

# CHAPTER I

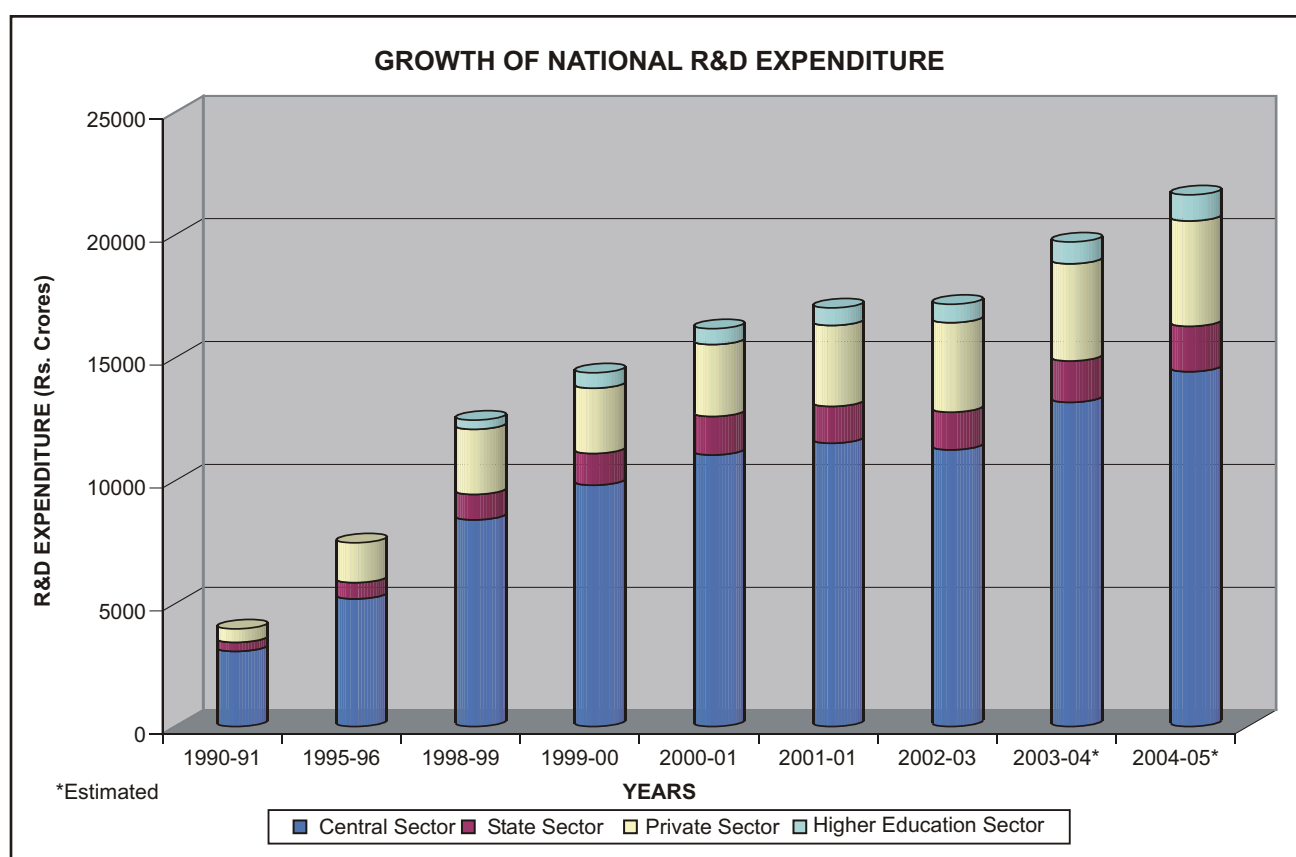
## NATIONAL RESOURCES FOR RESEARCH AND DEVELOPMENT

The national expenditure on Research and Development (R&D) has increased from Rs. 12473.17 crores in 1998-99 to Rs. 16198.78 crores in 2000-01 and to Rs. 18000.16 crores in 2002-03. By applying the appropriate rates of growth for different sectors as observed from 1998-99 to 2002-03, the projected R&D expenditure would attain a level of Rs. 19726.99 crores in 2003-04 and Rs. 21639.58 crores in 2004-05. The compound annual rate of growth of R&D expenditure at current prices for the period 1998-99 to 2002-03 works out to be 9.6% and the rate of growth of R&D expenditure at constant prices for the same period was 5.7%. R&D expenditure at constant prices (base: 1993-94) has increased from Rs. 8436.26 crores in 1998-99 to Rs. 10196.28 crores in 2000-01 and further to Rs. 10522.57 crores in 2002-03. R&D expenditure at constant prices has been worked out by using GNP price deflators as per Economic Survey 2004-05.

The share of the various sectors in the total R&D expenditure for the year 2002-03 was central

government including the public sector industry 67.1%, private sector 20.3%, the state governments 8.5% and the higher education 4.1%. If one considers industrial sector as a whole comprising both public and private sector, the share of industrial sector in the total national R&D expenditure decreased from 26.6% in 1998-99 to 24.8% in 2002-03. The decrease in the share of R&D expenditure of industrial sector in the total R&D expenditure is mainly due to the decrease in the share of public sector R&D expenditure. The share of private sector has remained constant during the period 1998-99 to 2002-03

Analyses have shown that 75.2% of the R&D expenditure was incurred by the institutional sector comprising of central, state and academic sector and 24.8% was incurred by the industrial sector (public and private) industries during the year 2002-03. 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%.



R&D expenditure as percentage of GNP in 2002-03 is 0.80% as compared to 0.76% in 1992-93. Though in absolute terms the R&D expenditure has shown an increasing trend, the R&D expenditure as percentage of GNP has hovered around 0.8% since 1990-2000. The annual compound rate of growth of R&D expenditure at current prices for the period 1992-93 to 2002-03 was 13.7% whereas the growth rate of GNP at current prices was 13.0% for the same period.

It may not be out of place to mention that in the national survey 2002-03, the scope and coverage of the R&D activities has been revised and substantially enlarged by including R&D expenditure incurred in (i) higher education sector, (ii) small scale industries sector (pilot study), (iii) private sector firms not recognised by DSIR. This has resulted in an increase in the estimation of R&D expenditure to the tune of Rs. 1541.47 crores in 2002-03, with a share of 8.6% in the national R&D expenditure.

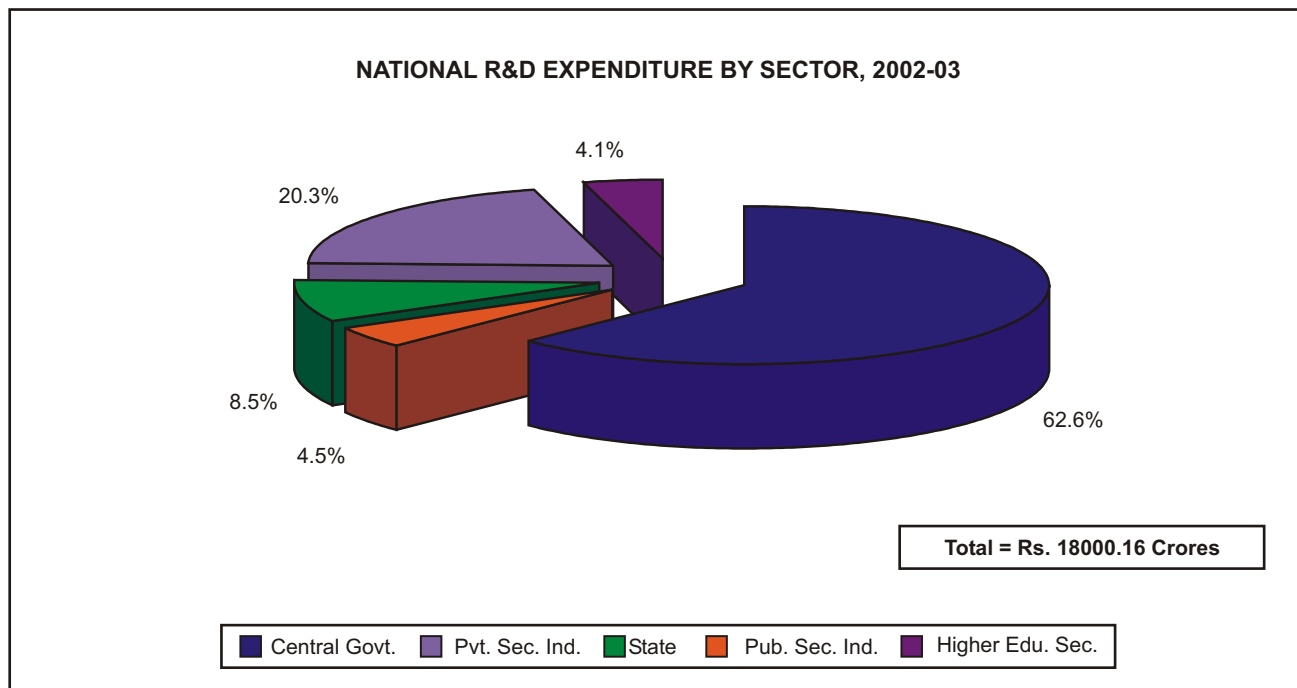
As per Economic Survey 2004-05, GNP data has been revised and updated for all the past years upto 2002-03 by the Central Statistical Organisation.

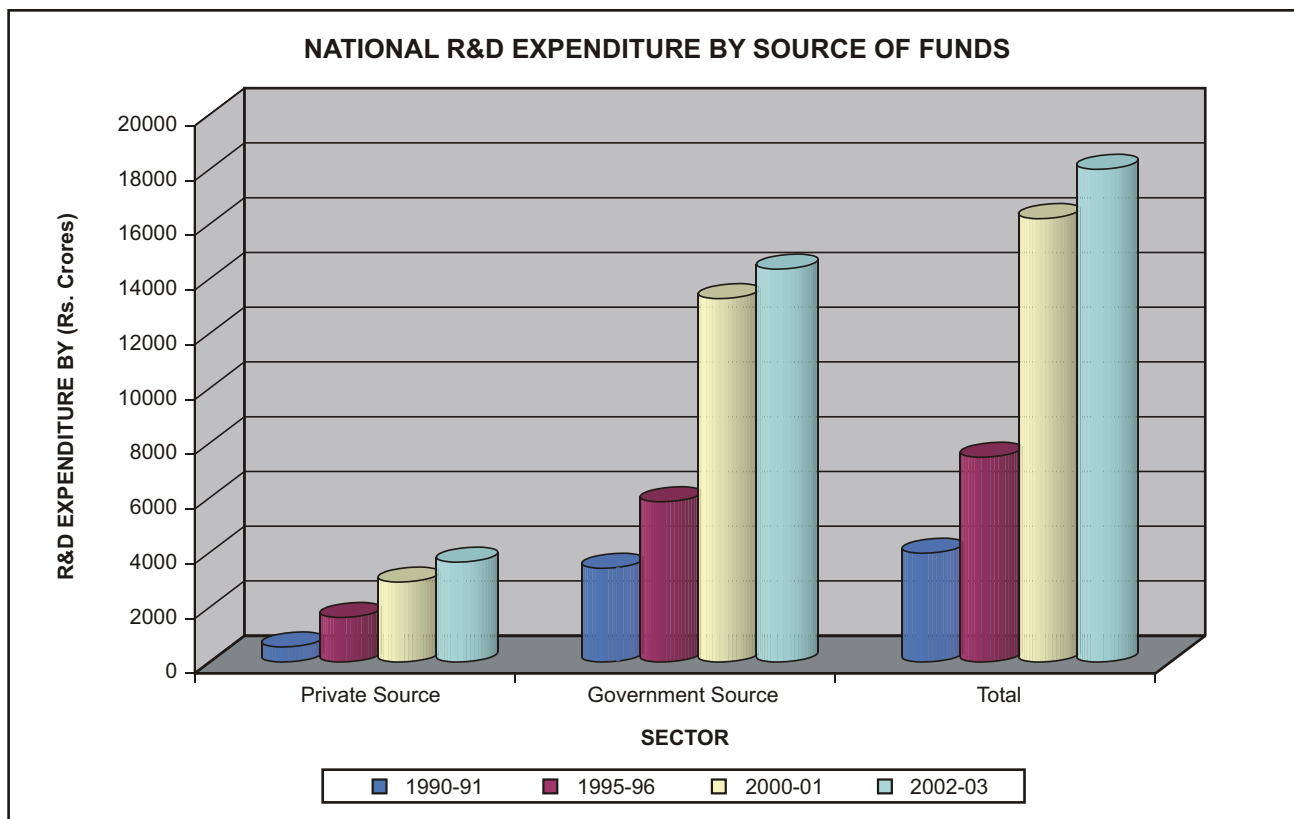
R&D expenditure has been classified into 13 objectives based on UNESCO classification. Ideally, the R&D expenditure should be apportioned amongst the 13 objectives based on project wise expenditure. Such an exercise being not feasible, each R&D institution has been assigned to a specific objective depending upon its predominant activity. On this basis,

the share of R&D expenditure by different objectives is given in Table 1.1.

**Table 1.1**  
**PERCENTAGE SHARE OF NATIONAL RESEARCH AND DEVELOPMENT EXPENDITURE BY OBJECTIVES, 2002-03**

Objective	Percentage
Defence	18.3
Development of Agriculture, Forestry and Fishing	17.7
Space	12.1
Promotion of Industrial Development	12.1
General Advancement of Knowledge	11.6
Development of Health Services	8.6
Production, Conservation and Distribution of Energy	6.0
Development of Transport and Communication	5.3
Protection of Environment	3.1
Others	5.2
<b>Total</b>	<b>100.0</b>





More than 60% of total R&D expenditure was accounted for by the objectives Defence, Development of Agriculture, Forestry and Fishing, Space and Promotion of Industrial Development.

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 excluding higher education. Such a classification of expenditure by type of work is not available for the industrial sector. During the year 2002-03, the percentage share of Basic Research was 17.8, Applied Research 41.7, Experimental Development 34.0 and the related supporting activities was 6.5. Table 1.2 gives the break up of S&T expenditure by type of work for the year 2002-03.

Central government including public sector has accounted for 67.1% of the total national R&D expenditure during 2002-03. Major scientific agencies have, in fact, accounted for a share of 84.1% 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 56.0% of the national R&D expenditure. The share of R&D expenditure in decreasing order among the major scientific agencies is presented in Table 1.3.

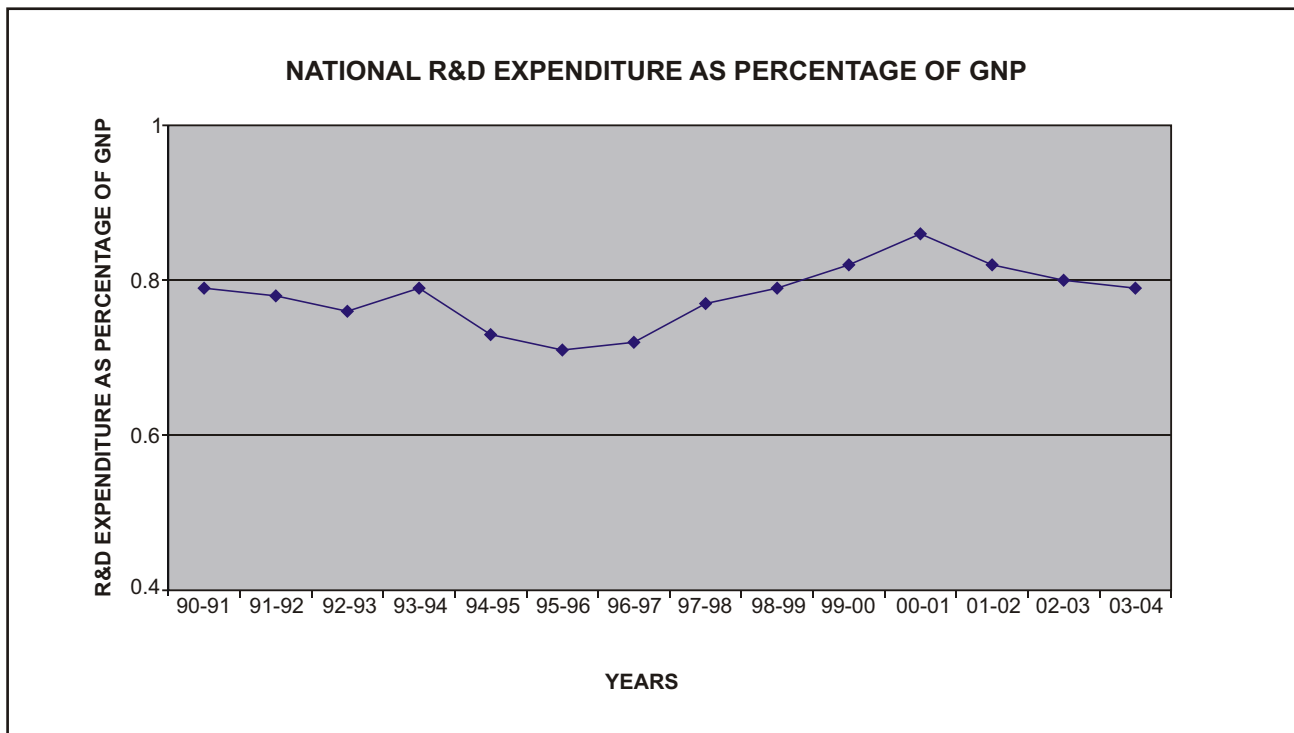
**Table 1.2**

**PERCENTAGE SHARE OF NATIONAL S&T EXPENDITURE BY TYPE OF WORK, 2002-03**

Type	Percentage
Applied Research	41.7
Experimental Development	34.0
Basic Research	17.8
Other Activities	6.5

Five major scientific agencies DRDO, DOS, ICAR, DAE, and CSIR account for 86.7% of the total R&D expenditure under the central government major scientific agencies with DRDO alone accounting for a share of 30.3%.

Industrial R&D expenditure has increased from Rs. 3314.92 crores in 1998-99 to Rs. 3766.21 crores in 2000-01 and further to Rs. 4457.19 in 2002-03. The respective share of public and private sectors was 18.1% and 81.9% in 2002-03. The number of R&D units in each of these sectors varies in terms of size of the firm. The public sector R&D units are larger in the size when compared to private sector.



**Table 1.3**

**PERCENTAGE SHARE OF R&D  
EXPENDITURE BY MAJOR SCIENTIFIC  
AGENCIES, 2002-03**

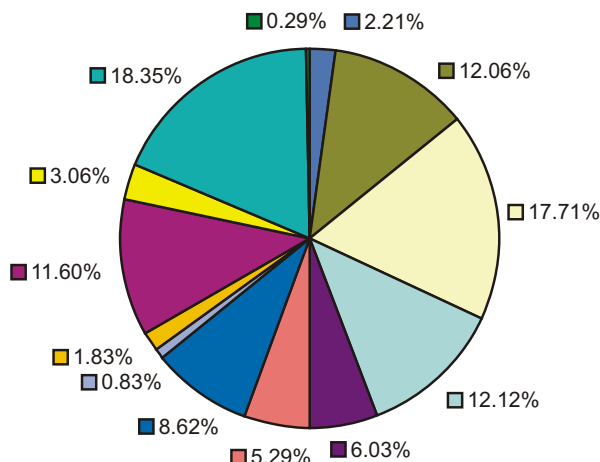
Scientific Agency	Percentage
Defence Research and Development Organisation (DRDO)	30.3
Department of Space (DOS)	21.3
Indian Council of Agricultural Research (ICAR)	13.5
Department of Atomic Energy (DAE)	12.2
Council of Scientific and Industrial Research (CSIR)	9.4
Department of Science and Technology (DST)	5.0
Ministry of Environment (MOEn)	2.6
Department of Biotechnology (DBT)	1.6
Indian Council of Medical Research (ICMR)	1.6
Department of Ocean Development (DOD)	1.4
Ministry of Information Technology (MIT)	1.0
Ministry of Non-Conventional Energy Sources (MNES)	0.1
<b>Total</b>	<b>100.0</b>

While more detailed analyses on personnel employed in R&D establishments is provided in the chapter on “Scientific and Technical Manpower”, some highlights borne out of R&D personnel data are discussed in ensuing paragraphs.

As on 1st April, 2000, 2,96,343 personnel were employed in the R&D sector. About 82% of them were employed by the institutional sector and 18% by the industrial sector. Out of the total, 31.7% of the personnel were engaged primarily on R&D work, 30.4% were performing auxiliary (technical support) activities and 37.9% were doing administrative and other non-technical activities. 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 1,83,881 S&T personnel were deployed in R&D sector as on April 1, 2000. This works out to a meagre 2.3% of the total estimated stock of S&T personnel for the year 2001, though one considers that R&D sector should be one of the major employers of S&T personnel. There were 11,304 females directly engaged in R&D activities (female R&D personnel) which accounted for only 12.0% 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

### NATIONAL R&D EXPENDITURE BY OBJECTIVES 2002-03



[1]	EXPLORATION AND ASSESSMENT OF EARTH SEAS ATMOSPHERE
[2]	SPACE
[3]	DEVELOPMENT OF AGRICULTURE FORESTRY AND FISHING
[4]	PROMOTION OF INDUSTRIAL DEVELOPMENT
[5]	PRODUCTION AND CONSERVATION AND DISTRIBUTION OF ENERGY
[6]	DEVELOPMENT OF TRANSPORT AND COMMUNICATION
[7]	DEVELOPMENT OF HEALTH SERVICES
[8]	SOCIAL DEVELOPMENT AND OTHER SOCIO ECONOMIC SERVICES
[9]	PROTECTION OF ENVIRONMENT
[10]	GENERAL ADVANCEMENT OF KNOWLEDGE INCLUDES DEVELOPMENT OF EDUCATION SERVICES
[11]	OTHER AIMS
[12]	DEFENCE
[13]	URBAN AND RURAL PLANNING

developing countries spend around 0.5% with a few exceptions. R&D spending of 0.80% of GDP in India was, though no doubt higher than a number of developing countries, the country needs to enhance its R&D expenditure to more than 2%.

India has 110 researchers per million population whereas the same for Sweden, Japan, Denmark and U.S.A. was 5171, 5085, 4822 and 4526 respectively. However, in terms of total researchers, USA tops the list with 12.90 lakhs researchers followed by China and Japan with 8.05 lakhs and 6.46 lakhs researchers respectively.

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. Patent statistics is considered to be one such indicator. If one looks at the data for the period 1976-2003, the number of applications for patents made

every year varied between 2,870 and 12,613 and it was highest 12,613 for the year 2003-04. The number of patents granted varied between 780 to 3,380 during 1976-2003 and it was 2,469 in 2003-04. The number of patents in force as of 2003-04 was 6,406. The state-wise distribution of number of patent applications filed by Indians shows that about 70.5% were from Maharashtra, Delhi, Tamil Nadu and Andhra Pradesh during 2003-04. As is well known, many foreign nationals take patents in countries other than their own with a view to putting a curb on unauthorised commercialisation of products developed by them.

The number of patents sealed in the name of foreigners was almost two to three times those sealed in the name of Indians. So, it may be seen that the number of foreign patents in force during the year 2003-04 was 67.6%. Amongst the foreign patents applications, those from USA accounted for 3,128 out of 9,395 total foreign applications made during 2003-04. The number of foreign patents in force has declined from 19,780 in 1976-77 to 4,331 in 2003-04.

**To sum up, the salient features are as under :**

- The national R&D expenditure has increased from Rs. 12473.17 crores in 1998-99 to Rs. 16198.78 crores in 2000-01 and further to Rs. 18000.16 crores in 2002-03.
- The share of R&D expenditure of the central government including public sector industry was 67.1% during 2002-03.
- R&D expenditure by institutional sector was 75.2% of the total national R&D expenditure and the rest 24.8% was incurred by industrial sector comprising both public and private sector industry during 2002-03.
- India has spent only 0.80% of her GNP on R&D during 2002-03.
- Major scientific agencies accounted for 84.1% 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 56% of the nation R&D expenditure.
- 86.7% 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 30.3%.
- As on 1st April, 2002, there were 2,96,343 personnel employed in the R&D sector. Out of these, 96,836 personnel were employed directly on R&D work.