Report of the Working Group On Science & Technology Human Resource Development For 12th Five Year Plan (2012-17)

Ministry of Science & Technology

Government of India

September, 2011

Foreword

Human resource in Science and Technology is a major driver for India' s emergence as a knowledge super power. Strategic and sustained support with higher investment in Science and Technology education and training in schools, colleges, universities, research institutions and industry is essential to generate effective leaders and competent scientific workforce and teachers for realizing this vision. For this purpose knowledge driven countries need to build critical mass of well trained scientists, engineers, professionals, technicians, graduates and domain experts with scientific training and skills. Significant component of the workforce must be equipped with skills to learn and deploy emerging knowledge to address the challenges in the changing economic scenario and fulfilment of aspirations of the people.

A comprehensive and inclusive analysis of information, inputs and data provided to the Working Group relates to the wide range of challenges in S&T education and training, institutional restructuring, new teaching methods, tools, incentives, rewards and mobility of scientists, new career paths for science students and for domain experts engaged in science, global partnerships, role of industry, global technological development trajectories and future career opportunities. It was appreciated that to address these complex issues effectively a long term vision and a parallel strategy encompassing policy interventions, investments, implementation strategies and action plan is required based on multi-stakeholder consensus involving Central and State Governments, universities, colleges, schools and many others. Therefore, out of this matrix of interconnected issues, efforts have been made in this report to identify priority issues/challenges and recommend strategic solutions, programs, schemes and other interventions for implementation during the 12th Plan.

In publishing these recommendations through this report, we envision thought- provoking discussions and debates that will value add to the proposed plans, strategies and implementation.

Finally the overall aim is to create and develop an ecosystem where concept and scope of education, innovation and science are integrated as a single entity leading to innovation and entrepreneurship.

I thank all the Members and Secretariat for this comprehensive treatment in addressing this complex yet critical issue.

M.K.Bhan
Chairman
12th plan working group on S&T HRD
Planning Commission

ACKNOWLEDGEMENTS

The Working Group would like to extend its sincere appreciation to the Dr.K.Kasturirangan, Member (Science), Planning Commission for constituting a Working Group for Formulation of 12th Five Year Plan in S&T – Human Resource Development to recommend strategies for strengthening S&T in India.

I would like to thank and appreciate the sincere efforts of Dr.M.K.Bhan, Secretary DBT &Chairman of the Working Group for his quality inputs and innovative ideas on addressing issues in S&T- Human Resource Development.

I sincerely appreciate the efforts of all the Working Group members like Prof. L. S. Shasidhara (IISER), Prof. Gautam Biswas (CMERI), Prof. T. K. Chandrasekhar (NISER), Prof. K. S. Dasgupta (IIST), Prof. Arup Raychaudhuri (SN Bose Institute), Prof. Hemachandra Pradhan (Homi Bhaba Centre), Dr. Hari Gopal (Advisor, DST), Dr. Rajesh Luthra (Scientist G, CSIR), Dr. Rajendran (CII), Shri Pawan Aggarwal (Advisor HRD, Planning Commission), Shri. A. K. Verma (Advisor S&T, Planning Commission), Dr. Bharadwaj (Jt. Advisor S&T, Planning Commission) and all other members for their innovative suggestions and key recommendations for addressing issues pertaining to S&T sector in the country. The generous contribution of members time, efforts and expertise often under stringent schedules are gratefully acknowledged.

In addition, I acknowledge the organizational and logistical support provided by the IISER, Pune especially to the Prof. Shashidhara and

Prof. Ganesh (Director) for facilitating the second Working Group meeting in Pune. The Working Group appreciates the contributions of various teachers, scientists, faculty of various Institutions in Pune who have actively participated in the second Working Group meeting and gave various suggestions for strengthening S&T education in the country.

The Working Group would like to extend its acknowledgements to all researchers, scientists, industry representatives, academicians and all others who have contributed their ideas and suggestions through written emails and published articles for addressing issues in S&T HRD. The Working Group would also like to appreciate the sincere efforts of its research and drafting team Dr. Padma Singh, Dr. Rajneesh K. Gaur of DBT, Mr. Murali Krishna Chimata and Mr. Ritesh Navale for providing key inputs and much needed background support in analysing the issues and key recommendations by the Working Group for Formulation of the 12th Five Year Plan in S&T-Human Resource Development.

Dr. S.R. Rao (Advisor, DBT)

Convener,

Working Group of 12th Five Year Plan in S&T-HRD

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EXECUTIVE SUMMARY

The approach paper of planning commission on “Innovation and Technology” for 12th five year plan prepared through consultative process envisages bringing in paradigm shift on two major fronts. The first one relates to expanding the scope of science and technology to domains where the full potential of S&T has not been fully exploited. These areas would include amongst others education, healthcare, energy, water, food security, environment and strategic and security sectors as well as wealth creation though industrial research, innovation and commercialization. The other aspect is related to new and effective mechanisms for funding research and development, institutional framework and connectivity, and where relevant, changing the governance patterns. The belief is that to be more impactful the same things need to be done differently.

Further, among the 12 strategy challenges of Twelfth plan identified by the Planning Commission, enhancing skills and faster generation of employment, improved access to quality education along with several steps for promoting technology and innovation have been emphasized. For this purpose knowledge driven countries need to build critical mass of well trained scientists, engineers, professionals, technicians, graduates and domain experts with scientific training and skills. Significant component of the workforce must be equipped with skills to learn and deploy emerging knowledge to address the challenges in the changing economic scenario and fulfilment of aspirations of the people.

There is an immediate need for creation of ecosystem where concept and scope of education, innovation and science are integrated as a single entity; where education is linked with innovation and entrepreneurship; and where critical mass of S&T enabled, educated and effective persons are required for the country through community engagement, innovation experience and experimentation in addition to education. The planning Commission has constituted the Working Group for S&T

HRD with major mandate to recommend strategies for strengthening the Science and Technology education system in the country to develop high quality S&T human resource and address the challenges of sustainable supply of talent pipeline for careers with research and innovation.

The working group constituted under the Chairmanship of Dr. M.K.Bhan, Secretary, DBT met on two occasions in New Delhi and Pune. Based on the observations in the first meeting, for further exploration various stakeholders were invited in the second meeting to define and express their views and send their written inputs and observations. The stakeholders with valuable inputs included 37% from academic and education institutions, 29% from universities and colleges, 17% each from policy makers from Government agencies and from industry. Besides these inputs, the secretariat collected and compiled resources and data from various publications and reports of national and international agencies to obtain insights on critical issues of S&T HRD. Efforts have been made to provide fact sheets and several Annexure for mapping and comparison of S&T HRD resources in Indian and the Globe. A separate chapter is formulated on S&T HRD Stakeholders Issues and Recommendations' to cover the entire range of issues, recommendations/interventions at various levels of S&T education and training.

A comprehensive and inclusive analysis of information, inputs and data provided to the Working Group relates to the wide range of challenges in S&T education and training, institutional restructuring, new teaching methods, tools, incentives, rewards and mobility of scientists, new career paths for science students and for domain experts engaged in science, global partnerships, role of industry, global technological development trajectories and future career opportunities. It was appreciated that to realize these complex issues a long term vision and strategy encompassing policy interventions, investments, implementational strategies and action plan, multi-stakeholder consensus, is required involving Central and State Governments, universities, colleges, schools and many others . Therefore, out of this

matrix of inter connected issues, efforts have been made in this report to identify priority issues/challenges and recommend the strategic solutions, programs, schemes and other interventions for implementation during the Twelfth Plan.

In brief the priorities and recommendations are:

1. **Appropriate Institutional Mechanism To Promote S&T HRD Activities:** It has been recommended to establish an autonomous *National Agency for S&T Education and Training* for policy research; serve as data warehouse for S&T HRD statistics and resources; foster global partnerships and establish linkages with international agencies (OECD, UNESCO); R&D in development and designing of education tools, training modules, curriculum/syllabus, monitoring and evaluation methods etc; and to implement programs/projects in critical areas including unaddressed national needs of S&T education, training and skill development.

2. **Adaption Of Existing Public Private R&D Partnership Models And Development Of New PPP Models For S&T HRD Activities:** It was recommended that through inter-ministerial/departmental committee a feasibility study may be commissioned for adaption of existing PPP models (of technology development across S&T Departments) and address new models specially tailored for the needs of S&T –HRD; with clearly stated legal and administrative aspects and generic guidelines for PPP in S&T education and training requirements. Fiscal incentives including grants / soft loans and tax benefits to participating private and non profit sector entities in PPP or as a part of corporate social responsibility have also been identified.

3. **Synergizing Inter Ministerial Policies And Programs In Education With Special Reference To Science And Technology Component:** Working Group envisages creating an environment where science, education and research is discussed as a single entity yet maintaining the needed diversity. Synergy is required at three different levels: Policy, Programs and

Projects. It was therefore recommended to constitute a permanent notified "Inter-Ministerial S&T Commission of Secretaries" (IMCS- S&T) at the Apex level chaired by Member (S&T) Planning Commission to address various issues. The recommendations in the report also contain suggested terms of references and policies to be reviewed and streamlined across ministries/departments.

4. **Reforms, Redesign and Strengthening S&T Education & Training:** Recognizing the ongoing schemes in strengthening universities and colleges, the working group recommended continuation and expansion of schemes (PURSE, FIST, BUILDER, STAR Colleges) of DST and DBT with necessary modifications based on current experiences and suggested eight different schemes for 12th Five Year Plan such as: scheme to upgrade 500 science colleges; establish 50 science parks / exploratory science centres; support mobile research laboratories or "Lab on Wheels; large scale support varied Summer School Programs; central assistance for faculty expansion in State S&T universities and institutions; graduate research projects; teachers ignition grants for R&D scheme and schemes for mentoring graduates /post graduates by established scientists from national and international institutions.

5. **Expanding Scope For Careers In S&T, Research, Innovation And Support Services:** Besides, generally acknowledged shortage of qualified Ph.Ds, scientists and teachers three other major challenges in S&T-HRD were recognized: the need for specialized human resource to address convergence and multi disciplinarity of sciences; gainful employment of graduate and post graduate students including women; specialized technical and skill requirements due to increased automation and sophistication in instrumentation for research, manufacturing and industrial requirements. Various innovative schemes proposed for addressing these challenges include: "Glue Grant "research scheme; Graduate Interdisciplinary Ph.D programs; special programs/fellowships for emerging areas; post graduate diploma courses or short term certificate courses for technician training and

skill development; establishment of vocational technician training centres in collaboration with industry and setting up of finishing schools to make available readymade talent to various S&T based industries.

6. **Expanding Current Global Partnerships In S&T To Augment Human Resource Development:** Recognizing the value addition and quality of HR training and skill development in the ongoing S&T-R&D collaborations, there was a consensus to expand the scope of global partnerships for leveraging and augmenting the requirement of large number of well trained and highly qualified researchers, teachers, professionals and technicians. Important recommendations in this context included simplification of the existing mechanisms and multiple clearance systems for international collaborations between Indian Universities, Institutions, colleges with foreign counter parts particularly for twining programs of R&D linked Ph.D and Post-Doctoral Programs, Incorporation of S&T education and training as an integral part in the Protocols of Cooperation signed between countries and launching of special competitive grant scheme such as “International Collaborations for Education and Training” (ICET) with funding levels up to Rs. 50.00 Lakhs per applicant University/ Institution/College for exploring opportunities.

7. **Diverse Fellowships And Career Development Awards For R&D, Innovation And Entrepreneurship:** Most of the current fellowships and awards are addressing the needs of physical and life sciences requirements pursuing post graduate studies or Ph.D. Adequate attention has not been paid to address the needs of (i) engineering, medical and other professional courses to engage themselves in S&T-R&D or pursuing Ph.D after post graduate studies and others relevant to innovation support; (ii) Specialists/ experts engaged in various steps and activities of S&T based product development involving regulatory/intellectual property due diligence, technology packaging, innovation and design and (iii) setting up of start-up

companies by scientist entrepreneurs: post graduate/doctoral students, group of students in universities and colleges. It was therefore recommended to review to rationalize the incentives, existing pay packages/fellowships for professionals interested in pursuing Ph.D or R&D as a career; Institute wide array of Career Development Awards with lucrative pay packages to working professionals/faculty to participate in innovation and technology development activities. It was recommended that a pull mechanism is required to attract domain scholars to scientific career than merely a career path that allows focus on research. This is crucial in medical, veterinary, forestry and other areas where careers are by practise rather than scholarship based. It was recommended that we expand the scope of the current technology development programs (example TePP of DSIR) and to include opportunities for S&T intensive colleges and institutions to promote collective innovation experience; and Institute 'Ignition Grants' (up to Rs. 50 Lakhs per project) for encouraging innovation and technology development by scientist entrepreneurs.

8. **Employing New Tools and Technologies for Education Including S&T:** The issue of employing modern tools and technologies for education in general and for development of HRD has been addressed at school level through several forums / committees and focus groups. However, Working Group has identified three different levels where interventions through new tools and technologies are required such as: teaching methods, learning methods and knowledge landscape. The S&T Departments may jointly set up a "Think Tank" of experts and stakeholders from industry and academia for review and assessment of existing as well as emerging S&T (education) technologies, feasibility for developing or adapting new technologies, addressing the issues of content, designing innovative schemes, including servicing and up gradation requirements. Meanwhile, it was recommended that in the 12th plan, the available schemes of Centres of Excellence in S&T Departments may be expanded to include setting up of up to 5 centres for S&T education content, technology and tool development with workshops.

9. **Science Literacy:** Programs on public perception and understanding of science requires novel outlook in the society with ever increasing applications of technology, emerging areas of complex scientific discoveries, convergence of sciences and easy access to information through internet, television and radio with multiple channels, influential people and agencies owning the communication systems. The working group has recommended that the S&T departments and research institutions under their administrative control should put in place an appropriate mechanisms for communication of scientific achievements, replying to public concerns in subject specific areas and canvassing the opportunities in S&T education and training. Some suggestions made included: designating an officer-in-charge for the purpose in each department/institution with good communication abilities and domain knowledge; departmental 'Media Box Corner' in respective home pages for

regulative upload authenticated information for media; constitution of Ad-hoc group of experts and policy makers for prompt communication and clarification in emergencies; schemes to promote courses for new generation of S&T journalists in collaboration with well-established media schools and foundations.

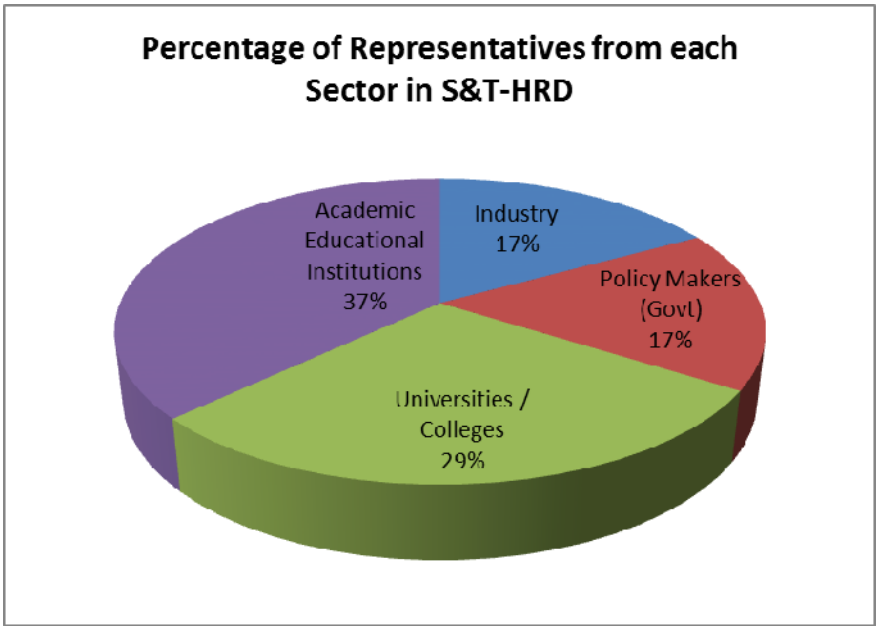
The detailed recommendations described in chapter-III also facilitate references, examples of success stories and models at national and international level. In general, these recommendations could be implemented with suitable amendments by any of the S&T Departments. The financial requirements for implementation of these recommendations over a period of 5 years have been estimated at the level of Rs. 4400 crores. It also provides a list of action points recommended for DST, DBT and CSIR for implementation in short term (1-2 years).

To sum up, the Working Group considers addressing S&T HRD as a most challenging task and requires continuous uninterrupted and inclusive dialogue at policy, people, programs / project levels. An organized annual assessment can ensure integration of S&T as component of education policy and fulfil the aspirations and expectations of the society in recognizing S&T as a main component of public policy, innovation and enterprise and socio-economic development.

METHODOLOGY

- Identification of key issues pertaining to Science and Technology – HRD
- Identification of diverse stakeholders from varied S&T Departments
- Constitution of a Working Group with diversified stakeholders
- First meetings with Working Group (New Delhi)
- Compilation of inputs, suggestions and recommendations for strengthening S&T-HRD
- Second meeting with wide range of stakeholders in an open house session
- Compilation of inputs, suggestions and recommendations
- Receipt of email inputs, suggestions and recommendations from other stakeholders concerned to S&T-HRD
- Secondary surveys, collection of background documents for drafting the Report
- Constitution of a drafting team
- Compilation of inputs and recommendations from the Working Group and other key stakeholders
- Formulation of a draft report
- Circulation of the draft report copy to Working Group members for their inputs and suggestions
- Finalization of the Report and submission to Planning Commission.

List of Working Group Members – Annexure 1.0



The above diagram presents an overview of representatives from various sectors of S&T. The Working Group constituted had representation from various stakeholders of S&T sectors (Faculty, Scientists & Teacher from national institutions, universitites and colleges, industry representatives from CII and FICCI; policy makers from Government S&T/HRD Agencies and Planning Commission) so that equal opportunity could be provided for all stakeholders to raise their concerns and issues affecting the fostering and growth of S&T HRD which could eventually be addressed effectively by recommending some strategic suggestions as well as by bringing some policy resolutions wherever felt appropriate.

Chapter-I

S&T HRD – India in Global Context

This chapter provides an overview of Indian scenario in comparison to the global economies. An overview of how developed and developing nations are strengthening their educational and S&T base for attaining self-reliance and overall economic development has been represented in the present chapter which could act as a critical focus point for encouraging education and S&T in HRD which are the key components in fostering the concept of innovation ecosystem, without which much progress could not be attained.

A large amount data and statistics are available in various publications/reports of National/International agencies comparing several indicators across developed and developing countries related to R&D expenditures, S&T personnel etc. To provide an overview, a factsheet is prepared highlighting salient indicators of India in comparison with selected countries such as China, Brazil and other relevant developing countries.

FACT SHEET

- Public Education Expenditure as % of GDP is 3% to 6% in India compared to European countries & some middle east countries

  (Annexure 1.1)

- Public Education Expenditure per student (% of GDP) Tertiary education 50 to 100 compared to Europe, Russia, Australia some American countries

  (Annexure 1.2)

- Public Education Expenditure per Student (% of GDP), secondary education is around 10 to 20 compared to Southern & Northern American countries

  (Annexure 1.3)

- Student Enrolment Ratio at Tertiary Education (Total) is between 10 to 30 compared to Russia, Australia, Europe, middle east countries and Southern America

  (Annexure 1.4)

- Regional Density of Researchers in India was 2.3 % in year 2002 and 2.2% in year 2007 compared European counties, Russia, Africa, Mexico, China, Japan etc.

  (Annexure 1.5)

- Distribution of researchers in India per million is less than 100 compared to European countries, Russia, Australia, Middle East Southern and Northern America

  (Annexure 1.6)

- In India, around 35% to 40% researcher employed in Private enterprises, around 45% to 50% employed in government and 10% to 15% employed in Higher Education compared to Korea, China, Japan, Singapore, Philippines, Canada & some African countries

  (Annexure 1.7)

Chapter II

India - S&T HRD Resource Mapping

Mapping of various resources with regard to S&T sector was done through secondary desk based research and through evaluation of various reports which were available in public domain to understand the existing resources in terms of availability of institutions, universities, organizations etc. The following chapter highlights the available resources with respect to S&T in India which can eventually give insights for strengthening or creation of new facilities as per requirement to foster the innovation in India.

Mapping of the following aspects and indicators have been done:

- S&T Agencies / Ministries and Departments in India.
- Professional Bodies
- Autonomous S&T Institutions
- Scientific Programs / Scientific Services and Statutory Bodies
- Current Status of various Institutions in India
- Structure of Education System in India
- Expenditure incurred by various departments on education
- Expenditure incurred by various Departments in R&D
- Status of graduate institutions, sanctioned intake of graduates, total output of engineering graduates, growth of engineering graduates per million and engineering degrees awarded in India.
- Status of vocational institutes in various States of India and utilization of seats with respect to sanctioned seats.

FACT SHEET

S&T Related Ministry/Departments in India

S No	Department / Ministry / Organization	No of Institutions	Annexure No
1	Council of Scientific and Industrial Research (CSIR)	39	2.0
2	Defence Research and Development Organization (DRDO)	48	2.1
3	Indian Council of Medical Research (ICMR)	30	2.2
4	Indian Space Research Organization (ISRO)	18	2.3
5	Department of Atomic Energy (DAE)	12	2.4
6	Department of Science and Technology (DST)	18	2.5
7	Department of Scientific and Industrial Research (DSIR)	5	2.6
8	Department of Biotechnology (DBT)	16	2.7
9	Ministry of Environment and Forests (MoEF)	13	2.8
10	Ministry of Food Processing Industries (MoFPI)	4	2.9
11	Department of AYUSH	11	2.10
12	Ministry of Communications and Information Technology (MoCIT)	17	2.11
13	Ministry of Petroleum (MoP)	23	2.12
14	Ministry of New and Renewable Energy (MNRE)	5	2.13
15	Ministry of Power (MoP)	14	2.14
16	Department of Coal (DOC)	6	2.15
17	Ministry of Water Resources (MoWR)	16	2.16
18	Ministry of Earth Sciences (MoES)	8	2.17
19	Indian Council of Agriculture Research (ICAR)	97	2.18
20	Department of Agriculture Research & Education (DARE)	7	2.19
22	Ministry of Human Resource Development (MHRD)		

Ministry of Human Resource Development (MHRD)	No of Institutions
Apex Bodies (UGC, AICTE etc)	5
Central Universities	40
Universities (State and Private / Deemed)	520
Indian Institute of Technology (IITs)	15
Indian Institute of Management (IIMs)	13
National Institute of Technology (NITs)	40
Indian Institute of Information Technology (IIITs)	4
Indian Institute of Science Education and Research (IISERs)	5
National Institute of Technical Teachers' Training & Research	4
Other Institutes of MHRD	30

Reference (www.mhrd.gov.in) updated August 2011

An Overview of Educated Human Resources in India

Number of Universities and University Level Institutions - State wise

(Annexure 3.9)

Universities	Numbers
Central Universities	28
State Universities	222
Private Universities	17
Deemed Universities	104
Institutions established under Legislature Act	5
Institutions of National Importance	33
Total	409

Number of Colleges and Polytechnics - State wise

(Annexure 3.10)

Arts, Fine arts, social work, Science & commerce	14146
Engineering/technology/architecture	2466
Medical	2230
Education/teacher trainings	3284
Others	3864
Total Colleges	25990
Polytechnics	1742

Source: *Higher Education Statistics Report 2008-09 by MHRD, (Up to 30 Sept 2008)*

Enrolment (Excluding Open Universities) By Level/Courses (All Category Students) - State wise

(Annexure 3.11)

Post Graduate Degrees	
Arts	660516
Commerce	189603
Ph.D./M.Phill	78388

(Annexure 3.12)

Post Graduate Degree	
Science	382619
Engineering/technology/architecture/design	95185
Medicine	31025

(Annexure 3.13)

Agriculture & allied	11461
Management/hotel/travel/tourism management	125002
Education/teacher training	25696

(Annexure 3.14)

Law	11625
Others	44430

Under Graduate Degrees

(Annexure 3.15)

Arts	5108233
Science	2000374

Commerce	1699263

(Annexure 3.16)

Engineering/technology/ architecture/ design	1663691
Medicine	273366
Agriculture and allied	81530

(Annexure 3.17)

Management/hotel/travel/tourism management	181277
Education/teacher training	460490
Law	203577

(Annexure 3.18)

Post Graduate Diploma	107020

Pupil Teacher Ratio in Higher Education

(Annexure 3.19)

Number of teachers	652665
Total enrolment	13577027
Pupil teacher ratio	21

Education Trends in India

The trend of growth in degree institutions can be seen in *Annexure 3.3*

The trend of growth in sanctioned intake of graduate can be seen in *Annexure 3.4*

The trend of growth in total output of engineering graduates can be seen in *Annexure 3.5*

The trend of growth in engineering graduates per million populations can be seen in *Annexure 3.6*

The trend of growth in engineering doctorate degrees awarded can be seen in *Annexure 3.7*

Vocational Training:

There are 2133 government it is having seating capacity of 432006, and 5960 are private it is having seating capacity 683622. (Total number of it is are 8039 and total seating capacity is 1115628)

Annexure 3.8

Expenditure on Education:

Expenditure budget of MHRD, Department of Higher Education was Rs 13,103 Cr. in year 2011-12, out of which 50% spent on general education, 40% spent on technical education and 10% spent on North-East region.

Annexure 3.21

Total expenditure on education by various departments is 13% to 14% as percentage of public expenditure.

Annexure 3.1

Expenditure on R&D by different S&T departments can be seen in *Annexure 3.2*

Schemes of Various Ministries for S&T HRD

There are 14 major schemes/programmes of DST for S&T Human Resource Development.

Annexure 3.22

There are 14 major schemes/programmes of CSIR for S&T Human Resource Development.

Annexure 3.23

There are 12 different schemes/programmes of Department of Atomic Energy for S&T Human Resource Development.

Annexure 3.24

There are 24 different schemes/programmes of DBT for S&T Human Resource Development.

Annexure 3.25

Current Status of Key Institutions in India

The below table represents the current status of various organizations in India. More than 500 Universities, Institutes of Global standards like IITs and NITs are catering to the national needs in terms of engineering discipline, however the number of students pursuing engineering need to be increased dramatically so that most of the students can pursue doctoral degrees which is a pre requisite for any knowledge driven nation like India. Apart from these Institutions various other departments and institutions are catering to the growing demand in S&T.

Resource Mapping of Institutions in S&T	No's
Central Universities	40
Universities	520
IGNOU	1
IITs	15
IISERs	5
IIMs	13
National Institute of Technology (NITs)	40
IIITs (Indian Institute of Information technology)	4
National Institute of Technical Teachers Training & Research	4
Regional Board of Apprenticeship / Practical Training	4
Other Organizations	**No's**
PSU (EdCIL)	1
Technical Education (AICTE)	1
NAAC	1
National University of Education Planning & Research (NUEPA)	1
National Book Trust	1
Indian Institute of Advanced Studies	1
Engineering Colleges	2466
Medical Colleges	2230
Educational Training Institutes (B.Ed)	3284
Polytechnics	1742
Others (ITIs , Vocational Colleges etc)	25990

Source: *Higher Technical Education Report in India by Prof. Chopra and Prof. Sharma (2007) & Ministry of HRD and DST*

Chapter III

Key Strategic Recommendations for

12th Five Year Plan

In the chapter 4 varied issues and wish list of suggestions from members of working group and stakeholders were enumerated in 18 categories/components. This enumeration opens up opportunities for continuity of the S&T-HRD consultative process for formulation of long-term strategy aiming at rational integration of S&T policy in education and HRD policy of the nation.

For the purpose of 12th plan, it was decided to address and prioritise the complex issues highlighting challenges and provide comprehensive recommendations which include strategy, mechanism, schemes/programmes that can be considered for implementation collectively or separately by all S&T and S&T related departments towards a common goal of addressing needs S&T-HRD.

1 Appropriate Institutional Mechanism to Promote S&T-HRD Activities:

Central and State Government Ministries / Departments / Agencies and stakeholders in the country are engaged in various S&T education, training and skill development activities. Innovative schemes have been implemented involving wide-ranging intellectual efforts, investments and institutional mechanisms. The Working Group emphasised that there is a need to leverage these on going efforts of various stakeholders to bring about needed synergy, resource optimization and provide a common platform for interfacing S&T HRD efforts with that of national HRD plan and strategy. Such a platform or institutional mechanism should orchestrate policies, people and programs through top down and bottom up approaches addressing medium and long term needs of S&T education and training for advancement of human resource capability to accelerate S&T based innovation and enterprise.

Recommendations

Establishment of National Agency for S&T Education and Training

To accelerate global S&T competitiveness, capability of the nation to innovate and engage in emerging and new generation R&D and technology development for the present and future requirements, it is imperative to coordinate and network the efforts and policies of various ministries and departments through a common platform for knowledge and resource sharing. There was a consensus among stakeholders during consultations of the working group that there is a need for establishment of a vibrant platform at national level to coordinate and network the existing centres and institutions, to leverage on going schemes and programmes of various ministries/ departments.

It is proposed to establish therefore a “National Agency for S&T Education and Training” under the overall administrative control of S&T division of Planning Commission.

Such agency shall function as an autonomous core institution for S&T Education and Training for policy formulation, implementing of projects for promotion, development and improvement of Science and Technology education, training and skill development at all levels for overall growth of S&T sector through optimal utilization of resources.

Some Major Tasks of the Proposed Agency include:

- Networking and co-ordination of various national policy making, funding and implementing bodies in S&T and HRD sector to evolve a coherent national strategy for S&T–HRD so as to create an ecosystem where the concept and scope of education, science and innovation are integrated as single entity for promotion of nation building activities.
- To serve as a national data warehouse where all S&T-HRD relevant data will be collected, compiled, analysed and disseminated for assisting various agencies in formulating area specific policies and strategies.
- To foster global partnerships and linkages with international agencies like World Bank, OECD, UNESCO for quality research in policy, S&T-HRD indicators, input and output management of S&T HRD.

- To engage in R&D for development and designing of education tools, training modules, curriculum/syllabus, monitoring and evaluation methodologies for use by various stakeholders.

- To implement programs / projects in critical areas and unaddressed national needs of stakeholders in S&T education, training and skill development.

Agency: National Agency for S&T Education and Training
Mandate: To cater the needs of overall S&T education and training. Networking & co-ordination of all S&T HRD relevant Ministries / Departments.
Chairman of Agency: Member (S&T), Planning Commission
Board members: Secretaries of all relevant ministries/departments
Financial and technical inputs: Under the administration of S&T division of Planning Commission.

Major Functions:

- Policy research for strategy and impact assessment
- Data resources and S&T education research platform
- Foster international partnerships
- Implement programs and projects
  - Designing education tools and training modules
  - Capacity building programs for teachers and educational Institutions
  - New schemes and interventions required for S&T-HRD
  - New models of curriculum, career development, monitoring and evaluation

Models available: International
www.sei.dost.gov.ph (Department of S&T- Philippines)
www.advanceeducation.gov.ab.ca/home.aspx
(Government of Alberta)
Proposed Budget: Rs. 400 Crores

2 Adaption of Existing Public Private R&D Partnership Models and Development of New PPP Models for S&T HRD Activities:

In addition to ever evolving global technology innovation trends, markets for new products, demand and supply of human resource with new skills and S&T competitiveness, it has been observed in the Chapter-II that there is a disproportion in the national investments and resources (Technical and Human) for scaling up of S&T education and training activities across the nation with 40 central and 520 other universities, 15 IITs, 3 IISERs, 13 IIMs, 2466 Engineering colleges, 2230 Medical colleges, 3284 Educational training institutes and more than 1700 polytechnics .

Globally, increased private investments have thus become imperative to expand educational infrastructure to provide greater access to quality education at all levels. While exclusive private investments are already addressed in education sector in general starting from establishment of public schools to private universities/institutions, very few public-private partnership initiatives are known in promoting general education especially in S&T education and training.

The Working Group observed that several PPP models initiated during the previous plan periods for promoting research and technology development programs such as Technology Development Board (TDB), Small Business Innovative Research Initiative (SBIRI), Biotechnology Industry Partnership Programs (BIPP) have resulted in success stories shifting the paradigm of innovation dynamics earlier involving only public sector institutions. However, recognizing that there are very few PPP initiatives in S&T education and training sector, it was deliberated first to examine the feasibility of adoption of existing PPP models (of technology development across S&T Departments) and also address new models for S&T–HRD. Second, to identify various projects/assignments/tasks where such partnerships are significant and complement the efforts of public sector initiatives to achieve large scale

interventions. Third, to suggest fiscal incentives including grants/soft loans and tax benefits to participating private sector entities.

Recommendations

A To examine the feasibility of adoption of existing PPP models (of technology development across S&T Departments) and also address new models for S&T–HRD.

It was recommended to constitute an Inter-Departmental/Ministerial Steering Committee (All Departments / Agencies of MoST, MHRD, D/O Space and Atomic Energy, MoES, MoCIT) with the following terms of reference:

i) To commission an independent study for assessing the suitability of existing PPP models, suggesting new models and possible fiscal and monetary benefits.

ii) To develop clear legal and administrative framework for PPP with broad generic guidelines facilitating sectoral adoption and implementation. The framework should also include, Standard Operating procedures (SOPs) for appraisal, approval, monitoring and evaluation processes.

PPP model could be worked out for

Support services:

- Educational tools: invention, creating, manufacturing, distribution & utilisation of tools.
- e-learning & self-learning schools
- Specialised skill development programmes
- Science literacy

Infrastructure development

- Laboratory infrastructure and cost sharing models for schools, colleges and universities
- Exploratory research centres
- Science parks

Capacity building

- Teachers trainings
- Training to students, teachers and institutes for quality management, soft skills, specialised skills, courses/modules
- Programme management, education management, resource management, effective execution and implementation
- Industrial trainings
- Education: vocational and skill development education
- Quality management in education

More Information:

Initiatives of Infosys

http://www.mysoresamachar.com/info_trg_cent.htm

Proposed Budget: 200 Crores

Dow Chemical Company. The aims of Dow science-grant program is to improve mathematics, science, and technology education; upgrade teacher training and development; and increased parental involvement. The company focuses on school districts and boards in Dow factory communities rather than on individual schools and on programs that promote systemic educational reform. The company also pursues projects with key strategic partners such as one with the U.S. National Science Resources Center where Dow gave financial assistance to 42 school districts for the organization of science centers, dissemination of new science-curriculum materials, and teachers professional development.

Hewlett-Packard Company. Hewlett-Packard reports that in 2001 it has 'contributed more than $54 million in resources worldwide to advance the ability of students, teachers, community residents, and nonprofits to solve some of their most fundamental challenges. The company programs sponsored the attendance of five U.S. school-district teams ranging from kindergarten to grade- 8 from low-income, ethnically diverse communities at the National Science Resources Center Institutes; supported the Institute for Women and Technology Virtual Development Centers; built Digital Villages in two communities in Ghana and South Africa; and recognized some of the Asia Pacific region most promising minds through Young Inventors Awards (YIA).

Sony Corporation. Founders Masaru Ibuka and Akio Morita wrote that introducing science education into elementary schools is key to rebuilding Japan in the aftermaths of World War-II. This belief guided the establishment of the Sony Foundation for Education, which has offered financial support for schools and teachers over the past 42 years. The Foundation's Science-Education Program for Children funds elementary and junior high schools and teachers throughout Japan, especially those who are enthusiastically fostering interest in science among children. Recently, Sony began providing assistance for public elementary schools in Mexican communities. In another program, Sony provided support for a project in South Africa called School TV Access, which is run by the South African Broadcasting Company.

Reference: www.interacademycouncil.net

B **Identify various projects/assignments/tasks where such partnerships are significant and complement the efforts of public sector initiatives to achieve large scale interventions**

The following activities could be implemented through simple management contracts to intricate PPP arrangements.

i. Development of education tools, skill development programs and ICT applications.

ii. Infrastructure development including laboratories, science/ research parks, incubators for R&D and education tool development, establishment of specialized skill development and training centres and finishing schools, vocational and (simple to high end instruments/equipment), speciality training centres etc.

iii. Implementation of projects and programs for capacity building and training to students, teachers/faculty and technicians, programs in niche areas such as project management, technology management.

iv. Other issues related to industry-academic interface:

- ✓ It was recommended to develop new or revisit the existing guidelines to promote lateral mobility of scientists/faculty between industry and academic institutions/universities for research assignments and sharing knowledge and experience.
- ✓ Industry experts should be recognized for supervising and mentoring the Ph.D scholars registered in Universities through some special scheme with guidelines.

C Fiscal Incentives including Grants/Soft Loans and Tax Benefits to Participating Private Sector Entities

The working group has realised the need of incentivization of private sector for their active participation in overall S&T HRD of the country. Besides, grants and soft loans arising out of PPP projects mentioned above, it has been recommended that private industry should be given following benefits-

i. The weighted tax deduction system currently provided to DSIR recognized R&D activities/facilities/ equipments of companies under section 35 of IT ACT. The Act should be extended to include those companies which are actively engaged in S&T education and training activities.

ii. Relevant tax exemptions should be given for education tools and softwares developed in India.

iii. Corporate social responsibility in activities related to S&T-HRD should be acknowledged in appropriate forums and should be widely publicised for encouraging more industries to come forward.

Corporates: Fiscal benefits, Corporate Social Responsibility accreditation
SMEs: Fiscal and monetary benefit in terms of priority/credit in grants, schemes
Available models:
BITP (Biotech Industrial Training Programme), DBT

3 Synergizing Inter Ministerial Policies and Programs in Education with special reference to Science and Technology component:

There are several agencies and departments in the country that are addressing the needs and issues of S&T sector through various schemes and programs as alluded in the previous chapter. Therefore, it has become increasingly difficult to have a comprehensive view of various policies, schemes, success stories and issues generic to all agencies. Further, Ministries other than Ministry of S&T in the Government have under their administrative control various Science and Technology research institutes addressing health care, energy, water, food security, environment, strategic and security sectors as well as industrial research and innovation (Annexure 2.0 of the Report: lists of Ministries/Departments engaged in S&T-HRD). Accordingly, there are varying levels of S&T capacity and HR requirements in both upstream and downstream areas of S&T applications across sectors of national importance. It was difficult for the Working Group to determine such diverse needs of S&T–HRD requirements in such complex milieu of different governing systems, institutional policies, mandates and activities.

The Working Group recommends to evolve mechanisms and arrangements to review and examination of this Inter-Ministerial complexity for synergizing the efforts and inputs of various Departments and Ministries and to share knowledge and experiences for developing generic approaches yet addressing tailor-made sectoral requirements.

4 Recommendations

Evolving Mechanisms and Arrangements for Review and Examination of Inter-Ministerial Complexity in S&T-HRD

Working Group envisages creating an environment where science, education and research could be discussed as a single entity yet maintaining the needed diversity. Synergy, is required at three different levels: Policy, Programs and Projects. It is therefore recommended:

- To constitute a permanent notified **Inter-Ministerial S&T Commission of Secretaries** (IMCS- S&T) at the Apex level chaired by Member (S&T) Planning Commission to address various issues.
- To support the Apex body with technical and subject specific inputs an **Inter-Ministerial S&T Experts Committee** may also be constituted either independently or as a component of the proposed National Agency for S&T Education and Training with following mandate:

To collectively address and work out a strategy for S&T-HRD requirements in priority sectors of National importance such as Disaster Management, Emergency health care, Water Management etc.

Policies to be reviewed and streamlined

- Process of recruitment of personnel (teachers/faculty, research, JRF, SRF etc)
- Eligibility criteria for selection and recruitment of S&T project staff (NET, BET, UGC-CSIR, BIT, ICMR, ICAR etc.)
- Evaluation criteria of Institutions including Universities
- Fellowships and Pay scales of personnel (asymmetry in JRF, SRF, Research Associate fellowships, state university faculty, central university faculty professionals in Ph.D courses)
- Accreditation and certification (Labs, Colleges, Institutions, Industries etc.)
- Central & State Bodies and Councils

Actors/Players/Partners:

- Funding bodies (DBT, DST, CSIR, DSIR, DAE, DoS, MoHRD,UGC)
- Policy Making Bodies (Planning Commission, DST)
- Monitoring Bodies (UGC)
- Accreditation Bodies (AICTE, NAAC)
- Project and Program Level Bodies (Various schemes of MoHRD, DBT, DST, UGC)

Reforms, Redesign and Strengthening S&T Education & Training:

The Working Group acknowledged benefits and outcomes of the 11th Plan programs to build S&T infrastructure such as 'Promotion of University Research And Scientific Excellence' (PURSE) and 'Fund for Improvement of S&T infrastructure' in universities & higher educational institutions (FIST) of DST and 'Boost to University Interdisciplinary Life Science Departments for Education and Research' (BUILDER) and STAR college program in Biology.

Universities and Colleges are at various levels of track record, governance (Central/State) with location specific disadvantages. The above schemes of DST and DBT are designed mostly to cater the top category of Universities/Colleges based on the publications 'h' index etc. Redesigning Universities and Colleges is an integrated activity involving various diverse and complementary activities like capacity building, infrastructure creation and renovation, efficient resource utilisation and mobilisation of human resources, knowledge and experiences for strengthening S&T at all levels of education. For a country with huge diversity and scale of operation, the Working Group deliberated on implementing varied innovative schemes to cater to diverse situations with an overall objective of rejuvenating the S&T capacity in research, education, innovation and enterprise. Redesigning should also consider fresh investments as well as smart efforts by all relevant stakeholders.

Recommendations

A Continuation and expansion of schemes (PURSE, FIST, BUILDER, STAR Colleges) of DST and DBT with necessary modifications based on current experiences would be highly beneficial.

B Launching of new schemes and programs to cater the diversity and scale of operations. Some suggestions include:

i. A onetime grant scheme to at least 500 graduate science colleges to upgrade laboratories, establish digital libraries and re-furbish the education tools based on past performance and aptitude for S&T education and training.

ii. Establishment of 50 Science Parks or Exploratory Science Centres for hands on experience and talent training around cluster of colleges in partnership with Universities and National Institutions in the vicinity.

iii. Mobile research laboratories or 'Lab on Wheels' may be supported to cater to small towns and rural or remote areas for enhanced learning of practical experiments by teachers and students. Large number of summer school programs may be supported by working out a budgetary package with guidelines.

iv. N ational Institutions and Universities may be supported to operate summer school programs for value addition and hands on training to college students. On pilot basis, a scheme could also be started to identify bright students in science at school level in rural or remote areas for such training programmes. Summer training concepts should be promoted for empowering knowledge to students in subjects of their choice. Institutions can select students based on certain set criteria and also can support for their travel and accommodation. Sustained engagement during all vacations should be promoted.

v. Special Central Assistance to S&T for faculty expansion in State Universities to be initiated to undertake regular recruitment of faculty positions. Initial funding for faculty recruitment and support could be provided by Central Government for a defined period of time (say 5 Years) subsequent to which this responsibility would be vested with their respective State Governments. Retirement age and service conditions need to be maintained uniformly between State Government Universities and Central Universities.

A. Continuation and expansion of existing schemes

B. New Schemes with modification & at larger scale

- One time grant scheme - up gradation of laboratory, digital library & educational tools
- Establish at least 50 science park
- Promote 'Lab on Wheels/Mobile Labs'
- Encourage summer school programmes
- Special Central assistance – S&T faculty recruitment
- Project grants at graduate level with support of mentorship & intercollege consortium
- Start Teachers Ignition Grant and Research Experience Scheme laboratory
- Special grant to graduate schools for inviting mentor for teaching, guiding in research activities.

Proposed Budget: Rs. 2000 Crores

vi. Support "Learn by Lab" approach involving new funding schemes and initiatives to attract the bright talent to study sciences. Project funding in the form of grants should be initiated for students from under graduate level to create interest and passion for science among the students. Inter-collegiate consortium may be encouraged where students are selected and mentors from various Colleges/Universities are identified for guidance and supervision.

vii. A new scheme like "Teachers Ignition Grant Research Experience "may be launched to address the issues pertaining to science education and research. Funding should be on continuous mode for a certain period of time with periodic review. The National Agency for

S&T Education and Training proposed earlier could coordinate this activity.

viii. A special grant should be made available for graduate science colleges to invite faculty or established scientists from National Institutions or Universities to mentor in various science subjects for teaching, guiding research activities and designing laboratories and experiments.

5 Expanding Current Global Partnerships in S&T to Augment Human Resource Development:

Working Group observed that the global partnership in S&T research has been playing a significant role in terms of capacity building, infrastructure development, scientific aptitude and participation in International Consortia and cutting edge research resulting in excellent outcomes. For example, currently India is collaborating through bilateral co-funding opportunities with 24 member countries in EU, 5 countries in North America, 5 countries in South America, 9 countries in Africa, 29 Asian countries and Australia (www.stic-dst.org). Although, education and training are integral parts of some of these collaborations, the opportunities are limited to project partners and their staff in a collaborative R&D project and in very few cases with joint Ph.D/PDF programs. Recognising the value addition and quality of HR training and skill development in these collaborations, there was a consensus in consultations to expand the scope of global partnerships for leveraging and augmenting the requirement of large number of well trained and highly qualified researchers, teachers, professionals and technicians.

Recommendations

On a policy front, Ministries of S&T and MoHRD in collaboration with Ministry of External Affairs (MEA), Government of India may open a dialogue for simplification of the existing mechanisms and multiple clearance systems for International Collaborations between Indian Universities, Institutions, Colleges with foreign counter parts particularly for twining programs of R&D linked to Ph.D and Post-Doctoral programs and knowledge sharing through International conferences, seminars, workshops, training and skill development programs.

The current international programs are under the umbrella of Protocols of Cooperation signed between MoST and its counter parts in foreign countries especially for joint R&D, exchange visits of scientists. The Working Group suggested that there could be collaborative agreements exclusively for S&T education and training for high quality human resource development.

Model agreements and explicit guidelines for collaboration at different levels should be made available by the MoST for facilitating various levels and modalities of partnerships. Few illustrations may be seen in the Box.

Policy level :

- ✓ Simplification of multiple clearance system for international collaborations
- ✓ Encourage International collaborations for S&T education and training
- ✓ Formulate partnership modalities & explicit guidelines for different level of collaborations

Activities to be supported:

- ➢ Exchange programs for Student, faculty, administrators (grants & special financial assistance)
- ➢ Organize knowledge sharing activities like conferences, exhibitions, workshops etc (grants)
- ➢ Special grant for foreign faculty/expert of adjunct faculties to come to India for short term and provide mentoring and teaching (grants)
- ➢ Skill development programmes and short term programs (grants)
- ➢ Arrange webinars of foreign experts (grants)

Support required from Government Agencies

- ➢ Scheme for universities/institutions for international collaboration upto Rs.50 Lakhs
- ➢ Timely and sufficient financial support
- ➢ Strict monitoring of collaboration standards and activities

International collaborations among Indian and Foreign Universities/Colleges also need to be promoted (beyond academics) with various foreign industries, professional bodies dealing with technology transfer, IPR, regulation, science awareness, policy research, governance research, high end technology research, teaching methods and several other knowledge sharing activities.

Mode of Collaboration:

- Indian University/Colleges – Foreign University/Colleges
- Indian Industry – Foreign University/ Colleges
- Indian University/ Colleges - Foreign Industry
- A network of Indian Universities – a network of Foreign Universities
- Indian Universities/ Colleges – Foreign professional bodies

Proposed Budget: Rs. 200 Crores

The concerned S&T Departments may also consider launching special schemes for facilitating financial requirements of the above recommended opportunities of collaboration at various levels. Different activities are listed in Box.

To accelerate the aforesaid collaborations at University and Institutional level, it has been recommended to start a special competitive grant scheme International Collaborations for Education and Training (ICET) with funding levels up to Rs. 50.00 Lakhs per applicant. Broad guidelines could be drafted, through consultative process among S&T departments and Stakeholders for mandate- specific applications.

6 Expanding Scope for Careers in S&T, Research, Innovation and Support Services:

Conventional programs on S&T-HRD implemented by various Departments are in general focussed on ensuring critical mass of research scientists or science teachers in Universities/Institutions. However, changing economic scenario and aspirations of the people along with emergence of new fields of S&T, there is a need to revisit and suitably amend S&T–HRD programs. Besides, generally acknowledged shortage of skilled Ph.Ds, scientists and teachers, during consultations with various stakeholders three other major challenges in S&T-HRD are as follows:

- ✓ Convergence or inter-disciplinary sciences requires trained research personnel trained at the interface of different disciplines.
- ✓ Many students with science background at graduate and post graduate level and even with Ph.D are not gainfully employed either due to lack of opportunity for higher studies or due to the quality of Ph.D training (with required skill sets) Vs high bench marks set of selection criteria for research and faculty positions in public and private sectors.
- ✓ Increased automation, highly sophisticated and expensive instruments/ equipment, Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in R&D and industrial production require human resource with specialized technical training and skill sets tailor made for the purpose.
- ✓ Many industries in India often complain of non-availability of ready made talent that fits into a job profile. While some companies do conduct training programs, there is a need to provide graduates and post graduates with technical skills as well as communication / IT and problem solving or analytical skills. Such training programs would provide job opportunities to students in S&T besides saving time efforts & investment of companies in preparing the fresh graduates.

Recommendations

A Convergence or Inter disciplinary of sciences

S&T departments may consider launching schemes:

i. **Glue Grant Research** linking education and research programs between Universities and Colleges, Universities and National Institutions, General Universities with professional Universities at the interfaces of for example: physical & biological sciences including space, atomic energy, engineering, medical, agriculture, veterinary sciences; some examples of research interfaces include: space and agriculture applications or meteorology; nano-science and biology; engineering and medicine etc.

- Promote linking education & research between university and colleges 'Glue Grant'
- Special schemes/grants & programmes for emerging interdisciplinary fields of S&T
- Support global pioneering research group meeting
- Support through grants & facilitate academic & research collaborations
- Set up graduate schools
- Initiate short term courses for gainful employment
- Set up vocational/occupational colleges of each S&T domain
- Setting up finishing schools

Proposed Budget: Rs. 300 Crores

ii. Setup **Graduate Schools** for inter disciplinary Ph.D programs involving 4-6 mentors belonging to different disciplines through a network of inter departmental or inter institutional arrangements linking disciplines at fundamental level and domain level. Some illustrations are given in the box.

Graduate School of Engineering and Applied Sciences, MIT, USA

The School of Engineering and Applied Sciences (SEAS) offers doctoral and master's degree programs that lie at the interfaces of engineering, the applied sciences (from biology to physics), and technology. Particular areas of academic focus include applied mathematics, applied physics, bioengineering, computer science, electrical engineering, environmental sciences and engineering, and mechanical engineering. In keeping with the interdisciplinary nature of modern research, the school does not have traditional academic departments and does not award degrees by specific research area. Students may instead work towards a Master of Science, Master of Engineering, and Doctor of Philosophy degree in one of four subjects—Applied Mathematics, Applied Physics, Computer Science, and Engineering Science.

The faculty members in the SEAS, nearly 30 percent of whom have joint appointments in other research areas, have close ties with the science departments (especially Physics, Biology, Chemistry, and Earth and Planetary Sciences) in the Faculty of Arts and Sciences and increasing ties to Harvard's professional schools (including business and medicine). Students may also pursue collaborative options through the Medical Engineering and Medical Physics (MEMP) program, which is part of the Harvard-MIT Division of Health Sciences and Technology.

The majority of the course offerings, most of which span across disciplines, are listed in the Courses of Instruction under the following broad headings: applied mathematics, applied physics, computer science, and engineering sciences. In addition to lecture courses and seminars, students may take directed reading and research courses in connection with their dissertations and, on occasion, use them to explore topics not covered in regular courses. Programs that include considerable work in one or more science departments are common. Students may supplement their studies by cross-registering in other Harvard graduate schools or at the Massachusetts Institute of Technology.

http://www.gsas.harvard.edu/programs_of_study/school_of_engineering_and_applied_sciences.php

iii. Special scheme (including recommendations A & B) and programs need to be implemented to address the requirement of talented manpower especially in the emerging fields of Science and Technology (for example Nanotechnology, Stem Cell Research, Nuclear Energy Safety, Bio-energy etc.) for globally competitiveness. These schemes may include support to pioneer group meetings for new, emerging and promising concepts on which very few research groups in the world are actively working involving at least one Indian research group. Similarly science-interaction meeting to discuss directions of work and facilitate collaborations would be also organized in India. Unlike conferences, these interactive meetings will be small groups on a round table, meeting for a focused purpose. Such meetings would facilitate leadership by Indian researchers in emerging fields.

B S&T Career Paths for Innovation and Support Services

i. Recognising that technology and product development requires large number of skills along the value chain from discovery to markets, it is suggested to support graduate/post graduate diploma courses, short term (3-6 months) certificate programs for gainful employment of students willing to take up alternative career paths to classical R&D based opportunities. The list of topics that can be explored may be seen in the box.

Activities:

- Advanced Courses: Biotechnology, Nanotechnology, Space Technology, Aerospace, Nuclear, Stem cells etc.
- Scientific Research: Basic, applied and high end research
- Vocational training courses
- Interdisciplinary courses
- Technical and industrial skill employment courses
- Supporting Business functions: marketing, managers, entrepreneurs

Support Services

- Teaching
- IPR
- S&T services
- Consultancy
- Entrepreneurship
- Process Services
- Educational Services

Institutional infrastructure/mechanism:

Finishing schools, Graduate schools, Self learning schools, Skill development schools

ii. Advances of technology are profoundly dependant on sophisticated equipment and facilities both for R&D and manufacturing. There is an acute shortage of S&T-HR with skills ranging from handling equipment in fundamental sciences to engineering and design. It is proposed to set up at least one occupational/vocational/technician training Institute/college for each domain area of S&T as per needs during the 12th Plan in collaboration with equipment manufacturing and facility designing/construction companies. There could be apprenticeship program with industry for a period as an integral part of vocational certificate programs.

iii. Setting up of **Finishing Schools** to make available readymade talent to various S&T based industries. These finishing schools could be S&T domain specific and could be established preferably through public private partnerships or consortium of industries with Government support or in partnerships with Industry associations (CII, FICCI).

Career Paths

Research Assistant	Safety Specialists	Editors for Scientific Journals
Research Associate	Application Specialists	Bio suppliers
Junior Research Fellow	Marketing Managers	Legal Attorneys
Senior Research Fellow	Business Analysts	Patent Attorneys
Scientist	Biostatisticians	Business Development Managers
IP Attorneys	Toxicologists	Liasoning Officers
Trainers	Assistant Professor	Technical Recruiters (HR)

Doctors	Associate Professor	Sales Representatives (Medical)
Clinical Technicians	Professor	Six-Sigma Trainers
Pharmacists	Vice Chancellor	Project Management Certification Trainers
Breeders	Registrar	Soft Skills Trainers
Agronomists	Rectors	Lab Coordinators / Lab Technicians
Entomologists	Lab Managers	Safety Health and Environment Specialist
Horticulturists	Disaster Managers	Utilities and Maintenance Managers
Clinical Data Managers	Documentation Specialists	Emergency Support Managers (Medical / Fire / Chemical Hazards)
Technical Writers	Technical Writers	Validation Specialists / Instrumentation Engineers
Grant Managers / Fund Managers	Project Managers / Project Engineers	

7 Diverse Fellowships And Career Development Awards For R&D, Innovation And Entrepreneurship

The Working Group took note of successful implementation of several fellowship and award schemes implemented during the earlier plans including the 11th plan by the S&T Departments. Some of these fellowships and awards recently instituted such as INSPIRE, Ramanujam Fellowship, KVPY of DST and CSIR Program on Youth for Leadership in Science (CPYLS), RAPID Grants to Young Scientists, Ramalingaswamy Fellowships, Tata Innovation Fellowships (TIF), Welcome Trust-DBT fellowships for Bio-Medical science, Various fellowships and studentship programs of Department of Atomic Energy and Department of Space *(Annexure 3.24).*

While analysing the range of on going fellowships and awards catering to various levels of stakeholders from students to retired scientists above, during the discussions of the Working Group the following observations were made.

- Ranges of professionals are required for validation, translational research, technology perfection and product development across various sectors of S&T. Most of the current fellowships and awards are addressing the needs of physical and life sciences requirements. As a result professionals such as those from engineering, medicine and others are constrained to engage themselves in S&T-R&D or pursuing Ph.D after post graduate studies due to asymmetry in the salary/fellowship requirements (related to non practice allowance, higher pay structure in Industry for professionals etc).
- The fellowships and awards are inadequate to encourage and recognize the contribution of specialists/experts engaged in various steps and activities of product development involving regulatory/intellectual property due diligence, technology packaging, innovation and design.

- The opportunities are limited to accelerate S&T innovation and setting up of startup companies by scientist entrepreneurs: post graduate/doctoral students, group of students in universities and colleges.

Recommendations

i. The existing pay packages/fellowships for professionals interested in pursuing Ph.D or R&D as a career (for example MD/Ph.D programs; MS/M.Tech (Engineering and Technology)/ Ph.D programs) need a review to harmonize the amounts and incentives with that of practicing a profession in an industry/PSU/manufacturing setup. This step would promote integration of professional inputs in research, augment appropriate technology development and provide multi-disciplinary perspective in various sector of S&T.

ii. Institute wide array of Career Development Awards with lucrative pay packages to working professionals / faculty to participate in innovation and technology development activities. (Some examples include DBT-Tata innovation fellowship given to R&D scientists). This would accelerate innovation and product development/design activities which quite often do not result into scientific publications (a measure of performance of science).

iii. Expand the scope of the current programs and (example TePP of DSIR) to include opportunities for S&T intensive colleges and institutions addressing collective efforts of graduate and post graduate students for providing innovation experience and experimentation. (for example, Nano Satellite Development Project of ISRO)

- Harmonise amounts & incentives
- Promote with lucrative pay packages to working professionals/faculty for participation in innovation, research and technology development (e.g. DBT Tata Innovation Fellowship)
- Expand scope of UG, PG students for innovation experience
- Encourage scientist/ entrepreneurship/ students for innovation and technology development by ignition grants

Proposed Budget: Rs. 500 Crores

iv. Institute Ignition Grants (up to Rs. 50 Lakhs per project) for encouraging innovation and technology development by scientist, entrepreneurs, post graduate/doctoral students.

Nano-Satellite by students

This is a project with different kind of experience for students. Stud Sat, Student Satellite, is a student satellite program jointly developed by institutes in Bangalore and Hyderabad. It is the first Pico-satellite of India. Even, ISRO is yet to launch its first Pico-satellite. One of the major characteristics of any Pico-satellite is the weight which is usually less than 1 kg.

There are around 45 students presently working on the project. The project is initiated and managed completely by students. Also, the team won Hans Von Muldau Award for the best team project awarded by International Astronautical Federation

Mission Objective were - to give hands on experience on the design, fabrication and realization of a space mission at a minimum cost to students. And to perform the functions carried-out by any remote-sensing satellite.

The satellite is jointly developed by the following institutes,

- Nitte Meenakshi Institute of Technology, Bangalore.
- B M S Institute of Technology, Bangalore.
- Chaitanya Bharathi Institute of Technology, Hyderabad
- Institute of Aeronautical Engineering, Hyderabad.
- M S Ramaiah Institute of Technology, Bangalore.
- Rashtreeya Vidyalaya College of Engineering, Bangalore.
- Vignan Institute of Technology & Science, Hyderabad.

The project is continuously being guided by many ISRO scientists, including Prof. UR Rao, former chairman of ISRO.

8 Employing New Tools and Technologies for Education Including S&T:

The issue of employing modern tools and technologies for education in general and for development of HRD have been addressed at school level through several forums / committees and focus groups. Some of the recommendations made for school level are also applicable to college and university settings. However, Working Group has identified three different levels where interventions through new tools and technologies are required such as: teaching methods, learning methods and knowledge landscape. These methods need a strong backup of various supporting activities like financial support, educational tools creation, tools adoption, tool literacy etc. Creation, distribution, utilization and tracking of tools and technologies in education is to be done. Similarly a strong backup of knowledge database is required and this includes knowledge collection, knowledge compilation etc. Knowledge creation needs a primary survey, knowledge customization according to users, knowledge customization should be aiming of more attractive, effective and interesting learning as well as teaching.

Recommendations

i. The S&T Departments may jointly set up a "Think Tank" of experts, eminent teachers/faculty and industry representatives with expertise in education technology, senior representatives of S&T Departments, Department of Information Technology, Ministry of Communications and Information Technology, Ministry of HRD, for review and assessment of existing as well as emerging S&T (education) technologies, feasibility for developing or adapting new technologies, addressing the issues of content, designing innovative schemes, including servicing and up gradation requirements. Some opportunities and modalities are shown in the Box.

ii. The available schemes of Centres of Excellence in S&T Departments may

Rejuvenation areas:

- Teaching methods – webinars, practical, labs
- Learning methods – e learning, self learning, user friendly methods
- Knowledge dissemination – specific knowledge creation, creation and compilation, customization

Monitoring: National Agency

Mode: PPP mode for tool creation, distribution, tool literacy, PPP mode for knowledge creation

be expanded to include setting up of up to 5 centres for S&T education content, technology and tool development with workshops. These centres could be integrated with the activities of IISERs, NISER, IITs, etc.

9 Science Literacy

With ever increasing applications of technology, emerging areas of complex scientific discoveries, convergence of sciences and easy access to information through internet, television and radio with multiple channels, influential people and agencies owning the communication systems, the civil society is overloaded with information. This situation of current times has therefore makes it difficult for a citizen to take decisions on choice of food, medicine, energy, house hold and personal S&T based products. In the democratic set up, therefore the populace exercises both direct and indirect influence on the formulation of public policy related to S&T. Some examples of recent times in India include public reaction to Nuclear Energy Bill, reactive response of Fukushima Nuclear Disaster due to Tsunami on Indian Nuclear energy establishments leading to formulation of Nuclear Energy Safety Authority Bill, activism inciting moratorium by policy makers for commercialization of Genetically Engineered Brinjal (Bt Brinjal) even after thorough scientific safety assessment etc.

The pioneering efforts of establishing Vigyan Prasar (VP) as early as 1989 under the DST to take on large scale science and technology popularization task is a recognition of the fact that the S&T policy makers considered public perception and understanding of science is important. Vigyan Prasar to a degree and scale with limited budget engaged itself in promoting and propagating a scientific and rationale outlook in the society. However contemporary challenges in terms of complexity of technologies, safety standards and regulations, international agreements and conventions on environment, biodefense agents, dual use technologies and related issues require a fresh outlook in our strategy of S&T communication, scale of operation, deployment of technology and tools, involvement of State Governments including its Universities / Institutions / Colleges / Schools.

Recommendations

The S&T departments and their research institutions should putting place appropriate mechanism for communication of scientific achievements, replying to public concerns in subject specific areas and canvassing the opportunities in S&T education and training. Some mechanisms suggested include:

i. Designating an officer-in-charge public relations and S&T communication in each department/institution with good communication abilities and domain knowledge. The name and full address with email and telephone numbers should be made available on respective websites similar to current practices of RTI information system.

ii. Each department and institute may consider including a 'Media Box Corner' in the respective home page of website for regular deposit of newsworthy and authenticated, achievements, information for carry access to journalists a media personal.

iii. Each department and institute depending on the requirements and emergencies may constitute an ad-hoc group of experts and policy makers for prompt communication and clarification of misconceptions etc in case of emergencies.

- Designate in charge in each S&T related ministry/department for effective Science Communication
- Start media box corner in ministry/department for authenticated information
- Formulate ministerial /departmental expert group for prompt communication and clarification
- Schemes for new science journalism programs
- Promote university/institute for collaborative scientific journalism courses with media schools
- Encourage research institution for outreach activities through special schemes

Proposed Budget: 200Crores

Schemes may be launched for training to produce new generation of S&T journalists for audio-visual, electronic and print media for mass communication and also provide new career opportunities to science graduates to address the emerging complexity of technologies, scientific controversies and wrong perceptions. Although such initiatives have been taken up to a degree by Vigyan Prasar in collaboration with Indian Science Communication Society, a non-profit organization in Lucknow, it is suggested to expand these opportunities addressing domain specific needs in collaboration with well established media schools and foundations such as Times Media Foundation, Hindu Media Foundation and other such institutions of regional importance.

The research institutions currently popularize scientific achievements on annual basis usually through celebration of National Science Day. Each S&T department may expand this programme through a special scheme to include universities and colleges.

The Working Group made following recommendation for implementation in short term

Sl. No.	Recommendation	Agency
1.	Set up Science centres in every district to complement school and college education in Science. Each centre will have hands-on activities/workshops for teachers and students and organize stimulating talks by experts from academia and industry. These centres may also be used for organizing INSPIRE science camps, science exhibitions etc.	▪ Department of Science and Technology
2.	Institute doctoral and post-doctoral fellowships for Indian students to get trained in abroad in topics (such as earth science, climate prediction, oceanography, theoretical computer science etc) that are not well represented in India, but most important in the current era. With fellowships on hands, our students could approach best Universities in the world for a position.	▪ Department of Science and Technology
3.	Expand the star college scheme of DBT to a full-fledged scheme for the entire country for all science subjects. At least one college is identified per district for converting it into a centre of excellence in post-school education in science. Provide, funding for hiring good teachers, set up good laboratories, invite reputed scientists, special training opportunities for teachers in Universities and national laboratories etc.-	▪ Department of Science & Technology ▪ Department of Biotechnology

Sl. No.	Recommendation	Agency
4.	Enhance post-doctoral fellowship to establish a vibrant post-doctoral culture in the country, which is almost non-existent now.	▪ Department of Science and Technology ▪ Department of Biotechnology ▪ Council of Scientific & Industrial Research
5.	Mobile Labs or Lab on Wheels (on PPP model) to introduce rural and under-privileged children to the excitement of science.	▪ Ministry of Human Resource Development
6.	Open at least 5 more HBCSE-type centres in different parts of the country to help develop better curriculum for school and post-school education in science and for training teachers in pedagogy. These centres should be set up as autonomous institutes with provision to introduce certificate courses on science education for teachers.	▪ Ministry of Human Resource Development
7.	Provide special funding to Universities and national institutes to jointly start graduate schools in interdisciplinary topics such as neuroscience, Nano-science, translational health science, etc. Make provisions for international collaborations for both teaching and research in graduate schools.	▪ Ministry of Human Resource Development ▪ Department of Science & Technology
8.	Special funding scheme for research projects submitted by college teachers. More liberal small grants to encourage them to start research and larger grants with better peer-review system.	▪ Department of Science & Technology ▪ Department of Biotechnology
9.	Current level of funding for chemicals and reagents is far too less for Indian labs to carry out cutting-	▪ Department of Science and Technology

Sl. No.	Recommendation	Agency
	edge research in frontier areas of biology, chemistry, nanotechnology etc.	▪ Department of Biotechnology ▪ Council of Scientific & Industrial Research
10.	Set up 5-6 fully-equipped state-of-the-art convention centres to exclusively to organize conferences/symposia/seminars/workshops and mentorship programs in all areas of science and technology. Any scientist or academician wanting to organize a conference/workshop should send the proposal to one of these centres, which would be subjected to a peer-review for selection. The centre will take care of funding and all logistics to execute proposals. In the current method of scientists/academicians having to run around for everything from funding to hotel bookings to transport arrangement is only a deterrent to organize quality meetings. People appointed to run proposed convention centres will be assessed based on the number and quality of the meetings organized in a financial year.	▪ Department of Science & Technology ▪ Department of Biotechnology

Financial Projections

It has been observed all the S&T Departments have separate schemes and programs addressing Human Resource Development. In general the Working Group recommended that at least 20% of the annual GBS may be earmarked for S&T-HRD. The recommendations contained in this report may be suitably integrated either as new initiatives within the existing schemes or implemented as new schemes. The budget estimated for various recommendations are as follows:

S. No.	Recommendation	Rs. in crores 2012-17
1	Appropriate Institutional Mechanism to Promote S&T-HRD Activities	400.00
2	Adaption of Existing Public Private R&D Partnership Models and Development of New PPP Models for S&T HRD Activities	500.00
3	Reforms, Redesign and Strengthening S&T Education & Training	2000.00
4	Expanding Current Global Partnerships in S&T to Augment Human Resource Development	200.00
5	Expanding scope for careers in S&T, research, innovation and support services	300.00
6	Diverse Fellowships And Career Development Awards For R&D, Innovation And Entrepreneurship	500.00
7	Employing New Tools and Technologies for Education Including S&T	300.00
8	Science Literacy	200.00
	Total Budget	**4400.00**

Chapter IV

S&T HRD Stakeholders Issues & Suggestions

Realizing the importance of complex and cross-sectoral issues in S&T, the Planning Commission has constituted a Working Group with experts from various domains and fields, to understand the complexity associated with every branch of S&T. It is an important aspect that all the essential S&T communities, including all those favouring the expansion and growth of S&T capacity building, engage the relevant stakeholders, recognize the issues and concerns appropriate and justified along with strategic solutions for those issues.

There were several suggestions from the members of Working Group. Suggestions and inputs were sought from various other stakeholders also through emails and written articles which were eventually circulated among the Working Group members to establish synergies with the issues raised by the Working Group and other stakeholders. For ease of understanding the issues & suggestions were categorized, articulated in a format and compiled of by the Working Group secretariat.

Most of these issues and suggestions have a long term impact and to harness the benefits of for improvement of S&T-HRD situation S&T in a quicker time majority of these recommendations can be implemented in 12th Five Year Plan and other recommendations could have a broad implication in Vision 2025. The following chapter highlights the key issues associated with respect to categorised area and also provides/suggestions and a 'Wish List' of the key action points captured from all stakeholders.

Educational Contents

Issues

Traditional syllabus
Lack of interdisciplinary subjects
Lack of effective S&T integration in school level education
Lack of updates in S&T
Lack of practical skills
Lack of industry orientated syllabus content
Lack of S&T industry involvement in syllabus formation
Lack of output driven inputs of syllabus

Suggestions

Change in S&T syllabus content at all levels of education
PPP mode of collaboration between Govt. and IT industry should be done to convert syllabus into audio visual
Interdisciplinary syllabus should be introduced at all levels of education
Involve S&T industry experts in framing the syllabus
Syllabus pattern should be in global context
A continuous research system/unit needed to study syllabus, its impact and updates required
Research orientation required in education contents and experience in place of education

Educational Tools

Issues

Lack of S&T educational tools including ICT
No Accessibility to students
High cost of educational tools
Lack of S&T advanced tools and its exposure
Hurdle in teaching without educational tools
Unclear science concepts for students
Loss of Science learning enthusiasm due to lack of S&T educational tools
Lack of PPP models for creating, distributing, utilizing S&T educational tools

Suggestions

PPP model need to produce safer, cheaper S&T educational tools and distribution in schools, colleges
Promote S&T educational tools at all levels of education
Teachers and students need to be promoted to development of innovative educational tools
Mobile Labs or Lab on Wheels to be introduced to provide practical training
Syllabus should be converted into animations and audio visuals through ICT at all levels of education
Various science modules need to be developed of all the subjects of all different levels of education
Schemes to be introduced for encouraging open innovation by students and teachers
Exploratory science centres for undertaking research activities should be done
Awareness programs to be launched to encourage science education
Teachers to be equipped with S&T educational tools
Practical training to be provided to teachers for effective use of tools

Teaching Methods

Issues

Traditional teaching methods
Lack of adoption of e- teaching/e-learning
Lack of advance teaching tools (ICT)
Lack of required S&T teaching set of skill with teachers

Suggestions

Novel teaching methods to be introduced
PPP mode of partnership with industries to be encouraged for adopting new teaching methods
Regular & updated training to be provided for teachers
Look into global teaching methods and customise it into Indian context
E-learning should be promoted
Training need to be provided for all teachers for sound and effective use of ICT tools for teaching
A continuous research is required to study and analyse teaching method, global context, customization & updating of training modules from time to time.

Examination Pattern & System

Issues

Rigid exam pattern & system
Rigid performance evaluation system
Textbook based exams
Lack of assessment of S&T skills in exams
Lack of testing applied knowledge in exams
Exam oriented studies only
Differences between exam system/contents and skills required by industry
Same exam for students going for basic science (research) and applied science (post R&D jobs)
Different exams for different states that leads to regional disparities

Suggestions

Reforms are required in exam pattern and exam system
Uniformity in exam pattern and method is needed all over the country to avoid skill assessment disparity
More weightage to be given for practical, field work in exams
Simplified and year long evaluation systems to be introduced rather than only exams
Inputs to be sought from industries for skill requirements and skill development
Examination pattern to be revised on a regular basis as per S&T industry requirement
Open book system need to be implemented
Involvement of S&T experts on framing exam system to assess required S&T skills from students
A S&T based exam need to be conducted by a central body irrespective of educational levels & academic syllabus to encourage bright students (like science Olympiad)

S&T Infrastructure

Issues

Lack of laboratories
Poor laboratories infrastructure/equipment
Less time for practical/laboratory learning for students
Restrictions to access of laboratories
Hurdle in teaching due to lack of infrastructure
Loss of Science learning enthusiasm due to lack of infrastructure

Suggestions

Cost sharing model of lab infrastructure required for inter-college, inter-university level
Cost sharing model to be follow at district places in PPP mode
More mobile labs should be established for rural/remote areas
Training to be provided for teachers for better utilization of infrastructure
A science park with excellent infrastructure can be established at district places
One time liberal support should be given for S&T lab infrastructure improvement to S&T academic institutions
Huge ICT based S&T infrastructure could be synergised with National Knowledge Commission
Educational institutes need to promote students to access laboratory facilities

S&T Knowledge

Issues

Lack of unavailability of customised science modules
Lack of knowledge access tools - ICT/Internet
High cost of ICT tools
Lack of S&T (audio-video) education material for all level of students & all subjects
Lack of self-learning modules of various S&T sectors
Lack of S&T data collection, compilation, customisation for various sectors
Lack of national database for S&T
Lack of access to various national & international databases in institutes, colleges, schools
Lack of S&T knowledge generation efforts

Suggestions

PPP mode of participation to be sought for development of audio visuals in S&T education
Rapid adoption of ICT tools and their continuous updation contracts/systems
Portal to be established with information on all schemes, institutions etc. related to S&T
e-learning tools to be introduced
National and International databases as well as e-library journal consortium could be maintained by a separate department
A national S&T database need to be created and open to all
A large scale project of national S&T data collection, compilation, customization and archival should be started immediately

S&T Awareness

Issues

Lack of science careers awareness
Lack of specialised studies/efforts to bring science career information in one platform
Lack of career guidance studies & efforts
Lack of organised efforts for S&T career awareness
Lack of S&T interaction platform

Suggestions

Common portal or website by Govt should be launched with all relevant information of S&T and HRD
Mentorship programs to be launched for students in schools and colleges
Awareness programs like Inspire, space / maths/ science Olympiads to be launched
Web based platform need to be create for career awareness
S&T career helpline (voice based/web based) need to be created

S&T Education System

Issues

Predefine streamlined/rigid education system at 11th PCB/PCM for engineering & biological sciences
Admission barriers - availability of science seats (11th standard) due to lack of eligibility flexibility
Lack of availability of S&T Flexible/distance/e-learning
Non availability of seats in specific science steam to meet demand
Inaccessibility for multiple degrees/education simultaneously
Lack of promising professions/jobs for basic science students
High cost of professional S&T courses (Engg, Medical, Pharma)
Less number of seats (S&T professional courses) in government colleges
No special incentives on innovation in UG
Demand supply gap in S&T-HR available and jobs available
No specialised courses available (science)
Variety of entrance exams for S&T courses admission
College/universities having different policies-admission, eligibility, fees, seats allotment

Suggestions

Major reforms in S&T education
New schemes to be launched to encourage science based research
An autonomous agency with integration of all S&T ministries for promotion of S&T education to be launched
Studies to be undertaken to assess demand supply gap in each S&T sector
Professional courses and colleges to be encouraged widely
Multiple degree education not only allowed but also encouraged
Special incentives and schemes to be launched to encourage science research
Research in education sector to be encouraged
Professional courses could be subsidised for talented students

Increase number of seats in government colleges
Special innovation scheme at UG level could be introduced at colleges/universities
A deep study with international agencies (UNESCO/world bank/OECD) can be done on continuous basis for S&T-HRD
More interdisciplinary with support of specialised courses of various science branches to be created
Industry involvement required for output oriented inputs in S&T HRD
A common exam to be conducted all over country for same course (JRF, SRF)
Harmonised policy to be established in college/universities for admissions, seat allotment & fees to mobilise quality HR

Financial Aids

Issues

Inaccessibility and unawareness of educational scholarships/ loans
Different policies of college fees
Unawareness of national and international scholarships
Lack of number of scholarships - huge gap in demand and supply
Lack of single platform of information & selection for higher study scholarships - national and international
Lack of organised information/guidance for higher studies abroad
Lack of scholarships/fellowships/pay offers to attract foreign students
Rigidity in eligibility criteria for scholarships/funds/incentives
High interest rates for educational loans (Industrial loans are available ranging from 1% to 5% by various S&T departments (educational loan minimum 10%)

Suggestions

Single window clearance for students to get education loan
Education loans strictly to be provided without mortgage or security
Educational loans from banks and other departments should be on a nominal interest basis
Common department or portal or website with all S&T and HRD relevant financial aid information to be established
Single window/platform for S&T financial aid application, evaluation and approval
Awareness campaign for scholarships at single platform
Provide attractive scholarships for foreign students to come India for study & research in S&T

Internships and Industrial Trainings

Issues

Lack of single window platform for selection & hiring for internships/industrial

trainings
Lack of availability of internships/industrial trainings
Lack of organised efforts in summer internships/industrial trainings
Lack of incentives for industry to hire interns/trainees
Lack of vocational trainings
Lack of Finishing schools
Lack of S&T skill acquisition specialised schools
Lack of entrepreneurial development provisions in education

Suggestions

Summer projects and training programs for school students to be launched
Finishing schools to be expanded & strengthened
Entrepreneurship development programs and schemes to be introduced
More idea incubators could be developed at university level
A single window platform need to be created for S&T internships and industrial trainings
Incentivise industry for offering internships/industrial training
Create vocational training schools, finishing schools & skill acquisition schools

International Alliances

Issues

Lack of strategic relations with foreign universities for education
Lack of international collaboration initiative by universities/colleges
Lack of synergy collaborations with national & international institutes
Cumbersome clearance mechanisms to forge international collaborations

Suggestions

More synergic international collaborations are required in S&T education along with R&D
International collaborations to be established with Indian universities/colleges
Single window clearance and facilitation for foreign universities to enter/collaborate in India
More alliances with foreign countries/universities need to be developed to facilitate Indian students to educate abroad
More scholarships are required for students willing to study abroad
Single window for all scholarships to all students
More collaborations of universities are required for student exchange programmes
Encourage & facilitate universities to initiate collaborations with foreign universities

Teachers/Faculties

Issues

Unavailability of teachers
Lack of expert teachers
Lack of teacher training
Lack of communication of appropriate teaching opportunities
Lack of uniform teachers performance evaluation system
Lack of communication with science educational institutes & industry
Lack of a platform for teacher & scientist interaction
Lack of incentives to attract talented HR in teaching
Lack of industry experienced teachers
Lack of industry exposure to teachers
Unawareness of industry skills requirement
Lack of support to teachers from host institution management
Low salaries (disparities)
Limited salary and service permanency based motivation
Lack of special incentives for teachers for extracurricular activities/research in S&T

Suggestions

Recruit the required teachers immediately
Laboratory training to be provided to school teachers
A uniform system to be developed for teachers performance evaluation
A uniform teacher eligibility criteria to be adopted
A national level platform required to communicate various teaching opportunities.
Increase pay scale of contract basis teachers, attract S&T students to serve in S&T education
PPP mode of partnership should be sought from Industries for teacher training
New schemes for providing financial support for teachers for undertaking research activities to be launched

Incentives to be provided for efficient teachers
A platform is required for providing interaction between teachers and scientists
Ignition or Glue grant scheme for teachers to be launched
Teachers to be encouraged to undertake innovative research in various institutions
A network of teachers training centres linked to industry, institutions or not for profit organizations
Promote industry people to join academics on high incentives
Incentivise professionals to involve in S&T interdisciplinary subjects (tax incentives for contributing time, expertise in academic education)
Teachers training modules should rapidly convey through ICT/webinars
A continuous research system is required to study specific needs of teacher training, its impact etc.

Educational Institutes

Issues

Lack of SOP's for autonomous bodies/colleges/universities for S&T

Lack of efficient utilization of available resources
Lack of well-developed performance evaluation indicators criteria of educational institutes
Lack of strong monitoring and performance evaluation system
Lack of uniformity of performance assessment criteria of institutions (various state Govt. policies)
Lack of clarity on mandates/roles of university, research institution, colleges
Lack of inter-institutional communication for S&T knowledge sharing activities
Lack of platform for inter-university, inter-institutional synergy communication
Lack of inter-institutional cost sharing models for S&T projects
Lack of inter-institutional synergising efforts on S&T
Lack of a national databases of students, faculties, projects & other potentials of institute

Suggestions

Develop SOPs with strong research study on global SOPs for S&T
Make uniform SOPs acceptable to all educational institutes
A performance evaluation criteria need to be more transparent & clear
Develop new customised performance evaluation criteria other than traditional (indicators) method from school to college (e.g. number of students getting placements rather than number of students passed)
Accept performance evaluation criteria uniformly in country for S&T educational institutes
Separate the mandate of university from colleges and focus on specific role of institutions
More communication platforms are required in S&T
Inter-institutional (infrastructure) cost sharing model could be adopted
A web based strong database of schools, colleges, students and their present job status need to be generated this is needed to map the real S&T human resources

(concept model of LinkedIn, orkut could be followed)
Promote, encourage & fund educational institutes for knowledge synergising activities like S&T exhibitions, competitions

Governance Agencies

Issues

Lack of effective coordination between Central Govt. & State Govt.

Different policies of different ministries - scholarships/education funding/ research funding
Different funding policies, eligibility, selection, performance by different ministries/departments
Short term support-project based recruitment of S&T HRD
Lack of communication between funding agencies & educational institutes

Suggestions

Policy resolutions to be brought for integration of S&T with HRD and education policy
More evolved system and policy is to be created for coordination
Coordination to be established with State and Central Governments in terms of schemes and funding for S&T
Harmonisation to be created in funding policies, eligibility and performance selection criteria in all departments of S&T and HRD
Considerable investment increase is required for the S&T HRD sector by all departments
Provisions to be made for long term support to project based personnel to attract & retain quality HR in S&T
A transparent, well-coordinated mechanism could be evolved for efficient communication between various institutional stakeholders, monitoring agencies and funding agencies

Public Research Institutes

Issues

Ambiguity in pay scale of research personnel (JRFs, SRFs & project staff)
Lack of long term promising career opportunity for S&T personnel
Lack of funding from funding bodies
Lack of quality human resources
Lack of funding for infrastructure
Lack of long term support for research
Lack of interdisciplinary knowledge
Lack of IPR, tech transfer knowledge and other supporting chains
Lack of market feasibility, global market guidance for research and technologies developed

Suggestions

Uniform pay scales and service conditions should be adopted for all S&T ministries
Long term support to project based personnel should be provided
Funding to personnel pay scale need to be increased considerably (JRF, SRF)
Attract quality HR to public institute research
Provide long term support to research projects
Interdisciplinary subjects, practical skills to be provided in public research institute
Technology transfer offices need to be promoted in universities and institutes
Linkages with industry need to be established
Single window for personnel recruitment in public research institutes
Single window for submission & approval of R&D projects for getting funds by different ministries/departments

S&T Industry

Issues

Lack of industry-ready talented/quality S&T HR
Lack of database/information on S&T human resources in country

Lack of single window for recruitment of S&T HR
Lack of link between college, faculty, students database on a single platform
Differences in exam system - unable to judge talent
Lack of inclusion of required skills in education system
Lack of clarity on basic science/basic concepts in candidates
Lack of interdisciplinary knowledge of subjects
Lack of innovativeness in candidates
Lack of interaction with academics
Lack of technical/practical skills
Lack of soft skills & analytical skills

Suggestions

National S&T HR database need to be created
A single window for S&T employment in country could be created
Platform is required for database of colleges, faculties, students
The exam/evaluation system need to be uniform to avoid diversity/disparity
Industry need to be involved and consulted to education bodies on regular basis for required skills
Corporates should teach/ train/ provide mentorship to students at graduate and PG level as a corporate social responsibility
Should have tie ups and linkages with universities and Institutions for undertaking effective research
PPP models are incentivised for R&D
Incentivise industry for skills development programs for S&T HRD
Finishing schools for industry-ready students

Public Sector Scientists

Issues

University professors/scientists have to do other work apart from research

(administration work load apart from research)
Long & time consuming procedures in approvals from university/college administration/management
Lack of funding support
Different funding schemes, eligibility and other criteria of various funding bodies
Lack of access to paid S&T databases

Suggestions

Separate the administrative work from scientists and let them concentrate on research
A mechanism need to be adopted by all research institutes to facilitate researcher at every level
Increase funding for public research institutes
Single window submission and evaluation can be made to increase the possibilities of funding from different bodies
To provide access to databases

Private Sector Scientists

Issues

IP ownership restrictions

Research publication restrictions
Lack of interdisciplinary training
Restriction to further education & PhD
Lack of investments in capacity building

Suggestions

A binding to company to retain share of inventor
Introduce interdisciplinary training from school level to college level
Promote and incentivise industry to educate its personnel (company rating and tax rebates)
Incentivise industry in capacity building of their personnel
Higher education and PhD to be allowed

Professionals

Issues

Less salary in research
Less job availability in basic research
Poor infrastructure in research in public institutes
More job opportunities in KPO/BPO rather than S&T jobs
Huge gap in skills required by industry and academic education

Suggestions

Attractive package need to offer to attract talented & quality HR
More jobs need to be created in basic research
Create world class infrastructure in some universities and colleges
Demand based skills should be included as a part of academics

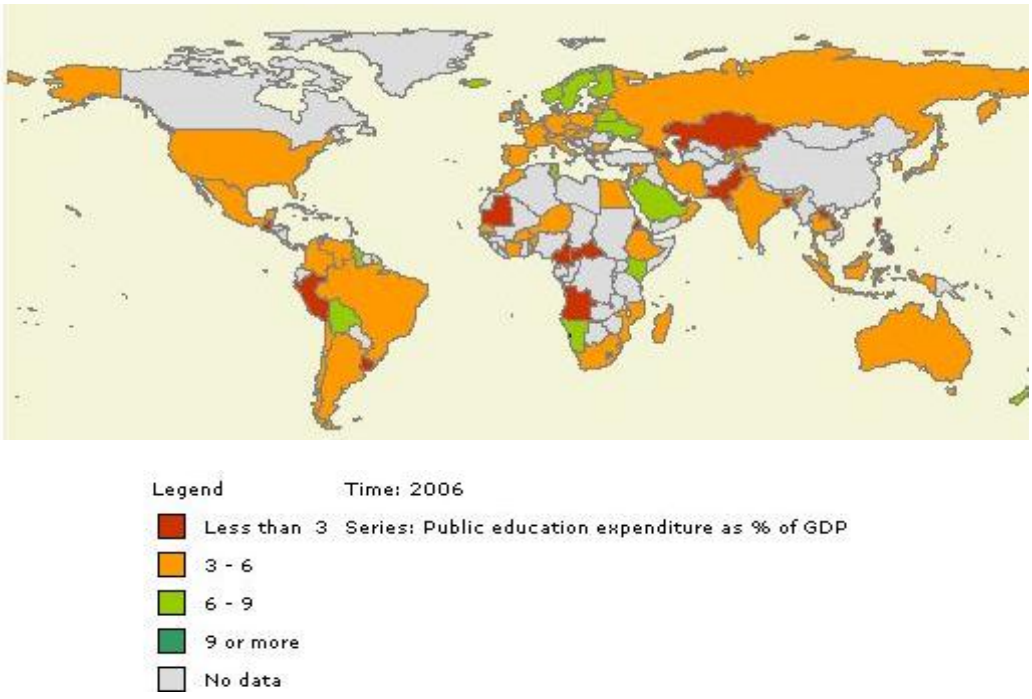
Annexure 1.0

List of Working Group Members

1. Dr.M.K.Bhan, Secretary, DBT (Chairman)
2. Dr.VedPrakash, Chairman, UGC
3. Prof. L.S.Shashidhara, IISER, Pune
4. Dr.N.Mukunda, IISc, Bangalore
5. Dr.GauthamBiswas, CMERI, Durgapur
6. Dr.T.K.Chandrasekhar, NISER, Bhubaneshwar
7. Dr. K.S. Das Gupta, IIST, Tiruvananthapuram
8. ShriPawanAggarwal, Adviser (Education), Planning Commission
9. Dr. Arup Kumar Raychaudhuri, SN Bose Institute, Kolkata
10. Dr.HemachandraPradhan, BARC, Mumbai
11. Dr.HariGopal, Adviser, DST
12. Dr. Rajesh Luthra, Head, HRDG, CSIR
13. Shri. A.K.Verma, Adviser (S&T), Planning Commission
14. Representative of DG, CII
15. Dr.S.R.rao, Adviser, DBT (Convener)

Annexure 1.1

Public Education Expenditure as % of GDP



Source : www.worldbank.com

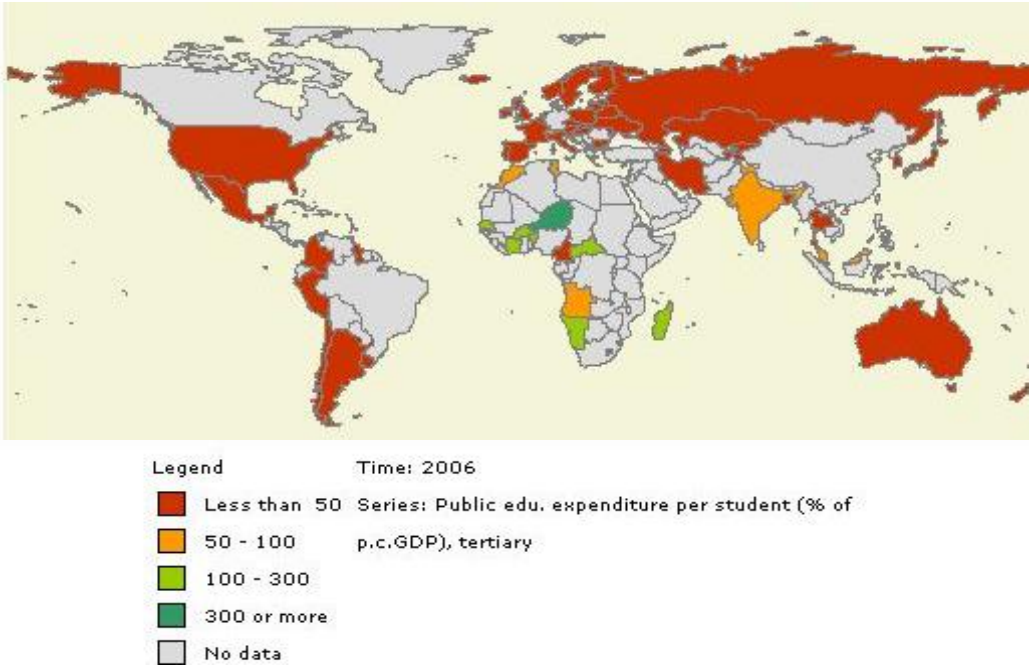
The graph represents the expenditure incurred by various nations as percentage of their gross domestic product (GDP) spent on public education.

The expenditure spent on education is less than 3 percent of their GDP in certain regions of Middle East, few African countries and a couple of South American countries.

It is clearly evident from the graph that European countries and few countries in Middle East are spending 6 to 9 percent of their GDP in education in comparison to few countries and regions like India, Australia, North America, South America, Russia and most of the Asian countries.

Annexure 1.2

Public Education Expenditure per Student (% of GDP) Tertiary Education

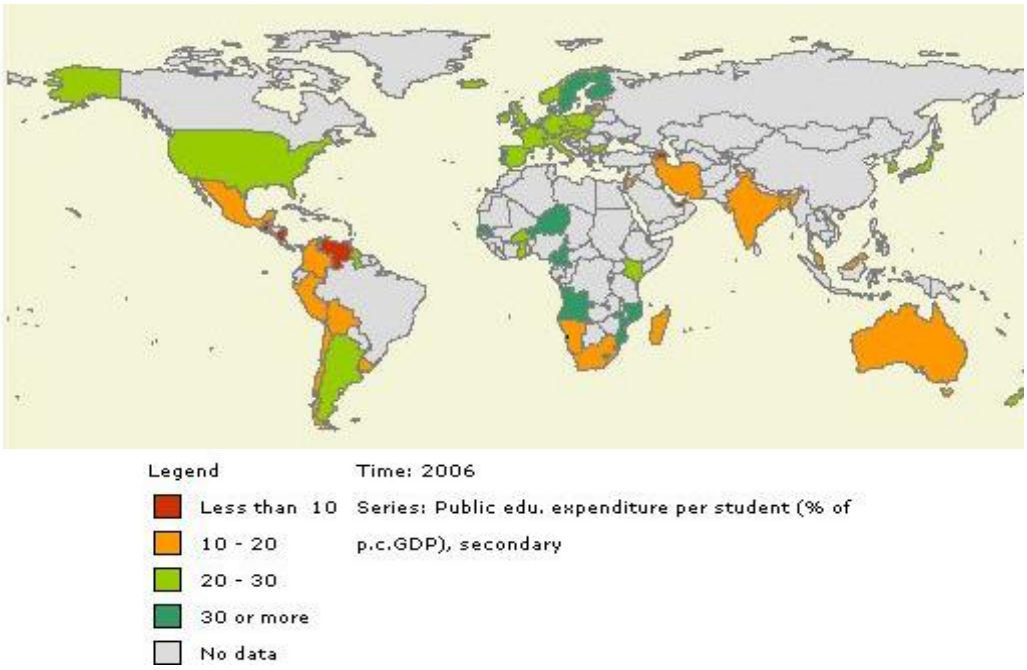


Source : www.worldbank.com

The graph represents the expenditure incurred by various nations as percentage of their gross domestic product (GDP) spent on public education expenditure per student. It is evident from the above graph that in comparison to India which is incurring 50 to 100 percent of p.c. GDP most of the other continents and regions like Australia, Europe, Russia, North America and few South American countries are spending less than 50 percent of p.c. GDP on public education expenditure per student on tertiary education.

Annexure 1.3

Public Education Expenditure per Student (% of GDP), Secondary Education

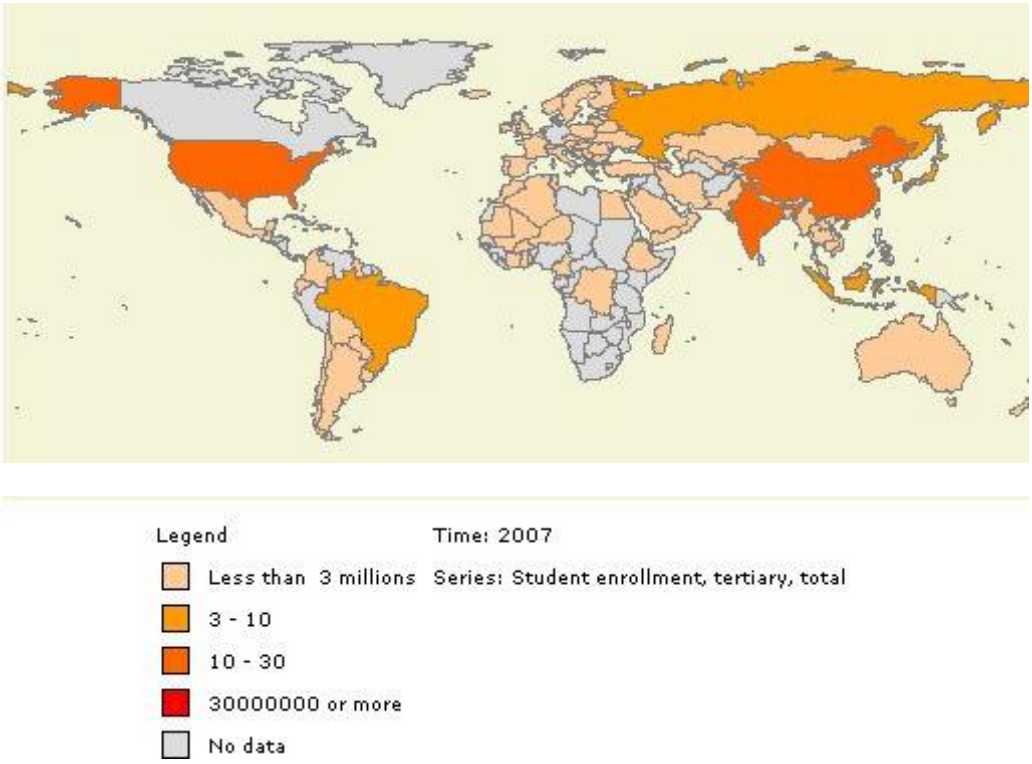


Source : www.worldbank.com

The graph represents the expenditure incurred by various nations as percentage of their gross domestic product (GDP) spent on public education expenditure per student for secondary education. It is evident from the above graph that regions like India, Australia, S. American countries and a few countries in Middle East are incurring around 10 to 20 percent of their GDP for strengthening secondary education in comparison to European Countries, USA and a few South American nations which are spending more than 20 to 30 percent of their p.c. GDP. Some of the European and African countries are spending more than 30 percent of their p.c. GDP.

Annexure 1.4

Student Enrolment Ratio at Tertiary Education (Total)

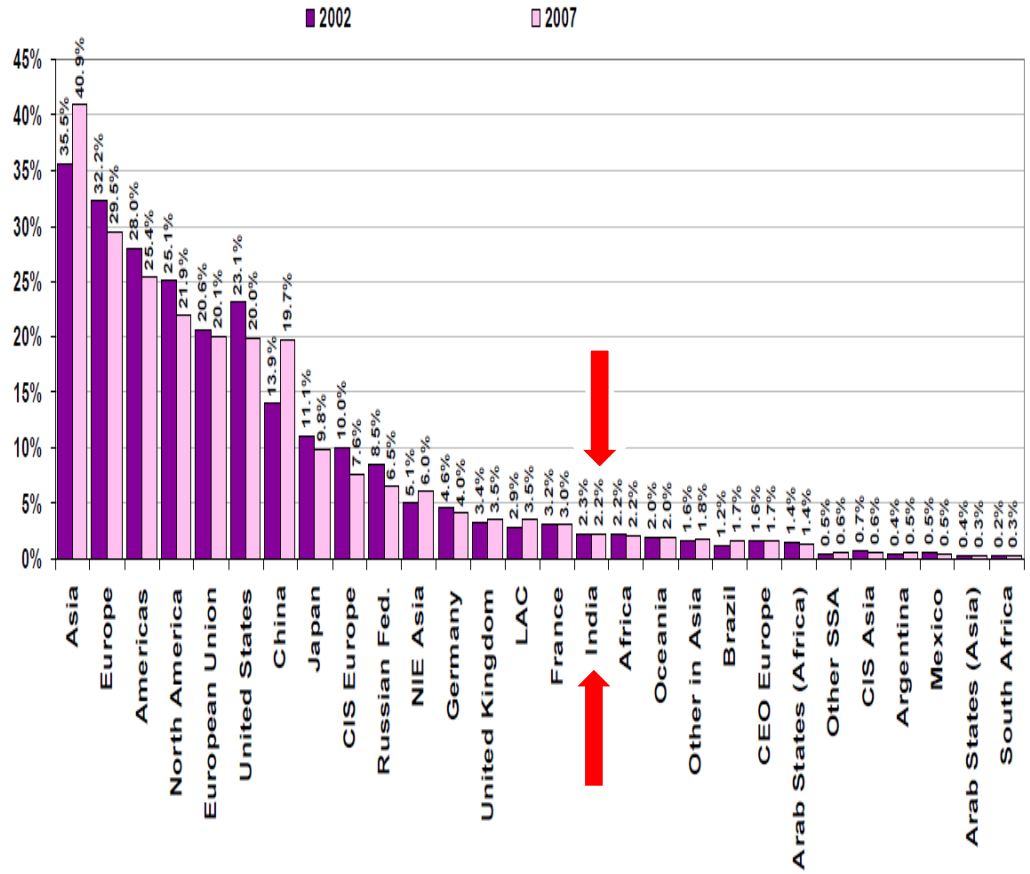


Source : www.worldbank.com

The graph represents tertiary student enrolment in a global perspective. It is clearly evident from the above graph that the tertiary student enrolment is quite high in regions like India, China, North America this phenomenon could be primarily due to the high population density in these regions.

Annexure 1.5

Regional Density of Researchers



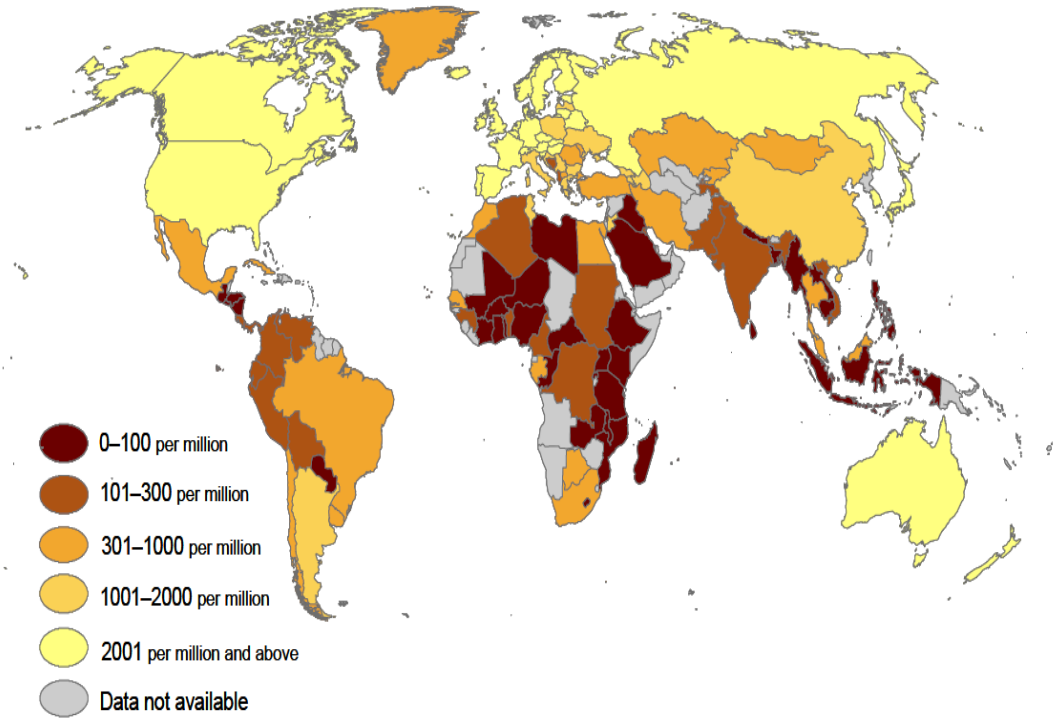
Source: UNESCO Institute for Statistics estimates, August 2010

Note : Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, as well as in the management of the projects concerned (Frascati Manual, 2002).

The graph provides a global overview of countries with the highest concentration of researchers as well as a breakdown by region. It is the responsibility of the policy makers to ensure that their countries have adequate number of researchers to foster the innovation ecosystem. It is the responsibility of the policy makers to ensure that their countries have adequate number of researchers to foster the innovation ecosystem. In the graph it is visible that the density of researchers in India is very low 2.2% whereas in developing countries the density is quite high up to 20%. Initiatives need to be taken by various nations to encourage the researcher by devising new innovative schemes etc. In the drive to strengthen knowledge-based societies, policymakers are looking to ensure that their countries have an adequate supply of researchers.

Annexure 1.6

Distribution of Researchers per Million - Regional Wise

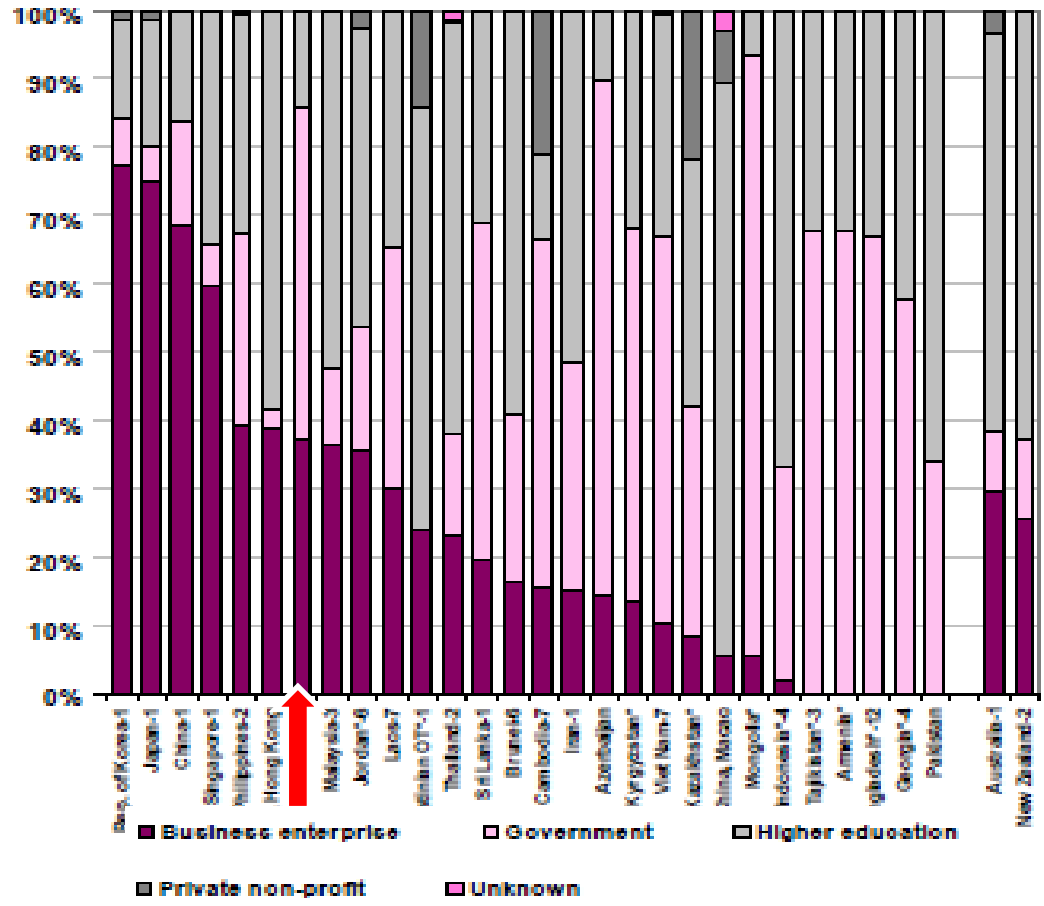


Source:UNESCOInstituteforStatistics,July 2011.

The graph illustrates the distribution of researchers per 1 million inhabitants. The data are expressed in full-time equivalents (FTE), which is a measure of the actual volume of human resources devoted to research and development (R&D). It is important to note when interpreting the data that headcounts (HC) were used for countries where FTE figures were not available. The above graph clearly depicts that the number of researchers per million in India are quite low than the most of the regions like USA, Australia, Europe and most of the Asian countries.

Annexure 1.7

Percentage of Researchers By Employment In Various Nations



The present graph represents the current global scenario in terms of availability of researchers sector wise. It is clearly evident from the graph that in India the percentage of researchers in business enterprises are approximately 38% and the availability of researchers in government is between 40-45% and in higher education the number of researchers are about 15%. It is felt from the above graph that the number of researchers in higher education needs to be improved and government should take initiatives and launch new schemes for providing sufficient funds to encouraging researchers in higher education to pursue research.

Annexure 2.0

List of S&T Funding Departments and Ministries

1. All India Council for Technical Education (AICTE)
2. Council of Scientific and Industrial Research (CSIR)
3. Defense Research and Development Organization (DRDO)
4. Department of Atomic Energy (DAE)
5. Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathy (AYUSH)
6. Department of Biotechnology (DBT)
7. Department of Coal (DOC)
8. Ministry of Earth Sciences (MoES)
9. Department of Science and Technology (DST)
10. Department of Scientific and Industrial Research (DSIR)
11. Indian Council of Medical Research (ICMR)
12. India Meteorological Department (IMD)
13. Indian Space Research Organization (ISRO)
14. Ministry of Communications & Information Technology (MOCIT)
15. Department of Information Technology
16. Ministry of Environment and Forests (MOEF)
17. Ministry of Food Processing Industries (MFPI)
18. Ministry of New and Renewable Energy
19. Ministry of Power, Central Power Research Institute (CPRI)
20. Ministry of Social Justice & Empowerment (MOSJE)
21. Ministry of Water Resources (MOWR)
22. Petroleum Conservation Research Association (PCRA)
23. University Grants Commission (UGC)

Annexure 2.1

List of CSIR Laboratories Biological Sciences

1. Centre for Biochemical Technology (CBT), Delhi - 110007
2. Centre for Cellular and Molecular Biology (CCMB), Hyderabad - 500007
3. Central Drug Research Institute (CDRI), Lucknow - 226001
4. Central Food Technological Research Institute (CFTRI), Mysore - 570013
5. Central Institute of Medicinal & Aromatic Plants (CIMAP), Lucknow - 226016
6. Indian Institute of Chemical Biology (IICB), Calcutta – 700032
7. Institute of Microbial Technology (IMT), Chandigarh - 160036
8. Industrial Toxicology Research Centre (ITRC), Lucknow - 226001
9. National Botanical Research Institute (NBRI), Lucknow -226001
10. Regional Research Laboratory (RRL,JM), Jammu Tawi – 180001
11. Institute of Himalayan Bioresources Technology (IHBT), Palampur - 176061

Chemical Sciences

12. Central Electrochemical Research (CECRI), Karaikudi – 623006
13. Central Leather Research Institute (CLRI), Madras - 600020
14. Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar
15. Indian Institute of Chemical Technology (IICT), Hyderabad - 500007

16.Indian Institute of Petroleum (IIP), Dehradun - 248005
17.National Chemical Laboratory (NCL), Pune - 411008
18.Regional Research Laboratory (RRL,JOR), P.O. Jorhat - 785006

Engineering Sciences

19.Central Mining Research Institute (CMRI), Dhanbad - 826001
20.Central Road Research Institute (CRRI), New Delhi - 110020
21.National Aerospace Laboratories (NAL), Bangalore - 560017
22.National Environmental Engineering Research Institute (NEERI), Nagpur
23.National Metallurgical Laboratory (NML), Jamshedpur - 831007
24.Regional Research Laboratory (RRL,BHO), Bhopal – 462026
25.Regional Research Laboratory (RRL,BHU), Bhubaneshwar - 751013
26.Regional Research Laboratory (RRL,TVM), Triuvananthapuram - 695019
27.Structural Engineering Research Centre (SERC-G), Ghaziabad – 201001
28.Structural Engineering Research Centre (SERC-C), Madras – 600113
29.Central Building Research Institute (CBRI), Roorkee - 247667
30.Central Fuel Research Institute (CFRI), Dhanbad – 828108
31.Central Glass and Ceramic Research Institute (CGCRI), Calcutta – 700032
32.Central Mechanical Engineering Research Institute (CMERI), Durgapur -

Information Sciences

33.National Institute of Science Communication & Information Resources (NISCAIR), New Delhi - 110012
34.National Institute of Science Technology and Development Studies (NISTADS), New Delhi – 110007

Physical Sciences

35.Central Electronics Engineering Research Institute (CEERI) , Pilani – 333031
36.Central Scientific Instruments Organization (CSIO), Chandigarh - 160020
37.National Geophysical Research Institute (NGRI), Hyderabad - 500007
38.National Institute of Oceanography (NIO), Goa - 403004
39.National Physical Laboratory (NPL), New Delhi – 110012

Annexure 2.2

List of DRDO Organizations

1. Aeronautical Development Establishment (ADE), Bangalore
2. Advanced Numerical Research & Analysis Group (ANURAG), Hyderabad
3. Aerial Delivery Research & Development Establishment (ADRDE), Agra
4. Armament Research & Development Establishment (ARDE), Pune
5. Center for Artificial Intelligence & Robotics (CAIR), Bangalore
6. Center for Fire ,Explosive and Environment Safety (CFEES)
7. Center for Military Airworthiness & Certification (CEMILAC), Bangalore
8. Centre for Air Borne Systems (CABS), Bangalore
9. Combat Vehicles Research & Development Estt. (CVRDE), Chennai
10. Defence Agricultural Research Laboratory (DARL), Pithoragarh

11. Defence Avionics Research Establishment (DARE), Bangalore
12. Defence Bio-Engineering & Electro Medical Laboratory (DEBEL), Bangalore
13. Defence Electronics Application Laboratory (DEAL), Dehradun
14. Defence Electronics Research Laboratory (DLRL), Hyderabad
15. Defence Food Research Laboratory (DFRL), Mysore
16. Defence Institute of Advanced Technology (Deemed University), Pune
17. Defence Institute of High Altitude Research (DIHAR)
18. Defence Institute of Physiology & Allied Sciences (DIPAS), Delhi
19. Defence Institute of Psychological Research (DIPR), Delhi
20. Defence Laboratory (DLJ), Jodhpur
21. Defence Materials & Stores Research & Development Establishment (DMSRDE), Kanpur
22. Defence Metallurgical Research Laboratory (DMRL), Hyderabad
23. Defence Research & Development Laboratory (DRDL), Hyderabad
24. Defence Research & Development Establishment (DRDE), Gwalior
25. Defence Research Laboratory (DRL), Tejpur
26. Defence Scientific Information & Documentation Centre (DESIDOC), Delhi
27. Defence Terrain Research Laboratory (DTRL), Delhi
28. Electronics & Radar Development Establishment (LRDE), Bangalore
29. Gas Turbine Research Establishment (GTRE), Bangalore
30. High Energy Materials Research Laboratory (HEMRL), Pune
31. Institute of Nuclear Medicine & Allied Sciences (INMAS), Delhi
32. Institute of Systems Studies & Analyses (ISSA), Delhi
33. Institute of Technology Management (ITM), Mussorie
34. Instruments Research & Development Establishment (IRDE), Dehradun
35. Integrated Test Range (ITR), Balasore
36. Laser Science & Technology Centre (LASTEC), Delhi
37. Microwave Tube Research & Development Center (MTRDC), Bangalore
38. Naval Materials Research Laboratory (NMRL), Ambernath
39. Naval Physical & Oceanographic Laboratory (NPOL), Cochin
40. Naval Science & Technological Laboratory (NSTL), Vishakapatnam
41. Proof & Experimental Establishment (PXE), Balasore
42. Research & Development Establishment (R&DE), Pune
43. Research Center Imarat (RCI), Hyderabad
44. Scientific Analysis Group (SAG), Delhi
45. Snow & Avalanche Study Estt (SASE), Chandigarh
46. Solid State Physics Laboratory (SSPL), Delhi
47. Terminal Ballistics Research Laboratory(TBRL),Chandigarh
48. Vehicle Research & Development Establishment (VRDE), Ahmednagar

Annexure 2.3

List of ICMR Institutions

1. National JALMA Institute for Leprosy & Other Mycobacterial Diseases (NJILOMD)
2. National Institute of Occupational Health (NIOH)
3. National Institute for Research in Environmental Health (NIREH)
4. National Institute for Research in Tuberculosis (NIRT)
5. National Institute of Epidemiology (NIE)
6. National Institute of Malaria Research (NIMR)
7. National Institute of Pathology (NIP)
8. National Institute of Medical Statistics (NIMS)
9. National Institute of Nutrition (NIN)
10. National Institute of Cholera and Enteric Diseases (NICED)
11. Centre for Research in Medical Entomology (CRME)
12. National Institute for Research in Reproductive Health (NIRRH)
13. National Institute of Immunohaemotology (NIIH)
14. Enterovirus Research Centre (ERC)
15. Institute of Cytology and Preventive Oncology (ICPO)
16. Rajendra Memorial Research Institute of Medical Sciences (RMRIMS)
17. Vector Control Research Centre (VCRC)
18. National Institute of Virology (NIV)
19. National AIDS Research Institute (NARI)
20. Regional Medical Research Centre Bhubaneswar
21. Regional Medical Research Centre Dibrugarh
22. Regional Medical Research Centre Port Blair
23. Regional Medical Research Centre Jabalpur
24. Desert Medicine Research Centre Jodhpur
25. Regional Medical Research Centre Belgaum
26. Food & Drug Toxicology Research Centre, Hyderabad
27. National Centre of Laboratory Sciences, Hyderabad
28. ICMR Virus Unit, Kolkata
29. Genetic Research Centre, Mumbai
30. Microbial Containment Complex, Pune

Annexure 2.4

List of ISRO Centers

1. Vikram Sarabhai Space Centre, Thiruvananthapuram
2. ISRO Satellite Centre, Bangalore
3. Satish Dhawan Space Centre, Sriharikota
4. Liquid propulsions Centre, Bangalore
5. Space Applications Centre, Ahmedabad
6. National Remote Sensing Centre, Hyderabad
7. ISRO Telemetry, Tracking and Command Network, Bangalore
8. Master Control Facility, Bhopal
9. ISRO Inertial Sytem Unit, Thiruvananthapuram
10. Laboratory for Electro Optic System, Bangalore.

11.Development and Educational Communication Unit, Ahmedabad
12.Regional Remote Sensing centres
13.Indian Institute of Space Sciences and Technology (IIST), Thiruvananthapuram
14.Physical Research Laboratory, Ahmedabad
15.National Atmospheric Research Laboratory, Gudanki
16.North Eastern Space Application Centre, Shillong
17.Semi-Conductor Laboratory , Chandigarh
18.Antrix Corporation Limted, Bangalore

Annexure 2.5

Aided Institutions and other Organizations of DAE

1. Tata Institute of Fundamental Research
2. Saha Institute of Nuclear Physics
3. Tata Memorial Centre
4. Harish-Chandra Research Institute
5. Institute of Physics
6. National Institute of Science Education and Research
7. Institute of Mathematical Sciences
8. Institute of Plasma Research
9. Board of Research in Nuclear Sciences (BRNS)
10. National Board for higher Mathematics (NBHM)
11. Atomic Energy Education Society
12. Homi Bhabha National Institute

Annexure 2.6

Autonomous S&T Institutions of DST

1. Agharkar Research Institute, Pune
2. Aryabhatta Research Institute of Observational-Sciences, Nainital
3. Birbal Sahni Institute of Palaeobotany, Lucknow
4. Bose Institute, Kolkata
5. Centre for Liquid Crystal Research, Jalahalli, Bangalore
6. Indian Association for the Cultivation of Science, Kolkata
7. Indian Institute of Astrophysics, Bangalore
8. Indian Institute of Geomagnetism, Mumbai
9. International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad
10.The Institute of Advanced Study in Science & Technology
11.Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
12.National Accreditation Board for Testing & Calibration Laboratories, New Delhi
13.Raman Research Institute, Bangalore
14.S.N. Bose National Centre for Basic Sciences, Kolkata
15.Sreechitra Tirunal Institute for Medical Sciences & Technology, Thiruvananthapuram
16.Technology Information, Forecasting & Assessment Council (TIFAC), New Delhi
17.Vigyan Prasar, New Delhi
18.Wadia Institute of Himalayan Geology, Dehradun

Annexure 2.7

Institutes of DSIR

- Autonomous Bodies
  - * CSIR (Council of Scientific and Industrial Research)
  - * CDC (Consultancy Development Cell)
- Public Enterprises
  - * CEL (Central Electronics Limited)
  - * NRDC (National Research Development Corporation)
- United Nations Agency
  - * APCTT-UNESCAP **(Asian and Pacific Centre for Transfer of Technology)**

Annexure 2.8

Department of Biotechnology

1. Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad
2. Institute of Bioresources and Sustainable Development (IBSD), Imphal, Manipur
3. Institute of Life Sciences, Bhuvaneswar
4. National Institute of Immunology, New Delhi
5. National Institute for Plant Genome Research (NIPGR), JNU, New Delhi
6. National Brain Research Centre (NBRC), Gurgaon
7. National Centre for Cell Sciences, Pune
8. Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram
9. National Agri-Food Biotechnology Institution (NABI)
10. International Centre for Genetic Engineering and Biotechnology (ICGEB)
11. Institute of Stem Cell Science and Regenerative Medicine (ISCSRM), Bangalore
12. Translational Health Science and Technology Institute (THSTI), Faridabad
13. National Institute of Biomedical Genomics (NIBMG) , Kalyani
14. UNESCO Regional Centre for Biotechnology Training and Education (URCB), Fairdabad
15. Bharat Immunologicals & Biologicals Corporation Limited, Bulandshahar
16. Indian Vaccines Corporation Limited, Gurgaon

Annexure 2.9

Ministry of Environment and Forests

1. Govind Ballabh Pant Institute of Himalayan Environment & Development
2. Indian Council of Forestry Research and Education
3. Indian Institute of Forest Management
4. Indian Plywood Industries Research and Training Institute
5. Wildlife institute of India
6. Central Zoo Authority
7. National Biodiversity Authority
8. National Ganga River Basin Authority
9. National Tiger Conservation Authority
10. Animal Welfare Board of India
11. Central Pollution Control Board
12. National Afforestation and Eco-development Board
13. Andaman & Nicobar Islands Forest & Plantation Development Corporation Ltd.

Annexure 2.10

Ministry of Food Processing Industries

1. National Institute of Food Technology Entrepreneurship & Management
2. Indian Institute of Crop Processing Technology (IICPT)
3. National Meat & Poultry Processing Board (NMPPB)
4. Indian Grape Processing Board (IGPB)

Annexure 2.11

Institutes of Department of AYUSH

1. North Eastern Institute of Folk Medicine, Pasighat, Arunachal Pradesh
2. All India Institute of Ayurveda, New Delhi
3. Institute of Post Graduate Teaching & Research in Ayurveda, Jamnagar
4. National Institute of Ayurveda, Jaipur
5. North Eastern Institute on Ayurveda & Homeopathy, Shillong, Meghalaya
6. Rashtriya Ayurveda Vidyapeeth, New Delhi
7. National Institute of Siddha, Chennai
8. National Institute of Homeopathy, Kolkatta
9. National Institute of Unani Medicine, Bangalore
10. Morarji Desai National Institute of Yoga, New Delhi
11. National Institute of Naturopathy, Pune

Annexure 2.12

Ministry of Communications & Information Technology

1. Controller of Certifying Authorities (CCA)
2. Cyber Appellate Tribunal (CAT)
3. Semiconductor Integrated Circuits Layout-Design Registry
4. Indian Computer Emergency Response Team (ICERT)
5. .in Registry (IR)
6. Standardization, Testing and Quality Certification (STQC) Directorate
7. National Informatics Centre (NIC)
8. Media Lab Asia
9. National Informatics Centre Services Inc.(NICSI) (PSE under control of NIC)
10. National Internet Exchange of India(NIXI)
11. Education & Research in Computer Networking(ERNET)
12. Centre for Development of Advanced Computing (C-DAC)
13. Centre for Materials for Electronics Technology (C-MET)
14. DOEACC Society
15. Society for Applied Microwave Electronics Engineering and Research (SAMEER)
16. Software Technology Parks of India (STPI)
17. Electronics and Computer Software Export Promotion Council (ESC)

Annexure 2.13

Ministry of Petroleum

Public Sector Undertakings

1. Balmer Lawrie & Co. Ltd.
2. Bharat Petroleum Corporation Ltd.
3. Biecco Lawrie Co. Ltd.
4. Bongaigaon Refinery and Petro-Chemicals Ltd.
5. Chennai Petroleum Corporation Limited
6. Cochin Refineries Ltd.
7. Engineers India Ltd.
8. Gas Authority of India Ltd.
9. Hindustan Petroleum Corporation Ltd.
10. IBP Co. Ltd.
11. Indian Oil Corporation Ltd.
12. Numaligarh Refinery Ltd.
13. Oil India Ltd
14. Oil & Natural Gas Corporation Ltd
15. Mangalore Refinery and Petrochemicals Limited
16. Centre For High Technology
17. Directorate General of Hydrocarbons.
18. Oil Industry Development Board.
19. Oil Industry Safety Directorate
20. O.N.G.C. VIDESH LIMITED
21. Petroleum Conservation Research Association.
22. Petroleum Planning And Analysis Cell
23. Petroleum Federation of India (PetroFed)

Annexure 2.14

Ministry of New and Renewable Energy

1. Indian Renewable Development Agency
2. Alternate Hydro Energy Centre
3. National Institute of Renewable Energy
4. Centre for Wind Energy technology
5. Solar Energy Centre

Annexure 2.15

Ministry of Power

1. Central Electricity Authority
2. National Thermal Power Corporation (NTPC)
3. National Hydroelectric Power Corporation (NHPC)
4. Rural Electrification Corporation (REC)
5. North Eastern Electric Power Corporation (NEEPCO)
6. Power Finance Corporation (PFC)
7. Power Grid Corporation of India (POWER GRID)
8. THDC India Limited
9. Satluj Jal Vidyut Nigam Ltd. (SJVN)
10. Central Power Research Institute (CPRI)

11. National Power Training Institute (NPTI)
12. Damodar Valley Corporation (DVC)
13. Bureau of Energy Efficiency (BEE)
14. Bhakra Beas Management Board(BBMB)

Annexure 2.16

Department of Coal

1. Coal India Limited (CIL)
2. Neyveli Lignite Corporation (NLC)
3. Singareni Collieries Company Limited (SCCL)
4. Coal Mines Provident Fund Organization (CMFPO)
5. Coal Controller
6. Commissioner of Payments

Annexure 2.17

Ministry of Water Resources

1. Upper Yamuna River Board
2. Central Water Commission, New Delhi
3. Central Ground Water Board, Faridabad
4. Central Water and Power Research Station, Pune
5. Central Soil and Materials Research Station, New Delhi
6. National Water Development Agency
7. National Institute of Hydrology, Roorkee
8. WAPCOS Limited
9. National Projects Construction Corporation Ltd, New Delhi
10. Narmada Control Authority, Indore
11. Sardar Sarovar Construction Advisory Committee(SSCAC)
12. Farakka Barrage Project, Farakka
13. Bansagar Control Board
14. Betwa River Board
15. Brahmaputra Board
16. Tungabhadra Board

Annexure 2.18

Ministry of Earth Sciences

1. Indian National Centre for Ocean Information Services, Hyderabad
2. National Institute of Ocean Technology, Chennai
3. National Centre of Antarctic and Ocean Research , Goa
4. Indian Institute of Tropical Meteorology, Pune.
5. Integrated Coastal and Marine Area management, Chennai
6. Centre for Marine Living Resources and Ecology, Kochi
7. Earthquake Risk Evaluation Centre, New Delhi
8. National Centre for Medium Range Weather Forecasting, Noida.

Indian Council of Agricultural Research

Deemed Universities - 4

1. Indian Agricultural Research Institute, New Delhi
2. National Dairy Research Institute, Karnal
3. Indian Veterinary Research Institute, Izatnagar
4. Central Institute on Fisheries Education, Mumbai

Institutions - 45

1. Central Rice Research Institute, Cuttack
2. Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora
3 Indian Institute of Pulses Research, Kanpur
4. Central Tobacco Research Institute, Rajahmundry
5. Indian Institute of Sugarcane Research, Lucknow
6. Sugarcane Breeding Institute, Coimbatore
7. Central Institute of Cotton Research, Nagpur
8. Central Research Institute for Jute and Allied Fibres, Barrackpore
9. Indian Grassland and Fodder Research Institute, Jhansi
10. Indian Institute of Horticultural Research, Bangalore
11. Central Institute of Sub Tropical Horticulture, Lucknow
12. Central Institute of Temperate Horticulture, Srinagar
13. Central Institute of Arid Horticulture, Bikaner
14. Indian Institute of Vegetable Research, Varanasi
15. Central Potato Research Institute, Shimla
16. Central Tuber Crops Research Institute, Trivandrum
17. Central Plantation Crops Research Institute, Kasargod
18. Central Agricultural Research Institute, Port Blair
19. Indian Institute of Spices Research, Calicut
20. Central Soil and Water Conservation Research & Training Institute, Dehradun
21. Indian Institute of Soil Sciences, Bhopal
22. Central Soil Salinity Research Institute, Karnal
23. ICAR Research Complex for Eastern Region including Centre of Makhana, Patna
24. Central Research Institute of Dryland Agriculture, Hyderabad
25. Central Arid Zone Research Institute, Jodhpur
26. ICAR Research Complex Goa
27. ICAR Research Complex for NEH Region, Barapani
28. National Institue of Abiotic Stress Management, Malegaon, Maharashtra
29. Central Institute of Agricultural Engineering, Bhopal
30. Central Institute on Post harvest Engineering and Technology, Ludhiana
31. Indian Institute of Natural Resins and Gums, Ranchi
32. Central Institute of Research on Cotton Technology, Mumbai
33. National Institute of Research on Jute & Allied Fibre Technology, Kolkata
34. Indian Agricultural Statistical Research Institute, New Delhi
35. Central Sheep and Wool Research Institute, Avikanagar, Rajasthan
36. Central Institute for Research on Goats, Makhdoom
37. Central Institute for Research on Buffaloes, Hissar
38. National Institute of Animal Nutrition and Physiology, Bangalore

39. Central Avian Research Institute, Izatnagar
40. Central Marine Fisheries Research Institute, Kochi
41. Central Institute Brackishwater Aquaculture, Chennai
42. Central Inland Fisheries Research Institute, Barrackpore
43. Central Institute of Fisheries Technology, Cochin
44. Central Institute of Freshwater Aquaculture, Bhubneshwar
45. National Academy of Agricultural Research & Management, Hyderabad

National Research Centres - 17

1. National Research Centre on Plant Biotechnology, New Delhi
2. National Centre for Integrated Pest Management, New Delhi
3. National Research Centre for Litchi, Muzaffarpur
4. National Research Centre for Citrus, Nagpur
5. National Research Centre for Grapes, Pune
6. National Research Centre for Banana, Trichi
7. National Research Centre Seed Spices, Ajmer
8. National Research Centre for Pomegranate, Solapur
9. National Research Centre on Orchids, Pakyong, Sikkim
10. National Research Centre Agroforestry, Jhansi
11. National Research Centre on Camel, Bikaner
12. National Research Centre on Equines, Hisar
13. National Research Centre on Meat, Hyderabad
14. National Research Centre on Pig, Guwahati
15. National Research Centre on Yak, West Kemang
16. National Research Centre on Mithun, Medziphema, Nagaland
17. National Centre for Agril. Economics & Policy Research, New Delhi

National Bureaus - 6

1. National Bureau of Plant Genetics Resources, New Delhi
2. National Bureau of Agriculturally Important Micro-organisms, Mau, Pradesh
3. National Bureau of Agriculturally Important Insects, Bangalore
4. National Bureau of Soil Survey and Land Use Planning, Nagpur
5. National Bureau of Animal Genetic Resources, Karnal
6. National Bureau of Fish Genetic Resources, Lucknow

Directorates/Project Directorates - 25

1. Directorate of Maize Research, New Delhi.
2. Directorate of Rice Research, Hyderabad
3. Directorate of Wheat Research, Karnal
4. Directorate of Oilseed Research, Hyderabad
5. Directorate of Seed Research, Mau
6. Directorate of Sorghum Research, Hyderabad
7. Directorate of Groundnut Research, Junagarh
8. Directorate of Soybean Research, Indore
9. Directorate of Rapeseed & Mustard Research, Bharatpur
10. Directorate of Mushroom Research, Solan
11. Directorate on Onion and Garlic Research, Pune
12. Directorate of Cashew Research, Puttur
13. Directorate of Oil Palm Research, Pedavegi, West Godawari

14. Directorate of Medicinal and Aromatic Plants Research, Anand
15. Directorate of Floriculture Research, Pusa, New Delhi
16. Project Directorate for Farming Systems Research, Modipuram
17. Directorate of Water Management Research, Bhubaneshwar
18. Directorate of Weed Science Research, Jabalpur
19. Project Directorate on Cattle, Meerut
20. Project Directorate on Foot & Mouth Disease, Mukteshwar
21. Project Directorate on Poultry, Hyderabad
22. Project Directorate on Animal Disease Monitoring and Surveillance, Hebbal, Bangalore
23. Directorate of Knowledge Management in Agriculture (DKMA), New Delhi
24. Directorate of Cold Water Fisheries Research, Bhimtal, Nainital
25. Directorate of Research on Women in Agriculture, Bhubaneshwar

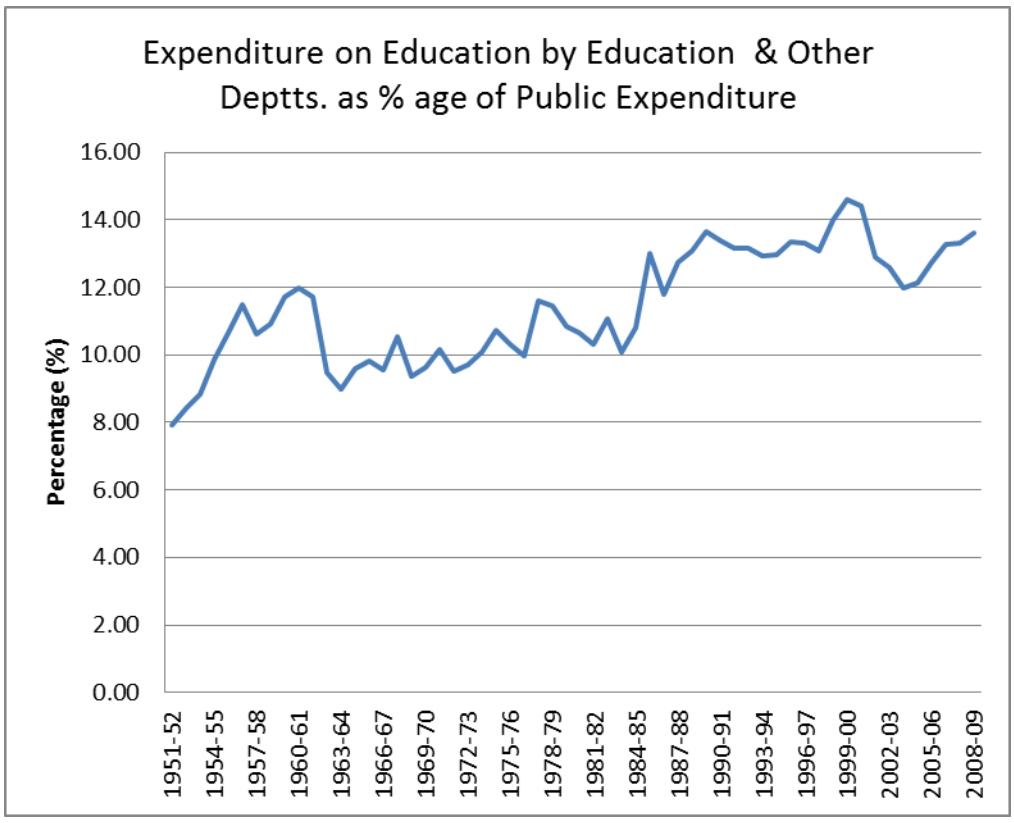
Annexure 2.20

Colleges under Department of Agriculture Research and Education (DARE)

1	College of Agriculture, Iroisemba, Imphal	Manipur
2	College of Vety. Sciences & A.H., Selesih, Aizawl	Mizoram
3	College of Fisheries, Lembucherra, AgartalaTripura	
4	College of Horticulture & Forestry, Pasighat Arunachal Pradesh	
5	College of Home Science, Tura Meghalaya	
6	College of Agricultural Engineering & Post-Harvest Technology, Sikkim	
7	College of Post-Graduate Studies, Barapani, Meghalaya	

Annexure 3.1

Total Expenditure on Education by Various Departments



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Expenditure on R&D by Different Departments

Ministries /Departments	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
DARE				2826.46	3143.44	3592.5
DAE	872.74	1003	1215	3083.13	4025.37	4189.93
MoES	340	438	690	321.39	616.46	739
DST	1250	1367	1526	1805.2	2003.61	2329.33
DSIR	846	975	1070	2387.2	2685.44	2975
DOS	2800	3220	3420	3255.48	2685.44	5062.22
DBT	445	521	675	-	-	-

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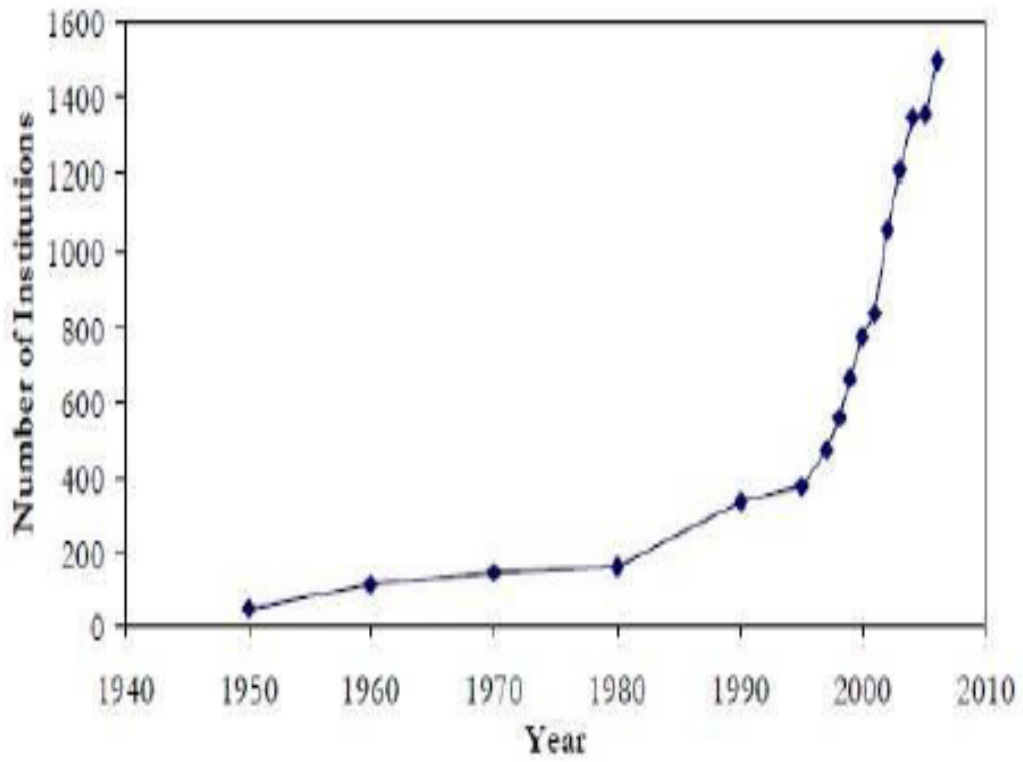
The above table provides a basic Idea about the various departments and ministries and the amount of expenditure incurred by them for the promotion and development of science and technology so that novel innovations could happen and which can subsequently be helpful to the society. High amount of expenditure is incurred by space and atomic energy departments for the promotion of R&D, which is growing rapidly in India

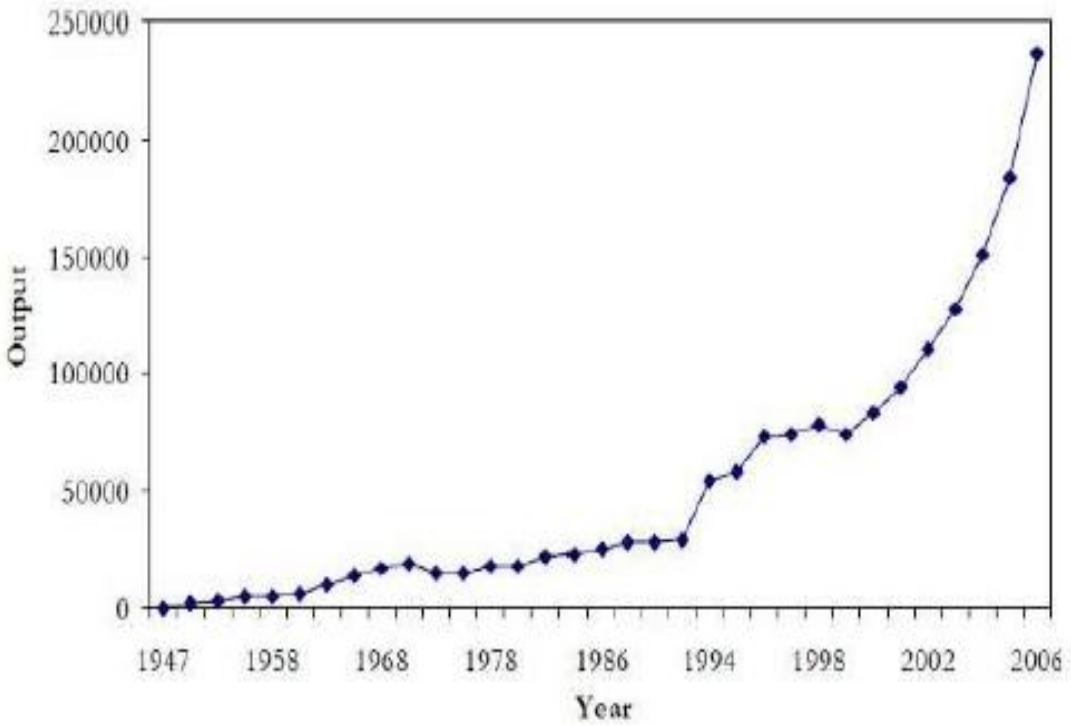
Annexure 3.3

Growth of Degree Institutions in India



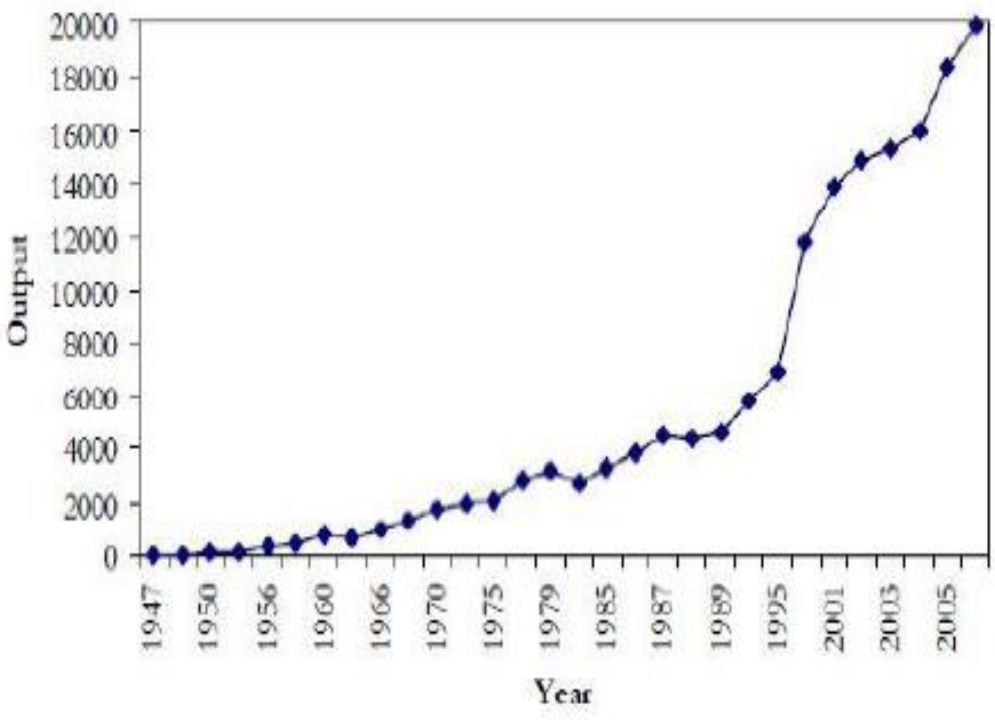
Source: Higher Technical Education Report in India by Prof. Chopra and Prof. Sharma (2007)

Growth of Sanctioned intake of Graduates



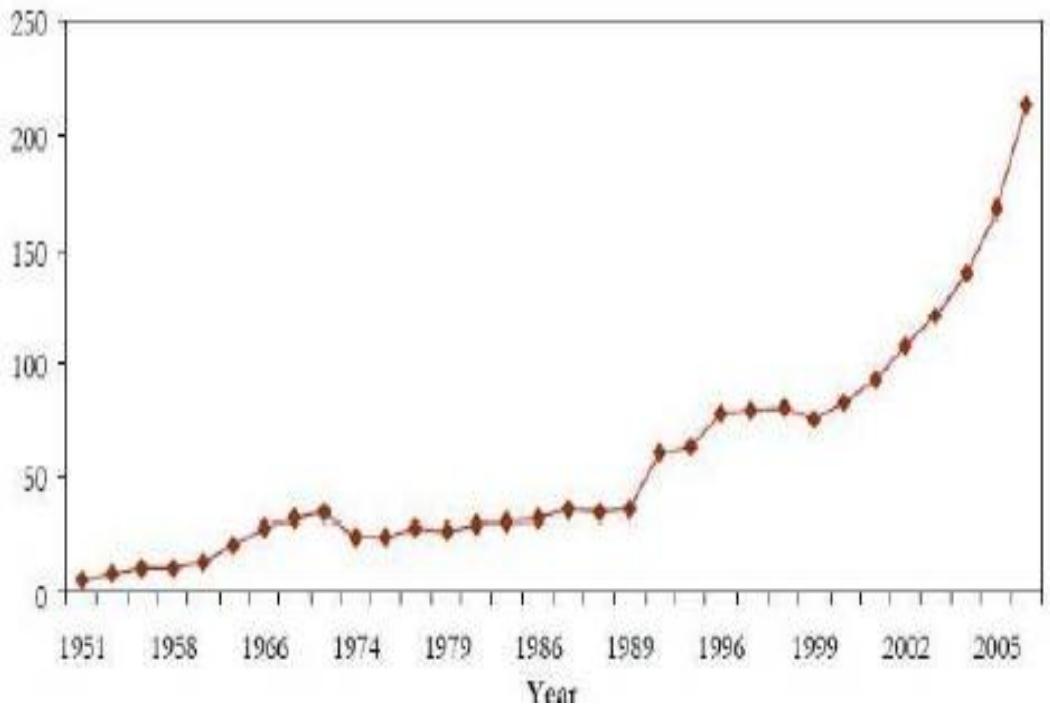
Source: Higher Technical Education Report in India by Prof. Chopra and Prof. Sharma (2007)

Total output of Engineering Graduates



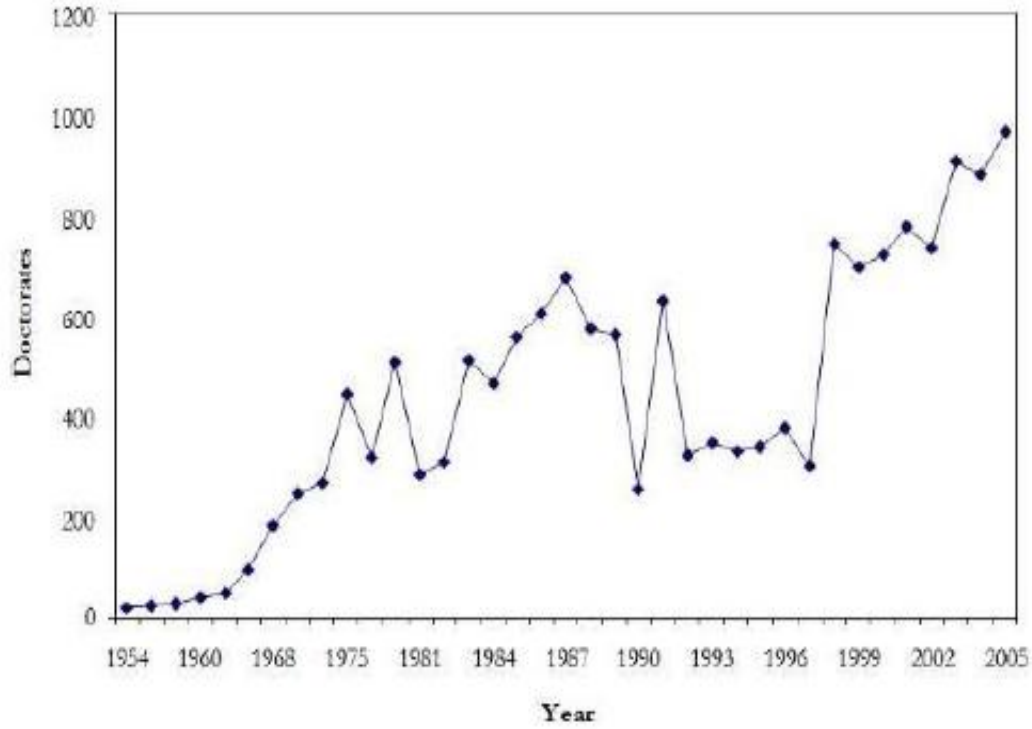
Source: Higher Technical Education Report in India by Prof. Chopra and Prof. Sharma (2007)

Growth of Engineering Graduates per Million Population in India



Source: Higher Technical Education Report in India by Prof. Chopra and Prof. Sharma (2007)

Engineering Doctorate Degrees Awarded in India



Source: Higher Technical Education Report in India by Prof. Chopra and Prof. Sharma (2007)

Annexure 3.8

Number of Seats in Technical (Vocational) Apprentices in India

(as on 30.06.2010)

Region/ States/UTs	Number of Govt. ITIs	Seating Capacity (Govt.)	Number of Pvt. ITCs	Seating Capacity (Pvt.)	Total ITIs/ ITCs	Total Seating Capacity
Maharashtra	388	86124	297	35620	685	121744
Andhra Pradesh	109	22510	506	97644	615	120154
Karnataka	150	25682	1046	78814	1196	104496
Uttar Pradesh	300	31500	564	63886	864	95386
Orissa	26	8464	495	84100	521	92564
Rajasthan	114	13264	668	76671	782	89935
Tamil Nadu	60	21832	627	62590	687	84422
Gujarat	153	56172	350	20744	503	76916
Kerala	36	15916	482	52890	518	68806
Bihar	34	11433	225	32569	259	44002
Madhya Pradesh	160	24862	75	9954	235	34816
Punjab	94	19316	153	15008	247	34324
Haryana	82	20824	85	9128	167	29952
Jharkhand	20	4672	95	24232	115	28904
Delhi	16	11132	57	4140	73	15272
Himachal Pradesh	70	8260	82	7004	152	15264
West Bengal	51	12700	22	1320	73	14020
Chattishgarh	87	10224	29	3376	116	13600
Uttrakhand	59	6395	29	2534	88	8929
Assam	28	5696	3	80	31	5776
Jammu & Kashmir	37	4087	1	110	38	4197
Goa	10	3264	4	380	14	3644
Poducherry	6	1352	9	508	15	1860
Chandigarh	2	968	0	0	2	968
Nagaland	8	944	0	0	8	944
Tripura	8	944	0	0	8	944
Meghalaya	5	622	2	320	7	942
Manipur	7	540	0	0	7	540
Sikkim	2	516	0	0	2	516
Arunachal Pradesh	5	512	0	0	5	512
Daman & Diu	2	388	0	0	2	388
Mizoram	1	294	0	0	1	294
Andaman & Nicobar	1	273	0	0	1	273
Dadra & Nagar	1	228	0	0	1	228
Lakshdweep	1	96	0		1	96
India	2133	432006	5906	683622	8039	1115628

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Annexure 3.9

Number of University & University Level Institutions

Sl. No.	State	Central University	State University	Private University	Deemed University	Institution Established Under State legislature Act	Institution of National Importance	Total
1	Andhra Pradesh	3	20	0	4	2	1	30
2	Arunachal Pradesh	1	0	0	1	0	0	2
3	Assam	2	4	0	0	0	2	8
4	Bihar	0	13	1	2	1	1	18
5	Chhattisgarh	1	7	0	0	0	1	9
6	Goa	0	1	0	0	0	0	1
7	Gujarat	0	16	5	2	0	1	24
8	Haryana	0	6	0	3	0	1	10
9	Himachal Pradesh	0	3	1	0	0	1	5
1	Jammu & Kashmir	0	6	0	0	1	1	8
11	Jharkhand	0	4	0	2	0	1	7
12	Karnataka	0	16	0	11	0	1	28
13	Kerala	0	7	0	1	0	2	10
14	Madhya Pradesh	2	13	0	2	0	1	18
15	Maharashtra	1	19	0	20	0	2	42
16	Manipur	2	0	0	0	0	0	2
17	Meghalaya	1	0	0	0	0	0	1
18	Mizoram	1	0	0	0	0	0	1
19	Nagaland	1	0	0	0	0	0	1
20	Odisha	0	10	0	2	0	1	13
21	Punjab	0	7	1	2	0	2	12
22	Rajasthan	0	14	0	7	0	1	22
23	Sikkim	1	0	2	0	0	0	3
24	Tamil Nadu	0	17	0	21	0	3	41
25	Tripura	1	0	1	0	0	1	3
26	Uttar Pradesh	4	19	2	8	1	2	36
27	Uttarakhand	1	3	4	3	0	1	12
28	West Bengal	1	15	0	1	0	3	20
29	Andaman & Nicobar Islands	0	0	0	0	0	0	0
30	Chandigarh	0	1	0	1	0	1	3
31	Dadra & Nagar Haveli							
32	Daman & Diu	0	0	0	0	0	0	0
33	Delhi	4	1	0	11	0	2	18
34	Lakshadweep	0	0	0	0	0	0	0
35	Puducherry	1	0	0	0	0	0	1
Grand Total		28	222	17	104	5	33	409

Source: University Grants Commission (UGC)

Annexure 3.10

Number of Colleges & Polytechnics

Sl. No.	State	Arts, Fine Arts, Social Work, Science & Commerce	Engineering/Technology/ Architecture	Medical	Education/ Teacher Training	Others	Total Colleges	Polytechnics
1	Andhra Pradesh	2286	535	378	610	1031	4840	187
2	Arunachal Pradesh	13	3	1	1	3	21	3*
3	Assam	337	7*	7*	40**	153	544	13
4	Bihar	817	10	37	33	106	1003	13
5	Chhattisgarh	330*	51	4*	4*	51*	440	15
6	Goa	24	4	7	2	6	43	5
7	Gujarat	599	93	262*	343*	569*	1866	67
8	Haryana	234	154	50*	739	54	1231	32**
9	Himachal Pradesh	90	8	20	72	71	261	15
10	Jammu & Kashmir	83	4	13	140	23	263	14
11	Jharkhand	110	4	12	9	26**	161	19**
12	Karnataka	344	141*	423**	0	13*	921	186*
13	Kerala	192	98**	125**	21	12	448	59**
14	Madhya Pradesh	792	159	97**	102**	149**	1299	44
15	Maharashtra	2171	329	172	471	536	3679	227
16	Manipur	58	3	1	6**	5	73	3**
17	Meghalaya	57	1**	0	3	2	63	3*
18	Mizoram	23	0	2	2	2	29	2
19	Nagaland	41	0	0	3	25	69	3
20	Odisha	700	47	66	14	73	900	33
21	Punjab	234	44	72	115	12	477	89*
22	Rajasthan	1017	96*	54**	111**	214	1492	71
23	Sikkim	5	2	3	2*	6	18	2
24	Tamil Nadu	550	344	198**	160	165*	1417	314
25	Tripura	17	2	2	1	6	28	1
26	Uttar Pradesh	2361	212	104	128**	299	3104	136
27	Uttarakhand	103	14**	20**	24	60**	221	42
28	West Bengal	426	64*	68**	88*	140	786	50
29	Andaman & Nicobar Islands	2	0	1	1	1	5	2
30	Chandigarh	15	7	7	6	4	39	7
31	Dadra & Nagar Haveli	1	0	1	1	0	3	0
32	Daman & Diu	1	0	0	2	0	3	1
33	Delhi	89*	15*	8	2	41*	155	79
34	Lakshadweep	2*	0	0	1*	0	3	0
35	Puducherry	22	15	15	27	6	85	5
Grand Total		14146	2466	2230	3284	3864	25990	1742

**- repeated from 2006-07, *- repeated from 2007-08

Annexure 3.11

Enrolment (Excluding Open Universities) By Level/Courses (All Categories Of Students)

Sl. No.	States/UTs	Ph.D/M.Phil			POST GRADUATE DEGREE					
					ARTS			COMMERCE		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1	Andhra Pradesh	2263	947	3210	8061	4589	12650	3116	1385	4501
2	Arunachal Pradesh	22	16	38	291	288	579	29	21	50
3	Assam	440	339	779	4215	3372	7587	880	229	1109
4	Bihar	1245	680	1925	28172	12467	40639	2142	816	2958
5	Chhattisgarh	98	163	261	25069	44914	69983	1955	674	2629
6	Goa	8	21	29	89	328	417	110	257	367
7	Gujarat	1132	782	1914	21177	22520	43697	13706	12498	26204
8	Haryana	866	746	1612	1843	3163	5006	344	632	976
9	Himachal Pradesh	1608	1223	2831	1006	1866	2872	25	55	80
10	Jammu & Kashmir	335	321	656	1602	2900	4502	249	355	604
11	Jharkhand	237	133	370	3951	2335	6286	3019	2104	5123
12	Karnataka	658	483	1141	1529	1484	3013	249	419	668
13	Kerala	741	755	1496	2401	6775	9176	1079	2281	3360
14	Madhya Pradesh	2804	0	2804	20255	24309	44564	9770	7586	17356
15	Maharashtra	5774	3735	9509	44449	41944	86393	29858	25959	55817
16	Manipur	480	470	950	409	405	814	45	35	80
17	Meghalaya	331	308	639	344	796	1140	44	46	90
18	Mizoram	118	126	244	249	241	490	25	18	43
19	Nagaland	97	78	175	261	258	519	19	17	36
20	Odisha	438	222	660	6420	3607	10027	1982	287	2269
21	Punjab	576	923	1499	3191	10929	14120	475	700	1175
22	Rajasthan	550	745	1295	12316	14077	26393	2088	1927	4015
23	Sikkim	4	0	4	0	0	0	0	0	0
24	Tamil Nadu	11391	8621	20012	14328	12421	26749	9398	9126	18524
25	Tripura	16	9	25	436	510	946	79	9	88
26	Uttar Pradesh	8252	5097	13349	97047	85834	182881	19899	7210	27109
27	Uttarakhand	831	562	1393	3355	6949	10304	1487	1446	2933
28	West Bengal	2054	1208	3262	18985	17565	36550	1799	875	2674
29	Andaman & Nicobar Islands	6	3	9	17	87	104	14	16	30
30	Chandigarh	305	337	642	2083	3565	5648	830	916	1746
31	Dadra & Nagar Haveli	0	0	0	0	0	0	0	0	0
32	Daman & Diu	0	0	0	0	0	0	0	0	0
33	Delhi	2358	2820	5178	3263	2808	6071	6071	901	6972
34	Lakshadweep	0	0	0	3	23	26	0	0	0
35	Puducherry	285	192	477	176	194	370	11	6	17
INDIA		46323	32065	78388	326993	333523	660516	110797	78806	189603

Annexure 3.12

Enrolment (Excluding Open Universities) By Level/Courses (All Categories Of Students)

Sl. No.	States/UTs	POST GRADUATE DEGREE								
		SCIENCE			ENGINEERING/ TECHNOLOGY/ ARCHITECURE/ DESIGN			MEDICINE		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1	Andhra Pradesh	53283	29377	82660	5666	2790	8456	281	186	467
2	Arunachal Pradesh	25	35	60	945	530	1475	0	0	0
3	Assam	2691	1337	4028	44	7	51	197	100	297
4	Bihar	8378	2824	11202	46	1	47	156	30	186
5	Chhattisgarh	2132	2485	4617	140	59	199	158	28	186
6	Goa	210	319	529	28	7	35	47	81	128
7	Gujarat	9031	5708	14739	8546	3108	11654	3781	2323	6104
8	Haryana	1234	2547	3781	243	177	420	133	156	289
9	Himachal Pradesh	324	501	825	158	75	233	85	52	137
10	Jammu & Kashmir	2846	2854	5700	42	18	60	79	42	121
11	Jharkhand	1635	913	2548	1188	291	1479	2	5	7
12	Karnataka	853	1310	2163	2745	653	3398	4205	2527	6732
13	Kerala	1238	6265	7503	1326	875	2201	593	758	1351
14	Madhya Pradesh	6247	8229	14476	2901	1105	4006	500	180	680
15	Maharashtra	29263	21773	51036	4994	1992	6986	1384	436	1820
16	Manipur	280	342	622	0	0	0	45	25	70
17	Meghalaya	241	242	483	85	25	110	0	0	0
18	Mizoram	98	34	132	20	12	32	0	0	0
19	Nagaland	92	43	135	0	0	0	0	0	0
20	Odisha	2809	1167	3976	1352	467	1819	528	269	797
21	Punjab	3002	7282	10284	6391	1521	7912	1276	1195	2471
22	Rajasthan	7728	8256	15984	396	206	602	1400	526	1926
23	Sikkim	103	66	169	10	3	13	74	12	86
24	Tamil Nadu	32799	29545	62344	17291	9824	27115	1655	829	2484
25	Tripura	139	141	280	19	22	41	263	134	397
26	Uttar Pradesh	41570	16081	57651	2460	558	3018	1440	587	2027
27	Uttarakhand	1449	2099	3548	844	109	953	35	14	49
28	West Bengal	9116	5855	14971	4342	1410	5752	571	157	728
29	Andaman & Nicobar Islands	15	23	38	0	0	0	0	0	0
30	Chandigarh	592	1368	1960	90	120	210	35	40	75
31	Dadra & Nagar Haveli	0	0	0	0	0	0	0	0	0
32	Daman & Diu	0	0	0	0	0	0	0	0	0
33	Delhi	1779	2232	4011	5327	1416	6743	707	703	1410
34	Lakshadweep	0	0	0	0	0	0	0	0	0
35	Puducherry	119	45	164	120	45	165	0	0	0
INDIA		221321	161298	382619	67759	27426	95185	19630	11395	31025

Annexure 3.13

Enrolment (Excluding Open Universities) By Level/Courses (All Categories Of Students)

Sl. No.	States/UTs	POST GRADUATE DEGREE								
		AGRICULTURE & ALLIED			MANAGEMENT/ HOTEL/ TRAVEL/ TOURISM MANAGEMENT			EDUCATION/ TEACHER TRAINING		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1	Andhra Pradesh	248	195	443	11239	5749	16988	649	312	961
2	Arunachal Pradesh	0	0	0	54	25	79	43	57	100
3	Assam	118	45	163	263	202	465	280	264	544
4	Bihar	22	9	31	672	161	833	2078	985	3063
5	Chhattisgarh	176	63	239	371	166	537	1369	1846	3215
6	Goa	0	0	0	81	46	127	14	23	37
7	Gujarat	651	106	757	6246	2965	9211	156	169	325
8	Haryana	207	28	235	1031	507	1538	70	133	203
9	Himachal Pradesh	159	111	270	934	268	1202	40	120	160
10	Jammu & Kashmir	145	47	192	1103	775	1878	1047	1474	2521
11	Jharkhand	96	27	123	269	149	418	134	462	596
12	Karnataka	664	323	987	558	130	688	53	74	127
13	Kerala	122	86	208	79	47	126	45	179	224
14	Madhya Pradesh	557	66	623	162	18	180	930	632	1562
15	Maharashtra	1255	420	1675	20192	8861	29053	3640	2766	6406
16	Manipur	45	29	74	37	25	62	20	30	50
17	Meghalaya	0	0	0	42	11	53	146	140	286
18	Mizoram	10	9	19	9	11	20	5	35	40
19	Nagaland	32	24	56	0	0	0	0	0	0
20	Odisha	109	52	161	4696	1504	6200	39	73	112
21	Punjab	319	237	556	2050	1270	3320	129	750	879
22	Rajasthan	430	106	536	6285	4127	10412	410	189	599
23	Sikkim	0	0	0	75	47	122	3	13	16
24	Tamil Nadu	53	116	169	10649	5161	15810	330	290	620
25	Tripura	5	1	6	49	10	59	6	14	20
26	Uttar Pradesh	2637	399	3036	11480	4594	16074	637	339	976
27	Uttarakhand	74	11	85	1216	552	1768	54	62	116
28	West Bengal	480	150	630	3598	1398	4996	308	362	670
29	Andaman & Nicobar Islands	0	0	0	0	0	0	0	0	0
30	Chandigarh	0	0	0	31	62	93	152	473	625
31	Dadra & Nagar Haveli	0	0	0	95	24	119	0	0	0
32	Daman & Diu	0	0	0	0	0	0	0	0	0
33	Delhi	138	32	170	1731	840	2571	167	446	613
34	Lakshadweep	0	0	0	0	0	0	0	0	0
35	Puducherry	10	7	17	0	0	0	18	12	30
INDIA		8762	2699	11461	85297	39705	125002	12972	12724	25696

Annexure 3.14

Enrolment (Excluding Open Universities) By Level/Courses (All Categories of Students)

Sl. No.	States/UTs	POST GRADUATE DEGREE					
		LAW			OTHERS		
		Boys	Girls	Total	Boys	Girls	Total
1	Andhra Pradesh	314	123	437	56	20	76
2	Arunachal Pradesh	0	0	0	0	0	0
3	Assam	196	208	404	42	48	90
4	Bihar	76	54	130	1597	586	2183
5	Chhattisgarh	207	40	247	184	218	402
6	Goa	0	0	0	3	6	9
7	Gujarat	681	307	988	7319	5347	12666
8	Haryana	104	57	161	276	300	576
9	Himachal Pradesh	16	36	52	170	115	285
10	Jammu & Kashmir	387	183	570	99	100	199
11	Jharkhand	32	5	37	272	0	272
12	Karnataka	46	26	72	313	92	405
13	Kerala	168	205	373	157	161	318
14	Madhya Pradesh	370	164	534	0	0	0
15	Maharashtra	1806	1197	3003	2140	1022	3162
16	Manipur	12	12	24	41	60	101
17	Meghalaya	371	241	612	21	29	50
18	Mizoram	0	0	0	50	47	97
19	Nagaland	0	0	0	0	0	0
20	Odisha	52	25	77	4347	2883	7230
21	Punjab	150	73	223	175	205	380
22	Rajasthan	271	134	405	252	145	397
23	Sikkim	81	27	108	0	0	0
24	Tamil Nadu	237	113	350	775	865	1640
25	Tripura	188	128	316	368	250	618
26	Uttar Pradesh	1193	172	1365	6251	2346	8597
27	Uttarakhand	42	26	68	78	48	126
28	West Bengal	443	357	800	667	470	1137
29	Andaman & Nicobar Islands	0	0	0	19	9	28
30	Chandigarh	25	21	46	33	153	186
31	Dadra & Nagar Haveli	0	0	0	0	0	0
32	Daman & Diu	0	0	0	0	0	0
33	Delhi	115	71	186	2891	154	3045
34	Lakshadweep	0	0	0	0	0	0
35	Puducherry	31	6	37	119	36	155
INDIA		7614	4011	11625	28715	15715	44430

Annexure 3.15

Enrolment (Excluding Open Universities) By Level/Courses (All Categories of Students)

Sl. No.	States/UTs	UNDER GRADUATE DEGREE								
		ARTS			COMMERCE			SCIENCE		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1	Andhra Pradesh	65091	33922	99013	138544	78317	216861	221245	115567	336812
2	Arunachal Pradesh	4953	4284	9237	439	199	638	363	362	725
3	Assam	87351	58221	145572	14316	2392	16708	26170	5362	31532
4	Bihar	269420	144702	414122	49287	10013	59300	112037	39858	151895
5	Chhattisgarh	52520	43017	95537	17174	14342	31516	12540	13659	26199
6	Goa	1116	3180	4296	3363	4804	8167	1660	2052	3712
7	Gujarat	87120	94963	182083	69521	48481	118002	33643	26245	59888
8	Haryana	89072	91407	180479	19809	17312	37121	9802	9784	19586
9	Himachal Pradesh	20760	30237	50997	5280	3189	8469	6487	8572	15059
10	Jammu & Kashmir	48540	43052	91592	1491	1261	2752	6531	6152	12683
11	Jharkhand	61297	35268	96565	24475	10774	35249	18961	8443	27404
12	Karnataka	81795	77122	158917	48505	41399	89904	20998	27592	48590
13	Kerala	26505	53536	80041	15770	19733	35503	18479	45922	64401
14	Madhya Pradesh	138406	144938	283344	60564	44663	105227	66615	52863	119478
15	Maharashtra	293778	287640	581418	191605	160731	352336	173336	89750	2630 86
16	Manipur	7047	5997	13044	769	499	1268	5485	3953	9438
17	Meghalaya	10748	14980	25728	1729	781	2510	1758	1550	3308
18	Mizoram	3137	3058	6195	217	171	388	1142	549	1691
19	Nagaland	9793	8984	18777	1926	1085	3011	1001	651	1652
20	Odisha	87720	32777	120497	27342	4659	32001	32242	8953	41195
21	Punjab	51359	68287	119646	10908	10777	21685	7123	14114	21237
22	Rajasthan	143520	104944	248464	33724	17214	50938	25833	20343	46176
23	Sikkim	1775	2233	4008	294	209	503	370	247	617
24	Tamil Nadu	117386	106285	223671	58811	57726	116537	116194	118351	234545
25	Tripura	11594	10384	21978	1330	105	1435	1651	944	2595
26	Uttar Pradesh	633341	487947	1121288	113776	60800	174576	192255	94378	2866 33
27	Uttarakhand	23286	39709	62995	12630	7904	20534	9223	8946	18169
28	West Bengal	291399	275626	567025	67442	22019	89461	60207	38818	99025
29	Andaman & Nicobar Islands	807	1056	1863	268	197	465	137	200	337
30	Chandigarh	11691	9039	20730	4162	4602	8764	2054	4247	6301
31	Dadra & Nagar Haveli	79	86	165	398	319	717	309	223	532
32	Daman & Diu	81	147	228	86	60	146	23	25	48
33	Delhi	19042	25613	44655	44655	9731	54386	28926	13226	42152
34	Lakshadweep	37	93	130	51	59	110	28	37	65
35	Puducherry	5819	8114	13933	737	1338	2075	1183	2425	3608
	INDIA	2757385	2350848	5108233	1041398	657865	1699263	1216011	784363	2000374

Annexure 3.16

Enrolment (Excluding Open Universities) By Level/Courses (All Categories of Students)

Sl. No.	States/UTs	UNDER GRADUATE DEGREE								
		ENGINEERING/ TECHNOLOGY/ ARCHITECURE/ DESIGN			MEDICINE			AGRICULTURE & ALLIED		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1	Andhra Pradesh	238520	117480	356000	4333	2447	6780	1722	1471	3193
2	Arunachal Pradesh	1332	494	1826	46	98	144	0	0	0
3	Assam	2168	830	2998	1760	796	2556	498	261	759
4	Bihar	7895	950	8845	7299	2555	9854	372	36	408
5	Chhattisgarh	15124	4306	19430	2270	2839	5109	3341	457	3798
6	Goa	2087	1289	3376	359	997	1356	0	0	0
7	Gujarat	67345	14414	81759	13527	9478	23005	2275	362	2637
8	Haryana	91585	35475	127060	4136	4171	8307	580	75	655
9	Himachal Pradesh	6225	1746	7971	1110	1501	2611	334	278	612
10	Jammu & Kashmir	2840	1072	3912	1734	1765	3499	641	149	790
11	Jharkhand	8235	2058	10293	387	158	545	223	52	275
12	Karnataka	112717	65440	178157	33248	30012	63260	2489	1160	3649
13	Kerala	63757	32834	96591	5327	11682	17009	412	367	779
14	Madhya Pradesh	35686	10353	46039	2405	490	2895	2062	616	2678
15	Maharashtra	182336	56710	239046	14501	7493	21994	8019	2977	10996
16	Manipur	265	130	395	57	43	100	368	237	605
17	Meghalaya	221	66	287	9	85	94	0	0	0
18	Mizoram	0	0	0	75	298	373	129	88	217
19	Nagaland	0	0	0	0	0	0	102	83	185
20	Odisha	43047	6365	49412	6493	3297	9790	294	238	532
21	Punjab	35901	10066	45967	2135	6057	8192	582	193	775
22	Rajasthan	51654	11432	63086	8176	3531	11707	2406	483	2889
23	Sikkim	1509	471	1980	370	287	657	0	0	0
24	Tamil Nadu	119505	61963	181468	17304	24392	41696	329	376	705
25	Tripura	1265	383	1648	20	10	30	80	48	128
26	Uttar Pradesh	47679	11461	59140	6802	2922	9724	20152	1212	21364
27	Uttarakhand	4819	758	5577	1344	418	1762	347	34	381
28	West Bengal	39201	10015	49216	8917	4034	12951	19022	2265	21287
29	Andaman & Nicobar Islands	0	0	0	0	0	0	0	0	0
30	Chandigarh	3834	993	4827	326	612	938	0	0	0
31	Dadra & Nagar Haveli	0	0	0	87	101	188	0	0	0
32	Daman & Diu	0	0	0	0	0	0	0	0	0
33	Delhi	6613	1103	7716	1674	1674	3348	789	260	1049
34	Lakshadweep	0	0	0	0	0	0	0	0	0
35	Puducherry	6486	3111	9597	855	2037	2892	120	64	184
INDIA		1199851	463768	1663619	147086	126280	273366	67688	13842	81530

Annexure 3.17

Enrolment (Excluding Open Universities) By Level/Courses (All Categories of Students)

Sl.		UNDER GRADUATE DEGREE								
		MANAGEMENT/ HOTEL/ TRAVEL/TOURISM MANAGEMENT			EDUCATION/ TEACHER TRAINING			LAW		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1	Andhra Pradesh	30114	13828	43942	36622	15695	52317	4812	2097	6909
2	Arunachal Pradesh	0	0	0	43	57	100	84	11	95
3	Assam	140	73	213	1431	957	2388	5593	1584	7177
4	Bihar	890	460	1350	2665	1605	4270	11722	2647	14369
5	Chhattisgarh	231	124	355	1307	1599	2906	1345	1145	2490
6	Goa	545	551	1096	26	209	235	340	392	732
7	Gujarat	11189	6058	17247	23327	20443	43770	6394	3737	10131
8	Haryana	17681	5384	23065	25973	31566	57539	2835	980	3815
9	Himachal Pradesh	1094	578	1672	1530	5407	6937	723	408	1131
10	Jammu & Kashmir	719	355	1074	23345	15192	38537	996	588	1584
11	Jharkhand	623	345	968	335	478	813	1624	217	1841
12	Karnataka	10932	5394	16326	4534	4828	9362	5477	1419	6896
13	Kerala	1565	1624	3189	450	2867	3317	1261	1675	2936
14	Madhya Pradesh	671	523	1194	6829	7257	14086	17147	5016	22163
15	Maharashtra	5917	2267	8184	26829	30254	57083	19177	12986	32163
16	Manipur	22	19	41	319	485	804	320	177	497
17	Meghalaya	314	253	567	360	280	640	435	370	805
18	Mizoram	0	0	0	51	120	171	121	77	198
19	Nagaland	10	3	13	117	160	277	242	126	368
20	Odisha	5632	2085	7717	442	258	700	4374	868	5242
21	Punjab	247	41	288	1361	3779	5140	196	85	281
22	Rajasthan	870	647	1517	23916	22479	46395	6881	2060	8941
23	Sikkim	96	20	116	87	111	198	128	157	285
24	Tamil Nadu	21582	19222	40804	7867	13547	21414	5942	2544	8486
25	Tripura	56	35	91	198	159	357	168	111	279
26	Uttar Pradesh	1102	608	1710	53171	19109	72280	39857	7895	47752
27	Uttarakhand	28	6	34	704	1378	2082	608	162	770
28	West Bengal	2661	1540	4201	5103	3413	8516	3465	2639	6104
29	Andaman & Nicobar Islands	33	45	78	42	174	216	0	0	0
30	Chandigarh	704	386	1090	362	1421	1783	1339	730	2069
31	Dadra & Nagar Haveli	51	17	68	33	13	46	0	0	0
32	Daman & Diu	0	0	0	18	142	160	0	0	0
33	Delhi	1678	914	2592	811	238	1049	4774	1770	6544
34	Lakshadweep	13	30	43	0	0	0	0	0	0
35	Puducherry	286	146	432	1512	3090	4602	374	150	524
INDIA		117696	63581	181277	251720	208770	460490	148754	54823	203577

Annexure 3.18

Enrolment (Excluding Open Universities) By Level/Courses (All Catogeries of Students)

Sl. No.	States/UTs	POST GRADUATE DIPLOMA		
		Boys	Girls	Total
1	Andhra Pradesh	1142	755	1897
2	Arunachal Pradesh	448	131	579
3	Assam	643	439	1082
4	Bihar	916	298	1214
5	Chhattisgarh	794	368	1162
6	Goa	7	32	39
7	Gujarat	3335	3530	6865
8	Haryana	380	731	1111
9	Himachal Pradesh	22	24	46
10	Jammu & Kashmir	230	104	334
11	Jharkhand	20	5	25
12	Karnataka	2852	1302	4154
13	Kerala	216	89	305
14	Madhya Pradesh	121	20	141
15	Maharashtra	5386	5020	10406
16	Manipur	81	22	103
17	Meghalaya	0	0	0
18	Mizoram	0	0	0
19	Nagaland	0	0	0
20	Odisha	570	199	769
21	Punjab	120	1360	1480
22	Rajasthan	0	7	7
23	Sikkim	0	0	0
24	Tamil Nadu	0	0	0
25	Tripura	0	0	0
26	Uttar Pradesh	1078	735	1813
27	Uttarakhand	34	38	72
28	West Bengal	2317	1082	3399
29	Andaman & Nicobar Islands	0	0	0
30	Chandigarh	679	648	1327
31	Dadra & Nagar Haveli	0	0	0
32	Daman & Diu	0	0	0
33	Delhi	40168	27515	67683
34	Lakshadweep	0	0	0
35	Puducherry	605	402	1007
INDIA		62164	44856	107020

Annexure 3.19

Pupil Teacher Ratio In Higher Education

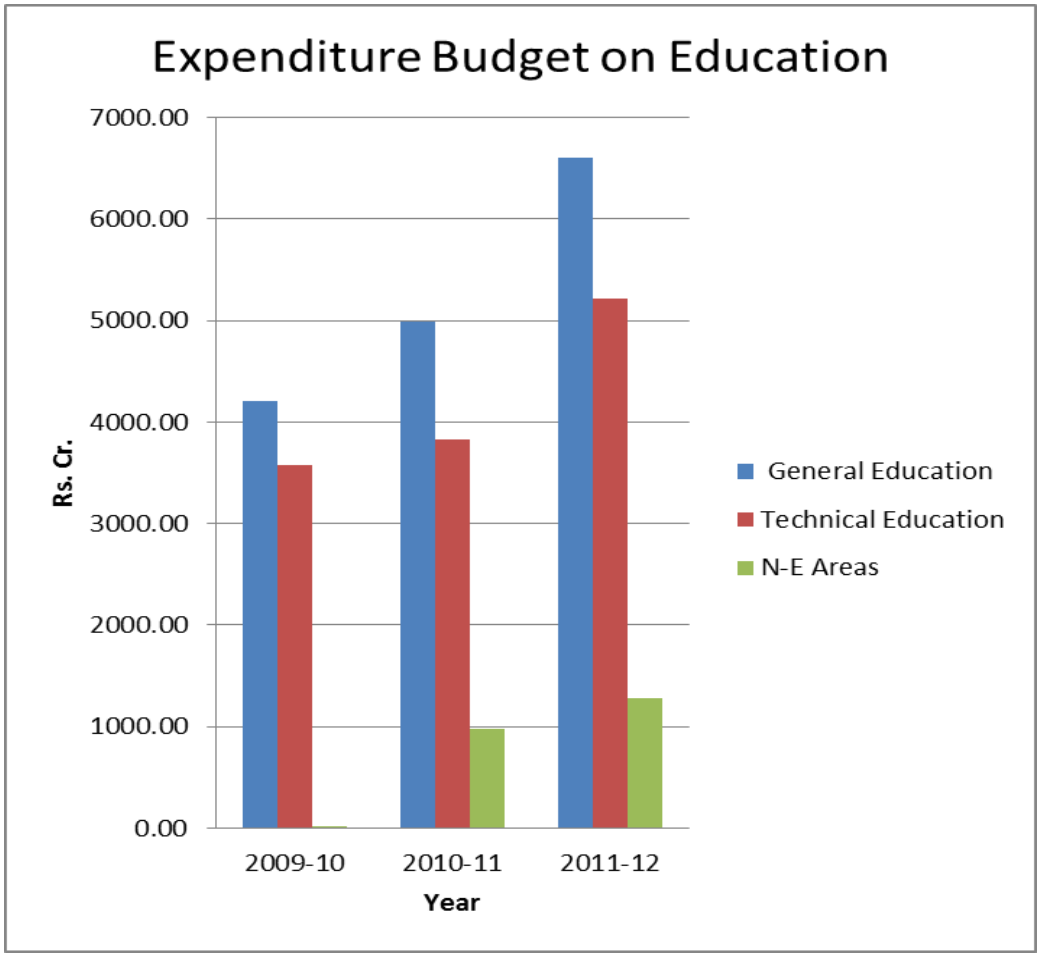
Sl. No.	States/UTs	Number of Teachers*	ENROLMENT**			Pupil Teacher Ratio
			Boys	Girls	Total	
1	2	3	4	5	6	7
1	Andhra Pradesh	79049	827391	427288	1254679	16
2	Arunachal Pradesh	559	9194	6664	15858	28
3	Assam	15417	149489	77161	226650	15
4	Bihar	24099	515021	227265	742286	31
5	Chhattisgarh	9296	138612	132555	271167	29
6	Goa	1671	10171	14671	24842	15
7	Gujarat	20207	392500	285928	678428	34
8	Haryana	19552	268409	205489	473898	24
9	Himachal Pradesh	5547	49800	57442	107242	19
10	Jammu & Kashmir	4882	95064	78784	173848	36
11	Jharkhand	8656	127461	64286	191747	22
12	Karnataka	63743	356339	282667	639006	10
13	Kerala	26194	142017	189061	331078	13
14	Madhya Pradesh	25128	380086	310869	690955	27
15	Maharashtra	76602	1080657	780787	1861444	24
16	Manipur	3348	16199	12995	29194	9
17	Meghalaya	2892	17212	20218	37430	13
18	Mizoram	906	5565	5290	10855	12
19	Nagaland	1741	14568	12304	26872	15
20	Odisha	22086	242146	76214	318360	14
21	Punjab	20867	128154	140185	268339	13
22	Rajasthan	27627	329773	213851	543624	20
23	Sikkim	234	4984	3917	8901	38
24	Tamil Nadu	77270	566023	484163	1050186	14
25	Tripura	1253	18121	13571	31692	25
26	Uttar Pradesh	67007	1306632	815827	2122459	32
27	Uttarakhand	4750	62886	71487	134373	28
28	West Bengal	24650	543623	392102	935725	38
29	Andaman & Nicobar Islands	134	1358	1810	3168	24
30	Chandigarh	2536	29449	30434	59883	24
31	Dadra & Nagar Haveli		1052	783	1835	0
32	Daman & Diu	36	208	374	582	16
33	Delhi	11555	173993	95768	269761	23
34	Lakshadweep	14	132	242	374	27
35	Puducherry	3157	18866	21420	40286	13
INDIA		652665	8023155	5553872	13577027	21

*- Data has been taken from UGC for the year 2007-08

**' - Excluding enrolment in Open Universities & Polytechnics (Post School Diploma)

Annexure 3.20

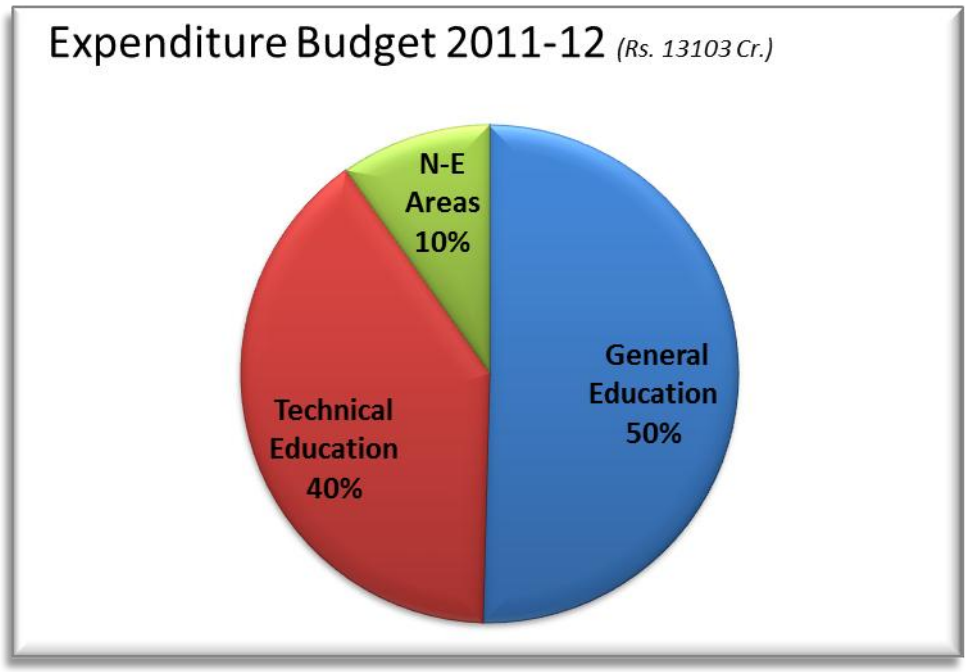
Expenditure on Higher Education by Ministry of Human Resource Development, Department of higher Education



Indiabudget.com

Annexure 3.21

Major components/split of the budget



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The above graphs provide a basic idea about the distribution of expenditure in technical and non-technical areas. Reasonably good amount of expenditure is incurred for the overall development of S&T and education in the North Easter States which is about 10% of the total expenditure.

HRD Schemes of DST

Scheme	For	Support
JC Bose National Fellowships	active scientists and engineers for their outstanding performance and contributions	Rs. 20,000 per month in addition to the Fellow' s regular income. In addition, it carries a research grant of Rs.5.00 lakh per annum
Ramanujan Fellowships	Brilliant scientists and engineers from all over the world to take up scientific research positions in India	Rs.75,000 per month for the first 3 years and Rs.60,000 per month during the last two years.
SwarnaJayanti Fellowship Scheme	Outstanding young scientists upto 40 years as recognition of the research work done by them in Science & Engineering	fellowship of Rs.25,000/p.m. is provided under the scheme apart from the salary drawn by the fellow from his institute
FAST track scheme for Young Scientists	Young Scientists to take up R&D in innovative and challenging areas	Fellowship of Rs. 20,000 per month apart from grants under travel, contingency, consumables and minor equipments
Better Opportunities for Young Scientists in Chosen Areas of Science and Technology (BOYSCAST)	young Indian scientists/technologists below the age of 35 years	Fellowship amountof US $ 3000 per month, air fare, and one time contingency grant of Rs.15,000/-
The Kishore VaigyanikProtsahanYojana (KVPY)	School students after 10th During BSc Integrated MSc	Rs 4000/mth, Rs 16,000 cont./annum Rs 5000/mth, Rs 20,000 cont./annum Rs 7000/mth, Rs 28,000 cont./annum
Science Olympiad Programmes	Promote excellence in science among pre-university students and selecting teams to represent India at respective International Olympiads	
Assistance for Participation in International Conference	Scientists working in educational/academic institutions and National R&D laboratories enabling them to participate in the International Conferences/Workshops	Travel grants to participate in International Conferences/Workshops, training Programmes
Training programmes/workshops	Research students, teachers and personnel from academic institutions, R&D labs and industries	
Utilization of Scientific Expertise of Retired Scientists (USERS)	Retired eminent scientists	Honorarium of 15,000/month

Scheme	For	Support
FIST" - Fund for improvement of S&T infrastructures	universities and higher educational institutions	
PURSE PROGRAMME	Universities Research fellowships are available under this special scheme	MSc; the first two years @Rs.14,000/- p.m. + HRA for the third year (JRF and SRF) M.E./M.Tech./M.Arch./M.Plan. @Rs.14,000/- p.m. + HRA for the first two years @Rs.15,000/- p.m. + HRA for the third year (JRF and SRF) Fellowship in Science, Engineering & Technology i) B.E./B.Tech./B.Arch. ii) M.Sc./M.Phil. @Rs. 8,000/- p.m. consolidated for 3 years
INDIA-UK Science Bridges Awards & Next Generation Network	Scientists of UK and India	Up to £4m (at 80% full economic cost) is available from RCUK to support Science Bridge Awards in each of 3 countries (USA, China, India). Up to £4m is available from DST to support partner bids in India and a parallel submission and review process will operate.
INSPIRE Program (For attraction of talent to science) **a) Scheme for Early Attraction of Talents for Science (SEATS),** **b) Scholarship for Higher Education (SHE) and** **c) Assured Opportunity for Research Careers (AORC)**	Two lakh school children in the age-group of 10 to 15 years i.e., 6th to 10th standards are being identified for the INSPIRE Award. For undertaking Bachelor and Masters level education in the Natural & Basic sciences Doctoral studies and opening up partnerships with private sector for topping the Government's efforts in nurturing talents for scientific research.	Each INSPIRE Award envisions an investment of Rs.5,000/- per child 10,000 scholarships every year @ Rs.80,000/- each INSPIRE JRFs and SRFs

HRD Schemes of CSIR

Scheme	For	Support
Junior Research Fellowships (JRF) through CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Eligibility for lectureship	MSc or equivalent degree holders with minimum 55% marks to pursue PhD.	Rs 16000/ p.m+HRA for the first two years and Rs. 18000/ p.m.+HRA for the next three years on up-gradation of the fellowship to Senior Research Fellowship (SRF). In addition, annual contingent grant of Rs. 20,000/- per fellow is also provided.
Shyama Prasad Mukherjee Fellowship (SPMF)	Nurturing the budding scientific talent and to nourish the objective of pursuit of scientific research. The following candidates are eligible to be considered for the SPM fellowships • top 15 rankers of CSIR-UGC NET from June and December exam of preceding year, • top 5 GATE score holders in the subject area of NET of the current year • top 3 students in each of the above disciplines of integrated MS programme of IISERs, of the current year. • IIT graduates of current year with CGPA 9.5 & above • B. Tech students of IIT who have completed 3rd year with 9.5 CGPA & above	Stipend Rs.20000/- + HRA per month during the first two years, may be raised to Rs.24000/- + HRA per month from third year onwards on the basis evaluation of research work by SPM Core Committee. In addition, an annual contingency grant of Rs.70000/- p.a. per fellow is also provided.
JRF-GATE Fellowship	Promoting higher studies leading to PhD in Engineering and Pharmaceutical Sciences. The candidates possessing the following qualifications are eligible: Fresh BE/ B Tech degree holders with valid GATE score. OR Those who are starting the thesis semester of ME/ MTech programme and having valid GATE score and desirous of pursuing PhD.	Rs 16000/ p.m+HRA for the first two years and Rs. 18000/ p.m.+HRA for next three years on up-gradation of the fellowship to Senior Research Fellowship (SRF). In addition, annual contingent grant of Rs. 20,000/- per fellow is provided. The fellowship is tenable in CSIR laboratories.
Senior Research Fellowship (SRF-Direct)	Candidates having M.Sc./BE/B.Tech. or equivalent degree with at least 55% marks & one publication in SCI Journal and should have completed at least 2 years of post M.Sc. /BE/B.Tech. research experience; OR ME/ M.Tech or equivalent degree in engineering/technology with at least 60% marks; OR B.Tech./ B.E. or equivalent degree with at least 60% marks and 2 years of research experience; OR MBBS/BDS or equivalent degree with at least 60% marks and one year of internship; OR	Rs. 18000/-p.m.+HRA to SRF having master degree in basic sciences and graduate degree in professional courses for three years. Rs. 18000/ p.m . to SRF having master degrees in professional courses for first two years and Rs. 20000/- p.m.+ HRA after two years. In addition, annual contingency grant of Rs. 20,000/- per fellow is provided. (Tenure of fellowship is 4 years for candidates possessing professional degrees, and 3 years for those having master degrees in basic sciences).

Scheme	For	Support
	B.Pharm/ BVSc/ B.Sc(Ag) or equivalent degree with at least 55% marks and one publication in SCI Journal and should have completed at least 3 years of research experience; OR MVSc/MSc(Ag) or equivalent degree with at least 55% marks and one publication in SCI Journal and should have at least one year of research experience; OR M Pharm. or equivalent degree with at least 55% marks and one publication in SCI Journal and should have at least one year research experience; OR M Pharm or equivalent degree in pharmaceutical sciences with at least 60% marks.	
Senior Research Fellowship (SRF)-Extended	meritorious candidates who have submitted their PhD thesis and are awaiting the award of PhD degree.	The fellowship tenure is one year only. A fellowship amount of Rs. 20000/-p.m.+ HRA and annual contingent grant of Rs. 20,000/- per fellow is provided.
CSIR Research Associateship (RA)	young research workers who have shown promise in original research and propose to pursue research work in science, engineering, medicine or technology on specific projects and possessing PhD/MD/MS/MDS or equivalent degree or having 3 years of research, teaching and design and development experience after MVSc/MPharm/ME/MTech.	A fellowship amount of Rs. 22000/-p.m. or Rs. 23000/-p.m. or Rs. 24000/- p.m. +HRA and annual contingent grant of Rs. 20,000/- per fellow is provided.
CSIR-Nehru Science Postdoctoral Research Fellowship Scheme	promising young researchers with innovative ideas, and to provide them with training and research opportunities in niche areas of basic science, engineering, medicine and agriculture	Rs. 35,000/- per month plus House Rent Allowance (HRA) as admissible and a contingency grant of Rs. 3.0 lakh per annum for two years, extendable for one more year .
Senior Research Associateship (SRA) (Scientist's Pool Scheme)	Qualified Indian scientists, engineers, technologists, and medical personnel, who are not holding any employment	Basic pay of a SRA is fixed between Rs. 21,000/- and 25,810/- per month, with Contingent Grant of Rs.20000 per annum
CSIR Research Grants	Promoting research work in the fields of Science & Technology, including Agriculture, Engineering and Medicine. The assistance is provided by way of grants to Professors/Experts in regular employment, in the universities, IITs, post-graduate institutions, recognised R&D laboratories both in public and private sectors to pursue state-of-art R&D.	Support is provided in the form of contingency, equipments grant, and manpower in the form of JRF, SRF and RA.

Scheme	For	Support
	Promoting scientific interaction between CSIR laboratories and universities/R&D institutions through research projects sponsored by CSIR laboratories and tenable in universities and R&D institutions.	
Emeritus Scientist	Superannuated outstanding scientists	Grant consists of (i) honorarium of Rs.20,000/- p.m. to the Emeritus Scientist (ES) for the duration of his/her tenure, (ii) suitable contingent grant per annum, and (iii)technical assistance in the form of research fellows/associates.
Visiting Associateship	Middle level scientists from universities/R&D institutions	TA&DA for two visits to a CSIR lab for maximum of 60 days in a year for 3 years
Indian Language Journal	Only journals brought out in Indian languages with the sole objective of popularizing science	Rs. 10,000/- and Rs. 1,00,000/- per annum
Travel Grant	Young Indian Researchers working in an academic or research institution in India for participating in Conferences, Symposia, etc. held abroad	
Grant for Holding Symposium/Seminar	Bonafide societies/associations of scientists and engineers, academic and R&D institutions are eligible	
CSIR Young Scientist Awards	Promoting in-house excellence in science and engineering. The awards are given in five disciplines: (1) Biological, (2) Chemical, (3) Earth, Atmosphere, Ocean and Planetary, (4) Engineering, and (5) Physical Sciences (including instrumentation).	The award carries a cash prize of Rs 50000/- , citation and a plaque. An honorarium of Rs, 75,00/- p.m. is also given till the age of 45 years. Awardees are also entitled for a research grant of Rs. 5,00,000/- p.a. for a period of 5 years.
Shanti Swarup Bhatnagar Prize (SSB) for science & technology	Outstanding contributions to science and technology, applied or fundamental made through work done primarily in India during the five years preceding the year of the Prize. The awards are given in the following disciplines: (1) Biological, (2) Chemical, (3) Earth, Atmosphere, Ocean and Planetary, (4) Engineering, (5) Mathematical, (6) Medical, and (7) Physical Sciences.	The award carries a cash prize of Rs 5,00,000/-, citation and a plaque. An honorarium of Rs, 15,000/- p.m. is also given till superannuation.
Prof GN Ramachandran Gold Medal for Excellence in Biological Sciences & Technology	Recognition of outstanding work in the inter-disciplinary subject/filed of Biological Sciences & Technology.	A Gold Medal and a citation are presented to the recipient on CSIR Foundation Day.
Technology Led Entrepreneurship Programme (TLEP) for Research Scholars:	Inculcating the spirit of technological entrepreneurship in research scholars.	Research scholars are provided first hand information on elements of entrepreneurship, formulation of business plan, IPR, team work etc. to enable them to learn how to take knowledge based innovation through a commercial outcome, managing all the major steps on the way.
Details of the HRD Schemes of CSIR can be seen on www.csirhrdg.res.in.		

HRD Schemes of Department of Atomic Energy

Scheme	For	Support
Department of Atomic energy (Excellence in science, engineering and technology) awards		
1. Young Scientist Award 50	*< 35 years*	Rs. 50,000/- each
2. Young Engineer Award 50		
3. Young Applied Scientist/ technologist Award 50	< 35 years	Rs. 50,000/- each
4. Homi Bhabha Science & Technology Award	< 35 years	Rs. 50,000/- each
5. Scientific & Technical Excellence Award 50	< 50 years	10 Rs. 5 Lakh each
6. Special Contributions Award 100	< 50 years	Rs.1 Lakh each
7. Group Achievement Award	Any Number	Upto a maximum of Rs.50,000/- each Rs. 50 lakh
Training Schools	Orientation Course for Engineering Graduates & Science Post-Graduates (OCES) and DAE Graduate Fellowship Scheme (DGFS)	
AMD studentship programme	M.Sc./M.Tech. students of different Universities	
1-year Pre-Doctoral Course followed by a Ph.D. programme	Postgraduate students	
Clinical Training Programme	M.D. and M.Sc. students	
Associateship Programme and Refresher Courses	College teachers	
Olympiad Programme	For organizing Olympiad programmes and for participation in International Olympiads in Physics, Chemistry, Biology, Mathematics, Astronomy & Astrophysics, and Junior Science Olympiad	
Dr. K. S. Krishnan Research Associateship	Highly talented young scientists and technologists	Stipend of Rs.26,000/- + benefits for a maximum period of 2 years
DAE Graduate Fellowship Scheme (DGFS)	Graduate Level students doing M.Tech. at the IITs	Rs.18000/- per month besides house rent and medical benefits
Raja Ramanna Fellowship	Eminent retired scientists	Honorariums. 20,000/- per month Contingency: Rs. 50,000/- p.a.
Advanced Training in Mathematics (ATM)	To encourage M.Sc / M.Tech / M.Sc Tech students to take up field-oriented project work	Grant of Rs.5,000/-

HRD Schemes of Department of Biotechnology

Scheme	Beneficiaries	Support
Postgraduate Programme	PG Students of M.Sc./M.Tech. and M.Sc.(Ag)/ MVSc, biotech	Grants for infrastructure and other support
Star Colleges	Under graduate students of life sciences stream	Financial support uptoRs 7.0 lakhs per department
Short term training courses	Mid-career scientists, faculty involved in under graduate and post graduate teaching	Financial support uptoRs 3.0 lakhs
Biotech Industrial Training Programme	Fresh B.E./B.Tech. /M.Sc./ M.Tech/ M.V.Sc/ M.Sc.Ag biotech students	Stipend of Rs. 8000/- p.m. is paid to trainees and Rs. 50000/- to company
Student Research Projects	fellowships for student research projects in life sciences including Biotech, Agriculture, Veterinary, Fisheries and Physical sciences	
Entrepreneurship Development Programme (EDP) in Biotechnology	To train the prospective entrepreneurs on different aspects of business management	
DBT Junior Research Fellowship (DBT-JRF)	Fresh B.E./B.Tech. /M.Sc./ M.Tech/ M.V.Sc biotech students	Fellowship of Rs. 12,000/- to 18,000/- per month
DBT-Research Associateship (DBT- RA)	For pursuing Post-Doctoral training	Fellowship of Rs. 22,000/- to 24,000/- per month
DBT-TWAS Fellowship	Post Doctoral research in India for foreign scientists	Fellowship including contingencies and cost of international travel
Ramalingaswami Re-entry Fellowship	To attract scientific talent of Indian origin working abroad	Fellowship of Rs. 75,000/- per month and contingency grant of Rs. 5.0 lakhs per annum for five years.
Tata Innovation Fellowship	To reward interdisciplinary and innovative work in biotechnology and related disciplines	Fellowship of Rs. 20,000/- per month in addition to regular salary and contingency grant of Rs. 5.00 lakhs per annum

Scheme	Beneficiaries	Support
Biotechnology Career Advancement and Reorientation Programme for Women Scientist (Bio-CARe)	For employed/unemployed women scientists	For unemployed women stipend of Rs.25,000/- p.m. and employed scientists get an amount of Rs.5,000/- p.m as an incentive in addition to their salary.
Distinguished Biotechnologists Research Professorship	to recognize eminent scientists who had superannuated and have made outstanding contribution	award of Rs. 60,000/- per month and a research grant uptoRs. 20.00 lakhs for a period of five years or till the awardee attains the age of 70 years
Programmes for North-Eastern Region DBT-RA programme BITP	support to universities/colleges in NER for strengthening and up-gradation of their biotechnology teaching, training and research activities	Fellowship of Rs. 22,000/- to 24,000/- per month
Biotech Product, Process Development and Commercialization Award 5-6 awards	scientists/innovators/entrepreneurs/Indian institutions & companies both in public as well as private sector for a new process, product development &commercialization of a technology or a product in the areas of biotechnology and biological sciences	Rs.2.00 lakhs along with a citation. Rs.5.00lakhs
National Women Bioscientists Award	Senior Category (One), awarded to senior woman biologist for life time contributions, and Young Category (Two) - given for outstanding contributions of women scientists below 45 years of age in basic and applied research for product and technology development	Cash prize of Rs.1.00 lakh along with citation and a medal
National Bioscience Awards for Career Development 10 awards per year	Young scientists below 45 years of age in basic and applied for application/product and technology development	Cash prize ofRs.1.00 lakh and a citation along with project research grant of Rs.9.00 lakh @ Rs.3.00 lakh per year for a period of three years
DBT Biology Scholarship	Biology/Biotechnology at Higher Secondary/Intermediate/10+2 level	Cash prize of Rs.20,000/- and a Certificate of merit

Scheme	Beneficiaries	Support
Innovative Young Biotechnologist Award (IYBA) 25 awards per year	Outstanding young scientists with innovative ideas and desire to pursue research in frontier areas of biotechnology	cash award of Rs. 1.00 lakh per annum as an add on salary and the awardees not in regular job get a fellowship of Rs.40,000/- p.m. for pursuing a project for 3years, extendable by two years
Rapid Grant for Young Investigators (RGYI) Scheme	Young scientists (below the age of 40 years) for the establishment of their laboratory and initiate research in the frontier areas of biotechnology	Grant is based on project goals and activities
Cutting-Edge Research Enhancement and Scientific Training Award (DBTCREST Award)	Biotechnology Overseas Associateship Award' and 'Associateship for Specialized Training of Young Scientists' in niche areas of biotechnology	Fellowship amount to US $ 3,000 and preparatory allowance of Rs. 1.00 lakhs
Visiting Scientists from Abroad Programme (VSAP)	Eminent scientists/ experts in the front line areas of Biotechnology from overseas institutions would be invited for visits to research institutions in India for a period of three weeks to three months	Stipend of Rs. 15,000/- per month and the cost of air passage with research contingency grant of Rs. 10,000/- per month
Biotechnology Entrepreneurship Student Teams (BEST)	To encourage young doctoral students in developing biotechnology entrepreneurship in a competitive mode, to submit as team business plans for scientific ideas which can be commercialized	Three awards of Rs 5.00 lakh, 3.00 lakh and 2.00 lakh are awarded to the first three teams, respectively
Khorana program for scholars	Indian Students to undertake research at University of Wisconsin-Madison (UW) for 10 weeks	Stipend, Accommodation, Airfare