,050**	**12,222**	**775**	**5,933**	**2,399**	**343**	**756**	**1,396**	**3,432**	**274**	**1,520**	**2,019**
South Korea	23,697(10)	18,160	7,476	584	2,132	941	272	851	663	1,804	454	2,983	5,537
Taiwan	12,036(5)	9,127	3,253	250	1,823	419	143	368	713	937	258	963	2,909
Canada	8,178(3)	5,765	955	168	1,219	220	200	282	322	671	664	1,064	2,413
Turkey	7,959(3)	6,629	2,814	226	590	451	78	338	50	662	144	1,276	1,330
Thailand	4,928(2)	4,261	1,665	359	496	212	36	137	469	366	32	489	667
Iran	4,522(2)	4,345	3,113	43	179	307	49	132	37	324	20	141	177
Japan	4,011(2)	2,991	443	76	433	82	83	94	164	335	179	1,102	1,020
Mexico	3,700(2)	3,131	831	402	440	114	110	190	73	287	36	648	569
Germany	3,523(1)	2,746	474	70	447	169	123	213	63	469	134	584	777
Brazil	2,828(1)	2,352	420	307	444	137	81	126	149	113	46	529	476
Russia	2,827(1)	2,496	382	16	342	136	77	279	17	863	44	340	331
Italy	2,582(1)	1,998	502	44	208	98	83	151	22	314	38	538	584
Colombia	2,410(1)	2,028	651	133	397	54	94	105	58	178	34	324	382

Source : Science and Engineering Indicators 2020, National Science Foundation, special tabulations (2018) of the 2017 Survey of Earned Doctorates (SED).

Note :
1. [a] Excludes cases with unknown region, country, or economy of origin.
2. [b] China includes Hong Kong
3. Data include temporary residents and non-U.S. citizens with unknown visa status. Rank is based on total number of doctorates.
4. Figures in paranthesis represents percentage

Table 31

RESEARCHERS PER MILLION INHABITANTS (FTE) FOR SELECT COUNTRIES, 2017

S. No	Country	Reseachers Per Million People	Population in Million	Number of Researchers
1	Australia	4539	24.58	100414
2	Brazil	888	207.83	179989
3	Canada	4264	36.73	155128
4	China	1225	1421.02	1740442
5	Denmark	7899	5.73	45277
6	Finland	6722	5.51	37047
7	France	4450	64.84	288579
8	Germany	5003	82.66	413542
9	Hungary	2922	9.73	28426
10	**India**	**255**	**1338.68**	**341818**
11	Israel	8342	8.24	63521
12	Italy	2245	60.67	136204
13	Japan	5304	126.99	676292
14	Malaysia	2397	31.10	73537
15	Mexico	252	124.78	29921
16	Netherlands	5011	17.02	85300
17	New Zealand	4052	4.70	18700
18	Norway	6489	5.30	34367
19	Pakistan	336	207.91	69769
20	Philippines	106	105.17	10791
21	Republic of Korea	7498	51.10	383100
22	Russian Federation	2822	145.53	410617
23	Singapore	6636	5.71	36666
24	South Africa	492	57.01	27656
25	Spain	2855	46.65	133195
26	Sri Lanka	106	21.13	2216
27	Sweden	7597	9.90	75247
28	Switzerland	5272	8.46	43740
29	United Kingdom	4341	66.73	289674
30	United States of America	4245	325.15	1371290
31	Venezuela	300	29.40	8963
	World	**1198**	**7510.99**	**9042285**

Source : UNESCO & World Bank website accessed March, 2020 ; India-R&D Statistics 2019-20, DST, GoI.

Note : S&T Indicator- Reference years:

1. Researcher per Million People : 2016-Canada, Malaysia, South Africa, USA, Venezuela
   2015- New Zealand, Sri Lanka, Switzerland; Philipines; 2014- Brazil, Singapore; 2013-Mexico, 2012- Israel; 2010- Australia
2. Researchers (FTE) : 2016- Canada, Malaysia, South Africa, USA, Venezuela;
   2015- New Zealand, Philippines, Switzerland, Sri Lanka;
   2014- Singapore, Brazil; 2013- Mexico; 2012-Israel; 2010-Australia
3. Population : Japan, USA & World data from World Bank ; other countries data-UNESCO

Table 32

R&D EXPENDITURE PER CAPITA AND GDP FOR SELECT COUNTRIES, 2017 (IN PPP US$)

S. No.	Country	R&D Expenditure (billion current PPP $)	R&D Exp. as % of GDP	Per capita R&D (current PPP $)	Per capita GDP (current PPP $)	R&D per Researcher, FTE ('000 current PPP $)
1	Australia	21.2	1.9	883.8	49653.7	205
2	Brazil	41.1	1.3	197.9	15662.2	234
3	Canada	27.2	1.6	746.7	46723.3	178
4	China	499.1	2.1	351.2	16782.2	287
5	Denmark	9.6	3.1	1670.5	54356.5	211
6	Finland	7.0	2.8	1277.1	46349.0	190
7	France	64.7	2.2	997.4	44255.9	224
8	Germany	131.3	3.0	1588.9	52574.3	318
9	Hungary	3.8	1.3	390.7	28798.6	134
10	**India**	**63.2**	**0.7**	**47.2**	**7169.0**	**185**
11	Israel	15.4	4.5	1867.0	38867.8	164
12	Italy	33.5	1.4	552.8	40981.3	246
13	Japan	170.9	3.2	1340.4	41959.0	253
14	Malaysia	12.4	1.4	404.9	30004.1	169
15	Mexico	11.3	0.5	91.3	19432.2	344
16	Netherlands	18.6	2.0	1090.6	54503.1	218
17	New Zealand	2.1	1.2	460.2	40438.6	114
18	Norway	6.9	2.1	1307.1	62182.8	201
19	Pakistan	2.6	0.2	12.4	5249.2	37
20	Philippines	1.2	0.2	12.0	8340.3	114
21	Republic of Korea	91.0	4.6	1780.5	38824.1	237
22	Russian Fed.	41.9	1.1	287.7	25766.9	102
23	Singapore	11.1	2.2	1965.0	96552.6	276
24	South Africa	6.1	0.8	108.5	13464.2	220
25	Spain	21.9	1.2	469.8	39037.4	165
26	Sri Lanka	0.3	0.1	12.9	12878.6	122
27	Sweden	17.2	3.3	1736.7	51404.8	229
28	Switzerland	17.9	3.4	2152.0	66299.6	408
29	United Kingdom	49.3	1.7	739.5	44896.3	170
30	USA	543.2	2.8	1671.1	59927.9	376
31	Venezuela	1.8	0.3	61.0	12640.7	224
	World	**2192.4**	**1.7**	**290.5**	**17117.2**	**242**

Source : UNESCO & World Bank website accessed March, 2020 ; India-R&D Statistics 2019-20, DST, GoI.
Note : S&T Indicator- Reference years:

1. R&D Exp.(billion current PPP): 2016- Malaysia, Mexico, Singaore, South Africa; 2015-Australia, New Zealand, Sri Lanka, Switzerland, Philippines; 2014- Venezuela
2. R&D Exp/GDP(%): 2016- Malaysia, Mexico, Singapore, South Africa; 2015- Australia, Philipines, New Zealand, Sri Lanka, Switerzerland; 2014- Venezuela
3. Per capita R&D ('curr PPP $) : 2016- Malaysia, Mexico, Singapore, South Africa; 2015- Australia, New Zealand, Philipines, Sri Lanka, Switzerland ; 2014-Venezuela
4. R&D per Researcher, FTE ('000 curr PPP $) : 2016- Canada, Malaysia, South Africa, USA; 2015- New Zealand, Philipines, Sri Lanka, Switzerland; 2014-Brazil, Singapore, Venezuela; 2013- Mexico; 2012- Israel; 2010-Australia
5. Per Capita GDP : Venezuela and World data from World Bank

Table 33

SCIENCE AND ENGINEERING (S&E) ARTICLES IN ALL FIELDS, FOR REGIONS, COUNTRIES, OR ECONOMIES (NSF): 2008 AND 2018

(Number)

Rank	Region, country, or economy	2008	2018	Average annual growth rate, 2008–18 (%)
1	China	249,049	528,263	7.81
2	United States	393,979	422,808	0.71
3	**India**	**48,998**	**135,788**	**10.73**
4	Germany	91,904	104,396	1.28
5	Japan	108,241	98,793	-0.91
6	United Kingdom	91,358	97,681	0.67
7	Russia	31,798	81,579	9.88
8	Italy	56,157	71,240	2.41
9	South Korea	44,094	66,376	4.17
10	France	66,460	66,352	-0.02
11	Brazil	35,490	60,148	5.42
12	Canada	53,296	59,968	1.19
13	Spain	44,191	54,537	2.13
14	Australia	37,174	53,610	3.73
15	Iran	17,034	48,306	10.99
16	European Union	528,938	622,125	1.64
	World	**1,755,850**	**2,555,959**	**3.83**

Source **:** National Science Foundation (NSF); Science-Metrix; Elsevier, Scopus abstract and citation database, accessed June 2019. Science and Engineering Indicators 2020

Note **:** 1 The countries or economies are ranked based on the 2018 total.
2 Article counts refer to publications from peer-reviewed journals and conference proceedings in S&E and indexed in Scopus.
3 Articles are classified by their year of publication and are assigned to a region, country, or economy on the basis of the institutional address(es) of the author(s) listed in the article. Articles are credited on a fractional-count basis

Table 34

SCIENTIFIC RESEARCH PUBLICATION TREND (SCOPUS DATABASE), 2011-2016

(Number)

S. No.	Country	2011	2012	2013	2014	2015	2016	% of World Share 2016	Rank 2016	2011-2016 CAGR
1	USA	525,626	538,357	548,182	557,395	552,803	546,548	21.8	1	0.8%
2	China	382,648	399,833	440,356	475,780	443,892	469,441	18.7	2	4.2%
3	UK	143,318	149,165	155,373	158,951	160,891	162,005	6.5	3	2.5%
4	Germany	140,260	147,978	150,139	154,975	153,289	154,809	6.2	4	2.0%
5	**India**	**90,864**	**99,974**	**106,957**	**121,516**	**128,021**	**136,238**	**5.4**	**5**	**8.4%**
6	Japan	123,653	123,689	124,893	121,401	115,060	115,541	4.6	6	-1.3%
7	France	100,330	104,144	107,387	108,758	106,737	106,557	4.2	7	1.2%
8	Italy	79,978	85,938	91,502	95,315	96,785	97,665	3.9	8	4.1%
9	Canada	81,766	85,724	87,691	90,134	89,640	89,806	3.6	9	1.9%
10	Australia	64,522	68,560	75,037	79,699	80,699	81,862	3.3	10	4.9%
11	Spain	71,428	75,959	78,030	81,044	79,309	80,253	3.2	11	2.4%
12	Korea	64,163	68,324	71,787	75,408	77,443	77,215	3.1	12	3.8%
13	Russia	42,075	42,662	47,137	55,949	64,769	75,595	3.0	13	12.4%
14	Brazil	51,609	56,863	59,748	63,396	64,220	67,012	2.7	14	5.4%
15	Netherlands	45,404	48,960	50,033	51,250	50,973	51,619	2.1	15	2.6%
16	Iran	38,472	39,677	40,563	43,009	42,820	49,500	2.0	16	5.2%
17	Polland	31,310	34,213	36,816	39,293	40,313	41,806	1.7	17	6.0%
18	Turkey	32,686	33,838	36,548	37,175	39,314	41,405	1.6	18	4.8%
19	Switzerland	33,828	36,387	37,931	39,427	39,792	39,938	1.6	19	3.4%
20	Taiwan	41,657	41,518	41,998	40,110	36,183	34,770	1.4	20	-3.5%
	World	**2,287,619**	**2,366,688**	**2,458,422**	**2,549,937**	**2,491,007**	**2,511,702**	**100.0**		**1.9%**

Source : NSTMIS, DST Commissioned Study, Elsevier (SCOPUS), 2019
Note : India retains the 5th position globally in research publications during 2017 and 2018 as per Advanced Trends, Elsevier (SCOPUS), 2019

Table 35

TOP 10 COUNTRIES, SCIENTIFIC RESEARCH PUBLICATION ADVANCED TREND (SCOPUS DATABASE), 2017-2018

S. No.	Country	Number of Publications 2017	Rank 2017	Number of Publications 2018	Rank 2018
1	USA	681,318	1	685,639	1
2	China	536,970	2	605,797	2
3	UK	209,849	3	212,696	3
4	Germany	179,230	4	179,914	4
5	**India**	**154,306**	**5**	**171,879**	**5**
6	Japan	131,385	6	132,135	6
7	France	123,044	7	121,265	7
8	Italy	118,173	8	120,507	8
9	Canada	108,304	9	111,640	9
10	Australia	101,758	10	106,044	10

Source : NSTMIS, DST Commissioned Study, Elsevier (SCOPUS), 2019

Table 36

INDIA'S PUBLICATION OUTPUT AND SHARE IN WORLD BY FIELD OF SCIENCE (SCOPUS DATABASE), 2011-16

(Number)

Field of Science	2011-2016	World	% Share in World Output
Agricultural & Biological Sciences	59,127	1,182,998	5.0
Biochemistry, Genetics & Molecular Biology	86,456	1,773,237	4.9
Chemical Engineering	45,976	671,451	6.8
Chemistry	91,605	1,289,921	7.1
Computer Science	115,263	1,862,957	6.2
Earth & Planetary Sciences	25,808	676,953	3.8
Energy	27,835	513,134	5.4
Engineering	155,556	3,132,574	5.0
Environmental Science	40,458	763,564	5.3
Immunology & Microbiology	17,746	408,455	4.3
Materials Science	84,969	1,519,868	5.6
Mathematics	45,377	1,025,437	4.4
Medicine	117,056	3,765,625	3.1
Pharmacology, Toxicology & Pharmaceutics	64,254	486,266	13.2
Physics & Astronomy	94,683	1,817,569	5.2
Veterinary	8,809	119,836	7.4
All fields	**683,570**	**14,665,375**	**4.7**

Source: NSTMIS, DST Commissioned Study, 2019, Elsevier, SCOPUS Database

Table 37

SCIENTIFIC PUBLICATION OUTPUT TREND BY SELECT COUNTRIES (SCI DATABASE), 2011-16

(Number)

S. No.	Country	2011	2012	2013	2014	2015	2016	% Share of World 2016	CAGR 2011-16
1	USA	367,493	380,423	394,642	401,761	407,638	411,363	26.2	2.3
2	China	162,968	188,460	222,401	256,655	287,702	312,983	20.0	13.9
3	United Kingdom	101,502	106,209	112,833	113,058	118,878	122,764	7.8	3.9
4	Germany	96,501	100,733	104,714	105,658	108,863	110,928	7.1	2.8
5	Japan	77,777	78,548	80,171	78,648	77,943	79,010	5.0	0.3
6	France	67,878	70,195	73,171	73,166	75,272	76,197	4.9	2.3
7	Canada	59,477	62,406	65,372	66,713	68,503	69,374	4.4	3.1
8	Italy	55,823	59,312	64,075	65,541	67,672	69,332	4.4	4.4
9	Australia	45,645	49,691	55,139	58,764	62,713	64,904	4.1	7.3
10	**India**	**47,081**	**49,607**	**54,529**	**59,311**	**61,825**	**64,267**	**4.1**	**6.4**
11	Spain	50,886	54,493	57,056	57,982	58,856	59,425	3.8	3.2
12	South Korea	45,723	49,898	52,340	55,210	58,260	58,930	3.8	5.2
13	Brazil	36,019	38,523	40,127	41,622	43,517	45,781	2.9	4.9
14	Netherlands	34,068	36,734	38,643	39,238	40,274	41,343	2.6	3.9
15	Russia	29,193	28,562	29,906	31,030	35,309	35,505	2.3	4.0
16	Switzerland	24,805	26,588	28,179	29,138	30,256	31,559	2.0	4.9
17	Turkey	24,047	25,695	26,888	27,518	29,056	30,710	2.0	5.0
18	Sweden	21,691	23,507	25,177	26,210	27,298	28,479	1.8	5.6
19	Taiwan	27,335	27,756	28,274	27,764	26,650	25,979	1.7	-1.0
20	Saudi Arabia	5,885	7,701	9,546	11,910	13,704	14,699	0.9	20.1
21	Mexico	10,572	11,414	12,200	12,789	13,749	14,457	0.9	6.5
22	South Africa	9,521	10,287	11,030	12,184	13,057	13,932	0.9	7.9
23	Argentina	8,176	8,555	8,831	8,868	9,265	9,170	0.6	2.3
24	Indonesia	1,218	1,422	1,651	1,776	1,966	2,258	0.1	13.1
	World	**1,308,375**	**1,376,849**	**1,453,771**	**1,498,240**	**1,546,276**	**1,568,706**	**100.0**	**3.7**

Source : NSTMIS, DST Commissioned Study 2019, Clarivate, Web of Science-SCI database

Table 38

TOP 10 COUNTRIES, SCIENTIFIC PUBLICATION OUTPUT ADVANCED TREND (SCI DATABASE), 2017-2018

S. No.	Country	Number of Publications 2017	Rank 2017	Number of Publications 2018	Rank 2018
1	USA	457,149	1	432,788	1
2	China	342,901	2	384,888	2
3	United Kingdom	143,662	3	135,331	3
4	Germany	121,625	4	117,208	4
5	Japan	84,523	5	82,199	5
6	France	82,103	6	77,618	6
7	Canada	77,543	7	75,173	7
8	Italy	76,084	8	74,779	8
9	Australia	73,909	9	72,483	9
10	**India**	**73,529**	**10**	**73,813**	**10**

Source **:** NSTMIS, DST Commissioned Study 2019, Clarivate, Web of Science-SCI database

Table 39

INDIA'S PUBLICATION OUTPUT AND SHARE IN WORLD BY FIELD OF SCIENCE (SCI DATABASE), 2011-16

(Number)

Field of Science	India	World	% Share in World Output 2011-16
Agricultural Sciences	15,941	241,321	6.6
Biology & Biochemistry	21,130	428,325	4.9
Chemistry	71,493	997,167	7.2
Clinical Medicine	32,251	1,589,211	2.0
Computer Science	7,929	213,756	3.7
Economics & Business	1,529	153,282	1.0
Engineering	34,092	719,308	4.7
Environment/Ecology	10,041	276,180	3.6
Geosciences	10,080	260,977	3.9
Immunology	4,251	149,583	2.8
Materials Science	29,677	475,887	6.2
Mathematics	7,061	247,761	2.8
Microbiology	5,692	122,461	4.6
Molecular Biology & Genetics	6,747	274,568	2.5
Multidisciplinary	675	11,997	5.6
Neuroscience & Behavior	4,327	300,772	1.4
Pharmacology & Toxicology	14,533	228,905	6.3
Physics	32,942	638,020	5.2
Plant & Animal Science	14,626	422,353	3.5
Psychiatry/Psychology	1,431	237,399	0.6
Social Sciences, General	5,304	521,050	1.0
Space Science	3,969	85,559	4.6
ALL FIELDS	**336,620**	**8,752,217**	**3.8**

Source **:** NSTMIS, DST Commissioned Study 2019, Clarivate, Web of Science-SCI database

Table 40

PATENTS APPLICATIONS FROM PERSONS IN INDIA AND ABROAD, 2000-01 TO 2017-18

(Number)

	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
India	2179	4521	5314	6040	6161	7044	8312	8921	9911	10941	12071	13066	13219	15550
Foreigners Resident abroad	6324	19984	23626	29178	30651	27243	31088	34276	33763	32010	30692	33838	32225	32304
Total	**8503**	**24505**	**28940**	**35218**	**36812**	**34287**	**39400**	**43197**	**43674**	**42951**	**42763**	**46904**	**45444**	**47854**

Source : Annual Reports of the Controller General of Patents, Designs and Trade Marks.
Note : Foreigners Resident Abroad includes Ordinary, Convention & National Phase Applications under PCT since 2000-01 onwards.

Table 41

PATENTS APPLICATIONS FILED IN INDIA BY FOREIGN COUNTRIES, 2000-01 TO 2017-18

(Number)

S. No.	Country	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1.	U.S.A.	2271	8048	8389	10653	10978	9154	10405	10600	10295	10113	9702	11815	10883	18179
2.	Germany	829	1736	2329	2908	3323	3111	3653	4174	4096	3553	3089	2965	2818	2773
3.	U.K.	359	796	933	1091	1178	972	965	1187	1075	1085	1059	1165	1008	1138
4.	France	309	1022	1226	1522	1671	1394	1609	1670	1666	1535	1469	1263	1214	1184
5.	Japan	787	1555	1887	2453	2962	3040	4117	5349	6284	5566	5425	4835	4275	4487
6.	Switzerland	338	927	1330	1647	1685	1579	1651	1671	1683	1756	1549	1385	1467	1268
7.	Italy	86	377	576	686	656	560	608	712	651	622	583	612	551	577
8.	Russia	23	34	45	37	63	45	55	71	85	73	90	93	67	93
9.	Netherlands	202	837	1108	1332	1544	1316	1336	1670	1203	1384	1323	1498	1359	1387
10.	Others	1120	4652	5803	6849	6591	6072	6689	7172	6725	6323	6403	8207	8583	1218
	Total #	**6324**	**19984**	**23626**	**29178**	**30651**	**27243**	**31088**	**34276**	**33763**	**32010**	**30692**	**33838**	**32225**	**32304**

Source : Annual Reports of the Controller General of Patents, Designs and Trade Marks.
Note : # Includes Ordinary, Convention & National Phase Applications under PCT.

Table 42

PATENTS APPLICATIONS FILED BY DIFFERENT STATES IN INDIA, 2012-13 TO 2017-18

(Number)

S. No.	State/Union Territory	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Andhra Pradesh	879	892	563	275	271	276
2	Delhi	930	1023	1131	1154	1066	1432
3	Gujarat	658	548	585	529	633	712
4	Haryana	289	288	343	395	444	449
5	Karnataka	1208	1670	2134	2020	1815	2022
6	Maharashtra	2690	2955	3267	3699	3595	3820
7	Tamil Nadu	1223	1452	1423	1756	2018	2742
8	Bihar	47	35	35	28	27	63
9	Telangana	#	#	462	795	805	823
10	Kerala	259	316	263	280	276	312
11	Punjab	109	89	97	192	207	247
12	Madhya Pradesh	112	96	101	159	141	191
13	Rajasthan	78	106	149	150	181	189
14	Uttar Pradesh	482	478	665	655	637	721
15	West Bengal	442	564	406	454	480	538
	Grand Total	**9911**	**10931**	**12071**	**13066**	**13219**	**15550**

Source : Annual Reports of the Controller General of Patents, Designs and Trade Marks.
Note : #- State of Telangana was formed in the year 2014 and data prior to 2014 are covered under Andhra Pradesh.

Table 43

PATENTS FILED AND SEALED IN INDIA, 1976-77 TO 2017-18

(Number)

Year	No.of applications made	No. of applications brought forward from preceding year	Total No.of applications to be examined	No. of applications examined	No. of applications deemed to have been abandoned due to non-filling of complete specification	Total No. of complete specifications notified as accepted during the year	No. of applications deemed to have been abandoned due to non-acceptance of complete specification	No. of patents sealed		No. of patents in force	
								Indian	Foreign	Indian	Foreign
1	2	3	4	5	6	7	8	9	10	11	12
1976-77	3104	3876	6980	3612	295	2840	533	928	1964	2746	19780
1977-78	2870	3067	5937	2369	378	2507	577	657	1857	3065	19795
1978-79	2932	3190	6122	1266	283	2070	498	281	499	2469	13966
1979-80	2980	4573	7533	1498	304	1210	429	516	1657	2786	14474
1980-81	2954	5751	8705	2301	325	1007	372	349	670	2757	14448
1981-82	2989	6079	9068	2984	274	1191	422	421	936	3038	14892
1982-83	3085	5810	8895	3165	310	1580	734	405	822	3329	15291
1983-84	3145	5420	8565	3043	295	1447	774	340	980	3523	15726
1984-85	3319	5227	8546	2270	224	3267	710	263	1206	3008	13162
1985-86	3526	6052	9578	2490	214	1495	824	451	1500	2549	10844
1986-87	3489	6874	10363	4846	267	1706	729	532	1594	2004	10059
1987-88	3457	5250	8707	3582	158	2966	912	588	1516	2150	10115
1988-89	3598	4967	8565	3650	166	2386	1049	795	2585	2584	11015
1989-90	3661	4746	8407	3333	225	1760	984	519	1371	2468	10941
1990-91	3764	4849	8613	2185	183	2170	878	379	1112	2238	8210
1991-92	3552	6255	9807	2431	213	2060	789	551	1125	1206	9093
1992-93	3467	7163	10630	2347	289	1600	567	251	1021	1034	8997

Table 43 Contd...

Table 43 (Contd.)
PATENTS FILED AND SEALED IN INDIA, 1976-77 TO 2017-18

(Number)

Year	No.of applications made	No. of applications brought forward from preceding year	Total No.of applications to be examined	No. of applications examined	No. of applications deemed to have been abandoned due to non-filling of complete specification	Total No. of complete specifications notified as accepted during the year	No. of applications deemed to have been abandoned due to non-acceptance of complete specification	No. of patents sealed		No. of patents in force	
								Indian	Foreign	Indian	Foreign
1	2	3	4	5	6	7	8	9	10	11	12
1993-94	3869	7994	11863	2590	224	1250	686	442	1304	1995	7281
1994-95	5330	9049	14379	2745	130	1590	765	476	1283	1923	7052
1995-96	7036	11504	18540	2862	204	1400	972	415	1118	2098	6694
1996-97	8562	15474	24036	3042	375	2049	675	293	614	2003	7202
1997-98	10155	20619	30774	2688	59	2580	803	619	1225	2047	6882
1998-99	8954	28027	36981	2931	820	1600	804	645	1155	2088	6691
1999-00	4824	33230	38054	2824	362	1310	195	557	1324	2200	6458
2000-01	8503	34968	43471	4264	89	1950	460	399	919	1495	6530
2001-02	10592	39118	49710	5104	325	1669	1031	654	937	1578	6742
2002-03	11466	44281	55747	9538	290	2780	1633	494	885	1479	6519
2003-04	12613	NIL	12362	10709	933	2805	1695	945	1524	2075	4331
2004-05	17466	NA	19001	14813	267	3307	775	764	1147	2200	4657
2005-06	24505	NA	21926	11569	414	NA	894	1396	2924	4486	11933
2006-07	28940	NA	20645	14119	694	NA	1121	1907	5632	3473	13593
2007-08	35218	NA	22146	11751	1066	NA	479	3173	12088	7966	21722
2008-09	36812	NA	30595	10296	888	NA	1075	2541	13520	6158	24664
2009-10	34287	NA	28653	6069	2720	NA	5171	1725	4443	6781	30553
2010-11	39400	NA	31493	11208	185	NA	5186	1273	6236	7301	32293

Table 43 Contd...

Table 43 (Contd.)
PATENTS FILED AND SEALED IN INDIA, 1976-77 TO 2017-18

(Number)

Year	No.of applications made	No. of applications brought forward from preceding year	Total No.of applications to be examined	No. of applications examined	No. of applications deemed to have been abandoned due to non-filling of complete specification	Total No. of complete specifications notified as accepted during the year	No. of applications deemed to have been abandoned due to non-acceptance of complete specification	No. of patents sealed		No. of patents in force	
								Indian	Foreign	Indian	Foreign
1	2	3	4	5	6	7	8	9	10	11	12
2011-12	43197	NA	33811	NA	698	NA	3800	699	3682	7545	32444
2012-13	43674	NA	36247	NA	361	NA	4559	716	3410	8303	35612
2013-14	42951	NA	37474	NA	224	NA	6418	634	3592	7464	35168
2014-15	42763	NA	34958	NA	12	NA	6970	684	5294	7561	35695
2015-16	46904	NA	35960	NA	1226	NA	12782	918	5408	7306	37218
2016-17	45444	NA	38578	NA	4357	NA	10408	1315	8532	7660	41105
2017-18	47854	NA	37208	NA	184	NA	24992	1937	11108	8830	47934

Source **:** Annual Reports of the Controller General of Patents, Design and Trade Marks

Table 44

TOP INDIAN APPLICANTS FOR PATENTS FROM SCIENTIFIC RESEARCH AND DEVELOPMENT ORGANISATIONS, 2013-14 TO 2017-18

(Number)

Name of Scientific and Research & Development Organizations	2013-14	2014-15	2015-16	2016-17	2017-18
Council of Scientific & Industrial Research	267	315	323	230	176
Defence Research & Development Organisation	116	98	85	58	126
Indian Council of Agricultural Research	71	68	63	41	37
Indian Space Research Organisation	#	#	25	13	14
GSP Crop Science Pvt Ltd.	#	23	#	#	9
Samsung R&D Institute India- Bangalore Private Ltd.	#	#	271	#	#
Hetero Research Foundation	17	22	40	23	#
G. H. R. Labs and Research Centre/G.H. Raisoni College of Engineering	26	31	33	50	#
Allinov Research & Development Private Limited	#	#	#	20	#
MSN Research & Development Centre	#	#	#	19	#
L&T Technology Services Limited	#	#	#	18	#
Sandip Institute of Technology and Research Centre	#	#	21	#	#
Centre for Development of Advanced Computing (C-DAC)	17	#	20	#	#
Sun Pharma Advanced Research Company Limited	#	#	19	14	#
Department of Biotechnology	34	23	#	#	#
Department of Electronics and Information Technology (DEITY)	#	18	#	#	#
Jubliant Life Sciences Limited	29	13	#	#	#
Rotary Wing Research and Design Centre, HAL	#	22	#	#	#
Indian Council of Medical Research	14	#	#	#	#

Source : Annual Reports of the Controller General of Patents, Design and Trade Marks (various issues)
Note : 1. # During the period under reference these organisatons did not fall among top patentees
2. The figures are arranged in the descending order by the reference year 2017-18

Table 45

TOP INDIAN APPLICANTS FOR PATENTS FROM INSTITUTES AND UNIVERSITIES, 2013-14 TO 2017-18

(Number)

Name of Institutes/Universities	2013-14	2014-15	2015-16	2016-17	2017-18
Indian Institute of Technology (Collective)	342	337	391	400	540
Amity University	92	43	99	106	119
SRM University	#	#	#	#	81
Bharath University	37	#	65	45	66
Shoolini University of Biotechnology and Management Sciences	#	#	22	#	62
Chandigarh Group of Colleges	#	#	#	45	58
Indian Institute of Science	32	46	46	54	58
G.H. Raisoni College of Engineering /G.H. R.Labs and Research Centre	24	#	33	49	56
C.H.R Labs and Research Centre	#	#	#	#	56
Sandip Institute of Engineering and Management	#	#	#	#	46
KCG College of Technology	#	#	#	#	40
Veltech High/Multitech Dr. RR & Dr. SR (College and University)	#	#	#	50	#
Chitkara university	#	#	46	29	#
Saveetha School Of Engineering, Saveetha University	74	#	33	#	#
Janardan Rai Nagar Rajasthan Vidyapeeth (Deemed) University	#	53	22	#	#
Veltech Dr. RR & Dr. Sr Technical University	#	#	20	#	#
Siddaganga Institute of Technology an Institution of Sree Siddaganga Education Society	24	19	17	#	#
National Institute of Pharmaceutical Education and Research (NIPER)	#	#	15	#	#
Dr.M.G.R Educational and Research Institute	#	#	15	#	#
King George's Medical University	#	#	14	#	#
Sandeep Foundation	#	33	#	#	#
Hindustan Institute of Technology and Science	#	31	#	28	#
National Institute of Science (Collective)	#	#	#	26	#
Sal institute of Technology and Research	#	22	#	#	#
Karpagam University	#	18	#	#	#
Shree Chitra	20	#	#	#	#
University of Calcutta	15	#	#	#	#
Sastra University	13	#	#	#	#
Rajaram Bapu Institute of Technology	13	#	#	#	#

Source : Annual Reports of the Controller General of Patents, Design and Trade Marks (various issues)
Note : 1. # During the period under reference these organisatons did not fall among top patentees
2. The figures are arranged in the descending order by the reference year 2017-18

Table 46

TOP FOREIGN RESIDENT APPLICANTS IN INDIA, 2013-14 TO 2017-18

(Number)

Name of Organisation	2013-14	2014-15	2015-16	2016-17	2017-18
Qualcomm Incorporated	1062	1214	1884	1840	960
Koninklijke Philips N.V.	839	805	949	557	520
Philps Lighting Holding B.V.	#	#	#	307	217
Google LLC	#	#	#	#	184
Mitsubishi Electric Corporation	#	#	#	218	176
General Electric Company	260	276	446	520	142
Diamler AG	#	#	#	#	134
Telefonaktiebolaget L M Ericsson (Publ)	386	449	407	470	128
Huawei Technologies Co.Ltd.	#	#	648	625	120
Honda Motor Co. Ltd.	#	280	268	#	110
Samsung Electronics Co. Ltd.	371	379	905	706	#
Microsoft Technology Licensing LLC	#	#	362	589	#
Toyota Jidosha Kabushikikaisha	#	#	304	#	#
BASF SE	304	297	302	216	#
Siemens AKTI	249	277	#	#	#
JFE Steel Corpn	#	230	#	#	#
Sony Corpn	263	218	#	#	#
Robert Bosch Gmbh	375	#	#	#	#
Alcatel Lucent	222	#	#	#	#

Source : Annual Reports of the Controller General of Patents, Design and Trade Marks (various issues)
Note : 1. # During the period under reference these organisatons did not fall among top patentees
2. The figures are arranged in the descending order by the reference year 2017-18

Table 47

YEAR-WISE PROGRESS OF EXPENDITURE OF SELECT CENTRAL SCIENTIFIC DEPARTMENTS

(Rs. Crore)

S. No	Agency	2009-10	2010--11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-2018#	2018-19	2019-20*	2020-21#
1	DST	2038.30	2279.93	2511.66	2514.91	2600.84	2889.84	3644.29	4217.08	4595.73	4912.54	5480.93	6301.53
2	DSIR/CSIR	2697.31	2982.68	3214.70	2945.66	3159.54	3393.53	4020.98	4030.48	4618.83	4548.78	4883.24	5385.00
3	DBT	906.66	1144.86	1208.44	1282.84	1291.32	1346.97	1554.27	1895.50	2331.42	2379.10	2381.10	2786.76
4	DOS	4162.95	4482.23	3784.27	4856.28	5168.96	5798.81	6920.01	7988.87	9127.16	11188.37	13139.26	13479.47
5	DAE (R&D Sector)	1619.27	1817.09	2193.87	2639.98	2842.30	2683.08	4891.13	5073.79	5786.35	5715.54	6502.80	6973.78
6	MoES	1079.83	1094.53	1170.27	1172.40	1243.30	1293.87	1292.45	1361.28	1541.47	1726.10	1809.70	2070.00
	Total	**12504.32**	**13801.32**	**14083.21**	**15412.07**	**16306.26**	**17406.10**	**22323.13**	**24567.00**	**28000.96**	**30470.43**	**34197.03**	**36996.54**

Source : Demands for Grants of Central Government, Expenditure Budget, GoI (various years)

Note :
1. Expenditure includes plan + non- plan figures
2. *Revised Estimates(RE) ; # Budget Estimate(BE)
3. DST- Deptt. of Science & Technology.
4. DSIR/CSIR- Deptt. of Scientific & Industrial Research/ Council of Scientific and Industrial Research.
5. DBT- Deptt.of Biotechnology
6. DOS- Deptt. of Space.
7. DAE- Deptt. of Atomic Energy
8. MoES- Ministry of Earth Sciences formerly Deptt. of Ocean Development

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