

# Annual Report 2013-14

## Annual Report 2013-14

### Department of Science & Technology



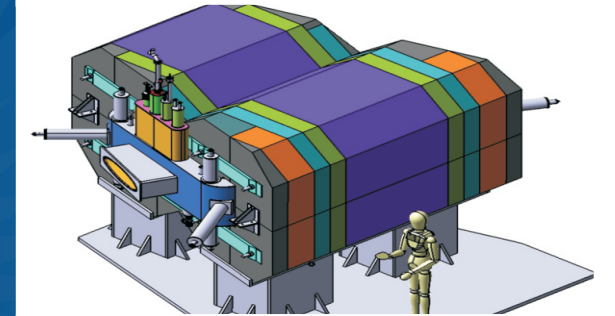
सत्यमेव जयते

Department of Science and Technology  
Ministry of Science and Technology  
Technology Bhawan, New Mehrauli Road  
New Delhi, India-110016



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Ministry of Science & Technology  
Government of India  
New Delhi



# Annual Report 2013-2014



Government of India  
Department of Science & Technology  
Ministry of Science & Technology  
New Delhi



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## OVERVIEW

Department of Science and Technology, in its endeavour to strengthen national Science and Technology capacity and capability, kept its pace to implement several planned initiatives to enable Indian S&T community to increase scientific and technological outputs. Some of the important domains in which the Department devoted its attention during the year are: strengthening the pool of scientists and technologists for carrying out globally competitive R&D in cutting edge areas of science; nurturing R&D institutions and building infrastructural facilities for enhancing global ranking of India in scientific research; support for the establishment of multi-stakeholder mechanisms for partnerships for promoting science, and deploying technology through national missions; developing capacity of institutions and industry for technology commercialization for solving national challenges; providing S&T inputs to society for its socio-economic benefits; and evidence based policy formulation for S&T sector.

Important highlights and achievements of the activities of the Department during 2013-14 are as following:

New **Science, Technology and Innovation (STI) policy**, unveiled on 3<sup>rd</sup> January 2013 by the Prime Minister of India, includes a thrust for innovations in science and technology sector. STI policy (2013) reveals an aspiration of India to gain global competitiveness and link science sector to the developmental agenda of the country. Science, Research and Innovation System for High Technology-led path for India, (SRISHTI) is the main policy goal. Integration of science, research and innovation systems and emergence of India as one of the top five of six knowledge powers in science are expressed aspirations of the new STI policy.

To translate the vision of STI policy into action agenda, the Department has already established a dedicated Policy Research Cell. Three Policy Research Centres in academic institutions have been established during the year to develop and design new programmes and action plans for implementation in science, technology and innovation sector in the country.

**Science and Engineering Research Board (SERB)** has intensified its activities for human capacity building through science and engineering research. Besides supporting individual scientist centric R&D projects through 19 programme advisory committees, the Board has launched several new initiatives during the year viz. Empowerment and Equity opportunities for Excellence in Science for enhancing participation of scientists from the weaker sections of the society; SERB Women Excellence Award to enroll large number of women into S&T activities; SERB Distinguished Fellowship Scheme.

Overall 681 scientists were supported under the Extra-mural Research (EMR) funding scheme for individual investigators through the Programme Advisory Committee mechanism. In addition, 1063 Young Scientists were supported under the Fast Track Scheme for Young Scientists. Annual releases for more than 2100 projects were made during the reporting period. 40 scientists received Ramanujan Fellowship

and 22 received JC Bose Fellowship. Five projects were sanctioned under Intensification of Research in High Priority Areas (IRPHA).

To stimulate and trigger industrial R&D and ensure private sector participation into R&D, Science and Engineering Research Board is implementing Prime Minister's Doctoral Fellowship Scheme with a view to develop human capacity for industrially relevant Research and Development. The scheme provides for double the scholarship (upto Rs.6 lacs per annum) for aspiring Ph D scholars with 50:50 cost sharing basis between Government and sponsoring industry. Already 28 awards have been made at the 100<sup>th</sup> Session of Indian Science Congress during 2013

A portal of SERB for online submission of R&D proposals ([www.serbonline.in](http://www.serbonline.in)) was launched by the Hon'ble Minister of Science and Technology and Earth Sciences. The system enables online submission of proposals by the project investigators, evaluation of proposals by the peer reviewers and technical committee, financial sanction, monitoring and its overall management. The system also supports real-time tracking of proposals online as well as through automated alerts and notifications.

**Women Scientists Scheme (WOS-A)** has completed a decade of support and encouragement to women scientists having break in their career and provide them opportunity to come back in main stream of science by pursuing research in Science & Engineering. This year the Department received a total of 1037 new proposals against which a total number of 222 projects have been sanctioned.

Support towards augmenting higher education and research at university and academic sector for basic infrastructural facilities for teaching and research was provided to 152 institutions/departments during the year.

The support provided to performing universities under the scheme viz. **Promotion of University Research and Scientific Excellence (PURSE)** has increased the number of publications and h-index of these Universities. Second round of support to all 14 Universities is being considered by the Department.

**Mega Science facilities and Mega Science programmes** were supported to improve access to state-of-the-art facilities. New projects for setting up India based Neutrino Observatory, Thirty Meter Telescope and National Large Solar Telescope have been initiated during the year.

Attraction of talent for Science and Research is being pursued through **Innovation in Science Pursuit for Inspired Research (INSPIRE)** programme since 2009-10. More than 10 lakh students in the age group of 10-15 have been provided INSPIRE awards from whom more than 230 innovations are being processed for provisional patenting. Over 2.10 lakh students in the age group of 16-17 have participated in Science camps during the last four years out of which 44000 participated during the year. More than 29,000 students from the top 1% performers in school boards have been attracted to study of undergraduate courses in Sciences. 3300 students, who are first rank holders at Master's level, pursuing doctoral degree are receiving INSPIRE fellowship. About 378 post doctoral scholars under the age of 32 have been provided INSPIRE Faculty awards as a measure of Assured Career Opportunity. More than 30% of the scholars receiving INSPIRE Faculty awards are from Indian Diaspora returning to research careers in the country.

The Department continued to play an active role to develop and deliver need based **S&T interventions at the grassroots level** for socio-economic development specially for weaker sections of the society. To encourage grass-roots innovators, National Innovation Foundation was able to scout about

14000 ideas, innovations and traditional knowledge practices from different parts of the country during 2013-14. 43 applications for intellectual property protection were filed nationally. A company named Yuvan Long Life was registered in collaboration with Pune based Ensign Biosciences for commercialization of grassroots technologies.

Implementation of **National Data Sharing and Access Policy** enunciated in February 2012 has now been initiated through National Informatics Centre (NIC) by launching Open Government data portal **www.data.gov.in**. A set of 6000 data sets including spatial data sets are now accessible through the Data Portal. The portal makes accessible Survey of India's 1:50000 topographic data for selected States in the form of Web Map Service (WMS) for visualization. This is a proactive step of the Government to make available Government owned data for civil society use. It will open up Government-owned data for meeting civil society needs and development of applications for servicing the common man.

**National Geographical Information System (NGIS)** offering services and imageries on cyber space has been prioritized. A major initiative to launch NGIS with 41 layers of information products on spatial maps was initiated. NGIS is expected to offer a unique set of services for people by providing GIS data products of high utility value.

Taking into account of the one of the objectives of the Government of India for main streaming developmental processes in North Eastern Region, the Department of Science and Technology has established a **North East Centre for Technology Application and Reach (NECTAR)**. The centre would strive to connect technology assets emanating from various scientific departments and their institutions to the developmental processes of state Governments of the North East Region. The center has already piloted several projects to provide an extension mechanism for technologies for development for State Governments in North Eastern Region.

**Technology Development Board (TDB)** has signed 15 agreements with industrial concerns with a commitment of Rs.83.73 crores out of a total project cost of Rs.302.65 crores to assist companies for commercialization of technologies in various sectors of economy viz Health, Biotech, Chemical, Engineering, Agriculture, Energy & Waste Utilization and ICT.

**International S&T Cooperation** programme is being leveraged by the Department for enhancing S&T competitiveness of the country. Large number of joint R&D projects, multi-institutional Networked Research Projects and Applied R&D projects are under implementation through bilateral and multilateral S&T cooperation mechanisms. Indicative trends in fostering international S&T cooperation and partnerships during 2013-14 are as following:- joint research project based networking of researchers under active bilateral S&T programs of cooperation with more than 40 countries including substantive programs with 9 countries; Establishment of virtual networked bilateral R&D Centres; Bilateral R&D projects involving industrial partners with Canada, Finland, France, Germany, Israel, Spain, United Kingdom and United States; Co-investment of resources including funds for symmetric joint research projects and strategic joint initiatives with Australia, Germany, Hungary, Norway, South Korea, Switzerland, UK, and USA; Execution of New Africa S&T Initiative Program including fellowships, trainings and strengthening of R&D institutions through twinning.

**National Mission on Nano Science and Technology** - an umbrella programme - was launched in the year 2007 to promote R&D in this emerging area of research in a comprehensive fashion. The main objectives of the Nano Mission are - basic research promotion, research infrastructure development, nano



applications and technology development, human resource development, international collaborations and orchestrating national dialogues. During the year 2013-14, India secured 3rd position in the world in terms of scientific publications in nano science and technology. It is widely acknowledged in the country that Nano Mission's activities played an important role in achieving this milestone.

Two **National Missions on Climate Change** i.e. National Mission for Sustaining the Himalayan Ecosystem [NMSHE] and National Mission for Strategic Knowledge on Climate Change [NMSKCC] launched under National Action Plan for Climate Change [NAPCC] are under implementation by the Department. As part of deliverables of these national missions, 6 major research programmes have been initiated and supported during the period 2013-14. These include: Socio Economic Vulnerability of Himachal Pradesh to Climate Change, at Integrated Research for Action and Development (IRADe), New Delhi; Strengthening of existing Centre of Excellence in Climate Change – Divecha Centre for Climate Change, IISc, Bangalore; Inter-University Consortium on Himalayan Cryosphere: Science, and Society, coordinated by JNU, New Delhi and participated by three other universities; Madhya Pradesh State Climate Change Knowledge Management Centre (MP SCCKMC) at EPCO, Bhopal; Building an International Research Network on Sustainability to Enhance Strategic Knowledge for Climate Change” at Indo-German Centre for Sustainability, IIT, Chennai; and National Knowledge Networks on Climate Change- two networks one each on Climate Change Science and Modeling and Climate Change Science and Human Health coordinated by IIT, Delhi and participated by a number of institutions.

The Department is poised to make every effort to take India to a much higher level globally in the arena of Science and Technology and thereby contribute to the overall socio-economic empowerment of the society.

## HUMAN CAPACITY BUILDING

### HUMAN CAPACITY BUILDING THROUGH SCIENCE AND ENGINEERING RESEARCH

Department of Science & Technology is the largest support system for promoting basic research in science and engineering in the country. **Science and Engineering Research Board (SERB)**, created through an Act of Parliament, implements various programmes for strengthening the human resource engaged in diverse fields of science and engineering. The Board has intensified its R&D activities through multifaceted programmes. The Board had met four times in the reporting period and has taken significant decisions on R&D management in the country. Following are the significant decisions taken by the Board:

- A Track Based Research Funding Scheme for Indian performers. Set benchmarks at par with global standards
- A special programme for establishing Inter-Institutional Centres to develop manpower in the area of Neutrino Physics & Accelerators to provide a pipeline of research manpower required for the Mega Science programme of DST and DAE.
- Approved the participation of SERB in “Graduate Research Opportunities Worldwide” (GROW) Program of National Science Foundation (NSF), USA to address the asymmetric flow of Indian students to USA.
- A US-India Grand Challenge Programme on Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in the US and India has been initiated.
- Launched SERB Distinguished Fellowship Scheme for scientists of high calibre with a Fellowship amount of Rs. 60,000/- per month and a research grant of Rs. 5 lakh per annum for a period of 3 years, extendable by two more years. Selection of first batch of 7 Distinguished Fellows was made.
- Approved a special programme for producing PhD’s in Computer Science. A total of 150 fellowships were offered by the Board for a period of 3 years.
- Approved institution of 250 doctoral fellowships and 150 postdoctoral fellowships during the XII Plan.

The following new schemes have been implemented in the reporting period:

For ensuring industry participation in research and development the Board has implemented a doctoral fellowship scheme titled ‘Prime Minister’s Fellowship Scheme for Doctoral Research’. The scheme is for supporting aspiring PhD scholars with double scholarship (up to Rs. 6 lakh per annum), 50% of which will be provided by government (Board) and balance 50% by a sponsoring industry, for doing industrial research for four years. Twenty eight fellowships had been awarded.

For ensuring enhanced participation of weaker sections of the society in research and development, the Board has implemented a new scheme titled “Empowerment and Equity Opportunities for Excellence in Science”. A three tier support was provided under the scheme for empowerment while ensuring excellence. Full support was provided for scientists identified under Category A. Category B provided limited support for a period of two years with an opportunity for scientists to seek mentoring support and return to SERB with value added proposals within 18 months. Under Category C, limited support was provided for a period of one year for rewriting the proposal with support of mentors and resubmit quality enhance research proposals for reconsideration by the Task Force. A total of 91 scientists were supported in the reporting period.

Board in partnership with Public Health Foundation of India (PHFI) had launched a ‘Public Health Research Initiative’ to build the research capacity in public health in the country.

Board launched a ‘SERB Women Excellence Award’ Scheme with a research support of Rs. 5 lakh per annum for a period of three years. The Board upholds that enrolment of large number of women into S&T activities and promoting excellence is vital for the growth of S&T in our country. A total of 19 women scientists were conferred the Award.

Board launched a SN Bose Scholars Programme in partnership with the Indo-U.S. Science and Technology Forum (IUSSTF) to provide an opportunity to Indian and U.S. students to develop a dynamic student exchange program between Indian institutions and premier U.S. Universities led by the University of Wisconsin at Madison. A call was made. A total of 1143 applications were received in response to a call and 41 candidates have been selected for this programme.

In the reporting period Board approved a proposal to join CS3 summit spearheaded by American Chemical Society in partnership with Chemical Research Society of India.

The ongoing programmes of the Board were also received substantial research funding.

Individual centric R&D projects were identified by 19 Programme Advisory Committees working in broad areas of Chemical Sciences, Physical Sciences, Life Sciences, Engineering Sciences, Earth and Atmospheric Sciences and Mathematical Sciences. In addition 5 Expert Committees help in identifying the Young Scientist R&D Programmes.

Under the Intensification of Research in High Priority Areas (IRHPA) Scheme the Board has approved a major project on *a novel feasibility study of newborn screening for inborn metabolic errors in developing and developed areas: A pre-national rollout initiative* at University of Delhi South Campus, New Delhi. The project was aimed to demonstrate feasibility of implementation of an important public health initiative of newborn screening for completely treatable disorders like congenital hypothyroidism etc. in less developed and remote areas in a few north Indian states from the point of view of operational rollout. It also plans to evaluate the possible deliverable health benefits for disorders such as congenital adrenal hyperplasia, fragile X syndrome and B12 responsive methylmalonic acidemia, where screening may confer benefits, in developed and less developed areas encompassing deep villages, semi urban and urban areas. It is expected that the project would generate basic epidemiological data for non-treatable

disorders like inborn metabolic errors of protein, fatty acid and organic acid metabolism, from geo-ethnic regions like urban areas, semi urban and rural areas.

Sub-continental lithospheric mantle research plays a fundamental role in our understanding of the nature and evolution of the Archaean cratons, their adjacent mobile belts and associated metallogeny. Direct information on the composition, stratigraphy and heterogeneity of the sub-continental lithospheric mantle can only be inferred from the mineral-chemical and petrological studies of deeper-mantle derived rock types such as kimberlites, lamproites, lamprophyres, alkali basalts and mafic dykes and their entrained xenoliths/xenocrysts. In this direction Board has supported a major IRHPA project on *Evolution of Indian Sub-continental Lithospheric Mantle: Insights from mineral chemistry of kimberlites, lamproites, lamprophyres, their entrained xenoliths/xenocrysts, mafic dykes and dyke swarms from Bastar and Eastern Dharwar cratons* at Banaras Hindu University, Varanasi.

Another high value project on *Low temperature, spatio-temporal spectroscopy of nanocrystals and multifunctional nanoassemblies* at Indian Institute of Science, Bangalore was approved during the reporting period.

Overall 681 scientists were supported under the Extra-mural Research (EMR) funding scheme for individual investigators through the Programme Advisory Committee mechanism. In addition, 1063 Young Scientists were supported under the Fast Track Scheme for Young Scientists. Annual releases for more than 2100 projects were made during the reporting period. 40 scientists received Ramanujan Fellowship and 22 received JC Bose Fellowship. Five projects were sanctioned under Intensification of Research in High Priority Areas (IRPHA).

More than 800 scientists were supported under the International Travel Support (ITS) scheme which is designed to provide financial assistance for presenting a research paper or chairing a session or delivering a keynote address in an international scientific event (conference/seminar/symposium/workshop etc.) held abroad.

Assistance to Professional Bodies & Seminar / Symposia Scheme extends partial support on a selective basis, for organizing seminar / symposia/ training programmes / workshops / conferences at national as well as international level. 648 events were supported.

A dedicated web portal of the Board has been made operational in early 2013 and information and details pertaining to the Board Programs / Schemes are available at [www.serb.gov.in](http://www.serb.gov.in).

A portal of SERB for online submission of R&D proposals ([www.serbonline.in](http://www.serbonline.in)) was launched by the Hon'ble Minister of Science and Technology and Earth Sciences. The system enables online submission of proposals by the project investigators, evaluation of proposals by the peer reviewers and technical committee, financial sanction, monitoring and its overall management. The system also supports real-time tracking of proposals online as well as through automated alerts and notifications.

A total expenditure of Rs. 550.16 crore was made by the Board for various R&D activities in 2013-14.

## Cognitive Science Research Initiative (CSI)

Cognitive Science Research Initiative (CSI) is exploring new avenues by supporting projects in various fields of Cognitive Science like Neuroscience, Psychology, Linguistics, Bio Engineering, Social Engineering, Education, Computer technology & Artificial Intelligence. Cognitive Science Research Initiative adopted holistic approach by supporting multi-centric mega projects, individual projects, human resource development through Post Doctoral Fellowship Programme, infrastructure development and various other promotional activities in order to encourage R&D in Cognitive Science in India.

This year, Department supported Thirty Eight (38) individual projects and Twelve (12) Post Doctoral Fellowships in Cognitive Science. Further in 2013, Department received **213** individual proposals and Ninety Eight (98) proposals were screened in for presentation before Task Force. On the other hand, Sixty Three (63) applications have been received for Post Doctoral Fellowship and Twenty Eight (28) applicants have been called for presentation before the Expert Committee.

Department has provided financial assistance to Two (2) Conferences namely ‘3<sup>rd</sup> Bangalore Cognition Workshop’ conducted at IISc, Bangalore and ‘Cognition, Experience and Creativity’ conducted at IIT, Gandhinagar.

### New Initiative:

This year Department has initiated “**A National Programme on Educational Neuroscience**” under which a new co-ordinated project has been supported on ‘*Development and validation of screening tool to identify Learning Disability (Teacher Administered Screening Tool)*’ in top-down approach. This is a multidisciplinary programme to address and understand the cognitive deficits of Learning Disabilities.

## EMPOWERING WOMEN SCIENTISTS

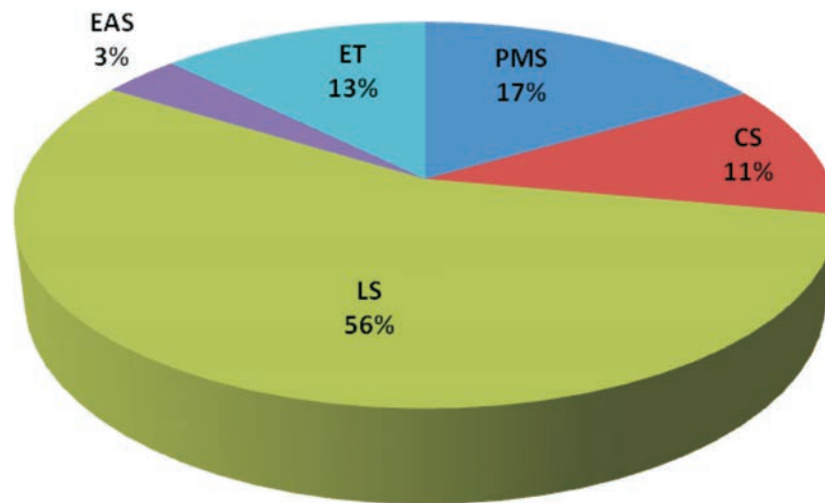
‘Women Scientist Scheme-A (WOS-A)’ has completed a decade of support and encouragement through S&T to women having break in their career and provide them opportunity to come back in main stream of science by pursuing research in Science & Engineering.

Since its inception, the Department has received **8186** proposals against which **1733** projects have been supported in different disciplines - Life Sciences: 944, Chemical Sciences: 248, Physical and Mathematical Sciences: 236, Engineering Sciences: 205, Earth and Atmospheric Sciences: 100.

This year the Department received a total of **1037** new proposals (Life Sciences – 655, Chemical Sciences – 132, Physical and Mathematical Sciences – 94, Earth and Atmospheric Sciences – 49, and Engineering Sciences – 107) against which a total number of **222** projects have been sanctioned. The subject-wise distribution of sanctioned projects is: Life Sciences – 124; Chemical Sciences – 25, Physical and Mathematical Sciences – 37; Engineering Sciences – 28; and Earth and Atmospheric Sciences – 8. It indicates approx. 22% of approval rate.

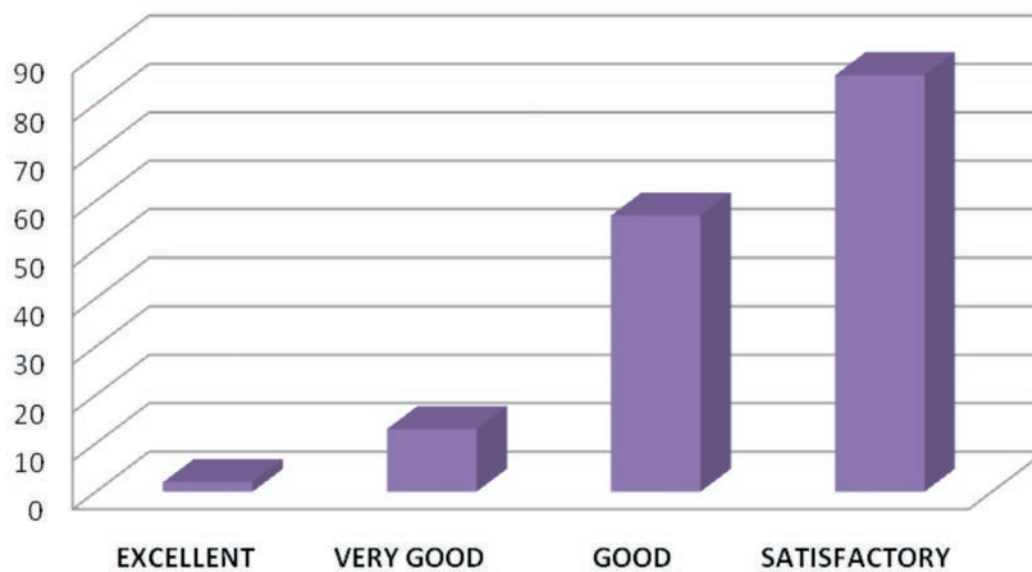
Approximately 40% women scientists achieved Ph.D. degree with the help of WOS-A project which show the relevance and popularity of the scheme.

## Subject Wise Distribution of Sanctioned Projects in 2013-14



During the year, the Department has also monitored **264** ongoing projects funded under this Scheme. Out of these, **2** were graded as Excellent, **13** were Very Good, **57** were Good and **86** were graded as Satisfactory.

## Group Monitoring Status



### **New Initiatives under WOS-A:**

- a. Training Programme on “Geomatics: Technology and Applications” for Women Scientists:**  
This training programme is based on the ‘geomatics technologies’ which have logically proved more accurate, scientific, unbiased and multi-disciplinary, thus allowing the decision making process in any area to be more effective and efficient. Therefore, it has immense importance in value addition of research result analysis and in policy making.
- b. Ph.D. Improvement Programme:** A mentoring programme has been initiated to improve Ph.D. standard in Engineering Institutions in which women scientists and their Ph.D. supervisors participated. These Ph.D. Candidates were mentored by a group of Subject Experts.
- c. ‘wosa’ Portal for Online Submission of Proposals under WOS-A:** In 2013, Online Project Proposal submission has been started for Women Scientists Scheme -A (WOS-A). The system not only enables aspiring women scientists to submit their project proposal online but also provides various formats and Guidelines which are required for project implementation.

### **Consolidation of University Research for Innovation and Excellence in Women Universities (CURIE)**

Department is providing support for six Women Universities under CURIE programme since 2009. Department has continuously monitored the progress of supported Universities by on-site visit. A visible impact of CURIE has been noticed on development of research facilities and infrastructure, human resource development and on the quality of research output in these universities. This has paved the way for 2<sup>nd</sup> Phase of CURIE Programme for additional support in these Universities.

### **New Initiatives under CURIE:**

- a. Networking of CURIE Beneficiaries:** Inception of CURIE has met with remarkable success as through CURIE support various State-of-the-art facilities have been established in supported women universities. The ‘*Networking Concept*’ has been introduced among CURIE beneficiaries to utilize these facilities and expertise of a particular university.
- b. CURIE support to Women PG Colleges:** Department is planning to extend the CURIE support in Women PG Science Colleges to develop research culture.

### **TRAINING OF SCIENTISTS AND TECHNOLOGISTS WORKING IN GOVERNMENT SECTOR**

Department of Science & Technology, in consultation with DOPT, other Scientific Departments and various organizations initiated an ambitious project of Human Resource Development namely “National Programme for Training of Scientists and Technologists working in the Government sector” for scientific and technical personnel during the X Plan to meet the challenges of national development and international competitiveness in S&T area. Considering the efficacy of the Scheme, the Department has decided to continue it in XI and XIIth Plan also.

During the year 2013-14, 33 training programmes were conducted under “National Programme for Training of Scientists and Technologists working in the government Sector” and a total number of 720 scientists got benefited from these training programmes.

Under the Foreign Component of the Training Programme, 25 Junior level Scientists were deputed for five day exposure visit to Germany and 14 Senior and Middle Level Scientists were deputed for five day exposure visit to Australia during the financial year 2013-14.

**Women Component Plan:-** Under women component plan of the Training Programme ‘10’ programmes were conducted exclusively for women scientists during the year in which 204 Women Scientists availed the opportunity of getting trained.



## INSTITUTIONAL CAPACITY BUILDING

### PROMOTING R&D THROUGH AUTONOMOUS INSTITUTIONS AND PROFESSIONAL BODIES

#### INTERNATIONAL ADVANCED RESEARCH CENTRE FOR POWDER METALLURGY AND NEW MATERIALS (ARCI), HYDERABAD

The International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) was established on April 01, 1997. The institute has 173 regular employees, out of which 71 are scientists.

##### Areas of Research:

Nano-materials, Engineered Coatings, Ceramic Processing, Laser Processing of Materials, Sol–Gel Technology, Carbon Materials, Fuel Cells, Solar Energy Materials, Automotive Energy Materials.

##### Major Accomplishments:

- In Concentrated Solar Power (CSP) programme, thermally stable solar selective absorber and anti-reflective coatings developed. For field-testing, the prototypes have been sent.
- Applications of such self-cleaning paints and odor-free textiles along with an industrial partner.
- For EV applications taking up of development of high saturation soft magnets (Fe-P) and high coercivity rare earth permanent magnets (Nd-Fe-B, Sm-Fe-N). Forging of collaborations with industry to develop and demonstrate the technology.
- Nano tungsten disulfide ( $WS_2$ ) in several forms such as particles/composites, coatings and sheets have been synthesized for possible applications such as solid lubricant, self-lubricating composites in automotive and manufacturing industries; and as co-catalyst to CdS for hydrogen generation.
- Successful demonstration of laser-hardening process for micro structural tailoring of automotive grade steel sheets and for improved tensile and fatigue properties without loss of formability under an industry-sponsored project.
- Improved thermal barrier performance could be achieved by developing hybrid coatings combining Solution Precursor Plasma Spray (SPPS) and Atmospheric Plasma Spraying (APS) processes, which enabled simultaneous or sequential feeding of solution precursors and spray-grade powders.
- Fabrication of first honeycomb based solid oxide fuel cell prototype including the feeding system and electrical circuit.
- Successful development of Proton Exchange Membrane (PEM)-based hydrogen generators of 1000 L/h capacity based on electrochemical reforming of methanol–water mixture.

### **Important Highlights of 5 Major Programmes:**

- Solar PV programme: A pilot facility established for production of CIGS thin film solar cell devices. Facility can produce CIGS thin films on substrates of size 300 mm × 300 mm.
- Pilot scale facility has been set-up to develop large format Lithium-ion cells and battery packs for Electric Vehicles/Heavy Electric Vehicles and for stationary storage applications.
- Grid Independent Power Supply System (GIPS-20000) based on two 10 kW PEM fuel cell stacks has been developed and tested for ~275 h intermittently. The efficiency of the inverter was ~84% at 0.82 power factor at peak load and is capable of taking different types of electric loads.
- An ultrafast laser micro-processing system, based on a Ti-sapphire regenerative laser source has been conceptualized and partly built in collaboration with National Research Council (NRC) of Canada for micromachining applications such as surface texturing, micro-scribing of thin film solar cells, micro-drilling of fuel injectors.
- Transparent spinel ceramics with >80% transmission combined with good mechanical properties have been developed.

### **Major and Unique Facilities Created:**

Gas Atomizer, Solar cell fabrication pilot facility including, Sputter coater, Evaporator-RTP (tunnel type furnace), Chemical Bath Deposition System, Scribing system, Glass washing machine, Laminator, X-Ray Fluorescence spectrometer (XRF), Intense pulsed light system, Solid oxide fuel cell test bench.

### **Major Honours and Awards Received:**

- Dr. S. V. Joshi inducted as a 'Fellow' of the Indian National Academy of Engineering (INAE).
- Dr. G. Padmanabham conferred the 'MRSI Medal' by the Materials Research Society of India.
- Dr. G. Padmanabham became a "Fellow" of the Indian Welding Society (IWS).

### **Important Collaborations (National and Global) established:**

#### **Global:**

Fraunhofer Institutions, Germany; Höganas AB, Sweden; National Research Council of Canada; Institute for Problems of Materials Science, Ukraine; International Centre for Electron Beam Technologies, Ukraine; PACT, France; Pratt and Whitney, USA; University of Central Florida, USA; Zoz, Germany.

**Indian:** National collaboration is with following organizations:

Ashok Leyland; BHEL; Bimetal Bearings Limited; Central Scientific Instruments Organization; Central Institute of Plastics Engineering and Technology; Cummins Technologies India Limited; Defense Research and Development Organization (DRDO); Fleetguard Filters Pvt. Ltd.; Honeywell Technology Solutions Lab Pvt. Ltd.; Indian Space Research Organization; Indira Gandhi Centre for Atomic Research; Indian Institute of Science-Bangalore; Indian Institute of Technology (IIT)-Bombay; IIT-Madras; IIT-Kanpur; IIT-Kharagpur; IIT-Hyderabad; National Institute of Technology-Warangal; Osmania University; Redson

Engineers Pvt. Ltd.; Resil Chemicals Pvt. Ltd.; Tata Steel Limited; Tata Consultancy Services Limited; Thermax Limited; Titan Industries; University of Hyderabad and Walchandnagar Industries Limited.

### C. Important Output Indicators:

S. No.	Parameters	Output
1.	Papers in Refereed Journals	73
2.	Chapters in Books	7
3.	Papers including invited lectures in Conferences/workshops/symposia other events etc. (with or without proceedings)	149
4.	No. of Ph.Ds. produced	4
5.	Foreign Patents filed	1
6.	Indian Patents filed	13
7.	No. of technologies/designs and other intellectual products supplied	17
8.	Number of technology leads awaiting transfer	14
9.	Research Manpower trained (No. of SRFs/JRFs)	42
10.	Technical Manpower trained (employees/fellows deputed for training/ participation in workshops etc.)	95
11.	B. Tech/UG projects guided	29
12.	M. Tech./M. Sc./M. Phil projects guided	42
13.	Number of current Ph.D. Scholars (excluding ARCI regular employees)	15

### MACS' AGHARKAR RESEARCH INSTITUTE (ARI), PUNE

MACS Agharkar Research Institute (ARI) was established in the year 1946. The Institute has 134 regular employees, out of which 33 are scientists/faculty and 17 are post-doctoral research staff.

#### Areas of Research:

Biodiversity; Crop improvement; Developmental biology; Human Nutrition in Health and Disease; Microbial processes; Nano-bioscience; Natural Product Chemistry; Palaeo-biology and Palaeontology; Virology.

#### Major Accomplishments:

**Crop improvement:** A new high yielding – 2.5 to 3.0 t/ha – soybean variety MACS 1188 has been released for Southern Agro-climatic Zone. This variety is resistant to pod shattering habit and major insect

pests. Identification of a high yielding bread wheat variety MACS 6478 for cultivation in high-fertility irrigated conditions in peninsular zone. The variety shows excellent chapatti making quality, good nutritional quality and resistance against stem and leaf rust.

**Microbial processes:** A microbial process for the degradation of total petroleum hydrocarbons present in the produced water to make it suitable for recycle and reuse was developed.

**Nano-bioscience:** Demonstration of Dextran-coated Lanthanum Strontium Manganese Oxide nanoparticles, as a new 'theranostic' agent in melanoma bearing C57BL/6 mouse model for treating cancer via hyperthermia and as a negative contrast agent in magnetic resonance imaging.

**Developmental biology:** Homologs of vertebrate vesicular endothelial growth factor and fibroblast growth factor have been found from hydra for the first time.

**Biodiversity and Natural product chemistry:** One new genus *Auxthronopsis bandhavgarhensis* and two new species *Gymnoascus verrucosus* and *Mycoenterolobium flabelliformis* (microfungi) and *Stropharia rubrobrunnea* (macrofungus) were discovered and described. Two new species of lichen genus *Graphis* (family Graphidaceae) were discovered and six species, viz., *Everniastrum cirrhatum* (Atranorin, protolichesterinic and salazinic acid) *Parmelaria thomsonii* (Atranorin, Alecoronic and á-collatolic acids), *Parmotrema nilgherrense* (Atranorin, Alecoronic and á-collatolic acids), *Nephromopsis pallescens* (Lichesterinic and protolichesterinic acid), *Stereocaulon foliolosum* (Atranorin and Lobaric acid), *Usnea orientalis* (Usnic and salazinic acid) were cultured.

#### **Important Highlights of 5 Major Programmes:**

**Crop improvement:** Development of high yielding wheat (MACS 6478) and soybean (MACS 1188) varieties for Peninsular India. Molecular marker assisted introgression of certain quality traits and rust resistance genes in the background of important bread and durum wheat cultivars of peninsular region.

**Nano-bioscience:** Process know how for 1) rapid identification and antibiotic susceptibility of uropathogens, and 2) one-step rapid DNA isolation from bacteria was successfully demonstrated and transferred to M/s Robonik (I) Pvt. Ltd., Mumbai for commercialization.

**Microbial processes:** Microbial community of oil reservoirs in Western India region was profiled using PCR-DGGE approach as well as by conventional culture dependent approach. Investigation of Kinetics of biogenic methanogenesis in simulated experiments mimicking methane hydrate deposits in submarine sediments. Development of microbial processes for treatment of produced water in oil extraction industry, and bio-hydrogen production from high strength industrial waste.

**Developmental biology:** Identification, isolation and characterization of hydra homolog of *XPF* gene of nucleotide excision pathway important in UV induced DNA damage repair; Identification of role of mitochondria in *fog* signalling.

**Palaeo-biology and palaeontology:** First report of the ichnogenus *Hillichnus* from India and new morphological variations in it discovered from the Jaisalmer formation. Study of foraminifera and diatoms integrated with geochemical analysis of toxic metals in sediments has led to the establishment of environmental status of Vasishti Estuary and ascertainment of types and sources of environmental degradation.

**Major and Unique Facilities Created:** Establishment of a large-scale hydra facility.

**Important Collaborations (National and Global) established:**

Birbal Sahni Institute of Palaeobotany, Lucknow; Central Bee Research and Training Institute, Pune; DSM India Pvt. Ltd.; Forest Department, Maharashtra; IISER, Pune; Jawaharlal Nehru University, Delhi; Kanbiosys Pvt. Ltd. Pune; KEM Hospital and Research Center, Pune; National Institute of Oceanography, Goa; National Research Centre for Grapes, Pune; NIT, Rourkela, Odisha; Physical Research Laboratory, Ahmedabad; Robonik (I) Pvt. Ltd., Mumbai; Shivaji University, Kolhapur; University of Agricultural Sciences, Dharwad; and University of Pune, Pune.

**Important Output Indicators:**

S. No.	Parameters	Output
1.	Papers in refereed journals	39
2.	Books	2
3.	Chapters in Books	11
4.	Papers in Conferences	32
5.	Number of Ph.Ds. produced	9
6.	Indian Patents filed	1
7.	Number of Technology leads awaiting transfer	3
8.	Research Manpower trained (other than Ph. Ds)	28
9.	Technical Manpower trained	9
10.	B.Tech/ UG projects guided	2
11.	M. Tech/M. Sc./M. Phil projects guided	15
12.	Other Products/ Indicators Soybean var. MACS 1188 releasedWheat var. MACS 6478 identified	11

**ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES), NAINITAL**

The Aryabhata Research Institute of Observational Sciences (ARIES) was established in the year 2004 under DST. The Institute has 113 regular employees, out of which 38 are scientists/faculty and 3 are post-doctoral research staff.

**Areas of Research:**

The institute specializes in research in Astronomy, Astrophysics and Atmospheric Sciences. The astrophysical topics include galactic and extragalactic astronomy, which include exoplanetary systems, star

formation, star clusters, optical variability in roAp stars, gravitational lensing, AGNs and quasars, supernovae, X-ray sources, Wolf-Rayet galaxies, giant radio galaxies and gamma ray bursts. The research in solar physics concentrates on observations and modeling of the transients (e.g., flares and associated plasma processes, jets, spicules, etc.), space weather phenomena and magneto-hydrodynamic waves in the solar atmosphere. In Atmospheric Sciences, main fields of research are aerosols, trace gases and dynamics.

#### **Major Accomplishments:**

- (i) Most of the telescope components of the 3.6 m telescope were transported to Devasthal site. The construction of enclosure is in advanced stage.
- (ii) Development of first light instruments FOSC & imager in advanced stage.
- (iii) Readiness of ST Radar building at ARIES and demonstration of mini ST Radar at ARIES, Nainital
- (iv) WRF-Chem:  
Incorporation of a CO tracer module in the WRF-Chem model which has been used for source contribution analysis for South Asia pollution.
- (v) Observations of different trace gases in Kathmandu valley during an international (India, Nepal, Germany, Japan, Korea, etc) and multi-institutional campaign, SUSKAT.
- (vi) Discovery of sausage-pinch instability for the first time in the solar corona.
- (vii) Studies of solar transients/eruptions and magnetohydrodynamic (MHD) waves.

#### **Important Highlights of 5 Major Programmes:**

- i) Successful transportation of the entire 3.6 m telescope components from the AMOZ factory, Belgium to the Devasthal site, India. The fabrication and transport of the aluminizing plant for coating the mirrors of the telescope is complete. The dome and the extension building construction at Devasthal are currently in progress.
- ii) A Faint Object Spectrograph and Camera (FOSC) as a backend instrument for the 3.6 m telescope is under development. In France (M/s Winlight) this year, a preliminary design review held. Manufacturing completed of all the optical components and the final tests carried out recently. The design of the mechanical components is in progress at ARIES.
- iii) A new 4K × 4K imager for the 3.6 m telescope is being developed fully in-house at ARIES. At the ARIES workshop, major portion of the mechanical parts have been fabricated.
- iv) Testing completed of a miniature version (sub-array of 49 elements) of ST Radar. Integration of its different subsystems is in progress at the ST Radar site. The construction of the building for the ST Radar completed.
- v) Civil construction of the 4.0 m international liquid mirror telescope (ILMT) completed and fabrication drawings of the enclosure structure finalized.

- vi) WRF-Chem: Incorporation of a CO tracer module in the WRF-Chem model, which is used for source contribution analysis for South Asia pollution. Model results show that winter-time CO in the boundary layer and free troposphere over India is mostly due to anthropogenic emissions and to CO inflow. Over the Arabian Sea and the Bay of Bengal, 43%–51% of surface CO mixing ratios come from the Indian subcontinent and 49%–57% from regions outside of South Asia.

**Major and Unique Facilities Created:**

The 1.3 m telescope is fully functional and good scientific results have started coming out from this facility.

**Important Collaborations (National & Global) established:**

- (i) For the design & development of a 4k × 4k CCD camera for astronomical applications, an MoU was signed between ARIES and Herzberg Institute of Astrophysics (NRC–NSI), Canada.
- (ii) Initiation of a collaborative project between ARIES and NCU, Taiwan under the Indo–Taiwan S&T cooperation program to investigate the formation and evolution of star clusters.
- (iii) An Indo–US Science and Technology Forum (IUSSTF) Joint Center Project on solar eruptive phenomena titled – “*Multi-wavelength study of solar eruptive phenomena and their interplanetary response*” was initiated.
- (iv) ADST–RFBR (Indo–Russian) project entitled “Study of Dynamical Events in the Solar Atmosphere during Maximum of Solar Cycle 24” within ARIES is in progress between ARIES Solar Physics group and IZMIRAN, Russian Academy of Sciences, Troitsk, Russia since July 2012.
- (v) ISRO–GBP Atmospheric Chemistry Transport and Modeling (ATCTM) Project.
- (vi) Indo–Russian DST–RFBR bi-lateral project titled “The spectral and photometric monitoring of gamma-ray burst terglows, core-collapse supernovae and their host galaxies”.
- (vii) An MoU signed between TIFR and ARIES to construct a near infrared spectrograph for the 3.6 m telescope – TANSPEC.

**Important output Indicators:**

S. No.	Parameters	Output
1.	Papers in refereed journals	24
2.	Papers in Conferences	05
3.	Number of Ph. Ds. produced	05
4.	B. Tech/UG Project guided	35
5.	M. Tech/M. Sc./M. Phil project guided	04
6.	Research Manpower Trained(other than Ph. Ds)	03
7.	Technical manpower trained	30

## **BOSE INSTITUTE (BI), KOLKATA**

The Bose Institute was established in the year 1917. The institute has 287 regular employees out of which 60 are scientists and 31 are post-doctoral research staff.

### **Areas of Research:**

Physical, Chemical and Biological Sciences, both Basic and Applied Research

### **Major Accomplishments:**

#### **Significant accomplishments made in the following Institutional Programmes:**

Improvement of Plants: Biotechnological, Genomic and Proteomic Approach; Protein Structure, Function and Engineering; Bioinformatics and Computational Biology; Molecular Medicine; Microbial Genomics and infection Biology; Development of Systems Biology; Basic and Applied Problems in Physical and Environmental Sciences; Integrated M.Sc. and Ph.D. Programme in Life Sciences; Rural Biotechnology Programme for mushroom cultivation preservation and Spawn production (Fig. 1).

#### **Important Highlights of 5 Major Programmes:**

##### **i. Improvement of Plants: Biotechnological, Genomic, and Proteomic Approaches**

- *Alternaria brassicicola* mediated auxin repression in susceptible *Brassica juncea*
- Genetic Diversity Analysis of *Carica papaya*
- Investigating the role of ARID/HMG in modulation of chromatin structure in plants
- Oligomeric conformational changes influence the functional alteration of an insecticidal lectin to anti-fungal protein
- Improvement of cultivated sesame varieties & genotyping of Mulberry varieties (Fig. 2)
- Regulation of micro-RNA transcription by *Alternaria* fungal-stress in tomato
- Analysis of the role of the membrane bound transcription factors (MTFs) in transmission of stress signals
- Functional characterization of a serine-threonine protein kinase gene isolated from *Bambusa balcooa*

##### **ii. Protein Structure, Function and Engineering**

- A systems level analysis of transcriptional changes in Parkinson's disease
- Cloning, expression, purification and structural studies on a toxin, Ace from *Vibrio cholera*
- Crystal structure of *E. coli* GluRS (Fig. 3)
- Domain–domain interactions of *E. coli* GluRS



- Effect of TFE on the fibrillation properties of insulin
  - Molecular action of caffeine
  - Molecular basis of specificity ubiquity-nation machinery in eukaryotes
  - PH-dependent oligomerization and crystallization studies of a lectin from the Rhizomes of Turmeric (*Curcuma longa* L.)
  - Understanding the interactions with sigma factors with RNA polymerase in *M. tuberculosis* and *B. subtilis*
- iii. Molecular Medicine, Microbial Genomics and Infection Biology Understanding mechanism of carcinogenesis**
- Role of tumor derived glycol-sphingolipids in mediating tumor growth, progression and metastasis
- iv. Role of cancer stem cells in drug resistance**
- A molecular insight
  - Role of integrin dynamics and recycling during cancer cell adhesion and migration in 3-dimensional microenvironment
- v. Targeting RET to induce medullary thyroid cancer cell apoptosis**
- An antagonistic inter-play between PI3K/Akt and p38 MAPK/caspase-8 pathways
  - Unveiling the molecular mechanisms of tumor angiogenesis
  - Molecular signalling involved in Benzo(a)pyrene, an natural aryl hydrocarbon receptor (AhR) ligand induced alteration in testicular steroidogenesis and steroidogenic acute regulatory gene(StAR) expression
  - Effect of Resveratrol on the Wnt/ $\beta$ -catenin signalling in cervical cancer cell line (Hela)
  - Immunomodulatory role of Arabinosylated Lipoarabinomannan against Visceral Leishmaniasis
- vi. Arabinosylated Lipoarabinomannan skews Th2 phenotype towards Th1 during *Leishmania* infection by chromatin modification**
- Involvement of MAPK signaling
  - Understanding the mechanism of protein kinase quality control
  - Understanding molecular mechanism of action of human heat shock factor 1 (HSF1) in human cancer cells
  - Novel gain-of-function for transcription factor FoxP3 as co-transcription factor of STAT3 in T-regulatory cells

**vii. Regio-selective N1-Alkylation of 3, 4-dihydro-pyrimidine-2 (1H)-ones**

- Screening of their biological activities against Ca<sup>2+</sup>-ATPase
- Studies on the protective action of bioactive molecules in organ patho-physiology
- Role of nanostructures in organ patho-physiology

**viii. Basic and Applied Problems in Physical and Environmental Sciences**

- Quantum Information Theory, Algorithms and spin systems
- A one-pot Sonogashira coupling-hetero-annulation route to 2-substituted pyrrolo[3,2-*e*]indoles
- Atmospheric Science Studies
- Studying the physics of super-heated liquids using superheated drop detectors
- Experiments and Computational Chemistry
- Testing and characterization of GEM prototype for CBM muon tracking system
- Active detector array in Darjeeling
- Astrophysical S-factor from nuclear reactions with a rare isotope beam of <sup>7</sup>Be
- Transfer reactions with radioactive nuclear beams
- Study of spin states of three interacting electrons confined in semiconductor quantum dots
- Study of crystal structure in In As nano wires using Raman spectroscopy
- Dielectric relaxation and transport properties of perovskite oxides

**Major and Unique Facilities Created:**

- Proteomics & Genomics Centre; Centre for Astroparticle Physics & Space Science
- Bioinformatics Centre
- Rural Biotechnology Programme for mushroom cultivation preservation and spawn production

**Important collaborations (national and global) established:**

National collaborations with a number of Research Institutions and Universities are established for scientific progression. International Collaborations with countries like USA, Germany, Switzerland, France, Japan, Israel etc are in progress. Bose Institute has been invited to become a collaborating institute for the ALICE programme at CERN, Geneva. Bose Institute is also the Indian shareholder in the Facility for Antiproton and Ion Research (FAIR) at Darmstadt, Germany.

### Important Output Indicators:

S. No.	Parameters	Output
1.	Papers in referred journals	88
2.	Papers in Conferences	30
3.	Chapters in Books	5
4.	Number of Ph. Ds. produced	4
5.	Research Manpower trained (other than Ph. Ds)	25
6.	Foreign Patents filed	11
7.	Indian Patents filed	2
8.	Technical Manpower trained	8
9.	B. Tech/UG projects guided	5
10.	M.Tech/M.Sc./M.Phil projects guided	35

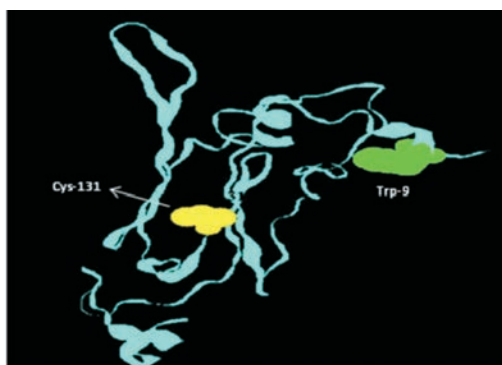


Fig. 1: Protein Structure, Function and Engineering: A-chain of crystallin showing the location of the hinge region (cys-131) and N-terminal (trp-9) region



Fig. 2: Crystals of an Ubiquitin E3 ligase complex

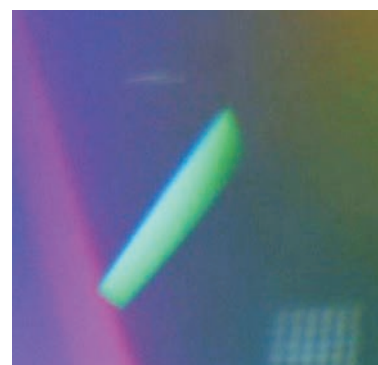


Fig. 3: Crystals of E. coli

## BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY (BSIP), LUCKNOW

The Birbal Sahni Institute of Palaeobotany (BSIP) was established in 1946. The institute has 172 regular employees out of which 72 are scientists and 2 post-doctoral research staff.

### Areas of Research:

- Early life and environment: Evidence from Indian Precambrian basins
- Phanerozoic terrestrial and coastal ecosystems: Biostratigraphical, palaeo-environmental, palaeo-ecological and palaeo-geographical aspects

- Integrative marine micro-palaeontology: Focus on high resolution biostratigraphy, sea level changes, palaeo-oceanographic and palaeo-climatic events
- Organic petrology: Characterization of solid fossil fuel for depositional and utilizational aspects
- Quaternary palaeo-climate reconstructions, vegetation dynamics and relative sea level changes
- Domestication of plants, early farming and ecosystem dynamics during Holocene/Anthropocene
- Geo-chronological and geochemical parameters for high-resolution dating, correlation, palaeo-climatic, tectonic and provenance studies
- India–Asia collision and Himalayan uplift: Palaeo-botanical and associated biotic signatures from the sedimentary records of northeast Himalaya
- Preparation of books, catalogues, atlases, databases, digitization of library, museum, herbarium and other holdings

### **Major Accomplishments:**

Research on Palaeo-botany and allied disciplines is being conducted on sedimentary sequences from Archaean to Recent (3200 Ma to 400 AD) with an integrated and multidisciplinary approach. Emphasis has been laid on deriving knowledge about the diversification of Precambrian life, diversity, distribution, zonation and inter- and intra-basinal correlation of Gondwana and Tertiary floras, terrestrial and marine microfossils and their application in solving geologic problems, coal/lignite quality and to understand the interaction between the climate and vegetation changes during Quaternary Period.

### **Important Highlights of 5 Major Programmes:**

*Precambrian Palaeobiology*—521 Ma old typical Middle Cambrian trace fossils have been recorded from the Nagaur Sandstone of Marwar Supergroup (in Rajasthan). An assemblage of cyanobacterial fossils has been recorded from the ~1000 Ma old Bhandar Limestone of the Vindhyan Supergroup. Organic-walled microfossils older than 635 Ma (Pre-Ediacaran) are recorded from the Chandrapur Group, Chhattisgarh Supergroup of Mesoproterozoic age.

*Phanerozoic Ecosystems*—Plant fossils studied from various Gondwana successions of Son-Mahanadi, Krishna-Godavari, Kashmir, Kachchh and Saurashtra basins have helped in interpreting floristic evolution and palaeo-ecology of the regions. The occurrence of vertically and diagonally preserved axes of the genus *Vertebraria* in a Late Permian coal seam of the Singrauli Coalfield (MP) indicates the presence of palaeosols in the area. Two types of *Williamsonia* flower have been recorded from Kachchh, besides petrified wood of Cyatheaceous stem. In addition, spores–pollen assemblages have been analysed from various coal-bearing Gondwana sequences of Son-Mahanadi, Damodar, Wardha-Godavari valley’s coalfields for biostratigraphic dating and correlations. Presence of Jurassic-Cretaceous sediments is indicated in the Chintalapudi sub-basin of Godavari Basin based on palynoflora. Data on the morphotaxonomy of spores from the Permian (Lower Gondwana) sediments of India has been compiled. A computer-aided information system on Indian Gondwana megaspores was prepared.

Additional data have been generated on plant megafossils (from western, central & northeast India, and Himalayan Foreland Basin), and micro-remains (from Kachchh, Saurashtra, Rajasthan basins, Lesser

Himalaya, northeast and central India) from certain terrestrial and marine Cretaceous-Palaeogene horizons in terms of their biostratigraphic, palaeo-environmental, and palaeo-geographic significance. The Coryphoid fossil palm leaves were reported from Deccan Intertrappean sediments of central India, which forms the oldest record of southern hemisphere. The oldest records of *Cocos* from the same horizon may well be considered as late Cretaceous origin in India, which later dispersed into southeast Asia and other parts of the world rafting northwards on Indian plate, thus supporting the 'Out of India' dispersal hypothesis. A leaf of *Uvaria* L. of the family Annonaceae is the first record from the Gurha lignite mine of Bikaner (Rajasthan). An evidence of equatorial forest build-up of the early Eocene climate optimum has been established based on palyno-assemblages recovered from the Panandhro lignite mine (Kachchh Basin).

*Marine Micropalaeontology*—Record of early Jurassic nannofossils and its implications on precise Pliensbachian age empirics transgressive event in Kachchh Basin was seen in response to break up of Gondwanaland in Pliensbachian or earlier time slice. This finding predates the existing view of earliest transgression in Kachchh Basin by ca. 15 my. Diatoms have been recovered for the first time from the Inglis Formation of Havelock Island.

*Organic Petrology*—Lower Gondwana coal from Rampuram area of Kothagudem sub-basin (Godavari Basin), and Tertiary lignites from Matasukh mine (Rajasthan Basin) and Surkha mine (Saurashtra Basin) have been evaluated for their characterization in relation to economic suitability and depositional conditions.

*Quaternary Palaeo-climate*—Studies have been carried out to understand the climates through palynological/palaeobotanical proxies (pollen, phytoliths, phytoplankton, tree-rings, Archaeobotany, etc). The data generated from Indo-Gangetic plain, southern MP, Sunderban Delta, flood plain of Assam, Meghalaya, Trans & Tethyan Himalaya, Polar regions, etc. has been utilized for the interpretation of spatio-temporal climatic changes covering major time span of the Quaternary Period. Pollen analysis of surface samples from Barehata, Nasinghpur district (MP) revealed the dominance of non-arbores (herbs) and much reduced frequencies of trees. Analysis of a sediment profile from Lashoda Tal, Raebareli district (UP) depicted the existence of open grassland vegetation in the region during 18,000 yrs BP under a cold and dry climate. Later on, the incursion of trees and aquatic flora since 10,000 yrs BP onwards denotes the amelioration of climate. Modern pollen studies depict the low core forest taxa in contrast to the open vegetation in and around Barak Valley of Assam. Middle Holocene shoreline is recorded through mangrove palynology in Avanigadda (Krishna Delta). Climatic history of Ziro Lake Basin of Arunachal Pradesh across the LGM time has been reconstructed using multi-proxy data. Detailed study of fluvio-lacustrine sediments in Indus river valley, Ladakh has been undertaken to mark the course of palaeo-Indus, landscape evolution and palaeo-climate. Sediment core samples from Schirmacher Oasis (Antarctica) were analysed for grain size. Late Quaternary climatic fluctuations were deciphered in the Arctic Region (Svalbard) based on pollen studies.

Archaeobotanical samples from Harappan site Khirsara in Kachchh region of Gujarat have been investigated to reconstruct the plant based subsistence economy and ecological conditions during 3<sup>rd</sup> to 2<sup>nd</sup> millennium BC. Anomalous distribution of *Cedrus deodara* and *Pinus roxburghii* in Parbati valley, Kullu, Western Himalaya has been studied using tree-ring data. Dating of coral samples from the island off Jam Nagar coast (Gujarat) seems to indicate toppling of the boulder sized coral samples some time during the past 5 thousand years.

### **Major and Unique Facilities Created:**

Equipment – Installation of UV Spectrophotometer, useful for the nutrient analysis in the water and sediment samples.

### **Major Honours and Awards received:**

Three scientists have been selected for Postdoctoral Fellowship awarded by the Third World Academy of Sciences. Prof. Sunil Bajpai, Director conferred with the Fellowship of the Palaeo-botanical Society of India, Lucknow.

### **Important Collaborations (National and Global) established:**

#### **National:**

Within the country, the Institute has entered into a collaboration with MS University (Baroda), PRL (Ahmedabad); Universities of Lucknow, Kutch, Kumaun, and Ravenshaw, Himachal Central University, and Rajasthan Vidya Peeth; WIHG (Dehradun); Indian Institute of Sciences (Bangalore); besides GSI, ASI, DSI (Visakhapatnam), IIG (Allahabad), NIO & NCAOR (Goa), ARI (Pune), IIT (Bombay, Kharagpur), Universities of Jammu, Bangalore, Calcutta, Manipur, etc.

#### **Global:**

Outside India, BSIP is collaborating with scientists of:

- (i) University of Minnesota
- (ii) West Virginia University
- (iii) American Museum of Natural History, NY
- (iv) University of Massachusetts (Boston)
- (v) University of Ohio (USA)
- (vi) Polish Academy of Sciences (Poland)
- (vii) Cardiff University (UK)
- (viii) National Museum of Wales (UK)
- (ix) Russian Academy of Sciences, Moscow (Russia)
- (x) University of Rio Grande (Brazil)
- (xi) Swedish Museum of Natural History (Stockholm)
- (xii) Institute of Botany, CAS Beijing (China), etc.

## A. Important Output Indicators

S. No.	Parameters	Output
1.	B.Tech/ UG projects guided	8
2.	Books	0
3.	Chapters in Books	2
4.	M.Tech/M.Sc./M.Phil projects guided	4
5.	Number of Ph.Ds. produced	2
6.	Papers in Conferences	5
7.	Papers in refereed journals	74
8.	Research Manpower trained (other than Ph. Ds)	18
9.	Technical Manpower trained	3
10.	Other Products/Indicators	
	Collaborative Research	24
	Consultancy Services (in Carbon dating, SEM, Palynology & Coal Petrology)	21
	National Scientific Meet/Conferences (organized)	2

## CENTRE FOR SOFT MATTER RESEARCH (CSMR), BANGALORE

In 1991, Centre for Soft Matter Research (formerly Centre for Liquid Crystal Research) was established, as a scientific society and was taken over in 1995 by the Department of Information Technology. In 2003, the Centre was transferred, as an autonomous institute, to the Department of Science and Technology (DST). It was renamed as Centre for Soft Matter Research (CSMR) with effect from 1.9.2010. The Institute has 44 regular employees out of which 8 are scientists and 6 are other post-doctoral research staff.

### Areas of Research:

The Centre was established to focus on basic and applied research on liquid crystals. Presently, Centre has broadened its scope to include Soft Matter like polymers, gels, membranes and so on.

### Major Accomplishments:

- **Enhancement of electrical conductivity, dielectric anisotropy and director relaxation frequency in composites of gold nanoparticle and a weakly polar nematic liquid crystal:** In dilute concentration composites, the absolute value of conductivity is observed to increase by two-three orders of magnitude with respect to that for the host liquid crystal. The concentration dependence is demonstrated to be described by the percolation scaling law generally observed in composites of metal particles and polymers.

- **Modified experimental technique to measure electroresistance behaviour of manganite thin films:** We have measured the out-of-plane electroresistance of  $\text{La}_{0.67}\text{Ca}_{0.33}\text{MnO}_3$  thin film, using a modified experimental technique. We find the resistivity peak temperature,  $T_p$  shifts towards higher temperatures with increasing current. This observation agrees with the predictions of the double exchange theory towards explaining the electroresistance behaviour of manganites.
- **Reduced graphene oxide based silver sulfide hybrid films formed at a liquid–liquid interface:** Free-standing, ultra-thin films of silver sulfide and reduced graphene oxide (RGO) based silver sulfide hybrids are prepared at a liquid liquid interface employing in situ chemical reaction strategy in a one-step or two-step sequential reaction. In the  $\text{Ag}_2\text{S}$  and RGO- $\text{Ag}_2\text{S}$  hybrid films, the morphology consists of  $\text{Ag}_2\text{S}$  nanocrystals on RGO surface while plain  $\text{Ag}_2\text{S}$  films contains branched network of dendritic structures. The hybrid films absorb in the region 500–650 nm and show emission in the red region. This simple low-cost method can be extended to prepare other RGO-based metal sulfides (Fig. 1).

#### Important Highlights of 5 Major Programmes:

- **Dual frequency conductivity switching in a carbon nanotube/liquid crystal composite:** Dielectric and conductivity measurements performed on a composite possessing dual frequency switching characteristics show that at low probing voltage, the conductivity increases by two orders of magnitude with respect to that for the pure compound, and achieves negligibly small temperature dependence. The frequency dependence of the ac conductivity is seen to be explained by an expression derived by the extended pair approximation model. It is demonstrated that the current through the sample can be field-driven between the two anisotropic values by simply changing the frequency of the applied voltage.
- **Electric field induced instabilities in the twisted smectic C phase of a liquid crystal:** In the smectic C phase of 90°-twisted 4,4'-diheptyloxyazoxybenzene, the following experimental observations are made for the first time: (i) Inhomogeneous Freedericksz effect, (ii) polarity dependent, gradient flexoelectrically assisted electroconvective patterned states, and (iii) flexoelectrically induced deformation of the undulatory structure of the periodic Freedericksz state.
- **Observation of wide thermal range ferrielectric phase in chiral liquid crystal dimmers:** In optically active liquid crystal dimers wherein cholesterol and three-ring salicylaldimine mesogenic cores are interlinked through a flexible even-parity ( $\omega$ -oxyalkanoyloxy) spacer, a wide thermal range of over 170K was observed. The electric field dependence of the spontaneous polarization measured in this phase showed a two-step variation. These features clearly indicate that molecular ordering is ferrielectric type. Most significant is the fact that these features were observed over a large temperature range of 170 K.
- **Synthesis of novel star shaped liquid crystals:** A new series of star-shaped liquid crystals has been synthesized by three-fold Horner-Wadsworth-Emmons (HWS) reaction of triphosphonate with three different types of aldehydes such as 4-(alkoxy)benzaldehydes, 3,4-di(alkoxy)benzaldehydes and 3,4,5-tris(alkoxy)benzaldehydes. Our study reveals the columnar phase formation exhibiting photoluminescence. These have potential technological applications.
- **Additional phases between the B2 phase and the true crystalline solid:** The effect of pressure on bent-core banana-shaped molecules shows that the relaxation parameters associated with the



rotation around the long axes of the molecules are significantly influenced. These studies bring out the fact that there are additional phases between B2 phase and true crystalline solid. The existence, of another variant of the B2 phase labelled B2', is revealed only in dielectric studies but not seen in x-ray calorimetry.

### Important Collaborations (National and Global) established:

#### National:

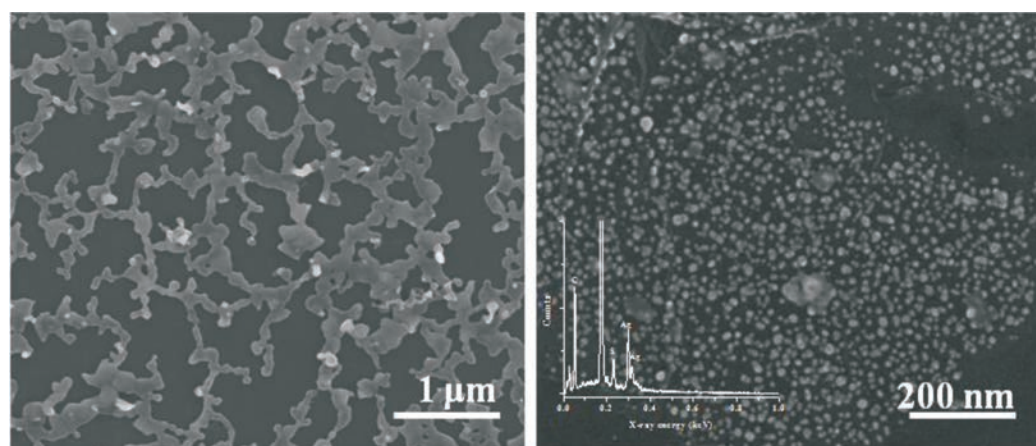
Bharat Electronics Limited; Raman Research Institute; Indian Institute of Science; Jawaharlal Nehru Centre for Advanced Scientific Research; National Chemical Laboratory and so on

#### Global:

Wigner Research Centre for Physics of the Hungarian Academy of Sciences under Bilateral Exchange Programme; Bulgarian Academy of Sciences under DST Bilateral Programme; Kent State University, USA; Tokyo Institute of Technology, Japan; Max Plank Institute for Dynamics and Self-Organization, Germany and so on

### Important Output Indicators

S. No.	Parameters	Output
1.	Papers in referred journals	24
2.	Papers in Conferences	1
3.	Number of Ph. Ds. produced	1 awarded and 1 submitted
4.	Research Manpower trained (other than Ph. Ds)	6 (from other institutions)
5.	Other Products/Indicators Lectures given at schools/ colleges under popularization of science	15 lectures



**Figure 1:** Field emission scanning electron micrographs related to reduced graphene oxide based silver sulfide hybrid films formed at a liquid/liquid interface (a) nanocrystalline plain Ag<sub>2</sub>S film (b) hybrid rGO-Ag<sub>2</sub>S film, obtained at a liquid/liquid interface. The inset in (b) gives the Energy dispersive spectra showing the presence of both Ag and S.

## INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE (IACS), KOLKATA

In the year 1876, Indian Association for the Cultivation of Science was established. The total number of regular employees is 229. There are 75 scientists and 40 post-doctoral staff.

### Areas of Research:

Molecular Science, Materials Science, Theoretical Sciences and Biological Sciences.

### Major Accomplishments:

- i) Development of Silicon quantum dot super lattice solar cell having the highest reported efficiency
- ii) Significant progress in the areas of nanostructured silicon and carbon
- iii) Simulation and Design of 2-Dim Analogues of Graphene
- iv) Theoretical demonstration of coherent control of atom atom interactions with lasers
- v) Development of functional models of nonheme iron enzymes that carry out O<sub>2</sub> dependent transformation reactions.

### Important Highlights of 5 Major Programmes:

**Molecular Science:** Stereocontrolled approach to the highly functionalized bicyclo[3.2.0]heptane core of bielschowskysin has been developed through intramolecular Cu (I)-catalyzed [2+2] photocycloaddition. A switch on-off “Click” fluorophore has been developed that can execute logic operation and detect heavy and transition metal ions in water and living cell. A new type of initiating system comprising ferric chloride and added salt is developed for the living cationic polymerization.

**Materials Science:** Materials and fabrication technology have been developed for thin film silicon solar cells. Different light emitting doped semiconductor nano crystals have been developed. Photovoltaic devices and organic electronics devices were synthesized for characterization of nano-materials. Functionalized nano-particle and CNT-enzyme conjugates were synthesized for nano-medicine, nano-photonics, hydrogen storage and other applications.

**Theoretical Sciences:** Extensive studies have been carried out on implications of warped geometry in Gauss-Bonnet gravity focusing on Higgs mass at 126 GeV, non-minimal scenario of SUSY breaking in a stochastic superspace. Highly accurate spin-free many body techniques were developed to understand chemical bond dissociation and treating non-dynamical correlation in molecules of lighter elements (Figure 1).

**Biological Sciences:** Peptide and nanomaterials based soft materials were developed for tissue engineering scaffold and sustained release of biomolecules/drugs. Carbon nanotube-amphiphile hybrids were designed and developed as functional delivery vehicle. Superior solid-state DNA detection by PNA/LNA probes, compared to DNA probes, was achieved.

### Major and Unique National Facilities Created:

- CRAY Super Computer facility
- A reference solar cell calibration facility

### Major Honours and Awards received:

Shanti Swarup Bhatnagar Prize: 1; FNA: 2; FNASc: 1; FNAE: 1; DST Ramanujan Fellowship: 3, AVRA Young Scientist Award: 1; DBT-Ramalingaswami Fellowship: 1; Indira Gandhi Priyadarshini Award: 1; Membership in the Advisory/Editorial Boards of International Journals: 5; Highlighted Author by ACS for high Quality Research in ACS Journals-2013: 3; CRSI Bronze Medal: 1, Important Award Lectures: 2; ICTP Regular Associate Award: 1, Silver Medal of CRSI: 1, C.N.R. Rao National Prize for Chemical Research award: 1, ACCMS Award: 1; MRSI Special Award: 1

### Important Collaborations (National and Global) established:

- a. SERIUS (Solar Energy Research Institute for India and the United States)
- b. Solar Energy Centre, MNRE
- c. IACS BARC collaboration (IBIQuS) on Quantum Structure Research
- d. India Sweden collaboration (VR SIDA) on Hydrogen Storage Materials (Figure 2)
- e. University of Monastir, Tunisia, under Indo-Tunisian Project
- f. Indian Institute of Chemical Technology, Hyderabad
- g. Department of Chemical Engineering, National Taiwan University, Taiwan
- h. Pasteur Institute, Paris
- i. Chittaranjan National Cancer Institute, Kolkata
- j. Saha Institute of Nuclear Physics, Kolkata
- k. Technical University of Dresden, Germany
- l. Helsinki Institute of Physics, Finland
- m. IISER, Pune and Bhopal
- n. Universität, München, Germany

### Important Output Indicators:

S. No.	Parameters	Output
1.	B.Tech/ UG projects guided	13
2.	Chapters in Books	11
3.	Foreign Patents filed	2
4.	Indian Patents filed + Indian Patents granted	3 + 3
5.	M.Tech/M.Sc./M.Phil projects guided	30
6.	Number of Ph. Ds. produced	54
7.	Papers in Conferences	125
8.	Papers in refereed journals	514
9.	Research Manpower trained (other than Ph. Ds)	23
10.	Technical Manpower trained	1

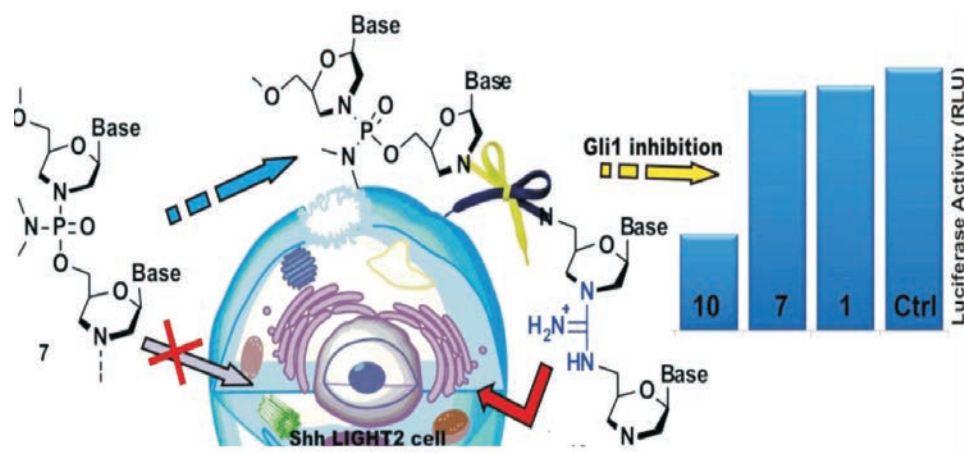


Figure 1: Synthesis of Morpholino reagents

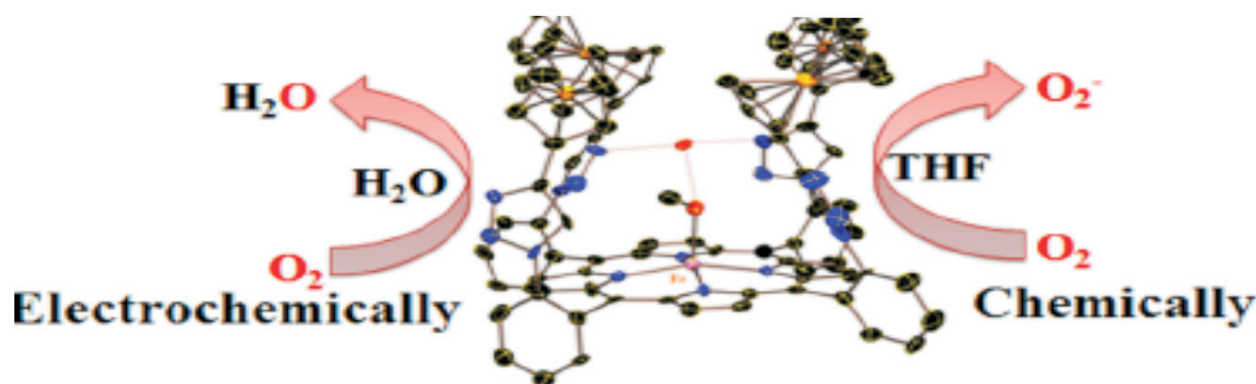


Figure 2: **Hydrogen Storage:** Research in developing functional models of metallo-enzymes like cytochrome P450 (C-H bond activation) and Hydrogenases ( $H_2$  production)

## INDIAN ACADEMY OF SCIENCES (IAS), BANGALORE

In the year 1934, Indian Academy of Sciences was established. The academy has 44 regular employees.

### Areas of Focus:

Publication of Scientific Journals, Election of Fellows and Associates, organize midyear and annual scientific meetings, Fellows Repository, Science Education Programmes.

### Major Accomplishments:

In FY 2013-14, 678 peer-reviewed articles have been published in 10 thematic journals and made available in open access platform. Over 27000 individuals, universities and other institutions received the journals. Worldwide visibility to Academy journals increased with more submission of articles. Journals citations have enhanced over years.

Under Summer Research Fellowship programme, over 1675 students and teachers underwent 2 months Fellowship and worked with Fellows and other mentors spread across 198 institutions.

## Important Highlights of 5 Major Programmes:

- (i) **Publication of Scientific Journals:** The journal wise account (ending November 2013) of total number of articles, issues, number of pages published and circulation figures are indicated below:

Name of the Journal	Number of published articles	No. of issues published (01/04/13 to 30/11/13)	No of pages published	Circulation figures
Pramana	114	8	1431	2318
Journal of Astrophysics and Astronomy	14	2	242	1322
Proceedings Mathematical Sciences	37	3	448	1942
Journal of Chemical Sciences	133	4	401	2054
Bulletin of Materials Science	134	4	950	2536
Sadhana-Proceedings in Engineering Sciences	70	5	1146	1817
Journal of Biosciences	64	3	642	2225
Journal of Genetics	44	2	347	1795
Journal of Earth System Science	88	4	902	1425
Resonance - Journal of Science Education	51	8	800	6205

- (ii) **Organizing Scientific Meetings:** The midyear meeting was organized in July 2013 in Bangalore. The annual meeting was organized at Chandigarh during November from 8<sup>th</sup> to 10<sup>th</sup> November 2013; Symposia, public lectures and scientific talk by Fellows/Associates were held in these meetings.
- (iii) **Fellows' Repository:** Through this initiative, 91549 metadata of important researches in the all branches of science carried out by Fellows of Academy are freely made available online. The number of full text available is 20646.
- (iv) **Science Education Programmes:** A total of 1698 students and teachers have availed Summer Research Fellowship and are provided with an opportunity of furtherance of studies and research in



Lecture Workshops

Refresher Courses

science and engineering. Till September 2013, 15 refresher courses in Physics, Life sciences have been conducted for university science teachers in different parts of the country. Thirty lecture Workshops held in various branches of Science in different parts of the country.

**1. Important Collaborations (National and Global) established:**

The Academy has collaborated with the other two National Science Academies: INSA, New Delhi and NASI, Allahabad to jointly implement Science Education Programmes. Collaboration for overseas online marketing of the Academy journals is established with Springer.

**2. Major Honours and Awards Received:** Dainik Bhaskar National Education Leadership Award 2013.

## **INSTITUTE OF ADVANCED STUDY IN SCIENCE & TECHNOLOGY (IASST), GUWAHATI**

Institute of Advanced Study in Science & Technology (IASST) was established in the year 1979; the Institute was taken over by DST (GOI) in 2009. The Institute has 67 regular employees. The institute has 18 scientists and 7 post-doctoral research staff.

**Areas of Focus:**

Nonlinear Phenomena of Plasmas, Waves and Instabilities in Dusty Plasma, Plasma Processing, Polymer Liquid Crystal, Synthesis of Nano-materials, Plasma Polymerization, Stochastic Process, Distribution Theory, Fuzzy Mathematics, Summability Theory, Image Processing, Exploration of Biodiversity in N.E. region, Eco-biological Study of flora and fauna, Abatement of Hydrocarbon pollution in oil contaminated soil, Medicinal plant, Seri-biotechnology.

**Major Accomplishments:**

- Linear and nonlinear Dust Acoustic Waves, Hole Peregrine soliton in multi-component plasma
- Fabrication of solar cell by plasma based process
- Development of propylene grafted Muga silk as suture biomaterial by plasma surface modification.
- Development of nitro-aromatic explosive sensors and biosensors.
- Synthesis of co-polymer gels and hydrogels for efficient absorption of organic solvent and oil (Figure 1).
- A new type of mixed fuzzy topological spaces have been introduced and its different properties have been investigated
- Application of Fuzzy C-means for classification of PAP-Smear image of cervical cancer
- Creation of Metagenomic DNA Bank for long-term storage of genomes of microbes inhabiting diverse ecosystems of Northeast India. A fosmidlibrary of  $49 \times 10^6$  clones containing metagenomic DNA of compost samples has been constructed (Figure 2).
- The gut microflora of 225 representative volunteers from 15 tribal populations of north-east of India and Andhra Pradesh have been revealed.

- First report on rhamnolipid biosurfactant produced by *Pseudomonas aeruginosa* DS9 against *Fusarium sacchari* the causal organism of pokkah boeng disease of sugarcane.
- Development of pharmacophore model for full AR antagonist using Ligand Based Drug Design approach for Prostate Cancer drug development.
- Fabrication and characterization of metallic and polymeric nanoparticles for antibiotic drug delivery system achieved with significant enhancement of Anti microbial activity.

#### **Important Highlights of 5 Major Programmes:**

- Measurement of linear dispersion relation of Dust Acoustic wave and observation of head on collision of dust acoustic solitons
- Synthesis of conducting polymer nano-fibre film by pulsed plasma process
- Development of proton exchange membrane for hydrogen fuel cell by plasma CVD process
- Growth of vertically aligned carbon nanotube on metallic substrate by pulsed PECVD
- Hybrid carbon-based nanomaterials for catalytic, chemical sensors and drug delivery applications
- Computational methods for Image Processing of medical data and Ab initio calculations based on Density Functional Theory for the study of structural, electronic and lattice dynamical properties of magnetic shape memory alloys.
- Studies on different topological spaces; application of Functional Analysis methods in summability theory and mathematical models using techniques of stochastic process
- Optimization of *In vitro* agarwood oil production technique is ongoing
- Efficient phytoremediation technology for hydrocarbon-polluted soil developed for oil fields of Assam.
- Research for development and standardization of herbal formulations against Diabetes mellitus, hepatotoxicity and breast cancer is in progress.

#### **Major and Unique Facilities Created:**

Plasma process application centre for Basic and applied research on functional analysis, topology and stochastic process; High performance computational facility for image and data analysis.

#### **Important Collaborations (National and Global) established:**

##### **National:**

- AIIMS, New Delhi; Annamalai University, Tamil Nadu; Asian Institute of Gastroenterology, Hyderabad; Asian Institute of Gastroenterology, Hyderabad; Assam Agriculture University, Jorhat; B. Barooah Cancer Research Institute, Guwahati; BARC, Mumbai; CAT, Indore; Central Agriculture University, Barapani; Central University, Mizoram; Central University, Nagaland; DRL Tezpur; Gauhati University; GB Pant University of Agriculture and Technology, Pantnagar; IBSD, Imphal; ICSIT, Kolkata; ICT, Hyderabad; IISc, Bangalore; IIT (Kharagpur, Bombay, Guwahati); IITR, Lucknow; IMTECH, Chandigarh; ISI Kolkata; JSS University, Mysore; Manipur University; National Institute of Nutrition, Hyderabad; NEHU Shillong; SINP, Kolkata; TERI, New Delhi

**Global:**

- Dalhousie University, Canada
- Deakin University, Australia
- Firat University & Adiyaman University, Turkey
- Michigan Tech. University & Chicago University, USA
- Mother Teresa Institute, Kosovo
- Museum national d'Histoire naturelle, Department Evolution et Syatematique, France
- National Taichung Institute of Technology, Taiwan
- Padova University, Italy
- Shanghai Second Medical University, China
- Shanghai Second Medical University, China
- Stazione spermente la seta, Milano, Italy
- University of Greece
- University of Maryland, USA
- University of Missouri-Kansas City, USA
- University of Ulster, School of Biomedical Sciences, Northern Ireland
- Yokohama University, Institute of Space, High Energy Accelerator Research Organization and Astronautical Science, Japan

**B. Important Output Indicators:**

S. No.	Parameters	Output
1.	B. Tech/ UG projects guided	10
2.	Chapters in Books	02
3.	Indian Patents filed	01
4.	M.Tech/M.Sc./M.Phil projects guided	10
5.	Number of Ph. Ds. produced	08
6.	Number of Technologies/Designs and other intellectual products commercialized	01
7.	Papers in Conferences	23
8.	Papers in refereed journals	46
9.	Research Manpower trained (other than Ph. Ds)	25
10.	Technical Manpower trained	01



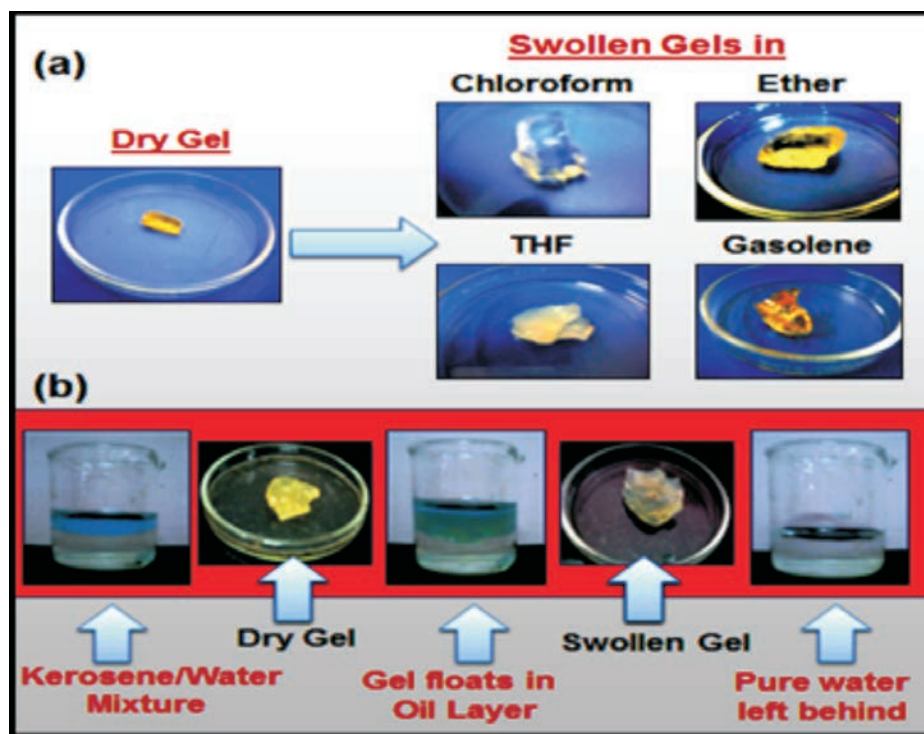


Figure 1: (a) Photographs of PODMAH1 gel of equal weight swollen in different solvents. (b) Removal of Kerosene from Water/Kerosene Mixture by the co-polymer gel.

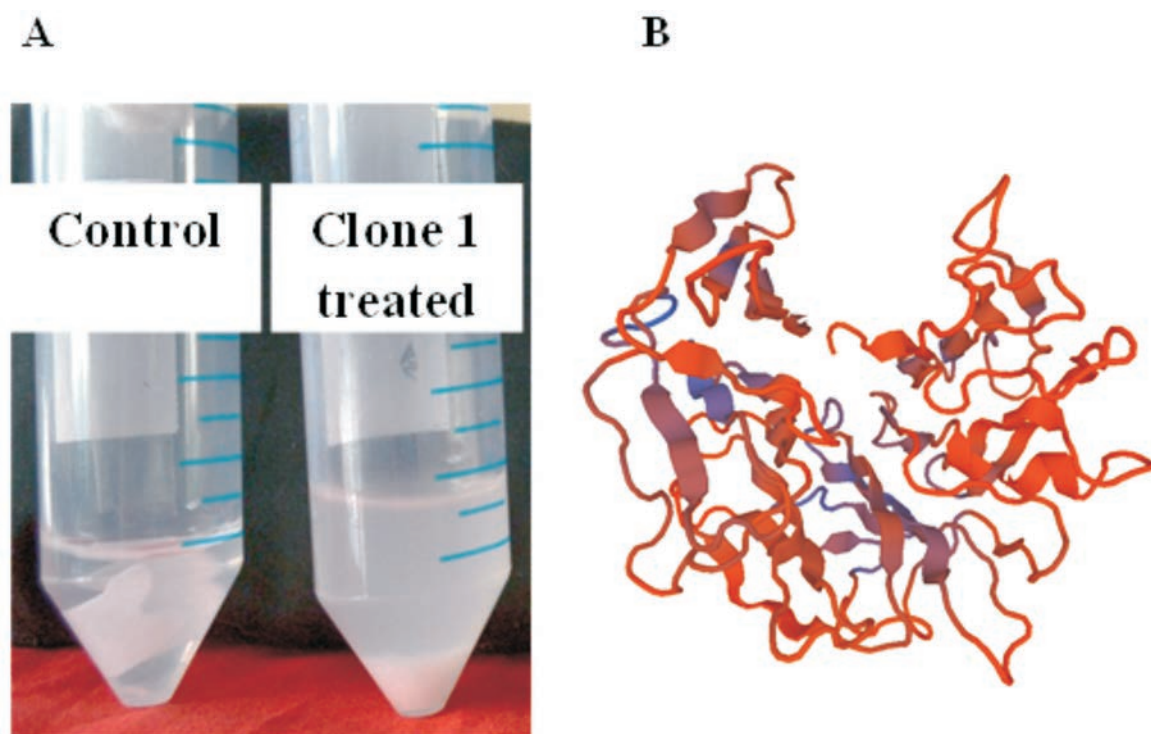


Figure 2: Cellulase degrading genes from metagenomic DNA. (A) A clone harboring cellulolytic gene(s) from metagenomic DNA having filter paper showing degradation activity and (B) putative protein structure of a novel gene of the clone having glycosyl hydrolase motif.

## INDIAN INSTITUTE OF ASTROPHYSICS (IIA), BANGALORE

The Indian Institute of Astrophysics, Bangalore was established in the year 1971. The Institute has a total of 292 regular employees, out of which 106 are scientists/faculty and 06 are post-doctoral research associates.

### Areas of Research:

Astronomy and Astrophysics, Atomic and Molecular Physics.

### Major Accomplishments:

The Indian Institute of Astrophysics is a premier institute devoted to research in astronomy, astrophysics and related physics. The institute has interest in various field of astrophysics and major results were reported in these areas. In the area of Solar Physics, the Solar Corona was studied using observations taken during the total solar eclipse which gave valuable clues about the heating mechanism. Research in the area of magnetic field in the solar atmosphere, asteroseismology, active regions and polarisation of spectral lines was continued.

In the area of stellar astronomy, high resolution spectral studies using data including those obtained from the 2.3 m telescope were continued. The studies were focused on the hydrogen-deficient stars; carbon enhanced metal poor stars and members of star clusters and stellar streams. The nature of star formation molecular clouds including those in the inner Galaxy is studied using observations as well as simulations. The studies of eruptive variables included Novae and Supernovae. Theoretical modelling of various systems was also performed.

In the area of Extragalactic astronomy, the nearby galaxies were studied using multi-wavelength data as well as theoretical modeling. These studies include various types of galaxies, with the aim to understand their properties, which include mass of black hole, presence of AGN, structural properties and jets. In Cosmology, new theoretical techniques have been formulated to determine the statistical properties of the cosmic microwave background (CMB) radiation. Furthermore, a novel method has been developed to detect the presence of residual foreground contamination in the cleaned CMB data—this is an important step forward in the extraction of cosmological information from CMB.

In the area of atomic and molecular physics, several investigations are carried out on the singly ionised barium (Ba II), which is of considerable importance in astrophysics. Detailed theoretical studies on the influence of three body interactions (on the superfluid to Mott insulator transition in ultracold bosonic atoms in optical lattices and superlattices) were undertaken. Behaviour of Be I and Na I isoelectronic sequence in the Debye plasma environment were also carried out.

The students program of the institute continues to be very active. The M Tech-PhD program in collaboration with Calcutta University has been getting very good response and the number of students in this stream are increasing. The Ph. D. program continues to produce well-trained and qualified graduates. The internship and summer programs are used to train a large number of undergraduate as well as postgraduate students from various institutions and universities. The outreach activity of the institute was spread across the field stations, apart from the Bangalore campus. The teams also participated in various exhibitions, open days as well as visit to schools. A large number of students and also members of the public at Bangalore, Kodaikanal and Kavalur (Figure 1) witnessed the Venus tranist of 6th June 2012.

## **Important Highlights of 5 Major Programmes and Collaborations (National & Global):**

The institute is a major partner in the multi-wavelength astronomy mission, ASTROSAT. Significant progress was made in the integration of the Ultra Violet Imaging Telescope (UVIT), one of the instruments on ASTROSAT. Both the telescopes were integrated and were sent to ISRO for environmental tests.

The high-resolution spectrometer for the 2 m Himalayan Chandra Telescope (HCT) at Indian Astronomical Observatory (IAO), Hanle is making significant progress with the fabrication of various components and construction of the enclosure at Hanle.

Among the new initiatives, the Indian effort to join the international consortium of TMT (USA, Canada, Japan and China) is progressing well. For the India TMT, the last year has been an eventful year both in terms of policy and the progress made at the ground level fulfilling our commitments to the project. India TMT hosted two TMT partner wide meetings: a two-day science meeting followed by the Science Advisory Committee (SAC) meeting at IUCAA, Pune during 10-14 December 2012 and the TMT Board of Directors meeting at New Delhi during 21-22 January 2013. India TMT has taken up various critical hardware and software work packages with the Indian Industry. The Indian institutions are involved in the development of science cases as well as with the instrument groups.

The National Large Solar telescope project is making progress with the detailed site characterisation and design of back-end instruments for the planned telescope. Several Indian institutions are participating in this program including PRL and ARIES.

The Aditya-1 Mission with the Visible Emission Line Space Solar Coronagraph has been progressing well. The Preliminary Design Review (PDR) of the optics has been completed and discussions on structure design are in the final stages. In January 2013, it was decided to enhance the capability of mission by changing the orbit of the satellite from low earth orbit (LEO) to L1—Lagrange point with a bigger satellite capable of taking more weight and volume (Figure 1).

The participating institutions include ISRO, PRL, IUCAA etc.

### **Major Honours and Awards Received:**

1. Prof. B. P. Das was elected as a Fellow of the American Physical Society (APS).
2. Prof. G. C. Anupama was elected Fellow of the National Academy of Sciences India.

### **Major and Unique Facilities Created:**

One of the major achievements was first light through the 1.3 m optical telescope at the Vainu Bappu Observatory, Kavalur (Fig.2). This is a 1.3 m aperture Ritchey-Chretien telescope, with a focal ratio of f/10. The telescope installation started from 7th February 2013 with the arrival of the three member team from the vendor company (DFM Engineering) at the site. A large team of institute personnel has been closely associated with the installation of the telescope. This has been a close collaboration of mechanical, electrical, optical engineers located at the VBO, as well as at Bangalore. The team has to its credit, in house development of installation and development of the interfaces between the telescope control electronics and the drives of the telescope dome, in the installation of the mirror supports and loading of the primary mirror in the cell, development of software needed for testing of the new fast CCD camera. Fine-tuning of the telescope is in progress and will be ready for science observations soon.

### Important Output Indicators:

S. No.	Parameters	Output
1.	Papers in refereed journals	105
2.	Chapters in Books	5
3.	Papers in Conferences	50
4.	Number of Ph. Ds. produced	8
5.	Research Manpower trained (other than Ph. Ds)	30
6.	Technical Manpower trained	10
7.	B. Tech/ UG projects guided	30
8.	M. Tech/M. Sc./M. Phil projects guided	30

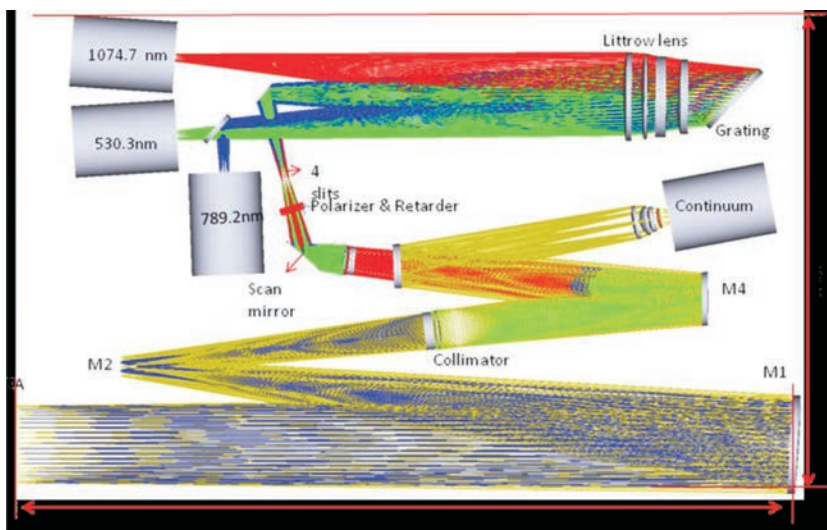


Figure 1: Enhanced VELC on Aditya-L1



Figure 2: A telescope of 1.3 m at Kavalur

## INDIAN INSTITUTE OF GEOMAGNETISM (IIG), NAVI MUMBAI

The Indian Institute of Geomagnetism was established in the year 1971. The institute has 38 full-time working scientists/faculty.

### Areas of Research:

Geomagnetism and allied fields

### Major Accomplishments:

IIG has the mandate to carry out basic and applied research in Geomagnetism and allied fields. IIG had established observational facilities to measure the geomagnetic field and several atmospheric and

ionospheric parameters at its two regional centres at Tirunelveli and Allahabad, its twelve magnetic observatories located in different parts of our country right from the geomagnetic dip equator to the northern focus of ionospheric Sq current system and at the Indian Antarctic stations, namely, Maitri and Bharati. The main objective of establishing the magnetic observatory network is to examine and understand the processes related to the dynamics of varying equatorial current patterns and global Sq current systems and those processes driven by the solar wind and interplanetary magnetic field that govern the storm-time response of the geospace environment.

### **Important Highlights of 5 Major Programmes:**

An experiment in collaboration with EuroSprite Team and ASIM mission was initiated last year. The aim is to probe TEL's like Sprites, Jets, Gigantic jets, Blue starters, etc above powerful thunderstorms, and to understand lightning electrical discharges and its effect on near Earth space environment and contribution to Global Electric Circuit. Following the first observation of the lightning discharge produced Sprites of various shapes in the Indian subcontinent, another class of TLEs, namely, the Gigantic Jet has been reported by the Institute scientists for the first time.

Properties of obliquely propagating ion-acoustic solitons and double layers in magnetized auroral plasma composed of hot adiabatic ions and two types of Maxwellian electrons, namely, cool and hot electrons are studied using Sagdeev pseudo-potential technique and assuming the quasineutrality condition. The new and surprising result which emerges from the model is that in contrast to the case of cold ions where ion-acoustic solitons and double layers are found for subsonic Mach numbers only, the hot ions case allows these nonlinear structures to exist for both subsonic and supersonic Mach number regimes (Figure 1).

A total of 30 vertical electrical soundings were carried out in a near grid pattern using the Schlumberger configuration. The contour maps for Dar-Zarrouk parameters were examined to delineate the resistivity regime of saline and fresh water bearing formations. The results illustrate that the Dar-Zarrouk parameters provide a constructive solution in delineating the saline and fresh water aquifers, particularly when the resistivity data interpretation encounters constraints due to intermixing of saline water aquifers, fresh water aquifers etc.

A proxy heat flow map of the Indian subcontinent was generated using CHAMP satellite data which can be used in a reconnaissance scale to locate regions of high thermal activity. A vertical integrated susceptibility model was generated for the Indian sub-continent using vertical magnetic field data from CHAMP satellite with structural and lithologic inputs from geology and aeromagnetic maps.

Transient geomagnetic field variations recorded at 20 stations in Kutch and surrounding regions were analyzed to infer the electrical conductivity distribution of this region. Different conductivity structures identified were: (1) Highly conducting sediments filling the western part of Kutch basin; (2) High conductivity over Kutch main land which is attributed to the fluids derived from the Kutch main land fault; (3) Two different conductivity anomalies related to Wagad upland and half-filled grabens with a resistive layer sandwiched between them – most of the Bhuj earthquakes are seated on this resistive block (Figure 2).

Rock magnetic and geochemical parameters obtained for a 30-m long piston core retrieved from the Bay of Bengal revealed evidences to show how profoundly primary magnetic signals can be overprinted by post-depositional geochemical and biogeochemical processes. The alteration of magnetic minerals in

marine sediments and the subsequent loss of their primary signal have strong implications for the magnetic record and its use as a palaeoproxy in the reconstruction of the presence of gas hydrates in the past.

**Major and Unique Facilities Created:**

- A state-of-the-art Environmental Geomagnetism Laboratory for use of students and scientists from India and abroad
- A state-of-the-art UWITEC drilling technology for lake-bottom sediment cores
- Archaeomagnetic dating technology

**Important collaborations (National and Global) established:**

(i) National Atmospheric Research Laboratory, Gadanki, (ii) Center of Exploration Geophysics, Osmania University, (iii) Geology Department, Allahabad University, (iv) BHU, Varanasi, (v) GFZ, Potsdam, Germany, (vi) Tuebingen University, Germany, (vii) National Space Institute, Technical University of Denmark, (viii) Research Institute for Sustainable Humanosphere (Kyoto University), Kyotom, (ix) School of Environmental and Earth Sciences, North Maharashtra University, Jalgaon, (x) Department of Environmental Sciences, Shivaji University, Kolhapur, (xi) National Geophysical Research Institute, Hyderabad, (xii) Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram, (xiii) University of Western Cape, Bellville and SANSA, Hermanus, South Africa through an Indo-South Africa Bilateral project, (xiv) Nevada Bureau of Mines and Geology, University of Nevada, USA, (xv) University of Kwazulu-Natal, Durban, South Africa, (xvi) Andhra University, (xvii) Pondicherry University, (xviii) M.S. University, Vadodara, (xix) GSI, (xx) NCAOR, Goa

**Important Output Indicators:**

S. No.	Parameters	Output
1.	Papers in refereed journals	46
2.	Papers in Conferences	65
3.	Number of Ph.Ds. produced	6
4.	Research Manpower trained (other than Ph.Ds)	5
5.	Technical Manpower trained	1
6.	B.Tech/ UG projects guided	1
7.	M.Tech/M.Sc./M.Phil projects guided	17
8.	Public Outreach (talks, articles, awareness workshops, science day, open house etc)	Yes, several of them
9.	Other Products/Indicators	
10.	Workshop conducted	1

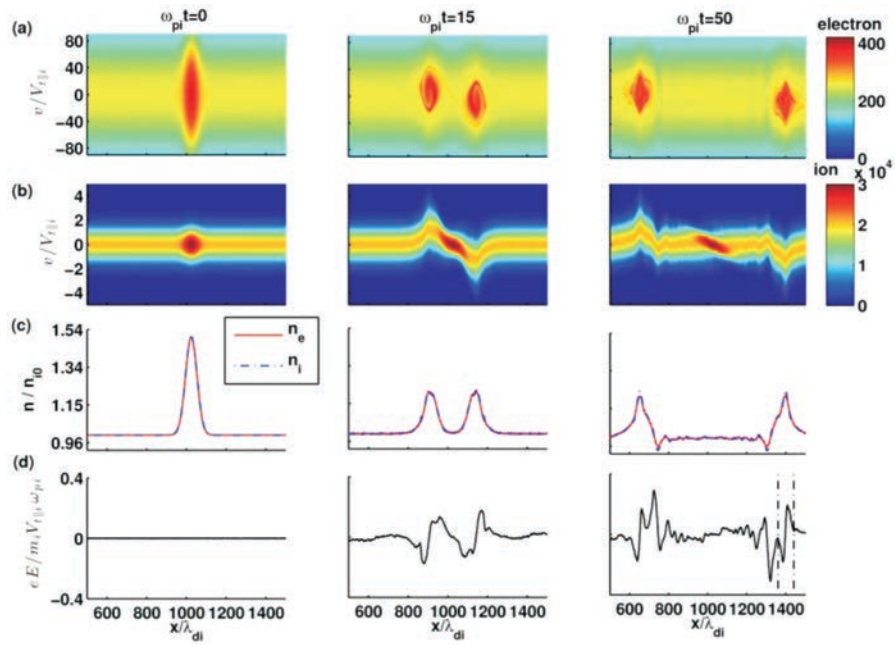


Figure 1: Nonlinear evolution of ion acoustic solitary waves using particle-in-cell simulation

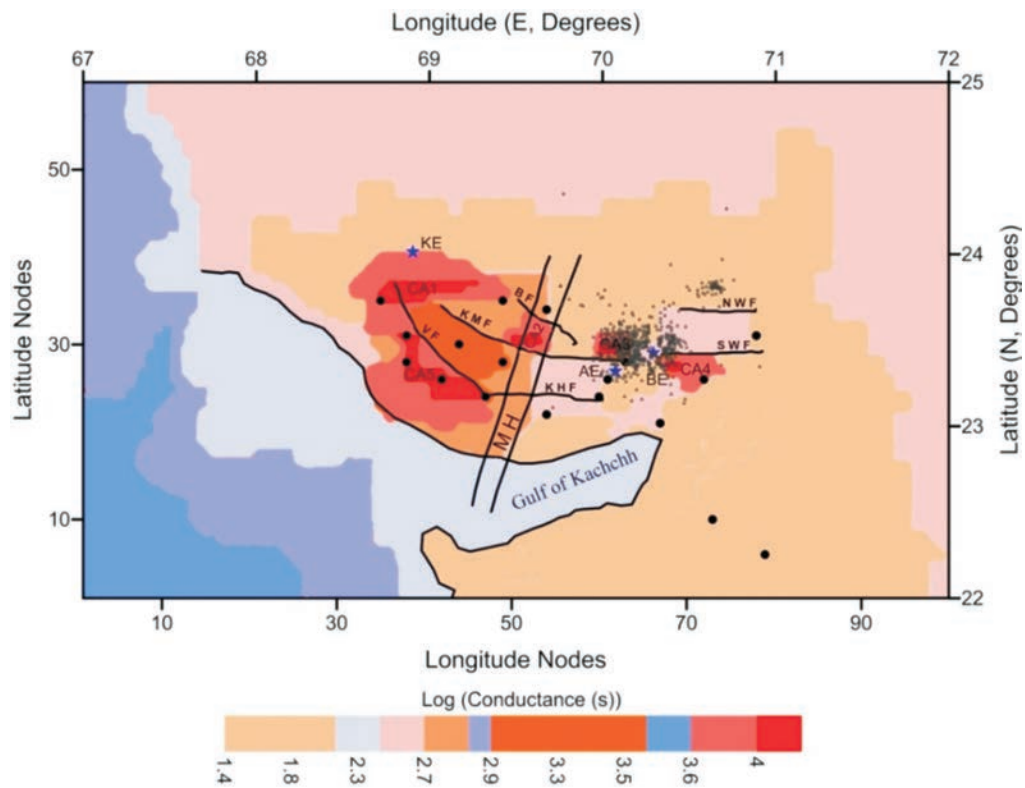


Figure 2: Spatial distribution in depth-integrated conductance in and around the KRB together with the mapped high conductivity anomalies, referred to as CA1, CA2 ..., CA5. Different colour codes used to represent conductance values are in logarithms scale. Prominent tectonics uplifts in the KRB are Kachchh mainland uplift (KMU), Wagad uplift (WU), and a chain of small uplifts along the Island Band fault (IBF) and major faults are Kachchh Mainland fault (KMF), Vigodi fault (VF), Katrol Hill fault (KHF), South and North Wagad faults (SWF, NWF), Banni fault (BF), Gedi fault (GF) are shown. The grey dots denote earthquakes recorded since 2001 Bhuj earthquake. The epicentres of the 2001 Bhuj (BE), 1956 Anjar (AE) and 1819 Kachchh (KE) earthquakes are also marked by blue star.

## INDIAN NATIONAL ACADEMY OF ENGINEERING (INAE), NEW DELHI

The Indian National Academy of Engineering (INAE), founded in 1987, comprises India's most distinguished engineers, engineer-scientists and technologists covering the entire spectrum of engineering disciplines. INAE functions as an apex body and promotes the practice of engineering & technology and the related sciences for their application to solving problems of national importance. The Academy provides a forum for futuristic planning for country's development requiring engineering and technological inputs and brings together specialists from such fields as may be necessary for comprehensive solutions to the needs of the country. It is the only engineering Academy in India. INAE is a Member of the International Council of Academies of Engineering and Technological Sciences (CAETS).

### Seminars/Workshops/Conferences:

The following seminars/workshops/conferences were organized during 2013-2014.

#### (i) Engineers Conclave:

INAE has taken an initiative of organizing an annual mega event of engineers as "Engineers Conclave" starting from the year 2013 to be organized jointly by INAE with Department of Atomic Energy (DAE)/Department of Space (DOS)/Defence Research & Development Organization (DRDO)/Council of Scientific and Industrial Research (CSIR) on rotation basis. Each conclave will have two themes, one specific to the host department and other specific to some social problem where engineering intervention is desired. The first "Engineers Conclave" was held jointly with DRDO during Sep 17-19, 2013 at New Delhi. The two themes for Engineers Conclave, 2013 were "*Production and Manufacturing in Aerospace*" and "*Engineering Interventions in the Sunderbans*". The speakers in the two parallel sessions composed of leading experts and scientists from R&D, Government, academia and industry. The recommendations emanating from the deliberations will be followed up by INAE with the concerned Departments/Ministries.

#### (ii) Seminar on "Building Process Excellence in Manufacturing" being held on Jan 17-18, 2014 at Kolkata

INAE and Indian Institute of Technology Kharagpur in association with Bengal Chamber of Commerce and Industry (BCCI) on Jan 17-18, 2014 at BCCI Auditorium, Kolkata, jointly organized a seminar on "Building Process Excellence in Manufacturing".

#### (iii) IGSTC Workshop on "Strategies and Concepts for Advanced Manufacturing"

Indo German Science and technology Centre (IGSTC) workshop on "Strategies and Concepts for Advanced Manufacturing" was organized by INAE and National Academy of Science & Engineering (acatech), Germany on Jan 23-24, 2014 at New Delhi..

#### (b) Joint AICTE INAE schemes

(i) **AICTE INAE Distinguished Visiting Professorship Scheme** Under this scheme,



launched in 1999, the Distinguished Visiting Professor is required to deliver lectures on the state-of-art of Industry, industrial ambience and R&D needs of the industry to the students and faculty of technical institutions; guide student projects/theses of interest to industry. The Scheme has received very enthusiastic response from industry and engineering institutions over the years. Fourteen industry experts were selected under the subject scheme in this year.

**(ii) AICTE INAE Teacher Research Fellowship (TRF) scheme** – This scheme has been started during the current year. Under this scheme, engineering teachers in AICTE approved engineering colleges/institutions are sponsored to pursue research in Council of Scientific and Industrial Research (CSIR)/Defence Research and Development Organization (DRDO)/Department of Space (DoS)/Department of Atomic Energy (DAE) laboratories leading to the award of a Ph. D degree in the chosen field of study. The first batch of engineering teachers selected under this scheme has already commenced their Ph. D programmes in the concerned labs.

**(iii) AICTE INAE Travel Grant (TG) scheme** – This scheme has also been started this year. The objective of the scheme is to provide partial travel assistance and registration fees to Bachelors and Masters Level engineering students for presenting a research paper in an international scientific event (conference/seminar/symposium/workshop etc) in order to encourage engineering students to engage in research. Engineering students pursuing 3rd/4th year B.E. /B. Tech; 1st/2nd year M.E./M. Tech from AICTE approved Engineering institutions are eligible under the scheme. Under this scheme, eligible engineering students are being selected each month, for the last 4 5 months.

**(c) International Affairs 20th CAETS Convocation and Annual Meeting**

The International Council of Academies of Engineering and Technological Sciences (CAETS) Annual Meetings and Symposium on “Innovative Approaches to Engineering Education” were held at Budapest, Hungary during June 26 28, 2013. INAE delegation participated in this event.

**(d) Promoting Excellence in the Field of Engineering**

**(i) Life Time Contribution Award in Engineering 2013** This award is given to an eminent Indian citizen who has made most distinguished contributions in the field of Engineering/ Engineering Research/Technology, which have brought prestige to the nation and regarded as landmarks of technological development of the country. Prof KL Chopra and Col SP Wahi were selected for the year 2013.

**(ii) Prof. Jai Krishna and Prof. SN Mitra Memorial Award 2013** – These awards are given to an eminent engineer, engineer-scientist or a technologist for Academic and scholarly achievements in any discipline of technology/outstanding research. Prof ML Munjal and Dr N Balakrishnan were selected for Prof. Jai Krishna and Prof. SN Mitra Memorial Award the year 2013.

- (iii) **INAE Outstanding Teachers Award** – This award has been instituted this year. The aim of this award is to recognize and honour teachers in Indian Colleges, Universities, and Institutions, who have provided guidance and inspired students to take up careers in Engineering and Technology Prof JC Misra and Prof Souvik Bhattacharyya were selected for the year 2013.
- (iv) **INAE Young Engineer Award 2013** – Instituted in 1996, INAE Young Engineer Award is given for excellence in design and technology transfer, innovative development and engineering research. Eleven candidates were selected for INAE Young Engineer Award 2013.
- (v) **Innovative Student Projects Award 2013** – The Academy has instituted ‘Innovative Student Projects Award’ during 1998 to identify innovative and creative research projects undertaken by the students at three levels, B.E./ B. Tech, ME/ M. Tech and Ph. D in Engineering Colleges. Five theses at Doctoral level, five at Master’s level and ten projects at bachelor level were selected for conferment of Innovative Students Project Award 2013.

**(f) INAE Forums**

One of the important objectives of the Academy is to assist the Government from time to time in formulating policies on critical technical issues. For this purpose, five forums have been constituted – INAE Forum on Engineering Education, INAE Forum on Energy, INAE Forum on Microelectronics, INAE Forum on Technology, Foresight and Management and INAE Forum on Engineering Interventions for Disaster Mitigation.

**(g) The Fellowship**

Twenty three Fellows and five Foreign Fellows were elected during the year.

**Publications:**

The following important publications have been brought out during the year 2013–2014.

- a) Annals of INAE – The Annals of the INAE contains the text of the lectures delivered by Life Time Contribution Awardees, such as: Professor Jai Krishna and Prof. SN Mitra Memorial Awardees, newly elected Fellows of the Academy and INAE Young Engineer Awardees.
- b) Research Study report on “Successes and Gaps in Our Metallurgical R&D Efforts”.
- c) INAE e-Newsletter – This monthly electronic newsletter contains engineering and technology updates and aspects of frontiers of engineering, news regarding INAE activities as well as articles by INAE Fellows.



Dr Baldev Raj, President, INAE delivering Address at the IGSTC Workshop on “Strategies and Concepts for Advanced Manufacturing” jointly organized by INAE and acatech, Germany on Jan 23-24, 2014 at New Delhi

## INDIAN NATIONAL SCIENCE ACADEMY (INSA), NEW DELHI

The Indian National Science Academy was established in 1935. The Academy has 60 regular employees.

### Areas of Focus:

Science Promotion & Recognition of Scientists

**Major Accomplishments:** Election to Fellowship of eminent Indian & Foreign Scientists, Bilateral Relationship with Foreign Science Academies, Research Professorship for Eminent Scientists, Support to Senior Scientist/Honorary Scientist projects, Young Scientist projects, Research Projects under History of Science Programme, INSPIRE project of DST, Publications.

### Important Highlights of Five Major Programmes:

- The Second Summit of South Asian Academies was organized at INSA during 24–27 September 2013.

- A workshop on “Women in Science Education and Research” was organized jointly with the Association of Academies and Societies of Sciences in Asia (AASSA).
- A group discussion meeting on “Uttarakhand Disaster’ supported by INSA was held on 21st September 2013 at INSA premises.
- The Academy has released a Special Publication on “Use of Animals in Scientific Research & Education “(Edited by Profs. PN Tandon, K Muralidhar & YK Gupta) by Dr K Kasturirangan, FNA on 2nd August 2013 at INSA .
- A document titled “India’s Nuclear Energy Programme – Future Plan, Prospects and Concerns” edited by Prof R Rajaraman was released by Hon’ble Vice President of India, Sh.Mohd. Hamid Ansari on 7th November 2013.
- The Academy’s Council elected 34 Indian Scientists as INSA Fellows and 4 Overseas Scientists as Foreign Fellows.

#### **Important Collaborations:**

The Academy has established linkages with Science Academies/Organizations in 49 countries in Europe, Asia, North America, South America and Latin America. During the year, MOU was renewed with Korean Academy of Science and Technology on 12<sup>th</sup> November 2013.

#### **Important output Indicators:**

INSA is continuing its research support thorough it’s various programmes/schemes as per details given below:

### **SCIENCE PROMOTION PROGRAMME**

Under the scheme, following components are there:

- a) **Research Professorships:** The Professorships were instituted to recognize the pioneering contributions of scientists (Fellows) in Science and Technology.  
Grant for four Professorships was released during the period.
- b) **Senior Scientist Fellowships:** Under this scheme, partial grant was released to 43 senior scientists during 2013–2014.
- c) **Honorary Scientist Scheme:** Grant was released to 40 scientists so far.
- d) **INSA Visiting Fellowship:** Grant was released for six Visiting Fellowships during the period.
- e) **Seminar/Symposia/Conference/Workshops:** Under this programme, during the year 2013–2014, INSA released grant for 40 seminar/symposia.

### **YOUNG SCIENTIST RESEARCH PROGRAMME**

Under this programme young researchers below the age of 35 years are recognized for their distinct contributions to any branch of science or technology coming within the purview of the Academy. Thirteen research projects of Young Scientist Medal awardees were supported during the year.

## **1. RESEARCH IN HISTORY OF SCIENCE**

During the year 14 new projects were recommended and 19 on-going projects were continued covering various topics like history of cannons, metals and metallurgy, mathematics and astronomy, ecology and forestry, art and architecture, etc.

## **2. INTERNATIONAL COUNCIL OF SCIENCE (ICSU) AND OTHER IMPORTANT SCIENTIFIC MEETINGS**

As an adhering organization in India and on behalf of the nation, Academy discharges its responsibilities of adherence to ICSU.

During 2013–2014, the Academy supported about 35 Scientists for ICSU programmes and about 52 Scientists for other important scientific meetings under Non-ICSU programmes.

## **4. INTER ACADEMY BILATERAL EXCHANGE PROGRAMME**

The programme aims at establishing collaborative scientific exchange activities with different countries of the world through visits of scientists on reciprocal basis to various scientific institutions in fields of mutual interest and for exchange of scientific information. INSA has exchange programmes with many foreign scientific academies.

During the year, 14 Indian scientists visited abroad and 9 overseas scientists visited India under the various exchange/International programmes.

## **5. PUBLICATION**

Pursuant to its objectives, the Academy brings out Proceedings, Journals, Memoirs and other scientific publications. Following publications were brought out during the year.

- a.) PINSA (Proceedings of Indian National Science Academy) – 2 issues
- b.) IJPAM (Indian Journal of Pure and Applied Mathematics) – 4 issues
- c.) IJHS (Indian Journal of History of Science) – 3 issues
- d.) INSA News – 2 issues
- e.) Biographical Memoir – 1 issue
- f.) Annual Report
- g.) Proceedings of The First Summit of The South Asian Science Academies, September 6–9, 2012

## **6. Teacher Award**

The Academy instituted in 2012 the INSA Teachers Award to value consistent and high level of teaching in Indian Colleges, Universities and Institutions. The award aims to recognize and honour teachers who have inspired students to take up careers in Science and Technology. Ten teachers were selected by the Academy for INSA Teachers Award for the year 2013.

## 7. SCIENCE & SOCIETY

Under the science & society programme, the Academy endeavors to address issues pertaining to science and technology that are of relevance to the society. Some of the initiatives are:

The Academy proposed to commission writing of well-considered reports by INSA Fellows on issues of societal/national importance. INSA Fellows are invited to undertake studies in areas of their expertise and prepare thoroughly researched authoritative documents, which could later serve as reference documents. During 2013-2014, five report-writing proposals were approved by the Academy.

During the period, the Academy organized 5 Public Lectures on important issue of science and their social aspects:

## 8. Local Chapters:

Academy has 16 local chapters charged with the responsibility of deliberating on various issues concerning their region. Local chapters continued to deliberate on various issues related to science policy, science planning etc in addition to organizing lectures and workshops.

## 9. Centre for International Cooperation in Science (CICS)

CICS (earlier known as CCSTDS), Chennai is mandated to spread the spirit of science and technology co-operation among developing societies. The centre functions under the auspices of the Indian National Science Academy (INSA). The activities pursued during the period ranged from providing support to scientists from developing countries to work in research institutions in India, partial travel fellowship to Indian Scientists to attend International Conferences abroad, organization of lecture series.



A document titled “India’s Nuclear Energy Programme – Future Plan, Prospects and Concerns” was released by Hon’ble Vice-President of India, Sh.Mohd. Hamid Ansari

## **INSTITUTE OF NANO SCIENCE AND TECHNOLOGY (INST), MOHALI**

The Institute of Nano Science and Technology, Mohali was registered under the Societies Registration Act in 2009 and started its operations from January, 2013, on appointment of its first Director. The institution has one regular employee at present. The institute has 8 scientists/faculty and 3 post-doctoral research staff on contract.

### **Areas of Focus:**

Encouraging all aspects of nanoscience and nanotechnology with major thrust on the following areas: agricultural nanotechnology, sensors, medical nanotechnology, nanotechnology-based solutions for energy and environment.

### **Major Accomplishments:**

Institute started its functions from January 2013 and created infrastructure for institute's immediate future requirements including setting up of a laboratory in its Transit Campus – Habitat Centre.

Scientists/Consultants/Staff were appointed on contract basis.

Rules and Regulations, Staff Rules, Bye-Laws including Recruitment Rules for all S&T and Administrative posts were framed and requisite approvals obtained. Process for recruitment against sanctioned posts is on.

Department of Scientific and Industrial Research (DSIR) approached and a certificate obtained for exemption from excise and customs duty under the Public Funded Research Institute (PFRI) scheme of DSIR.

A topographical survey and contouring of the land for INST campus in Sector – 81, Mohali, adjacent to IISER, completed. Work on Master Plan and model of the new campus initiated. Foundation stone laid on March 2, 2014.

### **Important Highlights of 5 Major Programmes:**

Important programmes being pursued are as under:

- i. Establishing state-of-art laboratory facilities for research work in the field of nanoscience and nanotechnology; instruments for research activities being purchased;
- ii. Starting PhD Programme at INST in collaboration with IISER Mohali;
- iii. Developing linkages of INST for furtherance of its research activities with academic/research institution and industry; signing of MoUs;
- iv. Lectures and endowed Chairs on Nanoscience and Nanotechnology sponsored by industry and scheme for awards/fellowships; financial assistance for organizing Conferences/Workshops in the areas of science and technology with special emphasis on nanoscience;
- v. Dissemination of information on nanoscience and technology and initiation of nanotechnology outreach activities for promoting public awareness of the subject.

**Important Output Indicators:**

S. No.	Parameters	Output
1.	Papers in refereed journals	10

**THE INDIAN SCIENCE CONGRESS ASSOCIATION (ISCA), KOLKATA**

The Indian Science Congress Association was established in the year 1914. The total number of employees is 27.

**Areas of Focus:**

- a) To advance and promote the cause of Science in India;
- b) To hold an Annual Congress at a suitable place in India;
- c) To publish such proceedings, journals, transactions and other publications as may be considered desirable;
- d) To secure and manage funds and endowments for the promotion of Science.

**Major Accomplishments:**

1. Holding of 101<sup>th</sup> Indian Science Congress Session at Jammu University, Jammu from 3–7 February, 2014.
2. Publications including ISCA's bi-monthly journal Everyman's Science
3. Augmentation of ISCA Chapter Activities
4. Science Awareness Programme for Popularisation of Science.
5. International Collaboration on Exchange Programme
6. Microfilming of ISCA Old Publications

**Important Highlights of Five Major Programmes:**

The 101<sup>th</sup> annual Indian Science Congress was held at Jammu University during 3–7 February 2014 and Regional Rural Science Congress at four different places of India during 2013–2014.

Instituted ten Asutosh Mookerjee Fellowships to honour and encourage seniors scientists in India during 2013–2014.

Popularisation and advancement of science by organising seminars, symposia, discussions, popular lectures, quiz contest, etc. thought out the year under twenty-nine ISCA Chapters.

Publication of the Journal of the Association "Everyman's Science," which is circulated to all thirty thousand members free of costs.





Science day celebration for popularization of science

## JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH (JNCASR), BANGALORE

Jawaharlal Nehru Centre for Advanced Scientific Research was established in the year 1989. The Institute has a total of 81 regular employees, out of which 48 are scientists/faculty and 80 are research associates.

Prof C N R Rao, Chairman, Scientific Advisory Council to the Prime Minister and Honorary President, JNCASR, was bestowed upon the Bharat Ratna, the highest civilian award of the country.

### Areas of Focus:

**The focus of research** In *Chemistry and Physics of Materials Unit*, organic photo voltaics and organic field effect transistors have been fabricated and studied. Clay-RGO hybrids have been prepared and their application in simultaneous adsorption of protein and DNA has been investigated. The Molecular Electronics lab carried out studies of photo-physical properties of semiconducting polymers. Raman studies of  $\text{RMO}_3$  ( $M = \text{Cr, Fe, Mn}$ ) were carried out to understand the microscopic origin of multiferroicity in these compounds. First demonstration of SERS as a tool for determining small molecule binding to therapeutic proteins was demonstrated in the case of Felodipine and Aurora A.

In *Engineering Mechanics Unit*, in the area of Aerospace and Atmospheric Fluid Mechanics, the concept underlying a novel design of optimal wing planforms for turboprop aircraft, has now been confirmed by wind tunnel tests conducted by NAL at IISc. In atmospheric fluid dynamics, entrainment measurements have been made in a transient diabatic jet for the first time. In the study of nocturnal atmospheric boundary layer, an error was identified in the flux-emissivity model for radiation widely used by many researchers in the atmospheric community. Other research areas in the unit were related to concentration fluctuations in bacterial suspensions; bacterial suspension rheology; particle-level simulation; vortex rings oscillations; sonic transition in viscoelastic flows; role of micro-scale inertia in multiphase heat-transfer.

The faculty of ***Evolutionary and Organismal Biology Unit*** continued their research in the broad areas of animal behaviour/phylogeography, chronobiology, evolutionary genetics, neurogenetics, and population dynamics.

The ***Education Technology Unit*** has been actively involved in the concept, development and production of multimedia CD-ROMs and books especially for school students and teachers in various disciplines of science, including resources in vernacular Indian languages. The C.N.R. Rao Hall of Science and Education Technology Unit has continued conducting the highly popular Teachers/students programs/workshops for students and teachers.

In ***Geodynamics Unit*** studies were carried out on neotectonics and environmental geology.

***Molecular Biology and Genetics Unit*** currently has several research and training avenues in broad areas of biological sciences. Research in nine of its laboratories spans diverse areas of modern biology with emphasis on biomedicine. In Chromatin Biology Laboratory, work carried out on chromatin TP2 acetylated in vivo as detected by anti-acetylated lysine antibodies and mass spectrometric analysis. Molecular Parasitology Laboratory has focused on understanding metabolism in the malaria parasite *Plasmodium falciparum*. The Human Molecular Genetics Laboratory, in a study of over 750 families with non-syndromic hearing loss, has examined several deafness-causing genes (Cx26, Cx30, TMPRSS3, TMC1, HAR, CDH23, PDS and TMIE) and identified a large number of pathogenic mutations in these genes. In Vascular Biology Laboratory, a comparative approach has been made by using embryonic stem cell models, mouse developmental biology and *Drosophila* genetics, to decipher the roles of novel genes expressed early in the cardiovascular and hematopoietic systems. Molecular Virology Laboratory has screened a large number of Indian clinical samples and identified an immunodominant B-cell epitope in the cysteine-rich domain of Tat only in the HIV infected people. This finding has a direct relevance for HIV vaccine design. The Transcription and Disease Laboratory has focused on understanding the role of epigenetic modifications, histone chaperones and non-histone chromatin proteins in chromatin dynamics and transcription regulation. The researchers in Molecular Mycology Laboratory have studied centromeres of a pathogenic yeast, *Candida dubliniensis* and compared centromere sequences with those of a closely related yeast *Candida albicans*.

In ***New Chemistry Unit***, research on several aspects of the chemistry of materials is being pursued by the research team led by Prof. C.N.R. Rao. These include transition metal oxides, nanomaterials and carbon materials. The efficient production of hydrogen fuel from water by using semiconductor nanomaterials as catalysts was also investigated.

In ***Theoretical Sciences Unit***, research has been carried out in areas such as multi-scale simulations of materials; fundamental Physics and Applications of Graphene; Materials with magnetoelectric coupling. Contributions were made to theory of electronic topological transitions, surfaces and interfaces.

In ***International Centre for Materials Science***, two major programmes have been initiated on energy research: one related to artificial photosynthesis involving photocatalytic oxidation of water by nanoparticles of Mn and Co oxides and the other on photocatalytic H<sub>2</sub> generation by hybrid nanostructures by using the Z-scheme. Synthesis, characterization and properties of anions substituted metal oxides where in oxygen is replaced by nitrogen and fluorine are being investigated.

### **Major Accomplishments:**

There have been regular breakthroughs, discoveries, and inventions in each of the units. A few representative accomplishments are the following:

Prof. C.N.R. Rao and collaborators have explored the absorption of  $\text{CO}_2$ ,  $\text{CH}_4$  and other gases on graphene and two dimensional BCN.

Strategy for low-cost large area organic solar cell structure was developed at Prof. K.S. Narayan's lab.

Prof. Ranga Udaykumar and his research team have tested a poly-herbal formulation that shown promise against HIV-AIDS.

### **Important Highlights of 5 Major Programmes:**

Seven students joined during mid-year admission in January 2013 and forty-four students joined during August 2013 admissions. The current student strength is 289. There are 171 students registered for Ph D, 22 for M S (Engg/Research), 87 for Integrated Ph. D., 4 for M S – Ph D programme, 3 for Postgraduate Diploma in Materials Science and 2 for Postgraduate Diploma in Science Education programmes respectively.

A tri-lateral (India–UK–USA) grant was received to support research on solution of graphene and BN.

The Centre supported ten Discussion Meetings, twenty-four International Conferences, Workshops and Schools, either wholly or partially. Around ninety-nine seminars were held including nine Endowment Lectures and three General Lectures were delivered by eminent scientists.

### **Major and Unique Facilities Created:**

High performance computing system

### **Major Honours and Awards received:**

The faculty members have made significant scientific contributions. In addition to Bharat Ratna, Prof C N R Rao has received Honoris Causa D. Sc from University of Kerala and the University of St. Andrews; and 2012 Award for International Cooperation by the Chinese Academy of Sciences. Prof. Roddam Narasimha was awarded Padma Vibhushan by the Govt. of India.

Prof P Rama Rao received the Fellowship of National Academy of Engineering, USA

Prof. Chandrabhas Narayana – Fellow of the NASI, Allahabad; Prof S Balasubramanian – Fellow of Indian Academy of Sciences, 2012; Prof Vijay Kumar Sharma – Fellow of Indian Academy of Sciences Bangalore, 2012 and Fellow of INSA, New Delhi; Dr. Tapas Kumar Maji – TWAS Young Affiliateship, 2012–2017; Dr Rajan Datta – Associate of Indian Academy of Sciences; Dr Ravi Manjithaya – DBT Wellcome Trust Fellowship; Prof. Swapan K Pati – TWAS Prize in Chemistry 2012 and Dr SJ George – MRSI Medal, 2013.

### Important Collaborations (National and Global) established:

The interactions with academic institutions and universities globally have continued and the Centre is expanding its formal ties in respect of collaborative research, exchange of graduate students and consultancy projects. A few MoUs were signed with Defense Food Research Laboratory (DFRL, Mysore), Queensland University of Technology, UKIERI – UK–US–India Trilateral Research in Partnership for academic interactions, Hindustan Petroleum Corporation Ltd, Shell Markets Pvt Ltd, RIKEN, Japan and Indian Institute of Science, Bangalore.

### Important Output Indicators:

S. No.	Parameters	Output
1.	Papers in refereed journals	206
2.	Books	02
3.	Chapters in Books	16
4.	Papers in Conferences	07
	Total publications	231
	Average Impact Factor	3.75
5.	Number of Ph. Ds. produced/awarded	16
6.	Other degrees awarded – M.S (Engg.)	07
	MS in Biological Sciences	02
	MS in Chemical Sciences	01
	MS (Material Science)	04
7.	Foreign Patents filed	13
	Foreign Patents granted	04
8.	Indian Patents filed	08
	Indian Patents granted	-
9.	Summer Research Fellowships availed	89
10.	Project Oriented Chemical Education – Diploma awarded	09
11.	Project Oriented Biological Education – Diploma awarded	08
12.	Visiting Fellowship Programme – offers made	08
13.	JNCASR-CICS Programme – offers made	08

## NATIONAL ACCREDITATION BOARD FOR TESTING & CALIBRATION LABORATORIES (NABL), GURGAON

The National Accreditation Board for testing and calibration Laboratories (NABL) was established in the year 1998. The total number of employees in the organization is 57. All the employees in NABL (including scientists/technical staff) except Director are engaged on contract basis extendable from time to time.

### Areas of Focus:

To strengthen the accreditation system accepted across the globe by providing high quality, value driven services, fostering APLAC/ILAC MRA, empanelling competent assessors, creating awareness among the stake holders, initiating new programs supporting accreditation activities and pursuing organisational excellence.

### Major accomplishments of NABL:

The total number of laboratories accredited by NABL during this period was 306 with details as follows:

Testing Laboratories	173
Calibration Laboratories	62
Medical Laboratories	71
<b>Total</b>	<b>306</b>

### Important Highlights of Major Programs:

#### (a) Proficiency Testing and related activities

Considering wide requirements of Proficiency testing in different disciplines of Accreditations, NABL launched Proficiency Training Program on 09.06.2011 on World Accreditation day. NABL has so far accredited two PT providers according to ISO/IEC 17043.

#### (b) Training of Assessors and staff/Awareness programs

NABL officials participated in / conducted 16 training/workshops during the period from April 2013 to 16 Dec 2013. Participation in such training workshops enhanced the skills and knowledge of the participants in the field of accreditation.

**(c) Participation in International Conference/Workshop/Evaluation**

During the period, NABL officials participated in 10 International Conference/Workshop/Evaluation programs to keep abreast with the latest developments and updation on standards of accreditation related activities.

**(d) NABL Medical Assessor Conclave**

Second National Conclave for Laboratories at Bangalore during 16<sup>th</sup> & 17<sup>th</sup> September 2013.

During the period April 2013 to 16 Dec 2013, 10 conclaves of medical assessors were held. The conclaves were attended by Lead Assessors from Medical discipline and the purpose was to harmonize the assessment process and understanding of ISO 15189. Technical issues being faced in the assessment were also discussed.

**Major and Unique Facilities Created:**

Now, NABL's functioning office is from new building in Gurgaon w.e.f. 01.04.2013, which is NABL's own building constructed at a total cost of Rs. 1066.88 lakhs.

**Important collaborations (national and global) established:**

NABL accreditation system complies with ISO/IEC 17011; 2004 and Asia Pacific Laboratory Accreditation Cooperation (APLAC) MR001.

NABL is also a signatory member of Mutual Recognition Arrangement (MRA) of Asia Pacific Laboratory Accreditation Cooperation (APLAC) and International Laboratory Accreditation Cooperation (ILAC). Because of this MRA, 80 Accreditation Bodies in 65 countries accept test reports of NABL accredited laboratories, as equivalent to test reports of laboratories accredited by them.

**Important Output Indicators:**

S. No.	Parameters	Output
1.	Technical Manpower trained	1
2.	Paper in conferences	3



NABL Conclave



'India-ASEAN workshop on Laboratory Accreditation in India' by NABL on 08<sup>th</sup>-11<sup>th</sup> April' 2013 at New Delhi.

## **THE NATIONAL ACADEMY OF SCIENCES, INDIA (NASI), ALLAHABAD**

The National Academy of Sciences, India (NASI) was established in 1930. The academy has 15 regular employees. Thirty-five NASI Senior scientists are associated as scientists/faculty and six of them are NASI Chair Professors.

### **Areas of Focus:**

Promotion & Popularisation of Science & Technology; to aid & advise in Policy Making

### **Major Accomplishments:**

The major accomplishments were the following:

### **Publications**

- History of Science in India in several parts.
- In collaboration with the Springer, the Academy published vast data on the Nematode Infestations (in three parts).
- The manuscript of a book on Dengue (in Hindi) of about 400 pages has also been prepared to be published in collaboration with the ICMR, N Delhi: a first of its kind in India.

### **Science Communication Activities**

- The highlights of activities were Children Science Meet, Summer & Winter Schools, Vacation Training Programmes, Workshops, Vigyan & Health Chaupals, Seminars, National Technology Day, National Science Day and World Environment Day etc. The Academy encouraged teachers for out of the class science activities by recognizing their talent and giving away NASI-Science Teacher's Awards to them.
- A first of its kind activity started for the young researchers was organising, a series of workshops on Scientific Paper Writing to train them for expressing their views and research findings in an appropriate manner. So far, five such workshops have been organized at BHU, SGPGI, NASI, Udaipur and CIFA Mumbai.

### **Annual Session/Symposia/Seminars & Scientific Discussions**

Organized Symposia on "Nano-science & Technology for the Mankind" at Varanasi, and on "Space for Human Welfare" at Goa University.

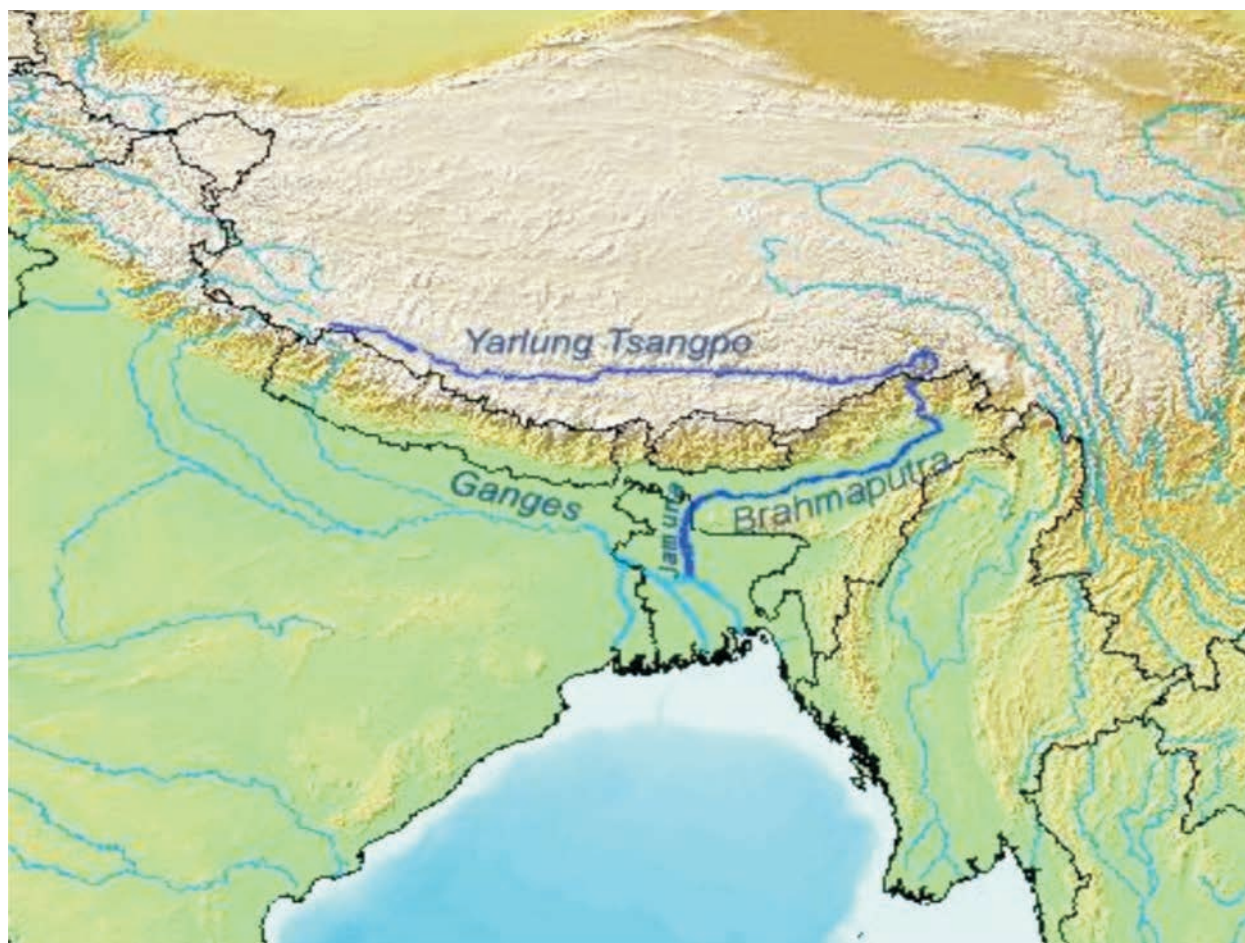
### **Major and Unique National Facilities Created:**

The Ganga-gallery, (IGNOU, New Delhi has included the gallery in its syllabus/project to make the students learn the aspects of conservation of a river; as well as UP Tourism and Consortium of IITs have also included the gallery on its official website). The Brahmaputra gallery is to be established soon.



**Important collaborations (national and global) established:**

- a) The NASI together with other two Science Academies – Indian National Science Academy, New Delhi and Indian Academy of Sciences, Bangalore is jointly sponsoring the Summer Research Fellowship under the joint Science Education Panel
- b) Also continuing its established collaboration with the Reliance Industries for recognizing the scientific research
- c) The Academy has established collaboration with the SCOPUS for recognizing the scientific talents.
- d) It has also established an association with the Springer for publishing its journals.



**Figure 1:** A Panoramic view of the Brahmaputra basin (as depicted in Brahmaputra Gallery of NASI) at Assam

**NATIONAL INNOVATION FOUNDATION (NIF), AHMEDABAD**

National Innovation Foundation (NIF)-India was established in 2000. Number of scientists/faculty is eight and post-doctoral staff is seven.

**Areas of Focus:**

Contemporary technological grassroots ideas, innovations and traditional knowledge.

### **Major Accomplishments:**

- i. NIF has entered into understanding with Suntec Agri Equip (P) Ltd to market milking machines; with Dhampur Sugar Mills, for marketing of select innovative technologies; Pipilika Enviro Private Limited, a Mumbai-based company for marketing of three innovations viz. Mitticool fridge, Natural Water Cooler and Low-Cost Sanitary Napkin Making Machine.
- ii. NIF organized innovation exhibitions at Babasaheb Bhimrao Ambedkar University, Lucknow, Central University of Assam, Silchar, Nagaland University, Lumami, Central University of Rajasthan, Kishangarh and Tripura University, Tripura, and helped initiate National Innovation Clubs during the visit of the Hon'ble President there (Figure 1).
- iii. US Patent 8,445,033: First patent granted to a grassroots traditional knowledge holder, Late Shri Shatrughan Prasad Vaidya, for his unique herbal knowledge.
- iv. Grassroots to Global: a movie on the grassroots innovations movement commissioned by Public Service Broadcasting Trust under the Indian Diplomacy initiative.
- v. NIF developed mobile irrigation system for providing irrigation at critical stage and declared it open source. The mobile irrigation system is successfully demonstrated in the Vidarbha area of Maharashtra.

#### **▪ Important Highlights of Five Major Programmes:**

- i. NIF was able to scout 13686 ideas, innovations and traditional knowledge practices from different parts of the country.
- ii. Over 70 grassroots technologies taken up for validation of innovators' claim at different research/ technological institutions.
- iii. Forty-three applications for Intellectual Property Protection filed nationally. In addition, one application under PPV&FR Act 2001 was filed.
- iv. Twenty thousand eight hundred and thirty-seven ideas and innovations were scouted from 301 districts of the country in IGNITE 2013 – students national competition of technological ideas/ innovations (Figure 2).
- v. A company named “Yuvan Long Life” registered in collaboration with Pune-based Ensign Biosciences for commercialization of grassroots technologies.

### **Major and Unique National Facilities Created:**

First Herbarium of non-codified plants and crude drug repository in collaboration with ICMR b) Multimedia mobile lab-cum-exhibition van for scouting, documentation, processing and dissemination of Grassroots innovations commissioned.

### **Major Honours and Awards received:**

B Mohanlal (Kerala), a grassroots innovator, won the Indian Merchants' Chambers (IMC) Inclusive Innovation Award 2013 for his innovations b) Student innovator Mohd Usman Hanif Patel (Maharashtra)

received National Child Award 2013 for Exceptional Achievement in the field of Technical Innovation c) Student innovator, Parth Vaidya won an award for his paper on water issues and sustainable cities at the World Youth Forum 2013 in Italy.

**Important collaborations (national and global) established:**

- a) With WWF-India for Climate Solvers Program to take forward green grassroots innovations.
- b) With DSM India to explore possibilities of joint development research program in the area of herbal human and veterinary leads.
- c) With Reckitt Benckiser (India) Limited for commercialization of grassroots innovations.
- d) With Kerala State Co-Operative Federation for Fisheries Development Limited (MATSYAFED) to commercialise two innovations viz. Z drive and gearbox for marine diesel engines.

**A. Important Output Indicators:**

S. No.	Parameters	Output
1.	Books	2
2.	Papers in Conferences	7
3.	Foreign Patents filed	-
	Foreign Patents granted	1
4.	Indian Patents filed	43
	Indian Patents granted	-
5.	Application for Design Registration	1
6.	New applications filed under PPV&FRA	1
7.	Number of Technologies/Designs and other intellectual products commercialized	10
8.	Number of Technology leads awaiting transfer	12
9.	B. Tech/ UG projects guided	17
10.	M. Sc/M. Tech/M.Sc./M. Phil/PGDM projects guided	19
11.	Improved Prototypes developed of various ideas/innovations	40
12.	Grassroots technologies validated	101
13.	Projects supported under Micro Venture Innovation Fund (MVIF)	2



Figure 1: The innovation exhibition organized by NIF at Rashtrapati Bhavan was inaugurated by Shri Pranab Mukherjee, Hon'ble President of India on 7th March 2014



Figure 2: Creative children of India received the IGNITE 13 Award at the hands of Dr. A P J Abdul Kalam, Former President of India on 19th February 2014

## **RAMAN RESEARCH INSTITUTE (RRI), BANGALORE**

Raman Research Institute (RRI) was established in 1948. The total number of regular employees is 187. The institute has 39 scientists and 11 post-doctoral research staff.

### **Areas of Focus:**

Astronomy and Astrophysics, Light and Matter Physics, Soft Condensed Matter and Theoretical Physics

### **Major Accomplishments:**

The on-going research programmes of the Astronomy and Astrophysics, Soft Condensed Matter, Light and Matter Physics and Theoretical Physics groups were continued with members formulating and solving problems on their own and in collaborations with PhD and other visiting students.

Major experimental developmental activities, as reported last year, were continued: they included (a) design and development of high-speed ADC-FPGA unit to facilitate the RRI Radio Astronomy related experimental research, (b) the Murchison Wide-field Array (MWA) has now moved from building phase to the next phase, i.e., carrying out science with it (Fig. 1 shows the first light fringes) (c) development of an X-ray polarimeter in collaboration with the Indian Space Research Organisation (ISRO) (Fig. 2 shows the polarimeter assembly) and (d) participation in the Large Area X-ray Proportional Counter (LAXPC) for the ASTROSAT – a satellite mission of ISRO for multi-wavelength astronomy (e) commissioning of Quantum Information and Computing as well as Brain Computer Interface Labs and (f) Epoch of Reionization/ Recombination Project.

### **Important Highlights of 5 Major Programmes:**

The Institute's participation in the Murchison Wide-Field Array (MWA), an international project among the US, Australia, New Zealand and India, this array has now moved forward and science is now being done with it.

The Institute's project on X-ray Polarimeter in collaboration and cooperation with the Indian Space Research Organization is progressing.

Work on the development of Radio Astronomy receivers for detecting spectral structures in the cosmic radio background from the Epochs of Reionisation (EOR) and Recombination is progressing.

The five quantum optics laboratories are being utilized for scientific experiments.

### **Major Honours and Awards received:**

A research coauthored by RRI student and faculty was nominated for the 2012 Luckhurst-Samulski Prize; it was one of the six articles commended by the Selection Committee.

### **Important collaborations (national and global) established:**

There are about 12 important collaborations that the Institute had established and reported until last year, which are being exploited to achieve the goals set out for them.

### Important Output Indicators:

S. No.	Parameters	Output
1.	Papers in refereed journals	133
2.	Papers in Conferences	20
3.	Number of Ph.Ds. produced (awarded and submitted)	11
4.	Foreign Patents under process	7
	Foreign Patents granted (total)	4
5.	Indian Patents filed – under process	9
6.	Research Manpower trained (other than Ph. Ds)	1
7.	Visiting Students (includes M. Tech/M. Sc./M. Phil projects)	124

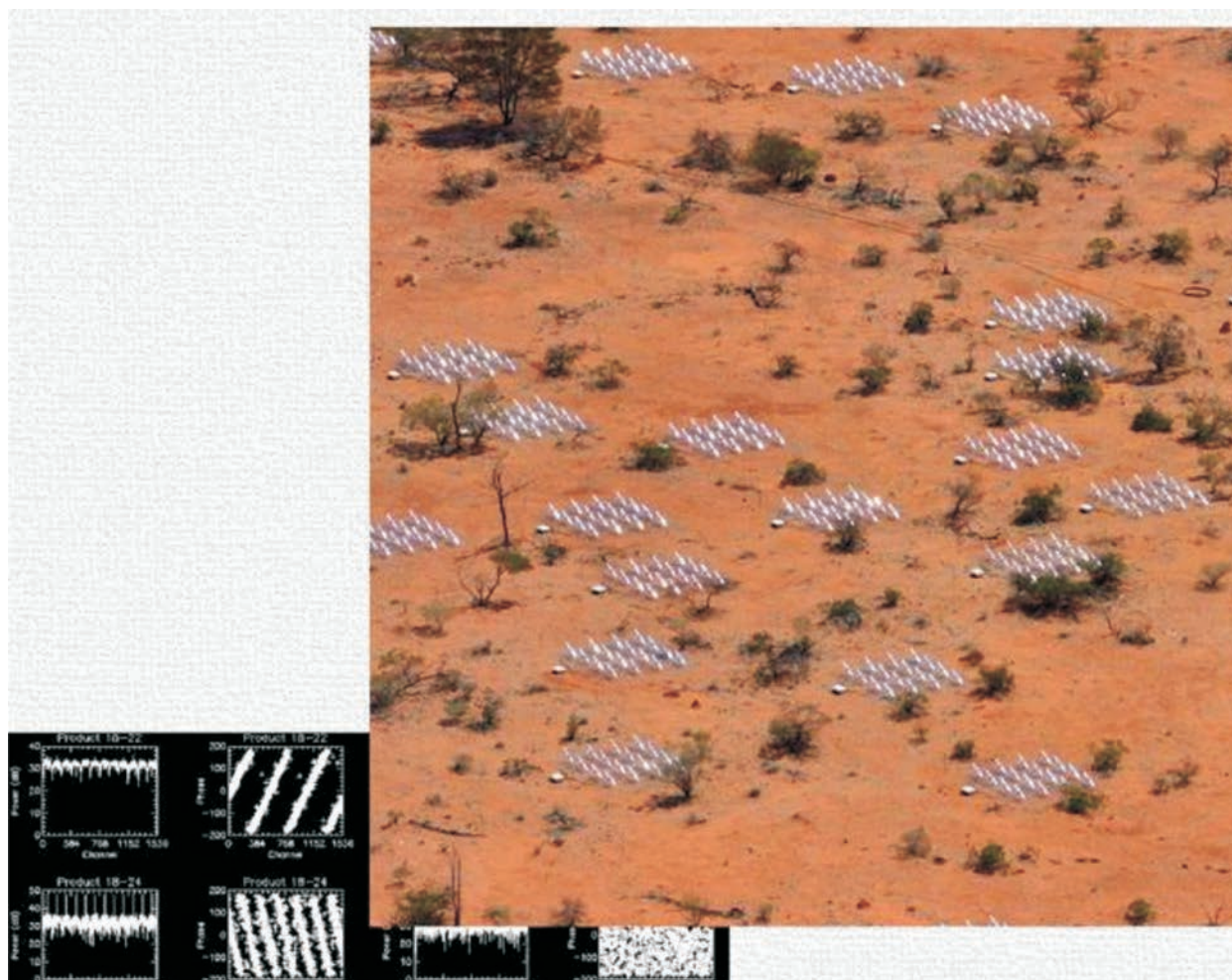


Figure 1: First Light Fringes from the MWA

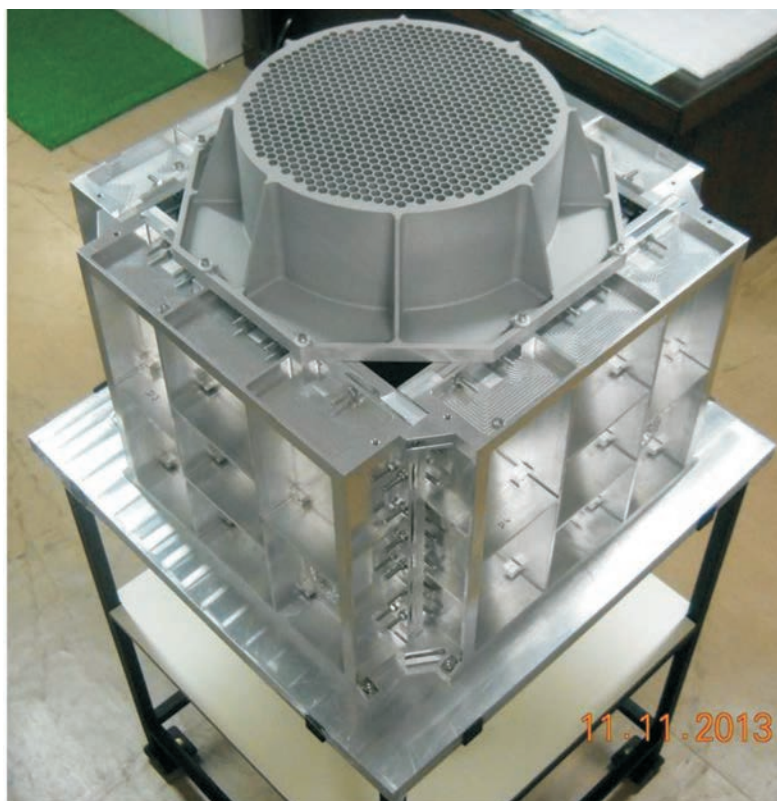


Figure2: The Polarimeter Assembly

## **SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY (SCTIMST), TRIVANDRUM**

Sree Chitra Tirunal Institute for Medical Sciences & Technology (SCTIMST), Trivandrum was established in 1980. The Institute has a total of 938 regular employees, out of which 138 are scientists/faculty and 107 are post-doctoral research staff.

### **Areas of Focus:**

Biomaterials Research and Development, Product Development, Technology Transfer and Industrial Linkages; Quality Management Systems, Testing and Technical services; Patient Care and Public Health.

### **Major Accomplishments:**

- Intrauterine device “Emily” developed by SCTIMST and HLL Life Care Ltd introduced in the market.
- Proposal submitted to DST for a Medical Research Park at Life Sciences Park at Trivandrum.
- Testing Services: Scope of COFRAC Accreditation renewed from June 1<sup>st</sup>, 2013 to May 31<sup>st</sup>, 2018. 2, 3 DPG added to the scope.
- Products entering into clinical evaluation phase: Triphasic Hydroxyapatite Scaffolds loaded with Autologous MSCs, Maxillofacial Reconstruction using Ceramic HASi Units,

- Products entering preclinical phase: coronary stent, coated vascular graft, decellularised Bovine pericardium as dura substitute, Skin Graft Substitutes for Wound Healing Applications from Mammalian Derived Extracellular Matrix.

### **Important Highlights of 5 Major Programs:**

#### **Product Development & Technology Transfer:**

Discussions are going on for technology transfer with regard to products like anti-snake venom, decellularised bovine pericardium, Skin Graft Substitutes for Wound Healing Applications from Mammalian Derived Extracellular Matrix, rapid urinary tract kit, etc. Development of different products like coronary stent, centrifugal blood pump, coated vascular graft, fibrin glue, pulsed laser ablation coatings of bioceramic materials over metallic implants, polymeric bone cement etc. is in progress.

#### **Biomaterial & Biological Products:**

Projects in progress: Development of oral heparin nanoparticles, Decellularised bovine pericardium for cardiovascular application, Mammalian Derived Extracellular Matrix for wound healing application, Fluoropolymer coated and hydrogel sealed large diameter vascular graft, Mandibular Advancement Device for the Treatment of Obstructive Sleep Apnea, Fibrin glue, Antivenom antibodies, UTI rapid diagnostic kit with antibiotic sensitivity, In vitro pyrogen test kit.

**Biomaterials Research & Development:** Pulsed laser deposition of bioactive ceramic on surface nanostructured titanium as delivery implants; Superparamagnetic iron oxide and zero valent iron nanoparticles as contrast agents for MRI, Design and development of supra-molecular drugs, Immune cell niches and other nanotechnologies, Toxicological evaluation of a new dental restorative composite containing 'Diphenyl [2,4,6-trimethyl benzoyl] phosphine oxide [TPO] as photoinitiator, Hemostatic scaffold using biodegradable polymer and biomimetic extracellular matrix components for healing of chronic dermal wounds, Bioengineered hybrid skin substitutes for burn wounds, Development of bioactive bone cements based on organically modified ceramic resin, Studies on clinically retrieved heart valves and orthopaedic implants.

**Tissue Engineering & Biological Research:** Tissue engineering of a carrier free corneal endothelial construct towards transplantation for endothelial – Keratoplasty; Fabrication of a prototype of bioreactor for bio-artificial liver; Construction of a tissue engineered myocardial patch by cell sheet engineering technology from umbilical cord mesenchymal stem cells; Bone Tissue Engineering using Adipose Stromal cells on 3D porous bioactive ceramic scaffolds; Epithelial–mesenchymal interactions in tissue engineered hybrid artificial lung – role of angiogenic factors; Development of a Dura Substitute by Electrospinning of  $\alpha$ -Caprolactone-Co-Lactide Polymers; Tissue engineering of pancreas, cartilage and blood vessels.

Quality Management System, Testing: Testing services is continuing with increased demand especially for biocompatibility testing. The scope of Accreditation from COFRAC was extended for another 5 years.

#### **Major and Unique National Facilities Created:**

Establishment of nationwide network of registries on management of acute coronary event (MACE REGISTRY) and Comprehensive Heart Failure Intervention Program supported by ICMR. Intermediary Care Unit in paediatric cardiac services and rehabilitation clinic and neuro intervention center are among the additions to patient care activities. Expansion of Noninvasive Brain Stimulation Lab for diagnostic,



therapeutic and research purposes with research funding by Dystonia Medical Research Foundation, USA.

Renovation of Animal Operation Theatre has been completed.

**Major Honours and Awards received:**

Two ICMR Awards to faculty, National Florence Nightingale Award and International Fellowships to faculty and students.

**Important Collaborations (National and Global) established:**

Collaboration in education and research: Osaka University (Figure 1), NIT, Trichy, IIITM.

Technical Collaboration: Indo–Danish, Indo–Spanish, Indo–Japan schemes of DST

Industrial collaboration: M/s Trivitron, SIDD Life sciences, TTK Healthcare Ltd.

**Important Output Indicators:**

S. No.	Parameters	Output
1.	Papers in refereed journals	168
2.	Books	1
3.	Chapters in Books	8
4.	Papers in Conferences	196
5.	Number of Ph. Ds. produced	9
6.	Indian Patents filed	16
	Indian Patents granted	4
7.	Number of Technologies/Designs and other intellectual products commercialized	3
8.	Number of Technology leads awaiting transfer	3
9.	Research Manpower trained (other than Ph. Ds)	35
10.	Technical Manpower trained	38
11.	B. Tech/ UG projects guided	15
12.	M. Tech/M. Sc./M. Phil projects guided	18



Figure 1: Exchange of MOU for collaboration in education, research and technology between the Institute and Osaka City University on 27th Aug 2013 during the visit of Prof. Y. Yokogawa, Department of Intelligent Materials, OCU to the BMT wing

## **S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES (SNBNCBS), KOLKATA**

S. N. Bose National Centre for Basic Sciences (SNBNCBS) was established in 1986. The Institute has a total of 55 regular employees, out of which 34 are scientists/faculty and 12 are post-doctoral research staff.

**Areas of Focus:** Theoretical and experimental studies in Physics, Astrophysics, Chemistry, Biology, Mathematics and Nano Science and Technology. Human Resource Development Programmes.

### **Areas of Research Focus:**

- Selected areas of Theoretical Sciences like Field theory, Quantum Information Theory, Statistical Physics and Non-Linear Dynamics.
- Areas of Physical and Quantum Chemistry that interface with Biological Molecules, Ionic Liquids and Energy Harvesting using tools of simulation and precision ultra-fast spectroscopy.
- Advanced Materials Sciences and Condensed Matter Physics including nanomaterials and computational materials science.
- Selected areas of astrophysics and cosmology like investigations on black holes, dark matter and observational astronomy.
- Networked research programmes through visitor and associateship programmes.

### **Other Major Programmes:**

- Integrated PhD Programme
- Extended Visitor and Linkage Programme (outreach and linkage activities)

## **Major Accomplishments:**

### **Research Accomplishments**

#### **Department of Astrophysics & Cosmology**

- Study of black hole accretion using numerical simulations of hydrodynamic and radiative flow
- Study of ionospheric response to solar and terrestrial high energy phenomena
- Study of solar X-ray radiation using balloon borne equipments
- Study of gas–grain interaction on a laboratory analog of interstellar dust grain
- Study of molecular hydrogen and water formation in diffuse clouds
- Quantum memory and quantum uncertainty
- Discriminating pure and mixed states using the uncertainty principle
- Establishing an Astronomical Observatory for Detection of Extra-solar planets using transit search
- Astronomical Instrumentation: Optical Design of Faint Object Spectrograph and Camera
- Detection of optically thin dust shell around nova V476 Scuti
- Detection of a possible Mira variable

#### **Department of Chemical, Biological & Macro-Molecular Sciences**

- Statistical mechanical theory for substrate binding in oligomeric enzyme developed.
- Entropy production in biosystems via simulations explored.
- Calculation schemes for thermodynamic quantities from simulated fluctuations in bio-macromolecular complexes developed.
- First experimental proof and explanation provided for green fluorescent proteins acting as red fluorescent ones upon laser irradiation.
- DNA–drug interactions, nano-composites, quantum dots studied, biomedical instrumentation explored.
- First theory for dynamics in (ionic liquid + solvent) mixtures formulated.
- First comprehensive simulation using a real solute confined in an aqueous medium performed.
- Ion-induced heterogeneity in polymer substantiated via fluorescence.
- Confinement effects on structure and dynamics of confined water molecules experimentally studied.
- Bio-compatible micro-emulsions investigated and characterized.
- Molecular mechanism for decoupling between polar solute rotation and longer-ranged interaction substantiated.

#### **Department of Condensed Matter Physics and Materials Science**

- Theoretical (DFT) calculations for modeling of diverse phenomena, like 2-D layered materials, nano-materials, complex materials, strongly correlated materials, direct band gap transitions in layered

materials, functional metalorganics, 4d and 5d oxides, disordered magnetic binary alloys, quantum phase transitions in electronic systems etc.

- Experimental measurements and theoretical band structure studies on binary and ternary ferro magnetic alloys.
- Experimental studies on various magnetic nano structures, like femto and pico second ultra-fast magnetization dynamics on magnetic nanodots, antidots etc. with theoretical modeling, nanofabrication with nanolithography of single metallic and semiconducting nano wires for studying optoelectronic and transport properties under high pressure, template and non-template methods for preparation of multiferroic hollow spheres and biocompatible materials etc.
- Theoretical studies on phase stability of quantum devices under transport conditions, various aspects of superconductivity, modeling of DNA mutations etc.
- Experiments on highly active magneto rheological fluids and feasibility study on them for real life use.

#### **Department of Theoretical Sciences**

- Investigations on phase transitions and critical phenomena in black holes showed that black hole thermodynamics was reasonably explained by a mean field theory type approach. The Ehrenfest scheme, as adapted for black holes, was a successful scheme. The study of critical phenomena in this context further bolstered the validity of the mean field approximation. We have extended our analysis for charged AdS black holes in the context of AdS/CFT duality. The critical exponents found here strongly support the mean field viewpoint.
- The generalized Riccati system has been studied and it is shown that for a specific value of the parameter the system admits a bilagrangian description. The dynamics has a node at the origin and it is aperiodic for a parameter value much smaller than a critical value, the origin being a centre. It is found that the solution changes from being periodic to aperiodic at a critical point which is independent of the initial conditions.

#### **Construction activities**

- Integrated Hostel Block & Transit Quarters Complex (G + 5) – Site for the construction has been selected. Soil exploration is completed. Architectural Plans have been approved by the Centre. Further work to be taken up in due course.
- Liquid Helium Plant Room – Planning, selection of Consultant Architect, review of Tender Document, Drawings & Specification and Tendering. The room is arranged for installation, testing and commissioning of the LHe Plant.
- 2 Nos PEB Laboratory Buildings – Planning, selection of Consultant Architect, review of Tender Document, Drawings & specification.

#### **Important Highlights of 5 Major Programmes:**

- (a) Physics of nanomaterials including application-specific materials development and use of nanomaterials in solar energy harvesting. Development of high frequency magnonic nano devices using array of nano-magnets, single nano-wire based high frequency optical detection.

- (b) Advanced computational materials science including soft condensed matter, ionic liquids and bio-molecules.
- (c) Interface of biology and condensed matter physics: DNA–protein and nanomaterials interactions and bio-molecular recognition in physiological conditions, biology of extreme conditions and application of ultra-fast spectroscopy in bio-molecules and quantum effects in fast molecular and non-adiabatic process.
- (d) Collective behavior in quantum and classical condensed state including driven systems, ultra cold quantum gases and spin transport through quantum wires.
- (e) Theoretical work on black holes and its cosmological consequences and astro-chemistry are selected problems in quantum field theory.

**Major and Unique National Facilities Created:**

- Establishment of ultra-fast spectroscopy set-up
- Extension of nanofabrication and device fabrication facility including clean room facility
- Establishment of Cluster Computing facilities
- Establishment of state-of-the-art materials characterization facilities
- Time and Space resolved Kerr Effect Measurements

**Important Collaborations (National and Global) established:**

SNBNCBS has large number of ongoing collaborative projects with Japan, Germany, UK, South Africa, EU, Sweden etc.

**Important Output Indicators:**

S. No.	Parameters	Output
1	Papers in refereed journals	142
2	Books	3
3	Chapters in Books	3
4	Papers in Conferences	65
5	Number of Ph. Ds. produced	12
6	Indian Patents filed	1
7	B. Tech/ UG projects guided	1
8	M. Tech/M. Sc./M. Phil projects guided	5
9	Other Products/ Indicators (M.Sc. Degree under Integrated Ph.D. Programme)	10

## **TECHNOLOGY INFORMATION, FORECASTING AND ASSESSMENT COUNCIL (TIFAC), DELHI**

Technology Information, Forecasting and Assessment Council (TIFAC) was established in 1988. TIFAC has 39 regular employees, out of which 23 are scientists/faculty.

### **Areas of Focus:**

Technology Foresight, Special Reports, Technology Support Programmes

### **Important Highlights of 5 Major Programmes:**

#### **Technology Vision 2035:**

Technology Vision 2035 is a nationwide mega-exercise to foresee the way India would evolve over the next couple of decades, on an impressive growth path. Technology Vision 2035 aims to plot the technology trajectories, which will enable India to surge ahead, as a developed nation and as a technology leader. The exercise started in early January, 2011 and is nearing completion. In addition to a Technology Vision 2035 document, twelve sectoral roadmaps in two technology areas are being prepared.

#### **Technology Foresight and other Studies:**

A technology foresight study on Solar PV has been initiated to facilitate pro-active policy formulation.

#### **TIFAC-SIDBI Revolving Fund for Technology Innovation Programme (SRIJAN):**

The programme aims at facilitating scaling up or commercialization of technology innovations in the country. Technical appraisal of innovations is carried out by TIFAC while SIDBI carries out the financial appraisal and manages the revolving fund. Three technology innovations were successfully commercialized during the period, as given below.

RFID technology based tags for Solar PV module tracking by M/s. IAITO InfoTech Pvt. Ltd., Kanpur.

Pouchable Grade Hi-Sep battery separator with discrete ribs and dot configuration for enhancing efficiency of flooded lead acid batteries by M/s Raman FibreScience Pvt. Ltd., Bangalore

Hybrid Idlers for conveyer belt systems towards reducing downtime in steel industries by M/s. Jyoti Cero Rubber, Jamshedpur in partnership with TATA Steel

In addition, five new technology commercialization projects were also sanctioned for implementation during the period.

#### **Patent Facilitating Centre (PFC):**

PFC continued to provide IP protection support to academia and research institutions and create capacity in the country for managing IP protection. During this period, 31 inventions were recommended for patent filings in India and foreign countries, 15 new patent applications were filed in India and one PCT

application were filed. Three Indian patents were granted on applications filed earlier. For projects from the INSPIRE exhibition last year, 33 provisional Indian patent applications were filed.

The training for 95 candidates of 7<sup>th</sup> batch of women scientists was conducted at four centres in Delhi, Chennai, Pune and Kharagpur.

#### **Technology Foresight for Automotive Research (TFAR):**

**TFAR** has facilitated the formulation of National Mission for Electric Mobility (NMEM). In-house technology foresight studies were continued on various aspects of electric mobility and its impacts, including Lightweight Materials and Design for Vehicles, Energy Storage for Electric and Hybrid Electric Vehicles, Availability and demand for Materials and other resources for electric mobility etc. The Department of Heavy Industry has entrusted TIFAC with the responsibility of preparing a DPR for the R&D Scheme under the National Mission for Electric Mobility. In this context, TIFAC has taken up a detailed survey of R&D competency in India in the area of electric mobility.

#### **Technology Refinement and Marketing Programme (TREMAM) Inputs (April, 2013 onwards):**

TREMAM is a unique programme that supports Indian innovations towards making them investment ready. **Three technologies were commercialized/transferred during the period, while two new projects were taken up. Under this programme, “National Awards for Commercializable Patents”** has been instituted. The award carries a sum of Rs. 5.00 lakh and a certificate. In addition, selected innovations are provided an incentive of Rs. 5.00 lakh on commercialization of the awarded patents. During the period, eight (8) patents were selected for the awards from 69 applications through a three-stage screening process.

#### **Bioprocess & Bioproducts Programme:**

The Bioprocess & Bioproducts Programme addresses critical technology needs for biotransformation and enzymatic processes towards development of active pharmaceutical ingredients, neutra-ceuticals, phyto-chemicals, bio-energy and bio-fuels etc.

A ligno-cellulosic (LC) ethanol pilot plant with processing capacity 80 kgs of biomass per day has been set up by TIFAC at National Institute for Interdisciplinary Science & Technology (NIIST), Trivandrum. Large scale production of *Aloe vera* extract for application **in diabetes control** was undertaken at Laila Pharmaceutical, Vijayawada, and the human clinical trials would be completed shortly. The optimization of enzymatic treatment of potatoes with differently produced and procured enzyme concoction ratios along with recycling studies of enzymes is in progress under a project on waste reduction in potato processing.

#### **Technology Upgradation of select MSME clusters:**

Six technical training programmes covering different aspects of innovative technologies including management aspects and IP protection were conducted for different clusters during the period. Gap Analysis Study for Production or Manufacturing Processes as well as Environmental Aspects of Readymade Garments Cluster in Tirupur, Tamil Nadu has been carried out. A feasibility study for conversion of potential CI foundries into Ductile Iron foundries for Howrah Foundry Cluster has also been taken up. Technology

interventions continued to be made in Howrah Foundry cluster through Jadavpur University.

### **India-IIASA Programme:**

A workshop on Analyzing Forest Carbon Accounts for Sustainable Policy Options with Special Reference to Livelihood Issues was organized jointly by Indian Institute of Forest Management (IIFM), Bhopal and TIFAC at New Delhi. In addition, TIFAC has commissioned a cluster project involving different studies such as: ‘Climate Change Adaptation Approaches for Sustainable Livelihoods’; ‘Integrating hydrology, climate change and IWRM with livelihood issues’; ‘Development of methodology and a DSS for water-scarce Bundelkhand region in India’; and ‘Evaluation of soil nutrient budgets at field, farm and regional level in humid tropics of Kerala and development of a model for management of soil health’.

For capacity building, an Indian researcher participated in the Young Scientist Summer Program (YSSP) during June–August 2013 at IIASA. Another researcher is undergoing training under the Southern African Young Scientists Summer Program (SA-YSSP), being conducted at the University of the Free State in Bloemfontein, South Africa.

### **Important Output Indicators:**

<b>S. No.</b>	<b>Parameters</b>	<b>Output</b>
1	Papers in refereed journals	7
2	Chapters in Books	1
3	Papers in Conferences	14
4	Number of Technologies/Designs and other intellectual products commercialized	7
5	Number of Technology leads awaiting transfer	1
6	B. Tech/ UG projects guided	2
7	M. Tech/M. Sc./M. Phil projects guided	1
8	Other Products (Technology Gap Studies, Foresight reports, etc)	1

### **VIGYAN PRASAR (VP), NOIDA**

Vigyan Prasar was established in 1989. The Institute has 35 regular employees, out of which 15 are scientists/faculty.

#### **Area of Focus:**

Science & Technology Communication/Popularization



### **Major Accomplishments:**

- VP has consistently served its mandate of reinforcing scientific temper among stakeholders across several sectors and expanse of our country. This has been through:
- Value added information support and capacity building/enhancement, so that receivers of such interventions are able to initiate and sustain well-informed action;
- Orientation of S&T communicators to use appropriately adapted tools, techniques and messages to enable locally relevant action, including such areas as biotechnology, climate change mitigation and adaptation, nuclear energy and gender mainstreaming (Fig. 1); and
- A mix of robust tools of communication for delivering appropriate information in a timely manner to serve the stated agenda (Fig. 2).

### **Important Highlights of 5 Major Programmes:**

VP has been engaged in extensive in-house research to conceptualize messages and strategies for communication in response to locally felt needs. The output and outcome of such need-based assessments are seen in the following:

- 1) Popularization & Sensitization Workshop on Mathematics for teachers/journalists/media persons throughout the country. Mass campaigns focused on the
  - ISON Comet &
  - Theme “Manage to Save Water” as part of the International Year of Water Corporation 2013 for general public and VIPNET Clubs
- 2) Newsletter outreach represented by Dream-2047, a bi-lingual science magazine reaching out to nearly fifty thousand receivers including about 8000 E-version subscribers.
- 3) Mass media based content enhancement especially through All India Radio and Doordarshan, through a series of new programmes in several Indian languages (Fig. 3).
- 4) National seminars highlighting the role of S&T communication to build scientific temper and empower people through rationality; Edu-SAT Network, VIPNET Clubs, State S&T Councils and other S&T centered organizations’ involvement for wide outreach; and the Vigyan Prasar Information Systems as a repository of resource materials on science and technology, available online on [www.vigyanprasar.gov.in](http://www.vigyanprasar.gov.in).

### **Major and Unique National Facilities Created:**

- i. A country – wide network of Science Clubs, and Edu-SAT
- ii. Dream-2047, a monthly publication. MoUs on Science broadcast with DD, AIR, LSTV.

- iii. Vigyan Prasar Digital Library, Discussion Forum.
- iv. Online availability of S&T communication content (publications, audio and video programmes) developed by VP.
- v. Workshop and training programmes throughout the country to train and motivate science teachers to carry out innovative activities during classroom teaching to make science interesting for the students &
- vi. Network of resource persons on astronomy, science activities and science communication etc.

**Important Collaborations (National and Global) established:**

DBT, Government of India, NCSTC (DST), Indo–French Centre for the Promotion of Advanced Research, Nuclear Power Corporation of India Ltd, NCSM of the Ministry of Culture, State Councils of Science & Technology, NCERT, Kendriya Vidyalaya, National Institute of Open Schooling, Universities and several NGOs.

**Important Output Indicators:**

S. No.	Parameters	Output
1.	Papers in refereed journals	10
2.	Books	8
3.	Chapters in Books	10
4.	Papers in Conferences	27
5.	Number of Technologies/Designs and other intellectual products commercialized (Activity Kits)	8
6	Technical Manpower trained (S&T Communication)	2570
7.	B. Tech/UG projects guided	1
8.	M. Tech/M.Sc./M. Phil projects guided	1
9.	Other Products (Popular Science article in different/Magazines/Newspapers)	78
10.	Teaching undergraduate course	1



Fig. 1. As special initiative, a series of theme based Skill up gradation training programme were organized in North Eastern States for science communicators and teachers.



Fig. 2. Women farmers interacting with scientists and experts on women friendly tools in a national seminar on women farmers at Junagarh in February 2014

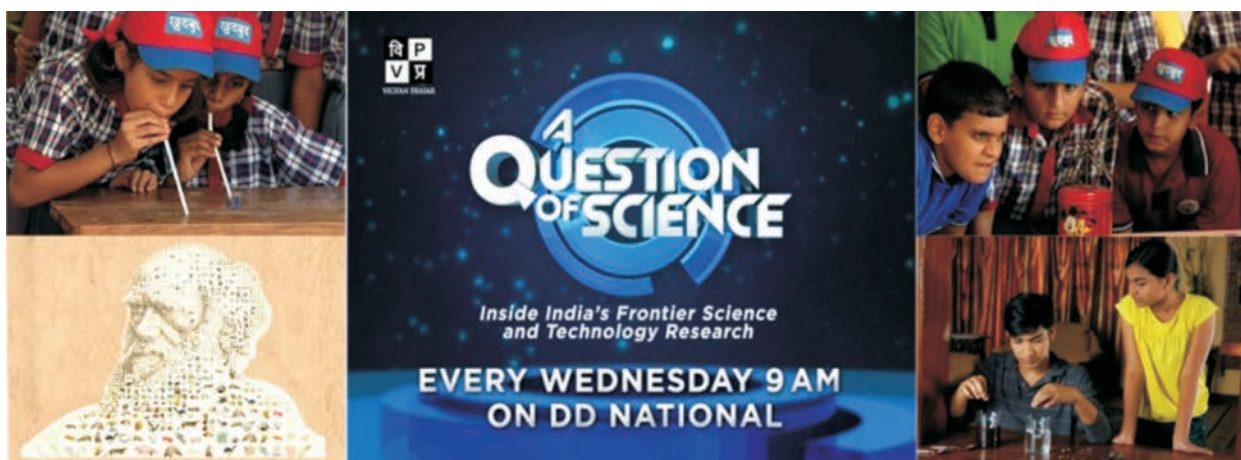


Fig. 3. Question of Science programme produced by Vigyan Prasar telecast on DD National

## WADIA INSTITUTE OF HIMALAYAN GEOLOGY (WIHG), DEHRA DUN

Wadia Institute of Himalayan Geology was established on June 29, 1968. The Institute has a total of 208 regular employees, out of which 63 are scientists/faculty and 06 are post-doctoral research staff.

### Areas of Research Focus:

The Institute has been given the mandate to carry out geological and geophysical investigations on the Himalaya – the youngest and loftiest mountain system on Earth, which plays a critical role in climate modulations. The research activities of the Institute have been grouped into five Thrust Area Themes (TAT), which are implemented through long-term and short-term projects. The main emphasis is on studying Himalayan river systems, glaciers, earthquake precursors and landslides.

### Major Accomplishments:

- The study of seismic data from 39 stations in the Garhwal-Kumaun Himalaya showed a striking feature of narrow belt of seismicity that follows the trend of the MCT zone, extending throughout the study region from west to east.
- Studies of core samples from Ocean Drilling Programme showed that the changes in deep-sea benthic foraminifera at southeastern Indian Ocean Hole are intimately related to changes in the Antarctic glaciation and Southern Hemisphere ocean circulation, including Antarctic Circumpolar Current (ACC) and Antarctic Intermediate Water (AAIW) during the Miocene.
- The study of mafic enclaves and host orthogneisses of eastern Ladakh suggests their genetic linkage and derivation from the hybrid melt resulting from the magma mixing of mafic and felsic melts.

### Important Highlights of 5 Major Research Programmes:

- The P-T evolution of the Higher Himalayan Crystallines (HHC) studied along Kaliganga valley of eastern Kumaun suggests a possible isothermal decompressional uplift path to which the rocks of the region are subjected.

- In the Shyok-Darbuk section of eastern Ladakh, partial melting of orthogneiss and metapelites resulted in generation of felsic granites, and that **the complex intrusive network of melt channels in the migmatite region are considered to merge and link-up with each other during melt ascent to upper crustal levels resulting in stocks and plutons.**
- New paleoseismic evidences are presented from the Bhatpur Trench site along the Himalayan Frontal Thrust (HFT) on the western margin of the Janauri Anticline in NW Himachal Himalaya, India.
- The studies of Cr-spinels in serpentinites from NE India suggest that the elements Zn and Mn were probably supplied from olivine upon serpentization, during syn- to post-obduction of the ophiolitic mélangé along the Tidding Suture Zone.
- From the cross-correlations between the 711-year long ring composite of *Pinus gerardiana* and *Cedrus deodara* from Kinnuar, Himachal Pradesh and Satluj River discharge data, it has been observed that the 50-year running mean period showed lowest river discharge in the eighteenth century and highest in the nineteenth century.
- The Institute is involved in the DST flagship programme to Map the Neighbourhood of Uttarakhand (MANU) for the Yamuna and the Bhagirathi valleys (Figure 1) after the June 2013 Kedarnath disaster, in order to help in sustainable development of the region.

**Important Collaborations (National and Global) established:**

With NGRI with an aim of developing new research and academic programmes

**Important Output Indicators:**

S. No.	Parameters	Output
1.	Papers in refereed journals	28
2.	Papers in Conferences (and other non-SCI papers)	8
3.	Number of Ph. Ds. Produced (4 awarded and 4 submitted)	8
4.	B. Tech/ UG projects guided	15
5.	M. Tech/M. Sc./M. Phil projects guided	19
6.	Research Manpower trained (other than Ph. Ds)	54
7.	Workshops/Seminars organized	6

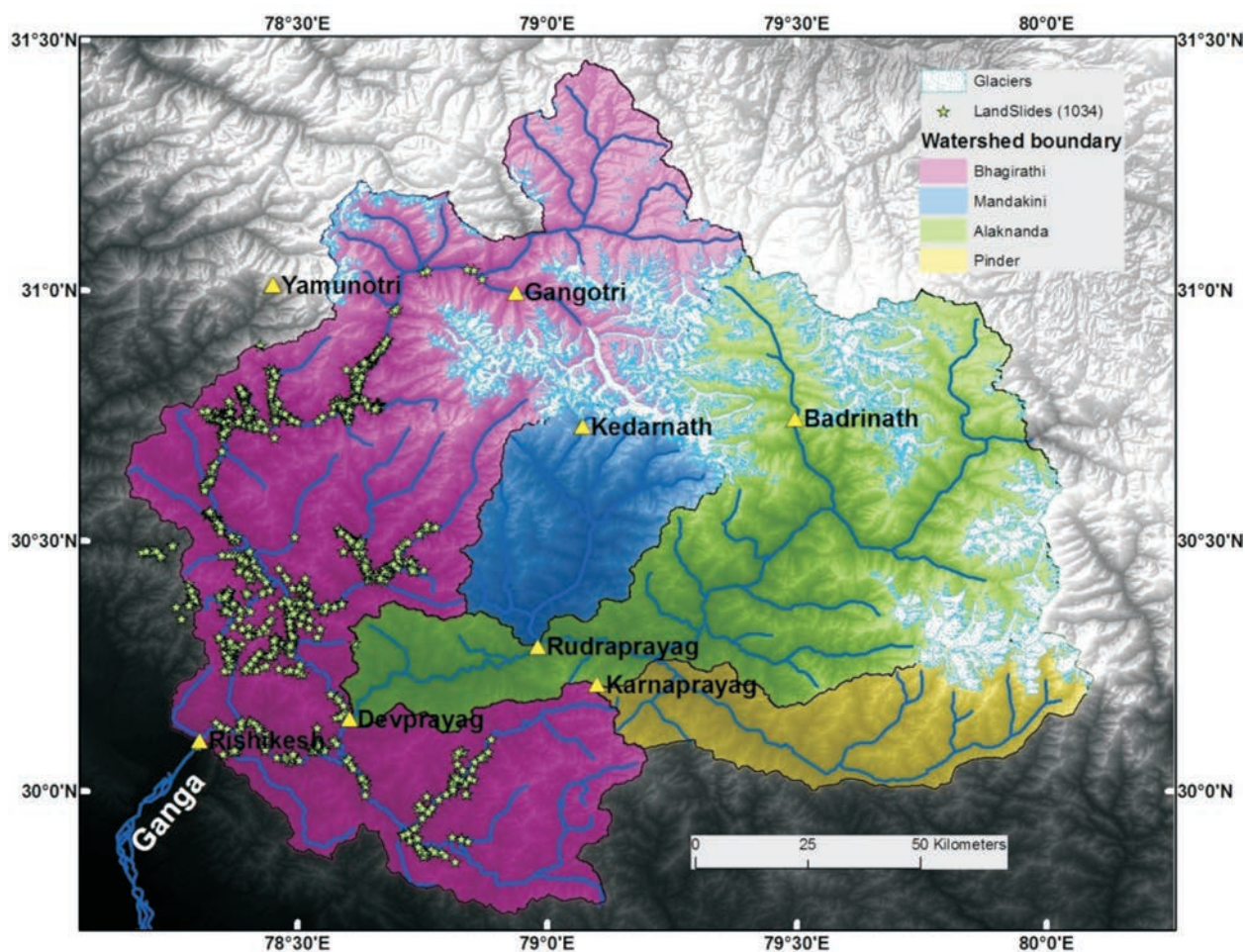


Figure 1: Spatial distribution of landslides in the Bhagirathi valley mapped during the DST flagship Programme-Mapping the Neighbourhood of Uttarakhand

## CAPACITY BUILDING OF R&D INSTITUTIONS

### SOPHISTICATED ANALYTICAL INSTRUMENT FACILITIES

Sophisticated analytical instruments are vital for research in many areas of science and technology. Many institutions in the country do not have these instruments. The Department of Science & Technology has set up Sophisticated Analytical Instrument Facilities (SAIFs) in different parts of the country to provide the facilities of sophisticated analytical instruments to the research workers in general and specially from the institutions which do not have such instruments through its Sophisticated Analytical Instrument Facilities (SAIF) programme to enable them to pursue R&D activities requiring such facilities and keep pace with developments taking place globally. At present the Sophisticated Analytical Instrument Facilities (SAIFs) are being supported by DST at IIT, Chennai; IIT, Mumbai; CDRI, Lucknow; Panjab University, Chandigarh; NEHU, Shillong; IISc, Bangalore; AIIMS, New Delhi; Gauhati University, Guwahati; IIT, Roorkee; CVM, Vallabh Vidyanagar and Sophisticated Test & Instrumentation Centre (STIC), Kochi.

The SAIFs are equipped with instruments such as Scanning Electron Microscopes, Transmission Electron Microscopes, Electron Probe Microanalyzer, Secondary Ion Mass Spectrometer, ICP, NMR, EPR Spectrometers, Mass Spectrometers, X-ray Diffractometers and Thermal Analysis Systems etc. to meet the needs of research workers in various areas of science & technology. The instrument facilities at the SAIFs are accessible to all the users irrespective of whether they belong to the host institutes or are from outside the host institutes and are being used extensively by the researchers from all parts of the country.

### **INSTRUMENT FACILITIES STRENGTHENED**

Instrument facilities were strengthened during the year in the areas of Electron Paramagnetic Resonance Spectroscopy, High Resolution Mass Spectrometry, Elemental Analysis and Thermal Analysis to meet the current and emerging needs of research community. Some of the major instrument facilities installed at the SAIFs during the year are EPR Spectrometer (Photograph 1) and Thermal Analysis System (TG/DSC) at the SAIF, Chennai, High Resolution LC-Mass Spectrometer (Photograph 2) at the SAIF, Mumbai, Elemental Analyser at the SAIF, Lucknow, X-ray Fluorescence Spectrometer (Photograph 3) at SICART, Vallabh Vidyanagar and Mercury Analyser at the SAIF, Kochi. Accessories including Ultramicrotome and EDAX were added to the existing Electron Microscopes at the SAIF, Shillong to make them more useful to the users. 200 KeV Transmission Electron Microscopes are being added to the SAIFs at Mumbai and Kochi to further strengthen them.

### **NEW SAIFs IN LESS ENDOWED REGIONS OF THE COUNTRY**

There are regions in the country where required instrument facilities are not available to the research community. During the year focus of the programme remained on this segment of less endowed regions and it was decided to create facilities in such regions to enable the research community from these regions to have access to the required instruments in their close proximity. Less endowed regions and institutes within these regions were identified and it was decided to set up new SAIFs at IIT, Patna, Guru Ghasi Das Vishwavidyalaya, Bilaspur, BESU, Kolkata, University of Rajasthan, Jaipur, Shivaji University, Kolhapur, Karnataka University, Dharwad and M.G. University, Kottayam. These SAIFs are being equipped with instrument facilities in the areas including Electron Microscopy, Mass Spectrometry, NMR Spectroscopy, X-ray Diffractometry etc.

### **ANALYSIS PROVIDED/OTHER ACTIVITIES UNDERTAKEN**

#### **Analysis provided/Usage of the facilities**

- A wide range of sophisticated analytical instrument facilities/techniques are being provided by the SAIFs to the research workers from all parts of the country. The instrument facilities at the SAIFs are meeting the analytical needs of scientists for materials characterization including qualitative/quantitative elemental, molecular/compound analysis/characterization, structure determination, microstructure analysis and surface topographic studies etc., and enabling them to pursue research in various frontline areas of S&T.
- Services like solution to analytical problems including development of analytical methods for specific needs, spectrum analysis and interpretation of results etc. are also being offered by the SAIFs. Facilities and assistance for sample preparation are also being provided by the SAIFs.

- The instrument facilities at the SAIFs facilitated research in various areas of Science & Technology. Some of these include synthesis of a variety of organic compounds, drug intermediates, extraction/ study of natural products/screening for their biological activities, drugs & pharmaceutical research, research in various areas of Chemical sciences, Study of biomolecules and their structure elucidation, Research in Condensed matter physics/material science, Nano-science & technology, studies related to crops/seeds, insecticides, various diseases etc. About 2,000 research papers were published by the users of the SAIFs with the support from the facilities provided by the SAIFs during the year. The facilities at the SAIFs helped about 500 Ph.D. students in their research work.
- About 16,000 research workers from all over the country utilized and benefited from the facilities provided by the SAIFs during the year. These included research workers from almost all the universities in the country. About 85% of the users are from academic sector.
- About 1,30,000 samples were analyzed at the facilities during the year.

#### **Workshops/Training programmes/Short term courses organized**

Workshops and training programmes were organized by the SAIFs during the year on use and application of various instruments and analytical techniques to create awareness among the research community about them and on maintenance/repair/operation of the instruments for technicians. About 30 participants attended each of these workshops/training programmes. Some of the workshops/training programme/short term courses organized are as follows:

- A workshop on “Electron Microscopy” by SAIF, Chandigarh.
- A workshop on “Recent Trends in Biological Electron Microscopy” by SAIF, Shillong.
- A training programme on “Electron Microscopy for Scientific Investigators” by SAIF, New Delhi.
- A workshop on “Material Characterisation at Nano Scale” by SAIF, Kochi.
- A workshop on “EPR Spectroscopy-Techniques and Applications” by SAIF, Mumbai.
- A workshop on “Theory and Applications of EPR Spectroscopy” by SAIF, Chennai.
- A workshop on “Applications of FT-NMR Spectroscopy” by SAIF, Chennai.
- A workshop on “Multidimensional NMR and its Applications” by SAIF, Bangalore.
- A workshop on “Applications of FT-NMR in Chemical and Biological Studies” by SAIF, Shillong
- A workshop on “Mass Spectrometry and its Application in Physical and Life Sciences” by SAIF, Shillong.
- A workshop on “Applications of Direct Analysis in Real Time (DART) Mass Spectrometry Techniques” by SAIF, Lucknow.
- A workshop on “Mass and NMR Techniques” by SAIF, Lucknow.
- A workshop on “NMR and Mass Spectrometry” by SAIF, Kochi.



- Workshops on “Chromatography” and “Mass Spectrometry” by SICART, Vallabh Vidyanagar.
- A workshop on “FT-IR and FT-Raman Techniques in Structure, Bonding and Chemical Property Studies” by SAIF, Chennai.
- A workshop on “Wavelength Dispersive X-ray Fluorescence Spectrometry” by SICART, Vallabh Vidyanagar.
- A workshop on “X-ray Diffractometry” by SICART, Vallabh Vidyanagar.

Apart from the above workshops/training programmes for researchers, the SAIFs at Lucknow, New Delhi, Guwahati and Vallabh Vidyanagar also organized short term training on various instruments/techniques for postgraduate students.

#### **Analytical techniques developed/significant analysis done/research work facilitated.**

Some of the analytical techniques developed/significant analysis done/research work facilitated by the SAIFs are as follows:

- Novel NMR pulse sequence entitled RES-TOCSY has been developed at the SAIF, Bangalore to unravel the overlapped spectrum of enantiomers. It permits the unambiguous assignment of all the coupled peaks and the measurement of enantiomeric excess (ee) from a single experiment even in combinatorial mixtures.
- GFT NMR technique (combined evolution of frequencies corresponding to different dimensions in 3 and 4-D experiments) for fast and efficient  $^1\text{H}/^{13}\text{C}$  sugar spin system identification in nucleic acids was developed at the SAIF, Bangalore.
- Proton-boron distance is a useful structural parameter. Boron being a quadrupolar nucleus, there are challenges in estimating distance. An NMR method has been successfully implemented for accurate measurement of boron-proton distances at the SAIF, Bangalore.
- In natural abundance C-13 NMR spectroscopy, measurement of proton-carbon dipolar coupling with proton evolution gives a separate doublet of lines for each pair of proton and carbon, thereby increasing the precision of estimation of the dipolar coupling. Improved methods of estimating these couplings for magnetic field orientable systems such as liquid crystals and membrane protein samples have been proposed and demonstrated at the SAIF, Bangalore.
- In a research work conducted at the University of Delhi, in an organic synthesis reaction involving Cyclopalladation, a fluxional behavior was observed resulting in dimer/trimer formation. A variable temperature NMR study to understand such behavior was facilitated by SAIF, Bangalore.
- Amino acid selective labeling and unlabelling protocols and corresponding pulse sequences were developed/optimized for protein resonance assignments at the SAIF, Bangalore.
- In a research work facilitated by the SAIF, Lucknow, a robust and controlled design to generate a variety of turn structures in  $\alpha_3$  cyclictetrapeptides induced and controlled by Carbo- $\alpha^3$  amino acid was demonstrated. While the design yielded  $\alpha$ -turn structure in a four residues cyclic peptide itself, the additional advantage of this design is the absence of any constrained residue.

- In a research work done at Dr. H.S. Gaur University, Sagar and facilitated by the Electron Microscope Facility at the SAIF, New Delhi, it was observed that AmBitubes can be employed as efficient nano-carrier for antileishmanial therapy.



EPR Spectrometer at the SAIF, Chennai.



High resolution LC Mass Spectrometer at the SAIF, Mumbai.



X-ray Fluorescence Spectrometer at the SICAT, Vallabh Vidyanagar.

**Fund for Improvement of S&T infrastructures in Universities and Higher Educational institutions (FIST)** aims to provide support towards augmenting higher education and research largely at the University and Academic sectors by augmenting basic infrastructural facilities for teaching as well as for conducting research in basic or applied science areas.

Currently, the Program is operated in competitive mode of support at three levels i.e. Level 0, Level I and Level II covering seven areas such as Life Sciences, Physical Sciences, Chemical Sciences, Engineering Sciences, Earth and Atmospheric Sciences, Mathematical Sciences and PG Colleges. While the support under Level 0 is considered to PG Science & Applied Science departments in “Colleges as a whole”, the supports in Level I and Level II are meant for Science and Applied Science departments of universities and academic institutions. The financial support is primarily provided for four basic purposes i.e. Equipment, Networking & Computational Facilities, Infrastructural Facilities and Maintenance. The financial support is limited to Rs 1.0 Cr, Rs 3.0 Cr and Rs 10.0 Crore for Level 0, Level I and Level II respectively, depending on the level of support.

**Highlights of activities during 2013-14:** For 13<sup>th</sup> round of operation, fresh proposals are invited in March 2013 through advertisements from eligible S&T related departments and PG colleges for considering support under this program. In this year about 296 new proposals in all levels (L0-94, Level I- 147 and Level II – 55) were received and finally 152 proposals (L0-53, Level I-85 and Level II-14) were identified to consider financial support for verifying quantum (from Rs.20 lakh to Rs.840 Lakh) at a total budget of about Rs.202.5 crores for 5 years. DST shall also considering some pro-active measures towards

enhancement of spread and enrolment of more colleges under PG College level and the making provision of additional support to performing colleges for encouraging research at the college level.

Besides these, supports to the ongoing projects were also provided during this year. Apart from the recommendations in the current year, 1827 S&T departments and PG colleges (Level 0-136, Level I-1529 and Level II-162) have been supported with a total investment of about Rs1500 crores during the last twelve years of its operation.

**Outcome:** The Program has provided sustainable funding over a period of twelve years and has enabled many departments across the country to carry out advanced research in emerging areas of science and technology and instituted modern teaching facilities. State of the Art facilities for performing high end research have been established and thus academicians and researchers across the country are benefited by the program. Some of the major facilities installed/recommended for support under the Program are: Scanning Near Field Optical Microscopy, Electron Probe Micro Analyzer, High Resolution Transmission Electron Microscopy, FEG Based Scanning Electron Microscope, 600 MHz NMR, Thermo-Mechanical Stimulator and Confocal Microscopes etc.

The Program has provided support in many prestigious Medical institutions in the country like All India Institute of Medical Sciences, New Delhi, Postgraduate Institute of Medical Education and Research, Chandigarh, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Mualana Azad Medical College, New Delhi, University College of Medical Sciences, Delhi, Mahatma Gandhi Institute of Medical Sciences, Wardha, JIPMER, Pondicherry, Christian Medical College, Vellore, Cancer Institute, Chennai, All India Institute of Speech and Hearing, Mysore, Institute of Post-Graduate Medical Education & Research, Kolkata etc.

Apart for acquiring these facilities for capacity building of teaching and research facilities, the Departments supported under the program have also established a computer laboratory with FIST support. The departments of small colleges and universities have also been benefited by acquiring useful Text Books for the Departmental Library. The Program has also provided Communication technology based infrastructures such as Grid Computing, Networks and Communications systems, Cloud Computing infrastructure in many engineering departments.

In the last twelve rounds of support, more than 225 PG Science Colleges have been brought under the ambit of FIST Program and program has extremely benefited the colleges in rejuvenation of teaching and research facilities.

FIST Program has enormously contributed to the area of Agricultural Sciences. The Program has provided teaching as well as research infrastructure support to several departments at Agricultural Universities such as University of Agricultural Science, Dharwad, Assam Agricultural University, Jorhat, CCS Haryana Agricultural University, Hisar, CSK Himachal Krishi Viswavidyalaya, Palampur, Dr Y S Parmar University of Horticulture & Forestry, Solan, University of Agricultural Sciences, Bangalore, Punjab Agricultural University, Ludhiana, Tamil Nadu Agricultural University, Coimbatore, GB Pant University of Agriculture, Pantnagar etc.

The Department of Science and Technology has also evolved state and region specific special packages under the FIST Program. North Region package (2008) and Jammu & Kashmir Package (2009) were instituted for augmentation of the teaching and research facilities at the S&T departments of the Universities

and Colleges in these states. Some of the salient features of these packages are: Enrichment of research efforts through exchange Fellowships, augmentation of S & T infrastructure to undergraduate Colleges, special assistance to universities for acquiring teaching facilities, one time support to universities for improving the quality of Power at these universities, support for establishing major facilities, Summer/Winter school for UG and PG Students etc. The Department has also initiated a Special package for Bihar State (2012) and its implementation is in process.



Neurosurgery related research and training infrastructure provided at the Department of Neurosurgery, All India Institute of Medical Sciences, New Delhi.



A simulation experiment being carried by Thermo-mechanical Simulator “Gleeble” supported out of DST-FIST support installed at Department of Metallurgical and Materials Engineering, IIT Madas. The facility was inaugurated by Dr T Ramasami, Secretary, DST on 21 September, 2013.

## Promotion of University Research and Scientific Excellence (PURSE)

The scheme was initiated with the purpose of building the research capacity of Indian Universities. Using a transparent criteria, forty four performing universities whose h-index ranging from 56 to 26 have been supported ranging from Rs 30.0 Crores to Rs 6.0 Crores for 3 years period based on the study report by NISTADS “Status of India in Science and Technology” as reflected in its publication output in Scopus International Database, for the period 1996-2006 and 1998-2008.

**Table- 1: Criteria for Support in PURSE Program**

<b>h-Index</b>	<b>Research Grant for 3 years</b>
More than 50	<b>Category A</b> (Rs 30.0 cr.)
40-49	<b>Category B</b> (Rs 15.0 cr.)
30-39	<b>Category C</b> (Rs 9.0 Cr.)
26-29	<b>Category D</b> (Rs 6.0 cr.)

**Highlights:** Under this program large investments have been made to encourage, nourish and sustain research performance of the leading universities. The Universities supported under the PURSE support are provided immense flexibilities with respect to choice of budget projection and selection of equipments required for conducting research etc. DST–PURSE provides support to universities essentially for research man-power cost, augmentation of equipment and computational facilities, establishing research infrastructure, acquiring research consumables, fund for travel, organizing workshops and conferences, contingencies and maintenance of the facilities.

### Some of the salient features of the program are as follows:

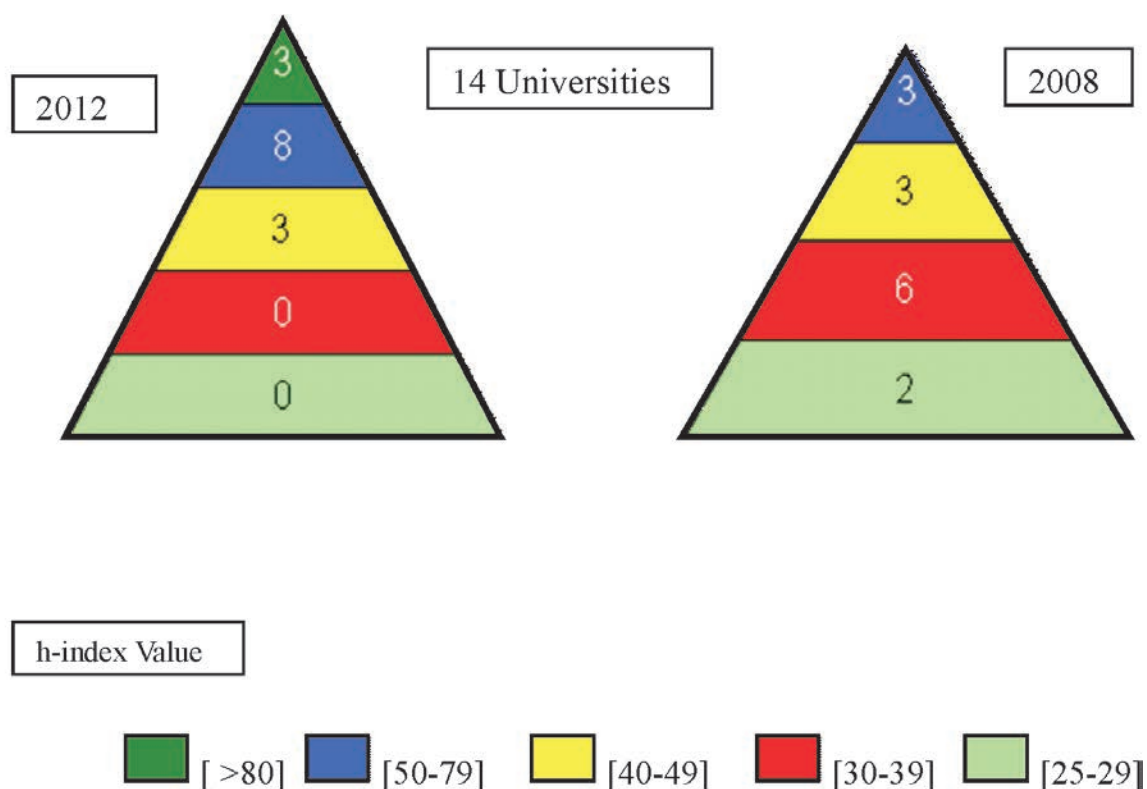
- The support provided to each university has been classified under ‘**Flexible**’ and ‘**Fixed**’ Components.
- The expenditure heads in ‘**Flexible Components (80-85%)**’ are totally flexible among the expenditure heads like support for acquiring Equipment, Consumables, Infrastructure Facilities and Networking & Computational Facilities.
- The support areas in ‘**Fixed Components (20-15%)**’ covers expenditure heads like Manpower Cost (10-15%), Contingences (1%), Travel (1%), Seminar/Workshop to organize or to attend abroad (1%) and Maintenance (2 %).
- No budgetary quotations for any equipment and other items are required for releasing grants by DST under this program. University will only inform DST about the equipment and other items as identified by them before acquiring and University would be responsible for all procurements.
- ‘Manpower’ to be engaged under this program should be for research and technical support and engaged on contractual basis and should not be equated with permanent faculty position.
- No support was made available for the building and civil construction related activities under PURSE initiative.

- Decision of Utilization of grants across different Departments of the Universities to be taken solely by the University.
- No Overhead amount is allowable under this Program.

The list of Universities identified through SCOPUS and supported in PURSE during 2009 is given below at Table 1 . Based on these criteria an investment of Rs 201 Cr was made for supporting 14 universities during 2009 -10 and that of Rs 264 Cr was planned for another 30 new universities during the year 2010-11. While the support to 1<sup>st</sup> set of 14 Universities has been completed now, Universities (30) supported in the 2<sup>nd</sup> set are ongoing and releases have been made in the current year. Since its initiation in 2009, an amount of about Rs 330 Crores has already been made available to performing universities supported under the PURSE Program.

### Outcome of the Scheme

Recently similar study was again commissioned at the NISTADS, New Delhi by the DST for evaluating the performance of the Universities for evaluation period of 2000-2010 through SCOPUS Database and compared the h-index as well as total publications of 1<sup>st</sup> set of 14 universities (**Table 1**) for the two study periods i.e. 1996-2006 and 2000-2010. However, the performance of this set of 14 Universities has improved greatly during the last 4 years. 11 Universities have now crossed the h-index mark of 50 against only 3 Universities in previous study period.

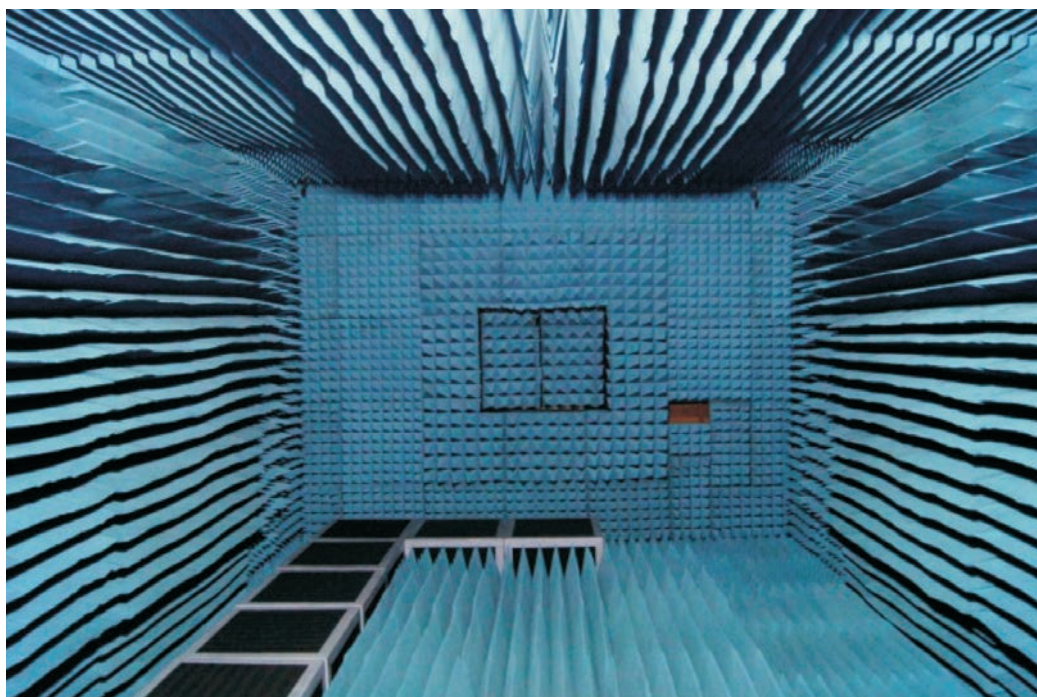


Due to this remarkable performance of the 1<sup>st</sup> set of 14 Universities, another round of performance linked investment under the PURSE Scheme to these 14 Universities has been decided and an amount of Rs 425 cr including an additional incentive of Rs 50 cr based on their growth rates both in overall publications and h-index has now been planned to invest in next 4 years, starting from the financial year 2014-15.

**Table1. List of 14 Universities under PURSE Program**

Sr. No.	Name of the University	Sr. No	Name of the University
1.	University of Delhi, Delhi	8	University of Bombay, Mumbai
2	University of Hyderabad, Hyderabad	9	Jawaharlal Nehru University, New Delhi
3	University of Punjab, Chandigarh	10	Anna University, Chennai
4	University of Pune, Pune	11	Karnataka university, Dharwad
5	Jadavpur University, Kolkata	12	Aligarh Muslim University, Aligarh
6	Banaras Hindu University, Varanasi	13	University of Rajasthan, Jaipur
7	University of Madras, Chennai	14	Andhra University, Vishakapatnam

The progress of these projects under PURSE is reviewed and monitored by the Programme Management Board (PMB) duly constituted by DST for this purpose.



A view of Anechoic chamber established out of DST PURSE support at Cochin University of Science and Technology, Cochin, Kerala. This is Central Research Facility in the University developed out of PURSE support.





Inductively Coupled Plasma Optical Emission Spectroscopy, Computational Facility, Fluorescent Microscope and Ultra Water Purification facility developed out of DST-PURSE at Sri Venkateswara University, Tirupati, Andhra Pradesh

### **Joint Collaborative R& D activities between DST and RCUK**

Since 2008, towards enhancement of linkages between India and UK, the Department of Science & Technology (DST), New Delhi and Research Councils (RC) UK have instituted a few collaborative research and development programs. Broadly the objectives of this partnership are for helping to develop innovative and entrepreneurial skills amongst researchers and support the commercial development of technology and expertise in spin-offs. The aims of such joint research and development collaborative programs is also raising the impact & profile of collaborative activity and facilitates innovation from existing research between these two countries. Moreover, these activities would also accelerate the deployment of research knowledge, deepen & strengthen current research links, enable the acquisition of new skills and encourage wealth creation through improving transfer of research and expertise from the research base to businesses and other users by building science and innovation bridges with world-class universities and high-tech businesses. So far the Department of Science & Technology (DST) and Research Council of UK (RCUK) have collaborated in programs like Science Bridges (2008), Next Generation Networks (2008), Solar Energy (2009), Fuel Cell (2010), BURD (2010), Advanced Manufacturing (2012-13), Smart Grid & Energy Storage (2012-13) and Applied Mathematics (2013) with an expected investment of about 30 M UK Pound by each country.

Specific details of some of the important projects are as following:-

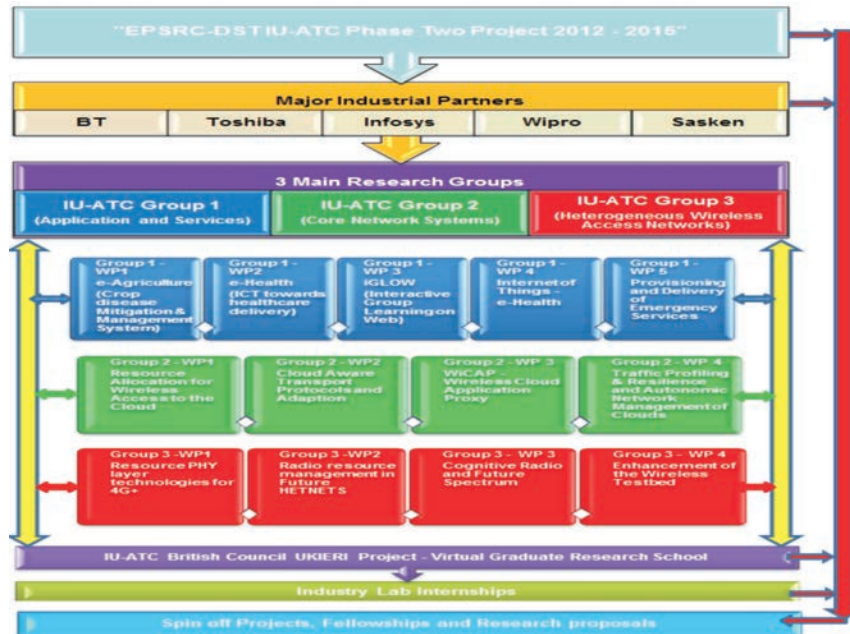
### 1. Indo-UK Advanced Centre of Excellence in Next Generation Systems and Services-Phase-2

The main objective of the project is to place infrastructure to facilitate, develop and enable the Digital and Information economy of both countries. This project is expected to develop novel solutions for research, innovation in Next Generation Communication Technology and wealth creation opportunities between UK and India.

Department of Science and Technology, New Delhi and Research Council, UK Digital Energy Programme invited the Indo-UK Consortium in Next Generation Networks to support a full proposal for funding to the level of 5 M UK Pound from DST to the Indian Partners and 5 M UK Pound from RC-UK for the UK Partners. This was for a total period of 60 months in two phases i.e 30 months in each phase and accordingly the contribution of each phase would be 2.5 M UK Pound each of India and RC-UK. Based on the success of the project in Phase I activities, activities at the Phase 2 of this joint project was sanctioned at a total of Rs 18.03 Crores (Indian portion) in October 2012 having nine participating Institutes from Indian Side. The consortium comprises seven leading IITs, nine leading universities in UK and industrial partners in UK and India.

The review of the Indian side activities in the project was performed in August 2013. The project has achieved commendable progress in various cross layer work packages in all three Groups in the Indian Side activities of the consortium.

Several farmers in rural India will be able use smart phones to detect crop diseases with the wireless communications developed under the initiative. Development of “Mobile Phone Enabled Public Health Management System”, Tackling emergency situations using communication technology are some of the outcomes of the project.



Make up of the IUATC Phase 2 project with the Research Groups and Work Packages within each group.

## 2. DST-RCUK Research Initiative on Solar Energy

Solar Energy has been identified by both the India and UK a crucial area of significance in providing solutions to the problem of meeting future energy needs and developing energy security. A cooperation agreement was signed in 2009 between the two countries has provided the framework for fruitful collaboration. The agreement conveys the two countries will invest 5 M GBP each to cooperate towards fostering of genuine and mutually beneficial research to develop novel materials, devices and systems applicable to solar energy.

Two projects have been supported by DST and RCUK, Digital Energy Program under the Research Initiative on Solar Energy. The duration of these projects is three years.

Solar Energy Research Enclave is established to house 5x10 KWp PV Power Plants under Indo-UK STAPP Project at IIT Kanpur. The review of these two projects was carried out in December, 2013. The projects have made considerable progress in the area of Solar Energy Research. However, the duration has now been extended by one more year to complete some of the goals.



A panoramic view of the Photovoltaic Field Performance Test Stations established at IIT Kanpur under Indo-UK STAPP Project for five different technologies; Crystalline Silicon, Multi-Crystalline Silicon, Amorphous Silicon Thin Film, CIGS Thin Film and High Efficiency, High Concentrator Cells in two different Configurations.

## 3. Research Initiatives on Advanced Manufacturing

Following a successful Joint Workshop on Advanced Manufacturing, held in New Delhi in January 2012, India's Department of Science and Technology (DST) and the Engineering and Physical Sciences Research Council (EPSRC), UK jointly identified following seven theme areas to initiate research in the area of Advanced Manufacturing with investment plan of 3M UK Pound by each country during 3 years of project duration:

- Advanced automation for manufacturing
- Engineering-driven sustainable manufacturing

- Manufacturing of high-performance materials and processes
- Industrialisation of biomedical procedures
- Integrated materials design, modelling, simulation and verification in a digital platform
- Next-generation sensors for manufacturing processes
- Realisation of functional surfaces

Joint announcement call was made and the Joint Panel recommended seven proposals by March 2013 to support jointly by India and RCUK. From Indian side the estimated cost of these seven proposals are about Rs 20 crores for 3 years project duration. Seven projects recommended by the Joint Panel are expected to start activities by January 2014:

#### **4. Research Initiatives on Smart Grid and Energy Storage**

Following a successful Joint Workshop on Smart Grid and Energy Storage Advanced Manufacturing, held in UK in June 2012, India's Department of Science and Technology (DST) and the Engineering and Physical Sciences Research Council (EPSRC), UK jointly identified following theme areas to initiate research in the area of Smart Grid and Energy Storage with an investment plan of 5M UK Pound by each country during 3 years of project duration:

- Appropriate distributed storage technologies
- On/Off grid energy systems
- DC Networks
- Control and communications

Joint announcement call was made and the Joint Panel recommended five proposals by March 2013 to support jointly by India and RCUK. From Indian side the estimated cost of these five proposals are about Rs 39 crores for 3 years project duration. The following five projects are expected to start activities by January 2014:

#### **5. Initiatives on Applied Mathematics**

Based on the Workshop organized in July 2012 at UK, decisions were taken to organize a few Workshops both at India and UK with the following objectives:

- (i) Encourage and enable closer collaboration between the Indian & UK Researchers in this strategically important area
- (ii) Develop networking between young Indian and UK scientists and students
- (iii) Identification of specific topic for the development of Joint Project
- (iv) Pedagogical course content development
- (v) Encourage students to take Mathematics as a Research Carrier.

However, it has finally been planned to organize 14 Workshops (7 in each country) during April 2014 and March 2016 with an investment of about 0.25M UK Pound (~INR 2.5 crores) by each country during this period. From Indian side the program will be coordinated by Professor Dinesh Singh, Vice Chancellor, University of Delhi, Delhi and the same will be coordinated by Professor Keneth Ball, ICMS. Joint Proposals received so far in this respect are being evaluated by the respective Coordinators.

## PROVIDING MEGA FACILITIES FOR BASIC RESEARCH

This programme was launched to create Mega Science facilities and launch Mega Science programmes in and out of the country to improve access to such state-of-the-art facilities for the Indian scientific community, especially from the academic sector. Because of their scale and technical complexity, such projects/programmes are manifestly multi-agency, multi-institutional and, most often, international in character.

While DST and the Department of Atomic Energy (DAE) had been jointly promoting such projects in the area of high energy physics for quite a long time, it was in the XI Plan Period that the programme got an independent identity. Both DST and DAE have a long-standing MOU on joint funding, implementation and monitoring of such projects and the inter-agency cooperation has been exemplary. Under this programme, several important developments took place during the year.

### Facility for Antiproton and Ion Research (FAIR), Darmstadt, Germany

Support towards construction of this accelerator facility continued during the year. Power Converters are among the most important 'in-kind' items identified for contribution by India. Significant progress was made towards fabrication of power converters. Prototypes of some of the power converters were built by Electronics Corporation of India (ECIL), Hyderabad in collaboration with Bhabha Atomic Research Centre (BARC), Mumbai, Variable Energy Cyclotron Centre (VECC), Kolkata and Raja Ramanna Centre for Advanced Technology (RRCAT), Indore. Fig. 1 shows one such prototype built at ECIL.



Fig. 1: A Prototype of Power Converter built at ECIL

India also plans to contribute some large superconducting magnets as 'in-kind' contribution to the construction of FAIR. Design of these magnets was completed at VECC, Kolkata. Fig. 2 shows the design of a Dipole Magnet.

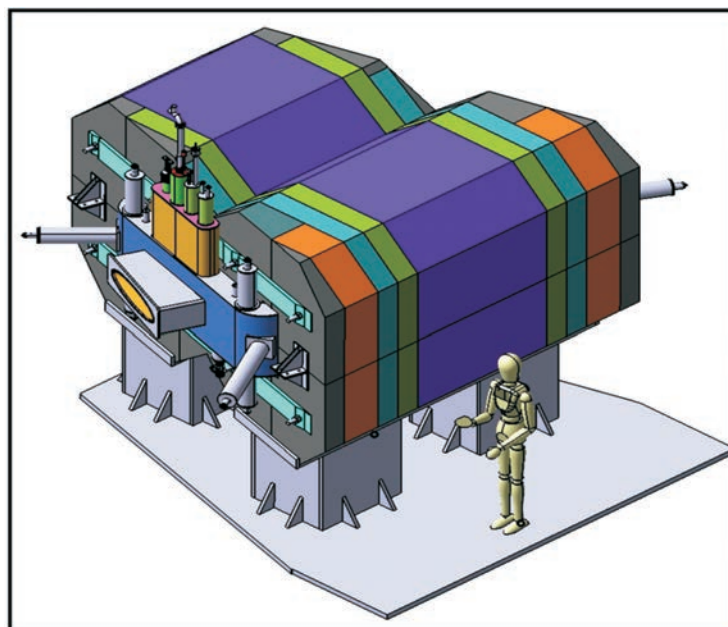


Fig. 2: Design of a Dipole Magnet for FAIR

National laboratories from the DAE system and various universities are deeply involved in designing components of some of the detectors that will be used to carry out important physics experiments after construction of this facility around 2020. Among them are advanced detectors using GEM (Gas Electron Multiplier) technology. Some prototypes of the same were built and tested at VECC.

***Setting up a macromolecular crystallography and high pressure physics beam line at the Elettra Synchrotron Facility, Trieste, Italy***

This is a multi-institutional international project supported by DST. Important achievements were reported from the project this year. The superconducting wiggler was reinstalled successfully in the ring, after necessary upgrade of the machine. Intensive tests in Novosibirsk and at Elettra were carried out which helped in its commissioning at full power (310 mA, 2.0 GeV). This being the heart of the facility, it is one of the most significant achievements of this project. Fig. 3 and 4 show the final appearance of the wiggler source and the common front-end of the two beamlines (located in the synchrotron ring area) during installation of the source.

Also, large area detector for the macromolecular crystallography beamline was received and tested using the beam of the existing XRD1 beamline during the year. Two scientists were offered to work on this project as beamline scientists.



Fig. 3: Wiggler Source of the two beamlines

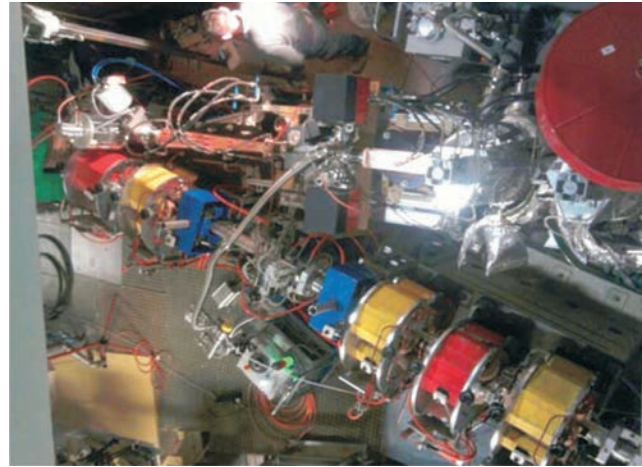


Fig. 4: Common front-end of the two beamlines

### ***Experiments at the Large Hadron Collider (LHC) at CERN, Geneva***

India is participating in the Compact Muon Solenoid (CMS) Experiment and A Large Ion Collider Experiment (ALICE) and has been actively participating in the management and development of the LHC Computing Grid which enables physicists from across the world to access and analyze data from the experiments at LHC.

After being proud partners in the discovery of the Higgs Boson last year, Indian scientists continued to make valuable contributions to the analysis of data coming out of the CMS experiment. Indian scientists are also involved in the upgrade of the CMS Detector. They also continued their active participation in ALICE and its upgrade. India maintains two Tier-2 Centres of the LHC Computing Grid, at Tata Institute of Fundamental Research (TIFR), Mumbai and at VECC, Kolkata. Large number of collaborative research publications came out of these projects besides training of good number of Indian research students at CERN. All these activities were jointly supported by DST and DAE.

### ***The India-based Neutrino Observatory (INO), Madurai***

Neutrinos are very weakly interacting elementary particles found in Nature and they hold promise to unravel some of the deepest mysteries of the Universe. Study of properties and interactions of these very weakly interacting particles requires that they be shielded from all other backgrounds as far as possible. Such neutrino observatories are mostly built deep underground or under mountain tops which provide the natural shielding. India had a good laboratory in the Kolar Gold Mines which had to be abandoned at the time of closure of the mines. India decided to build another neutrino observatory under a mountain top. It had to be shifted from a site near Ooty to another site near Madurai because of environmental considerations. Work towards construction of the cavern and other site facilities have started with funding from DAE. DST extended financial support to 13 university groups for INO-related R& D work. This project is also being jointly funded by DST and DAE.

### ***Indian Participation in Neutrino Experiments at Fermilab, USA***

The project by Indian physicists to collaborate in Neutrino Projects at Fermilab (USA) made good progress during the year. 12 Indian faculty members/scientists from 8 universities/institutions collaborated with Fermilab on different experiments like MIPP, MINOS/MINOS+, NOVA and LBNE. 10 Indian

Ph.D. students from different institutions in the country are doing their research work at Fermilab. A large number of research papers came out of this collaborative project. This collaboration is expected to grow further in the years to come.

### ***Thirty Metre Telescope (TMT) Project at Mauna Kea, Hawaii***

TMT will be one of the largest optical telescopes in the world based on segmented mirror technology. After carefully studying the feasibility, India decided to join this project. India is currently an 'Observer' on the Board. Indian Institute of Astrophysics, Bangalore signed the Master Agreement for this project as the Scientific Authority on behalf of India. The process of seeking financial sanction for the TMT project was initiated during the year. This will also be jointly funded by DST and DAE.

### **National Large Solar Telescope (NLST), Ladakh**

The process for seeking financial sanction for this project led by Indian Institute of Astrophysics, Bangalore advanced further during the year. There are some excellent sites for this telescope in the Ladakh area.

### **Square Kilometre Array (SKA) Project, South Africa and Australia**

SKA will be the largest radio telescope to be built in the world and it will be located in South Africa and Australia. Given India's standing in the area, the international community was very keen that India became a partner in the project. After careful evaluation, Indian scientists decided to join this project. It will be led by the National Centre for Radio Astrophysics (NCRA), TIFR, Pune and the Raman Research Institute, Bangalore. This project will also be jointly funded and managed by DST and DAE. Funding to NCRA started this year from the DAE and to RRI from the institutional funding provided by DST.

### **Others**

As most of these projects are very long-term projects, DST and DAE provided funds to the scientific community to participate in international discussions on the International Linear Collider (ILC) and to participate in the deliberations of the Asian and International Committee for Future Accelerators (ACFA and ICFA). Through DST, funding has also been provided to the Inter-University Accelerator Centre (IUAC), New Delhi for organizing periodic schools and workshops on accelerator science and technology.

## **STRENGTHENING SURVEY AND MAPPING CAPABILITY**

**Survey of India (SoI) and National Atlas and Thematic Mapping Organization (NATMO)** are two subordinate offices under the Department of Science & Technology. Both these offices provide scientific services to various Central Govt., State Govt. Ministries/Departments/offices.

### **Survey of India**

Survey of India is the national mapping agency, which has been assigned the special responsibility to ensure that the country's domain is explored and mapped suitably, provide base maps for expeditious and integrated development and ensure that all resources contribute with their full measure to the progress, prosperity and security of our country now and for generations to come. It is the repository of National Frame work data, Geodetic Control (Horizontal and Vertical) & Geodetic surveys, Topographical Control,



Surveys and Mapping. The Survey of India acts as adviser to the Government of India on all survey matters, viz Geodesy, Photogrammetry, Mapping & Map Reproduction. It provides base maps, geographic and geo-spatial information to user community. Survey of India is dealing with the National Map Policy, 2005 and is involved in the updation, digitisation and printing of topographical sheets of entire India in the scale of 1:50K and 1:25K in two formats, i.e. Open Series Maps (OSM) and Defence Series Maps (DSM). The Open Series Maps are brought out exclusively by SoI for supporting development activities in the country. The Defence Series Maps are classified/restricted maps, which mainly cater to defence and national security requirements. It is also undertaking many departmental projects like National Urban Information System (NUIS), Central Mines Planning and Designing Institute (CMPDI) Project, Integrated Coastal Zone Management (ICZM) Project, Mapping the Neighbourhood in Uttarakhand (MANU), certain activities under the National Geographical Information System (NGIS) Project, etc.

#### **Highlights of activities of the Scheme during 2013-14:**

- i) Creation of NGIS Version-I data from existing OSM DTDB on 1:50,000 scale.
- ii) Densification of first order precision Ground Control Points (GCPs) network in Phase-II, under GCPLibrary.
- iii) Modernisation and Expansion of Indian Tide Gauge Network along Indian Ocean and Islands.
- iv) Generation of Digital National Topographical Database on scale 1:25 K.
- v) Preparation of Defence Series Maps (DSM).
- iv) Execution of various Developmental projects of national importance.

#### **R&D manpower trained/generated (Ph Ds etc.)**

The Indian Institute of Surveying & Mapping (IIS&M), imparts training to the Officers and staff of Survey of India and other Government Organisation, private individuals and Scholars from other Afro-Asian countries. The Institute also conducts M.Tech (Geomatics) and M.Sc. (Geospatial Science) Academic two years Post Graduate Programme in collaboration with Jawaharlal Nehru Technological University, Hyderabad. 104 departmental officers, 470 extra-departmental and 300 others were trained during the year. Training for officials of 20 NAM countries was conducted at IIS&M, Hyderabad during November, 2013.

#### **Technologies developed and transferred**

##### **i) Creation of National Geospatial Information System (NGIS) Version-I:**

Survey of India has been entrusted with the work of preparation of GIS-enabled, country-wide seamless data from the existing 1:50000 scale Digital Topographical Data Base (DTDB) currently held sheet-wise to meet the immediate data/metadata requirements of NGIS version 1.0, which would operationalize a National GIS Asset from existing 1:50,000 foundation data sets owned by Survey of India.

**Achievements:** Topology cleaning of 1:50,000 scale data as per specification of NGIS for the State of Punjab & Chandigarh, Haryana, J&K, Delhi, HP, Meghalaya, Assam, Nagaland Bihar, UP,

West Bengal, Tripura, Manipur, Mizoram, Rajasthan and Kerala have been completed.

To establish technical procedure for establishing the Continuously Operated Reference Station (CORS) Network across India under this Pilot project “Establishment of Continuously Operated Reference Station Network” has been initiated by Survey of India in the State of Andhra Pradesh, Karnataka and Odisha through inviting Expressions of Interest ( EoI) of eligible OEMs.

(ii) **National Standardised Control Framework :**

Survey of India is the only government organisation, which provides Geodetic Control throughout the country and also provides data to the various governments and other national organisations including defence forces, according to their requirements.

Survey of India is establishing a GPS control network throughout the country under National GCP Library Phase-II for densification of first order network which will help State and other agencies engaged in generating geo-spatial information to carry out their job in a national geodetic reference system.

**Achievement:** Survey of India has completed the observation in 2<sup>nd</sup> Phase at 188 Ground Control Points (GCPs) for densification of first order network in the States of J&K, H.P. and North Eastern State during 2013-14 and total 2226. Processing of GPS data for GCP Library phase-II has been completed for most of the States and coordinates and description of the GCPs has been supplied to the State Government of West Bengal, Uttarakhand, Maharashtra, Madhya Pradesh, Tamil Nadu, Kerala, Bihar and Mizoram as per their requirement.



GPS Observation under GCP Library Project at Mann, Leh (J&K)

iii) **Digital Topographical Base on 1:25,000 Scale:**

Generation of Digital National Topographical Database (DNTB) on scale 1:25,000 by digitizing existing maps available in the hard copy form as Printed Maps, PT Section, Air Survey Section, Scribing Section, etc to fulfill the purpose of the National Map policy (NMP).

**Achievements:**

- Digitisation of 880 sheets on 1:25,000 scale during the year and 8780 sheets up to end of the year.
- QC of digital data for 2500 sheets.

iv) **Defence Series Maps (DSMs) on Scale 1:50,000:**

As per the New National Map Policy, 2005 Survey of India has been mandated to prepare Defence Series Maps (DSMs) on Everest / WGS-84 Datum and Polyconic / UTM projection with heights, contours and full content on 1:50,000 scale. The Defence Series Maps (DSMs) will mainly cater for defence and national security requirements. Defence series maps (in analogue or digital forms) for the entire country will be classified and the guidelines regarding their use will be formulated by the Ministry of Defence.

**Achievements:**

Survey of India has completed updation of DTDB of 4792 Sheets on 1:50K by using field updated data and by using latest satellite imagery where field work is not possible. DSMs of 4787 sheets have been completed.

v) **Modernisation and Expansion of Indian Tide Gauge Network along Indian Ocean and Islands for Disaster Management:**

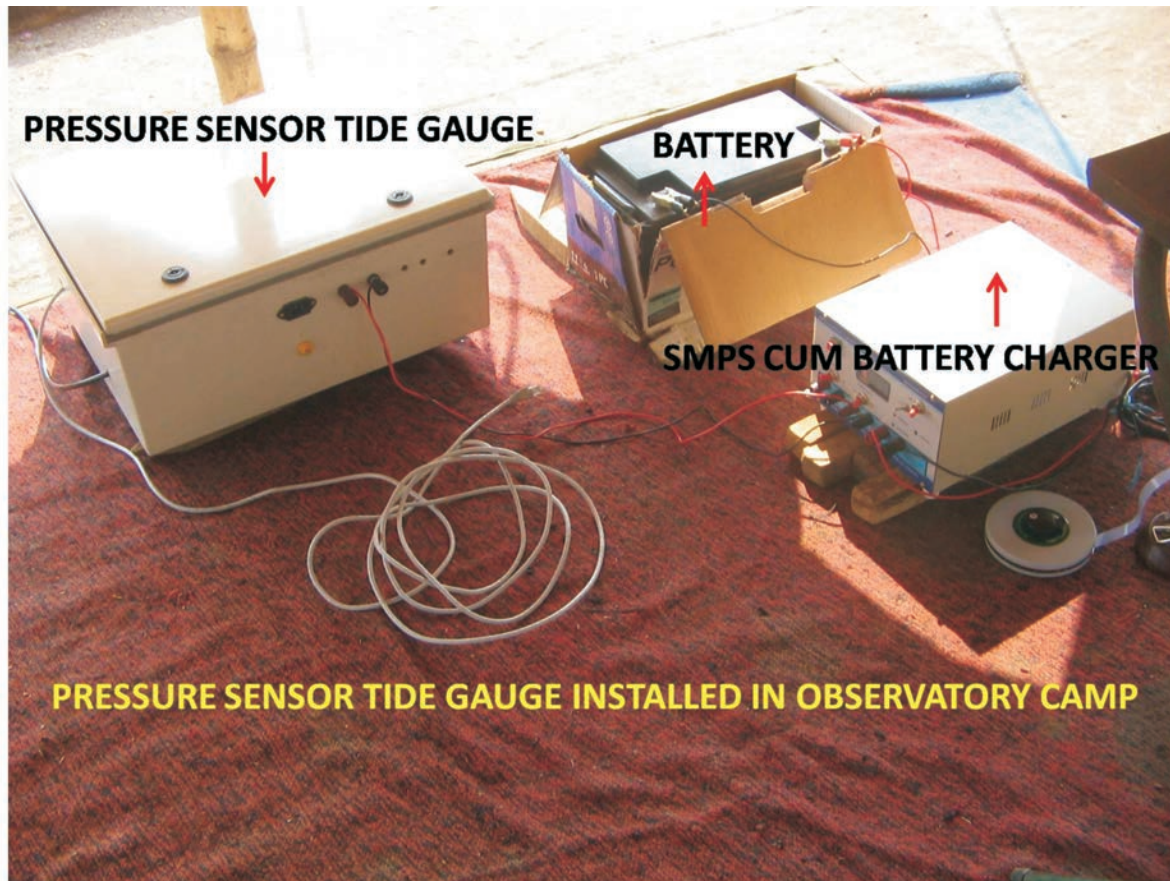
Survey of India is continuing the work of “Modernisation and expansion of Indian Tide Gauge network with special reference to storm Surge Modeling and Tsunami Warning System”. 30 Observatories out of 36 planned have been made functional and equipped with real time data transmission facilities.

**Achievements:** Survey of India constructed tidal observatories at Kanyakumari and Rameshwaram during the year. Pressures Sensor Tide Gauges and conventional Tide Gauges along with VSAT have been installed in both the observatories.

vi) **Checking of verticality of Qutab Minar:**

In 1964, a Committee of Experts submitted recommendations for structural stability of the monument of Qutab Minar after observing some cracks

The Director General of Archaeology in India requested Survey of India for checking the verticality of Qutab Minar which was subsequently repeated at different intervals and reports were submitted. Survey of India was also entrusted the responsibility for conducting the study of verticality of Taj Mahal and minarets of historical monuments. Archaeological Survey of India requested Survey of India for checking the verticality of Qutub Minar during 2013-14.



**Achievements:** Survey of India carried out the angular observations and high precision levelling to assess the horizontal and vertical movements. To assess the horizontal movements, angular observations were carried out by tangential method. For ascertaining vertical movements, vertical control was provided by high precision levelling line run from stable bench mark.

iv) **Mapping and Delineation of Hazard Line:**

Survey of India was entrusted the work of generation of 0.5 meter elevation contour map on 1:10,000 scale as base map to delineate the hazard line for the entire mainland coast of India up to the maximum width of 7 km from shore line on the landward side under the “Integrated Coastal Zone Management” (ICZM) Project.

**Achievement :**

1. Primary and secondary control consisting of GPS and levelling work of the entire coastal area has been completed.
2. QA/QC of Aerial photography of the project area has been completed and in some sub-blocks fresh aerial photography is required.
3. Survey of India carried out 32 days’ tidal observations for densification of secondary ports which was required for delineations of hazard line as per the recommendation of the World Bank.

4. Pilot Project in three sub-blocks to test the methodology for delineations of hazard line has been completed.

viii) **Coal Mine Project**

Survey of India has taken up the work to generate Updated Topographical Maps of major Indian coal fields on 1:5,000 scale with 2 meter contour interval in Plains (in case of hilly terrain contour interval may be 3-5 meter as practical) in GIS digital format based on Digital Photogrammetric Techniques using high resolution aerial photographs and adequate ground verification.

**Achievement:** Primary GPS and Levelling Control survey (construction of 252 pillars, 12 hours GPS observation on 267 Points, 2 hours observation on 1225 and 6170 Linear Km. DT levelling) has been completed.

2D feature extraction of 518 sheets and 3D feature extraction of 100 sheets and Photo/field verification of 1274 Sq. Km./ 683 Sheets have been completed during the year.

**Study reports produced/generated and their brief findings:**

- i) Indian and Hugli River Tide Tables are printed a year in advance and made available to National/ International users to facilitate their navigational activities. Publication of Indian Tide Table - 2014 and Hugli River Tide Table-2014 has been completed by Survey of India.

- ii) **32<sup>nd</sup> & 33<sup>rd</sup> Antarctica Expedition**

Survey of India started participation in Indian Antarctica Research Programme from 10<sup>th</sup> Expedition, since then a network of Ground Control Points and large scale mapping has been carried out during all Expeditions.

**Achievement:** Survey of India team participated in the 32<sup>nd</sup> Expedition and detail survey on 1:10,000 scale with contour interval 5 metres in Schimacher Oasis for an area of 7.01 sq.km. and detail survey on scale 1:2500 with contour interval of 1 metre for an area of 1.39 sq.km. for new station at Schimacher Oasis. Final report along with map on 1:2,500 scale has been submitted to NCAOR, Goa. Survey team from Survey of India moved during November, 2013 to participation in the 33<sup>rd</sup> Expedition.

**National Atlas and Thematic Mapping Organisation (NATMO)**

The main objective of NATMO is to educate people of India about the scenario of physiographic, hydrologic, climatic, administrative, political, social, agricultural, industrial, cultural & economic scenario and changes happening in the country – with the help of maps/atlas on different themes. The organization motivates the planners and decision makers to use maps as complimentary documents for development planning at national level, State/UT level and district and sub-district levels. District Planning Maps are being prepared to meet the planners' demand. NATMO is also a pioneer in urban mapping. Using high resolution satellite data rectified by GPS recordings, large scale city maps are being prepared with detailed information collected from field survey. To promote tourism industry, tourist atlases, maps, trekking route maps, maps showing the detailed information on national parks and wild life sanctuaries are being prepared and updated. NATMO is an expert in collaborative projects. Hydrological Atlases of Odisha and West

Bengal with Central Ground Water Board, Environmental Atlas of India and Sensitive Zone maps with Central Pollution Control Board are some of the examples that had been appreciated by scientists and scholars all over India.

The main functions/programmes of the organization during the year are described below:-:

### **Golden Map Service**

Accumulating the cartographic base, generated in pieces over the years under several projects, and with the help of the remote sensing data, now available under the Indian Remote Sensing Satellites (IRS) series, particularly the panchromatic data of IRS 1C, 1D and P5 along with the recently launched Cartosat-1 & 2, (the resolution has come to 5.8 and 2.5 metres and 1 metre), NATMO has taken up this project of Golden Map Service with the objective to provide location maps of any site of the country in Black and white on web either by place-names or by geographical co-ordinates; provide route maps between two points in the country; provide a basis for a variety of social, economic, administrative operations related to elections, crime, rural marketing, relief and supply, etc.

### **Achievement:**

NATMO has almost completed site selection for GCP for adjustment of GPS data covering whole of the country. State/Region-wise field survey has been going on in the final stage. GMS Kolkata, GMS-Varanasi, GMS-Udaipur, GMS- Panipat, GMS- Pushkar, GMS-Amethi have been published during the year. Conversion and patterning of the digital format is going on.



GIS Lab in NATMO

## District Planning Map Series (DPMS)

To provide a ready-reckoner to the planners, researchers, students in respect of complete geographical, geological, geomorphological, demographic, cultural information and features along with administrative boundary, blocks, speciality, etc. of a particular district both in paper format and in digitized format both in Hindi and English.



Digital Cartography in NATMO

### Achievement:

NATMO has almost completed the project and maps of 260 districts have been published for the users. Digital version of the maps are also going on in the final stage and will be published for the users very soon. However, revision and updation work on account of formation of new districts, are in progress along with the rest project.

### National Atlas of India

#### Objective:

- i) To have India's National Atlas like the other countries of the world.
- ii) To depict the country in respect of its geology, geography, geomorphology, demography, culture, administration, etc. in thematic map form.

### **Achievement:**

National Atlas of India, both in English and in Hindi version, has been appreciated by the users of every corner. It is for the vertical demand of the users, NATMO is still publishing the editions of the Atlas till today and regular updation and revision of the same is going on.

### **Large Scale Mapping**

In this cyber age, availability and accessibility of accurate and reliable information (both micro and macro level) with geospatial solutions, plays a pivotal role in planning and implementation of national policies in respect of natural resources and management. Effective use of geospatial information and technology has become the platform of solution for different environmental and developmental challenges. But due to absence of high-resolution map data in appropriate forms, many planning and development programme are lagging behind in our country. NATMO has taken initiative for preparation of large-scale maps (1:10,000 scale) on various themes to facilitate micro-level planning like irrigation, agriculture etc. using its own database and technical methodology.

### **Training and Development**

NATMO also provides training on Thematic Cartography, Digital Cartography, Photogrammetry, Remote Sensing and GIS, Aerial Photography, Colour Cartography to the officers and staff of various govt. and private departments, university and college teachers, scholars and students of the country. Training courses of NATMO are held in high esteem by scientific departments and organizations all over the country as well as abroad.



Trainees are getting practical knowledge of GPS in DMGIS training course



### **Number of people getting benefited from the projects/schemes:**

Millions of students all over the country, research scholars, teachers, professors are using NATMO maps and atlases. Recently NCERT has expressed interest towards school atlases and atlas for visually handicapped. These will soon be recommended by NCERT in school curriculum.

Hundreds of scholars, technocrats, teachers, engineers take training in digital cartography, remote sensing, GIS, GPs technology application from NATMO.

### **Infrastructure Development**

During the year, NATMO has almost completed the construction of **Rashtriya Atlas Bhavan** to get a wholly dedicated place for its research activities which will house a complete Digital Laboratory and Printing & Camera Unit.



Rashtriya Atlas Bhavan

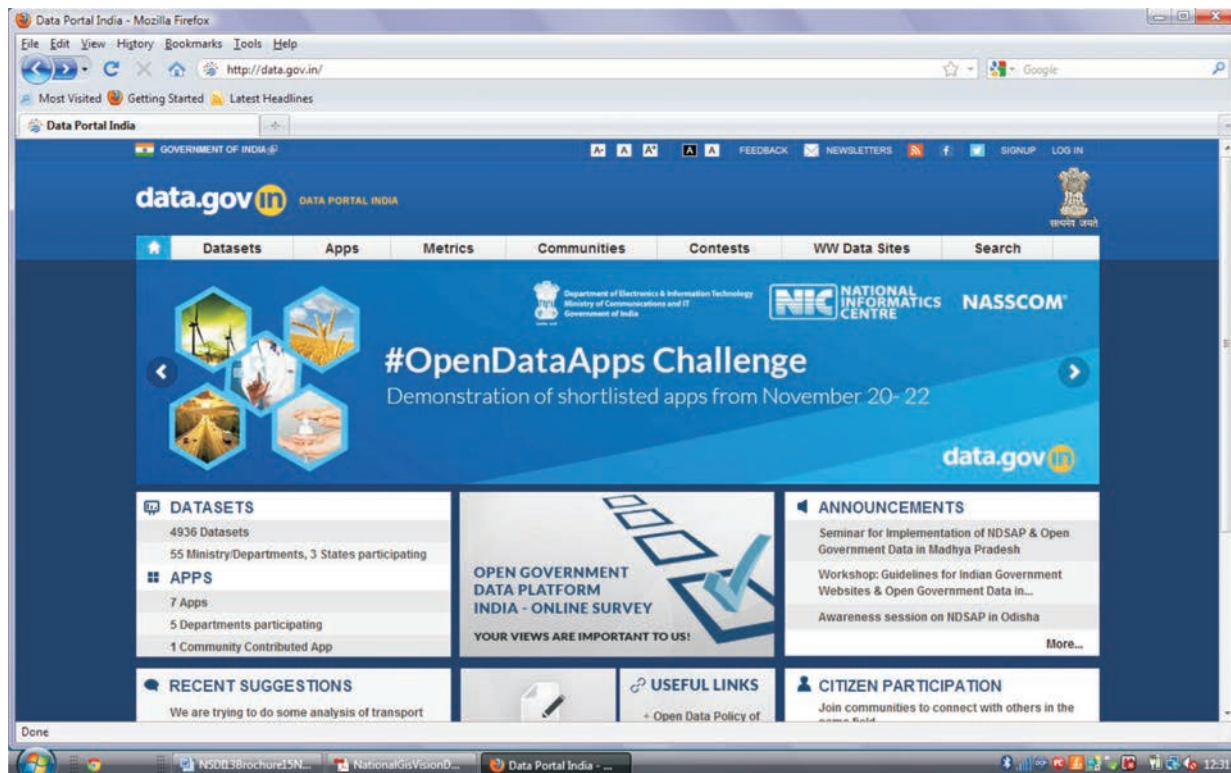
## **BUILDING GEOINFORMATION CAPACITY**

**Natural Resources Data Management System (NRDMS)** Programme aims at promoting R&D in emerging areas of Geospatial technologies and applications for providing relevant inputs to solve area specific problems. Launched in 1983-84, has undergone various stages due to the change of technologies and the resolution as well as accuracy of data acquisition techniques over the last more than two decades. Initially the NRDMS programme focused on developing district data bases on natural and allied sectors and provided solutions to deal area specific issues in the context of micro level planning based on 73<sup>rd</sup> & 74<sup>th</sup> Constitutional amendments. Now, NRDMS has developed capability for handling resource management at State, District and Panchayat level. The data matrix required for implementing various developmental schemes at different level have also been developed. Efforts have been made to develop capability and

capacity to absorb geospatial technologies with the aim to apply the same to provide solutions to deal with the specific issues. In this endeavor interactions with the state and district authorities have been built up. Some of the issues which need more R&D support to deal the problems, application projects under land and water system analysis, infrastructure development and other related areas were supported. In addition, efforts are also made to develop capability for landslide hazard mitigation and urban flood monitoring. In this process, concerted efforts have also been made to develop tools and technologies to handle such problems. New areas are also being identified like geothermal energy, mapping of hotspots in Uttarakhand and health GIS etc. Specific training programmes for the faculty of the Universities and Engineering Colleges on the application of geospatial technologies in resource management is the regular feature annually.

**National Spatial Data Infrastructure (NSDI)** has been a major initiative for enabling nodal agencies towards setting up mechanisms for provision of standardized spatial data sets to user agencies. During the current year, NSDI is being re-oriented to implement the National Geographical Information System (NGIS) for providing processed information. Several activities have been completed towards achieving the above goals during the year 2013-14. As part of the NSDI the national geo-portal is operational to showcase the data which can be shared with the stakeholders for further use.

**National Data Sharing and Accessibility Policy (NDSAP)** – notified in March, 2012 is being implemented jointly by DST (NRDMS) and DeitY (NIC). As part of this, a national open data sharing portal i.e. data.gov.in is developed to proactively share the government shareable data to the general public. At present more than 6000 data sets contributed by 82 Central Govt. departments/ Ministries have been uploaded on the portal for sharing to the general public. Efforts are also being made to enroll all the State Governments to adopt the NDSAP and come out their on open data sharable policy. The home page of the open data portal is given as under :



(Homepage of data.gov.in Portal)

## **Spatial Data Re-engineering and GIS Data Assets**

Setting up of a web-accessible spatial data node in each Data Providing Agency is a pre-requisite to an operational NSDI. Data nodes have been established in agencies like SOI, GSI, and FSI and existing nodes (e.g. NRSC's BHUVAN) harmonised for improving access to spatial data and satellite images from the single window gateway of India Geo Portal set up in NSDI. Preparation of GIS data assets from the existing digital cartographic data, development and maintenance of geo-relational database, compilation and sharing of metadata, and provision of catalogue, feature and map services are core activities at each Data Node. A Standard Operating Procedure (SoP) is now available for re-engineering of Survey of India digital topographic data to GIS-ready format.

## **State Spatial Data Infrastructure (State SDIs)**

A Detailed Project Report has been prepared for setting up State SDIs in various States during the XII Plan on a competitive grant basis. State Geo Portal prototypes are being set up in West Bengal, Haryana, Jammu & Kashmir, and Uttarakhand. The Karnataka State Geo Portal is being re-oriented with additional capabilities to develop applications and products to support decision-making in two selected Line Departments of Watershed Management and Health.

## **Sensor Networks and Web Enablement (SNWE)**

This programme aims at developing technology platforms for Health and Security based on state-of-the-art multidisciplinary technologies. SNWE has immense potential for application in sectors like infrastructure development, disaster management, climate change, emissions, environmental observations and agriculture.

## **Indian Digital Heritage (IDH)**

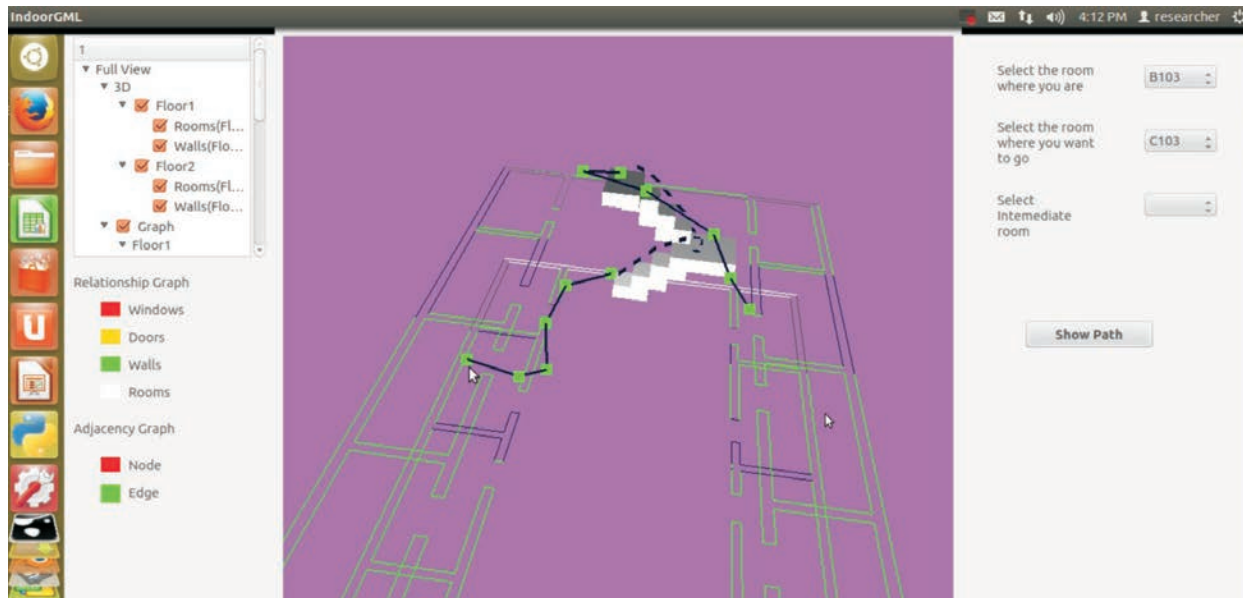
IDH project aims at synergizing Geospatial Technologies with Information & Communication Technologies for development of tools useful in preserving, using, and experiencing India's vast heritage in a digital form. A multi-institutional initiative has thus been launched with the involvement of different communities - the technology community consisting of scientists and engineers who can invent, innovate and develop appropriate technologies, the culture community consists of artists, art-historians, archaeologists, architects, anthropologists and other experts from the humanities and the social sciences who know and understand the heritage, and Government Agencies who as custodians of India's vast heritage can bring the necessary executive power to enable the collaboration, and private agencies, companies and other organizations who may be interested in this for a variety of reasons including tourism.

## **Hyper Spectral Remote Sensing (HSRS)**

In India, Hyper spectral signature studies and database systems are currently inadequate and need to be developed further. Thus, from sensor to desktop, NRDMS positioned an R&D scheme on HSRS aiming at the latest technologies and developments in acquisition and applications in remote sensing, GIS and GPS with minimal human interventions. Data users and value-added providers will thus have the opportunity to share their experiences using these advanced and exciting new technologies to optimize projects, analyze and solve problems, and explore new applications and technology improvements. .

## Indoor Information Representation and Management System

Spatial data concerning indoor space of buildings are often useful in indoor navigation, emergency response, asset management, facilities management, tracking and localization. On-line sharing and querying of spatial information over the web or mobile devices are increasingly gaining importance in these applications. A prototype of the Indoor Information Representation and Management System has been developed for testing and demonstrating techniques for indoor data modeling and management.



(Display of the result of the Navigation Query)

## GeoSMS

Sharing health information with locational attribute is an important requirement for the beneficiaries of Health related schemes and programmes. An application using the emerging GeoSMS standard specification from OGC has been developed for sharing of geospatial information from a patient to a doctor/dispensary. The application is required to be downloaded and installed from a central server of the NSDI/ State SDI in a mobile phone for collecting information about the patient and sending the SMS.

## Advanced Lab on Geo-Information Science & Engineering (GISE)

The Advanced Lab on Geo-Information Science and Engineering (GISE) has been set up at the Department of Computer Science and Engineering (CSE) of Indian Institute of Technology Bombay to provide technical back up to the NSDI activities. The Lab has been pursuing R&D in the frontier areas of GISE, conducts pilots and demonstrates proof-of-concept for capacity building and training of officials and scientists.

## Map the Neighborhood in Uttarakhand (MANU)

Due to the heavy rains received during 15-17<sup>th</sup> June, 2013 in Kedarnath Valley in Uttarakhand, heavy damages were caused to infrastructures like roads, buildings, water pipelines, houses and communication network etc. In order to develop a concrete scientific action plan for reconstruction and

relocation of infrastructure facilities in Uttarakhand, a multi-institutional initiative “Map the Neighborhood in Uttarakhand (MANU)” has been launched with the participation of the following institutions:

- 1) Survey of India, Dehradun
- 2) HNB Garhwal University, Srinagar
- 3) Kumaun University, Nainital
- 4) University of Kashmir, Srinagar
- 5) Wadia Institute of Himalayan Geology(WIHG), Dehradun
- 6) Delhi University, Delhi
- 7) Indian Institute of Remote Sensing (IIRS), Dehradun.

Focus of the Initiative has been on compiling the information on damage of the objects through intensive field survey with the involvement of local academic institutions. More than 200 students have been engaged from different participating universities and provided with suitable equipment to collect the field data of the damaged objects. Data sets captured in the Initiative has been uploaded with the photographs from the fields directly to the Bhuvan Portal maintained by National Remote Sensing Centre. The data sets will be analyzed to draw up local level action plan for relocation and reconstruction of the infrastructure facilities in the affected areas.

### **Landslide Hazard Mitigation**

As part of the integrated landslide programme, efforts are being made to develop forewarning system to monitor the critical landslides in different geo-environmental areas. At present instrument monitoring is being carried out in 3 locations i.e. Himachal near Naphtha Jhakri Project, Linga landslide in Ooty and Munnar slide in Kerala. Efforts are being made to develop a correlation between threshold of the rainfall intensity and landslide occurrence. Once it is established, it would be easier to simulate the landslide hazard and risk assessment nearly accuracy and the products would be of the great help for maintaining the problematic roads section along with the major infrastructure in the country. To prove the models and the technologies for providing base information data to handle the landslides, more than 40 R&D projects are operational addressing various underlying causes and their remedial measures related to landslide mitigation.

### **National Geotechnical Facility**

The National Geotechnical Facility has been set up in Poonch House, Dehradun. Wadia Institute of Himalayan Geology, Dehradun is coordinating the activities. As part of this, state of the art facility on rock and soil mechanics testing facilities have been set up. This facility is providing enough scope to meet the requirement from academic as well as stakeholders to analyse the soil and rock samples for their strength parameters. This is important to draw a comprehensive action plan for implementation of major developmental projects.

### **Urban Flood Risk Mapping of Chennai City**

Using ALTM technique, about 500sq km area of Chennai City has been taken up for flood risk mapping. The study has been focused on the following:

1. Selection of flood mitigation techniques to manage flood risk in the study area using Orthomaps, DEM and thematic layers in GIS
2. Site specific mitigation strategies for the 36 flood prone hotspots in Chennai Corporation limits and Ambattur Industrial Estate
3. Implementing intensive Artificial Recharge and Rain Water harvesting in the CMA and Chennai Corporation area.
4. Post project activities and follow up project for Chennai Corporation using ALTM data and automatic weather stations (development of DSS and EWS for a pilot area) to make the best use of the resolution database
5. A real time monitoring of meteorological parameters is being developed to forecast the inundated areas in the event of abnormal rainfall in short span of time
6. Total area has been divided into 22 micro-watersheds and all the micro watersheds have been adequately instrumented to collect field data for undertaking modeling for forecasting the flood pattern.

### **Capacity Building, Dissemination and Training on Geospatial Technologies**

Under NRDMS programme, concerted efforts are being made to provide support for conducting short term and long term training programmes on geospatial technologies and applications. During last year, three short term and 26 long term (21 days) training programmes were supported to various universities and institutions. The training programme was meant for faculties and research scholars. In addition to this, a portal on GIS/ Remote Sensing Tutorial has been developed by Bhartiya Vidhyapeeth, Pune to help the resource persons. To strengthen this concept, 5 geospatial chair professors were also created in different universities in the country to strengthen the education and training on geospatial technologies to larger community.

## **PROMOTING GOOD LABORATORY PRACTICES**

**National Good Laboratory Practice (GLP) Compliance Monitoring Authority (NGCMA)**, set up in August, 2002, is involved in certification of the test facilities, which are engaged in conducting safety studies on chemicals in accordance with Organization for Economic Co-operation and Development (OECD) Principles of GLP. GLP is a quality system under which **non-clinical safety studies** are conducted on various **chemicals** for their submission to regulatory authorities e.g. Drugs Controller General of India, which assures that test facilities can be relied upon in assessing of hazards or risks to man, animals and/or the environment. India is fully adherent to OECD Council Acts related to Mutual Acceptance of Data (MAD) w.e.f March 3, 2011. As a result, the data generated by the GLP certified Test facilities in India are acceptable in the 34 member-countries of the OECD and other nations.

Some of the major achievements of the Indian GLP programme during the year are mentioned below:

Three new test facilities, listed below, were granted the GLP-compliance status:

- a) Indofil Industries Limited, Thane.
- b) Venus Medicine Research Centre, Baddi.

c) Piramal Enterprises Pvt. Ltd., Mumbai

Ten test facilities, mentioned below, were re-certified with validity for the next 3 years:

a) Laboratory Animal Research Services, Reliance Life Science Pvt Ltd., Navi Mumbai

b) Intox Pvt. Ltd., Pune

c) Indian Institute of Toxicology, Pune

d) Gharda Chemicals Limited, Dombivli

e) Jai Research Foundation, Vapi

f) Aurigene Discovery Ltd., Hyderabad

g) Torrent Research Centre, Ahmedabad, Gujarat

h) Syngene International Limited, Bangalore

i) GLP Test Facility, Ranbaxy Research Laboratories, Gurgaon

j) RCC Laboratories Pvt. Ltd., Hyderabad

In order to ensure that the Test Facilities certified under GLP are conforming to the OECD principles of GLP, surveillance inspection is carried out every year or in the middle of the certification period. Surveillance inspection was carried out in case of 8 test facilities and they were found to be in conformity with norms prescribed for GLP thus extending their certification.

Training and capacity building are important measures to update Test facilities, GLP Inspectors, etc. The following training programmes were organized for this purpose:

a) Training Course for Quality Assurance Professionals of GLP Test Facilities

b) Sensitization Workshop on GLP.

c) Training Course for Study Directors of GLP Test Facilities

Three Indian GLP Inspectors attended the 11<sup>th</sup> Training Course for GLP Inspectors held in Chiba, Japan. NGCMA, India has been selected to organize the 12<sup>th</sup> OECD Training Course for GLP inspectors, to be held during October 2015.

In order to expand the GLP network, NGCMA has entered into a Memorandum of Understanding with Quality Council of India, facilitating conduct of training courses, organize regular surveillance/inspection visits and also take up other professional activities, jointly with NGCMA.

## TECHNOLOGY CAPACITY STRENGTHENING

### TECHNOLOGY DEVELOPMENT

#### SOLAR ENERGY RESEARCH INITIATIVE

Solar Energy Research Initiative (SERI) targets to drive down the costs of delivered solar energy, through technology innovations and build research capacity to create critical mass of researchers in the area of Solar Energy. Research initiatives on solar energy were primarily demand driven and had strong built in component of pro-active effort for R&D theme identification to address current and emerging challenges. The initiatives were designed to direct R&D effort for addressing the challenge and also offer enough scope to support new ideas to nurture and promote oriented fundamental research to catalyse research led innovations. Intra and inter institutional collaborative R&D programmes, synergising strengths of various groups, were leveraged through setting up of centres equipped with state-of-art facilities.

In addition to development of Solar-Biomass hybrid desalination systems, for potable and industrial water and off-grid hybrid solar power system, to validate its viability to meet rural energy needs, 16 projects for development of materials, devices, coatings, storage options, grid connectivity etc., for solar based system were supported. The flagship projects under the initiative included setting up of solar photovoltaic hub at Bengal Engineering and Science University, Howrah and IIT Madras-Chennai, development of large area high efficiency silicon solar cells by BHEL-IIT Delhi and development of superior thin films for solar cell application. Capacity building for solar energy research was recognized as important building blocks of the initiative. Shaping up and operationalising Bhaskara Advanced Solar Energy (BASE) Fellowship for capacity building and the development of critical mass of researchers in the area of solar energy was another important initiative.

A novel collaborative approach, following principles of equity and reciprocity, culminated in setting up Indo-US Joint Clean Energy Research and Development Centre (JCERDC), in a public-private-partnership mode, with matching contribution from large industry-institute research consortia. Solar Energy Research Institute for India and US (SERIUS) and Centre for Building Energy Efficiency Research and Development (CBERD), set up under JCERDC, started yielding results in development of new processes, technology, besides publication of nearly 40 papers in high impact journals.

Realizing the need to develop strong research groups in the area of Solar Energy, Building Energy Efficiency (BEE), Smart Energy Grids and Energy Storage (SEGES) research partnerships forged by runners up projects crossing threshold for various collaborative programmes were encouraged as national initiative. Collaborative programmes were also developed in the area of solar energy and smart grids with UK, US and European Union.

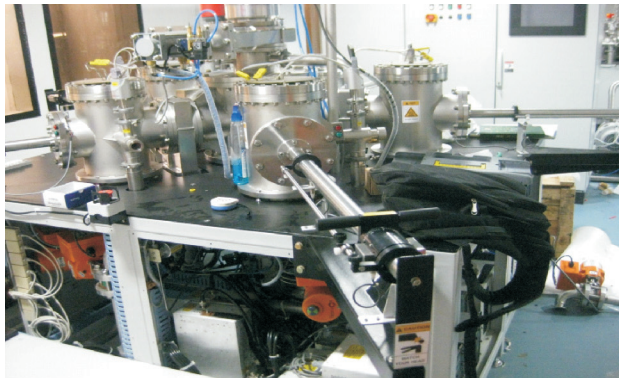
The salient achievements of current year are as below:



- 1. Pre-Competitive Research & Development:** Innovative pro-active endeavour to synergize industrial capabilities with academic expertise resulted in development of pre-commercial systems for furthering industrial scale R&D for solar energy .:

### 1.1 Solar Photovoltaic Hub at *Bengal Engineering and Science University(BESU), Howrah*

The hub is equipped with pre-commercial base line fabrication facilities for both crystalline and amorphous silicon solar cells. A network of 5 academic institutions and 3 industrial organizations have been developed to further R&D activities for enhancement of efficiency of crystalline silicon and amorphous solar cells from their baseline values through metal plasmonics and other nanostructures. Relative efficiency improvement of about 7% has been achieved through application of silica nanoparticles on front glass of superstrate type amorphous silicon solar cells. 7 Journal publication and 12 conference publication have resulted from the work carried out at hub.



PECVD System(BESU)



Screen printer and curing furnace for special paste (BHEL)

### 1.2 Large Area, High Efficiency (19%) Passivated Interface Hetero Junction (PIHJ) Solar Cells (*Bharat Heavy Electricals Limited, Amorphous Silicon Solar Cell Plant, Gurgaon & IIT Delhi*)

The n-type wafers were optimized with focus on low thermal budget. Amorphous silicon film processing and characterization of dark and photoconductivity band gap and activation energy studies have been carried out to evaluate critical parameters. The wet chemical bench having high frequency ultrasonic cleaning, high resistivity DM Water with precise control of temperature and automatic operation with spin drying facility, Screen Printer and Curing Furnace have been setup.

### 1.3 Large Area, High Efficiency (>18%) Silicon Solar Cells Using Selective Emitter Technology (*BHEL-Amorphous Silicon Solar Cell Plant, Gurgaon & IIT Delhi*)

Under this project, various diffusion process parameters have been optimized leading to improved efficiency of screen printed solar cells. Thickness of solar cell front contact finger was optimized and methodologies to avoid nonlinear misalignment across the wafer between printed metal and laser doped pattern have been developed. Optimization of contact firing process for selective emitter with etch back approach for high throughputs has been done.



*Dryer cum firing furnace*

**1.4 Development of textured ZnO thin films for solar cells front contact applications using sputtering technique and the demonstration of its performance in silicon thin film solar cells (Hind High Vacuum co. Pvt. Ltd. R&D Unit, Bangalore)**

Conceptualization and design of the sputtering system has been completed, with all the necessary parameters worked out. The transport mechanism compatible with the high deposition temperatures and the frameless glass holding has been successfully done. The notable features of the system includes multi-chamber vertical in-line system and large size of the substrate on which the TCO deposition and texturisation is being attempted.



*Assembly of Sputtering System for large area substrate*

## 2. Capacity Building for Research in the Area of Solar Energy

Bhaskara Advance Solar Energy (BASE) Fellowship Programme has been launched to support capacity building activities in the area of Solar Energy, provide an opportunity to research scholars and young scientists to gain exposure and access to world class research facilities in leading U.S. institutions, encourage and motivate outstanding students to take up research as a career path, and pave the way for interaction between India and USA thus helping to build long-term R&D collaborations. 9 fellows and 12 interns have been supported under the programme during the year in the areas of photo-voltaics, thermal, materials, system development and integration.

## 3. Joint Clean Energy Research and Development Centre

Under Indo-US Joint Clean Energy R&D Centre, Solar Energy Research Institute for India and the United States (SERIUS), co-led by the Indian Institute of Science (IISc), Bangalore and the National Renewable Energy Laboratory (NREL), Golden, was initiated in January 2013, for the Sustainable PV, Multi-scale Concentrated Solar Power, and Solar energy integration Research. About 160 scientists and engineers from India and the U.S are working on following areas:

- PV based on Earth-abundant, available materials with performance potential comparable to or exceeding existing thin-film systems.
- Novel process and processing technologies that can produce cells and modules with low production and capital cost, low thermal budget, and environmental sustainability, e.g. non-vacuum deposition processes.
- High temperature, closed-cycle CO<sub>2</sub>-Brayton cycles for distributed applications (100-kW to 1-MW size)
- Low-temperature Organic Rankine Cycle (ORC) for distributed applications (25 kW to 1-MW size)
- Thermal storage and hybridization, to develop hybridized storage systems for the diverse temperature ranges of the Brayton and Rankine converter
- Technology road mapping, analysis, and assessments
- Solar-energy integration and storage analysis

The vision of Centre for Building Energy Research and Development (CBERD) is to build a foundation of collaborative knowledge, technologies, human capabilities, and relationship that position the U.S. and India for a future of high-performance buildings, with accelerated, measurable and significant energy use reduction. The research group is pursuing the following areas:

- Building Energy Simulation and Modelling, Bench Marking and Controls and Communication.
- Building Envelop-Wall insulation systems and High performance Window systems.
- Cool Roofs,

- Post occupancy Evaluation and Thermal Comfort Studies, Advanced HVAC Systems and Lighting technology workshop.
- Renewable Energy Integration and Grid responsive buildings

#### **4. Solar Energy Enabling R&D and Solar Oriented Fundamental Research**

##### **4.1 Process Development of CIGS thin film solar cell on flexible substrate using co-evaporation technique** (*KIIT university, Bhubaneswar*)

CIGS absorber layer deposited using co-evaporation technique by controlling different process parameters. Intrinsic ZnO and doped ZnO film were deposited using RF and DC sputtering and film properties are optimized for device fabrication.

##### **4.2 Development of CdS/CdTe thin Films solar cells by electrochemical technique using indigenously produced starting materials** (*BESU, Howrah & C-MET Hyderabad*)

The optimized Molybdenum (Mo) thin film for low resistivity ( $3 \times 10^{-5} \Omega\text{-cm}$ ) with better adhesion is achieved using magnetron sputtering process. The Vacuum Chamber for Co-Sputtering has been designed.

##### **4.3 Development of amorphous silicon solar cells with embedded silicon quantum dots for enhancement of efficiency** (*IACS, Kolkata*)

The p-i-n structure solar cells were fabricated with the silicon quantum dot super lattice layer (Si-QDSL) as the intrinsic (i) layer. The reported super lattice solar cell performance was  $V_{oc} = 0.744\text{V}$ ,  $I_{sc} = 6.57 \text{ mA/cm}^2$  and Efficiency = 1.68 %, which are also the highest values reported so far in the literature for the silicon based super lattice solar cells.

##### **4.4 Assessment of Silicon Wire Array Radial Junction Solar Cells by simulations and Experiments** (*IIT Bombay*)

Fabrication of nanowires, using reactive ion etching, has been carried out in producing solar cells and radial junctions were formed by conformal deposition of doped poly-Si and contacts.

##### **4.5 Plasmonics for improved photovoltaic devices: Realization and Characterization of Solar Cells** (*Jadavpur University, Kolkata*)

Introduction of plasmonic layer in p-Si/undoped CdS/indium doped CdS (p-Si/CdS/In:CdS) solar cell indicated an enhancement of short circuit current which improved the overall efficiency. The introduction of n-Ag layer increased the  $V_{oc}$  decay time significantly.

##### **4.6 Incorporation of Plasmonics Structures to Improve Organic Photovoltaics** (*Indian Institute of Science Education and Research, Thiruvananthapuram*)

Power conversion efficiency of about 7% was achieved for the solution processed ITO/PEDOT:PSS/PTB7:PCBM/AI solar cells fabricated in air.

**4.7 Enhancement of Functional Property of N3-based Dye Sensitized Solar Cell by use of Conducting Polymers and Surface Plasmon Resonance of Metal Nano-particles** (*Bengal Engineering and Science University, Howrah*)

Dye Sensitized Solar Cell (DSSC), sensitized using N3 dye, resulted in substantial increase in cell efficiency

**4.8 DSSC modules with improved reliability through development of Titania pastes with reproducible characteristics, metallization and sealing methodologies** (*IIT Bombay*)

Successful improvements in particle de-agglomeration through chemical and mechanical means led to faster diffusion of electron through the film and thus, DSSCs made from these films exhibited highest Jsc (7.2 mA/cm<sup>2</sup>). Efficient sealing of DSSCs has been achieved.

**4.9 Lock-in-Thermography for Solar Cell and Module Characterization** (*IIT Kanpur*)

The hardware setup for both dark and illuminated lock-in-thermography and software for analysis of the lock-in thermal images has been developed. The technique is implemented for both multi-crystalline and organic solar cell.

**4.10 Development of Multilayer Coatings for Enhanced Solar Thermal Absorption at High Temperature** (*R. V. College of Engineering, Bangalore*)

A coating system has been designed and fabricated to develop a novel multilayer coating on steel tubes.

**4.11 Smart network controls for Resynchronizable grid** (*IIT Kanpur, IIT Madras & IIT Kharagpur*)

A reliable paralleling strategy is being developed to ensure robust current sharing suitable for plug and play operation and to eliminate master-slave approach which pins the entire system reliability on the master unit.

**4.12 Development of Micro inverter based modular solar energy generator** (*IIT Kanpur*)

AC modules are considered as the new face of photovoltaic power. A micro-inverter system has been designed and modelled in Matlab/Simulink and the effectiveness of the proposed control scheme is evaluated.

**4.13 V-trough concentrator for enhanced output from photovoltaic array powering a community scale reverse osmosis (RO) unit** (*CSMCRI, Bhavnagar*)

The PV-V trough units had water circulation from the rear side of an individual PV panel to extract the thermal energy, generated due to the enhanced solar insulation. The warm water obtained thereby was then allowed to flow to the RO plant, vide a continuous system. The flow rate of water through the PV panels was synchronized with the feed water flow rate to the RO plant. There was in average 43.22 % enhancement in power output from the PV panels in V-trough configuration due to the reflectors and additional cooling of the PV panels using RO feed water. The average synergistic enhancement in permeate flow rate from the RO unit was found to be 75.22%.

#### **4.14 An integrated device for converting water, carbon dioxide and light to electrical energy and organics (IIT Delhi)**

Simulation studies on various holographic light coupling architectures as well as for the optimization of various parameters is carried out. Computer simulations have been carried out to optimize the band gap of solar cell materials in terms of optical absorption efficiency.

### **WATER TECHNOLOGY INITIATIVE**

Water Technology Initiative (WTI) is a research initiative aimed at development and proving of low cost convergent technology solutions for domestic application to ensure safe drinking water quality under real life conditions. It encourages scientific evaluation to develop database to recognize and rank water purification technologies for decentralized applications for referencing them in specific social context. Capacity building of water managers, R&D institutions and academics for adaptation and adoption of appropriate technology options for drinking water purification is also one of the objectives of the initiative. This initiative, subsequently, at the behest of Hon'ble Supreme Court, developed into Technology Mission on 'Winning, Augmentation and Renovation (WAR) for Water' to come out with appropriate research based technological solutions to address various water challenges related to water availability, water purification and water reuse and recycling. Technology Mission Cell (TMC), in consultation with all States/UTs and experts in the subject area, following principles of scientific approach, identified hot spots representing various water problems across the country related to various chemical, micro-biological, and physical contaminants, less per capita availability of water, mis-matched withdrawal of water, surface runoff due to geological terrain, storage capacity for seasonal variations, rain water harvesting, seawater intrusion, augmentation of water resources for irrigation through utilization of seawater for high salt resistant species, management of reject water, etc. The Mission and related activities have so far addressed 19 water challenges in 25 clusters directly benefiting 212 villages across 23 states.

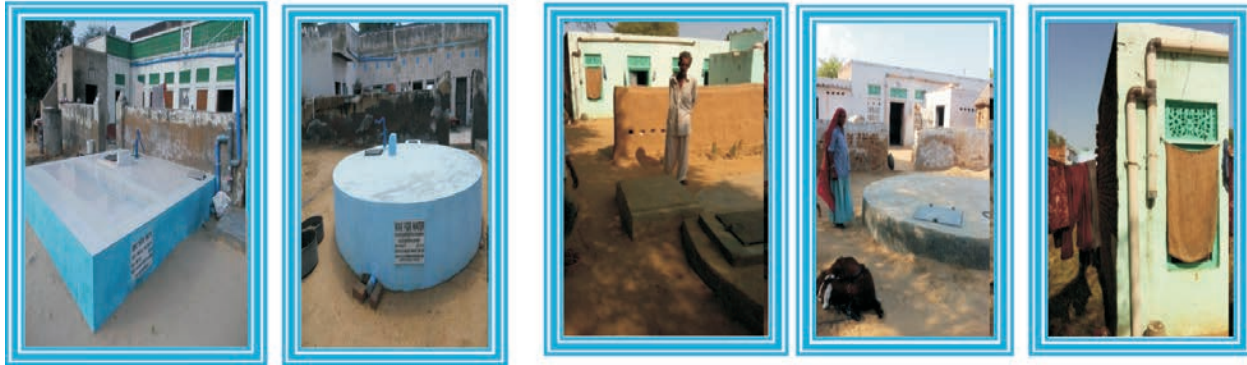
During the year, convergent solutions for augmenting ground water in Mewat Region of Haryana, Jhunjhunu district in Rajasthan and Sabarkantha district in Gujarat were successfully initiated/implemented. Rain water harvesting systems in the states of Mizoram, Nagaland and Tripura, established with active participation and contribution of local community, showed efficacy of technology in addressing water scarcity issues to a great extent, across villages located in hilly terrain. New technology elements of energy recovery and remote monitoring were developed and successfully integrated in indigenously developed reverse osmosis systems for desalination of sea water. Research collaboration between India and European Union, initiated under New Indigo programme, progressed well as evidenced by 59 exchange visits, 7 workshops and 18 publications. A Programme of cooperation (PoC) on Dutch India Water Alliance for Leadership Initiative (DIWALI) was signed and first set of projects were evolved. 19 R&D projects in the area of water research were also initiated.

Some of these notable initiatives to address water challenges are elaborated below:

#### **1. Development and proving of Convergent Technology Solutions:**

**1.1 Integrated approach for augmenting ground water in Jhunjhunu District, Rajasthan:** An innovative technical solution with strong community capacity building component for a cluster of 15 villages of Chirawa block in Rajasthan, covering 19,000 people, has been completed to address the challenges of low per capita availability and quality deficit of available water for specified uses

through two pronged approach of water conservation techniques to recharge groundwater and tapping of rainwater as alternate safe source for potable water needs, using rain water harvesting tanks, recharge wells, monitoring wells, ponds, soak pits, improved toilets, and appropriate plantation. The cost effective first rain separator and hand pump, coupled with chlorination, etc., were integrated in the designed solution through community managed networks of community and household level water harvesting and storage structure. The tankas constructed under the project have resulted in saving on account of household expenditure in purchasing drinking water. The full tanka can provide drinking water up to 8 months depending upon the family size and household water demand.



*Community tanks and Household tankas      Roof Rain Water Harvesting with household tankas and pop up filter/first flush filter*

**1.2 Integrated approach for augmenting ground water in Mewat region, Haryana:** Technological solution for a cluster of 10 villages in Mewat, affected by water challenges related to water winning and mining in water starved area, alkaline earth metal salt salinity and hardness and surface run off on account of geological terrain leading to depletion of fresh ground water pockets through novel recharge of aquifers, water conservation and water harvesting measures, has led to increased availability of drinking water for domestic use. The intervention of harvesting rain water and its storage in community-based tanks, is benefiting 2500 families across 5 villages in high salinity and surface run off affected areas in Mewat region of Haryana. Fresh water pocket formation has been completed in four government schools at Malab, Rajaka, Jaitaka and Untka villages in this region.



*Harvesting, Storage and Fresh Water Recharge tanks with bio-sand filters      Children in Government Schools of Mewat villages benefiting from the Storage and Recharge tanks*

**1.3. Ground water recharge and community water management network in Sabarkantha District of Gujarat:** The key water challenges here were surface run off and low ground water table. The solution providing intervention has been mainly in the form of construction of check dams and catchment areas for recharging of the aquifer and raising the ground water table. A network of village and neighbourhood level reservoir tanks has also been created for supplying water for domestic needs to the four villages, viz., Halodar, Limbda, Mota Kanthariya and Mudshi villages in Sabarkantha District of Gujarat.



*Overhead Community Reservoirs*

*Check Dams and Catchment areas for Ground Water Recharge*

**1.4 Water Conservation and Rain Water Harvesting in Nagaland, Mizoram and Tripura:**

The major water challenge in these areas is scanty drinking water availability in lean periods due to surface run off being an undulated hilly terrain. The intervention has aimed at rain water harvesting and creation of storage capacity in the hilly terrains of Nagaland, Mizoram and Tripura. Major achievements have been to provide drinking water to high water scarce villages through development of water management system through community participation. The projects have been implemented in villages of Kohima District (Nagaland), Aizwal District (Mizoram) and Rupaichiri cluster (Tripura).



RWHS in Kijumetouma (Mizoram)

RWHS in Zhadima(Nagaland)

Community managed technology solution, covering a population of 7320 people spread over 6 villages, to address the challenges of surface run off due to hilly terrain leading to low per capita availability in lean periods for villages situated at hilltops in Nagaland has been implemented fully. The scientific rain water harvesting systems, coupled with disinfection, installed with the support of local community and Churches, have assured drinking water quality for the people of the cluster.

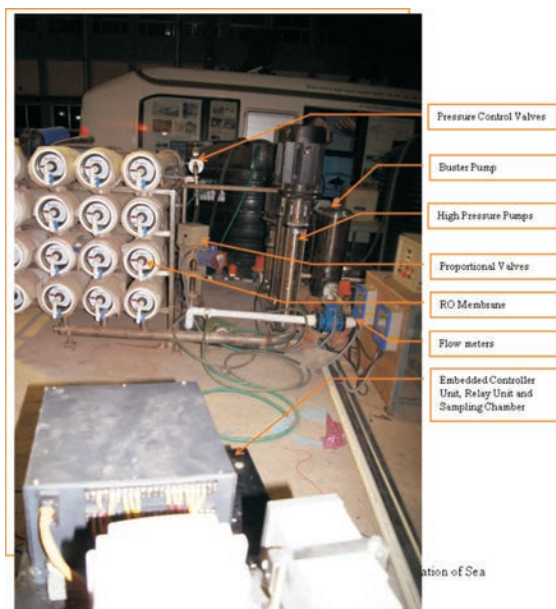


Technology solution, covering a population of 9634 people spread over 6 villages in Rupaichiri Cluster, South Tripura District, Tripura, to address the challenges of surface run off due to hilly terrain, leading to low per capita availability in lean periods, has been implemented fully. The scientific rain water harvesting approach, coupled with integrated water management practices, has assured drinking water supply for the people of the cluster.

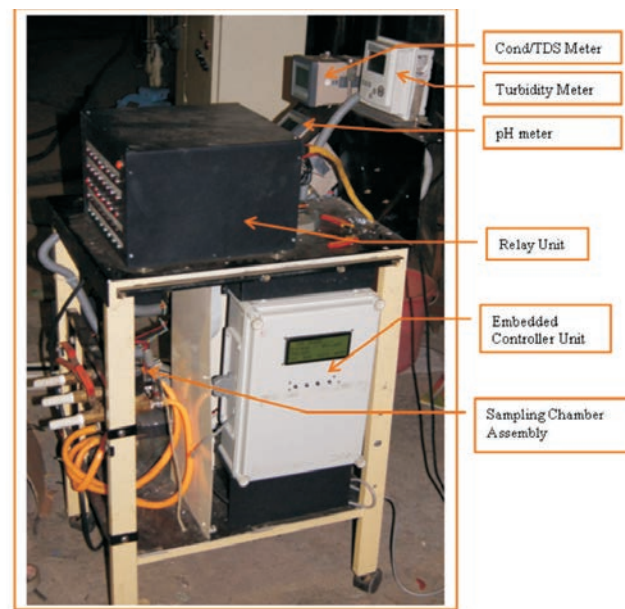
Integrated water technology solution to address low per capita availability covering a population of 1200 people for village Hmunpui in Mizoram to address the challenges of low per capita availability and surface run off due to hilly terrain leading to low per capita availability in lean periods is underway. The scientific rain water harvesting, installed by involving community and using roofs of school buildings, Churches and a few closely located individual houses, is expected to increase water availability from 20 lpcd currently to 40 lpcd for the people of the cluster.

### 1.5 Remotely monitored and controlled RO plant for desalination of sea water:

An energy recovery membrane based remotely monitored process for addressing challenges related to deficit of assurance for drinking water quality, alkaline earth metal salt salinity and hardness and biological contamination covering population of 12500 at Ervadi panchyat and Mullimunai panchyat in Ramanathapuram district of Tamilnadu has been operationalised for sea water desalination. Council of Scientific and Industrial Research (CSIR)-Central Electronics Engineering Research Institute (CEERI) Pilani and CSIR-Central Salt marine Chemicals Research Institute (CSMCRI), Bhavnagar have jointly designed and developed remotely monitored and controlled high capacity reverse osmosis (RO) system for desalination of sea water. The project is aimed at design and development of automation system for high capacity RO plant for desalination of sea water thus making it potable. The monitoring and controlling of the RO plant is done with two technologies based on Linux and embedded system. A handheld water parameter measurement system and embedded backwash controller have also been developed and tested during the project.



*Remotely monitored and controlled RO plant for Desalination of Sea Water*



*Embedded Controller Unit, Relay Unit and sampling chamber assembly*

## **2. International Cooperation**

### **2.1 New Indigo - Networking Pilot Programme in the area of water**

New Indigo programme was mounted to reinforce the Indo-European Union (EU) cooperation in thematic areas of mutual interest. The open call was made last year under the programme in the area related to water. 9 projects were supported with focus on treatment and management of waste water, including applications in industry and agriculture, and green chemistry applied to water purification including drinking water. During the year, 59 exchange visits of researchers in different disciplines of science and engineering took place. 7 workshops were held between the Indian and EU partners to reinforce strong scientific links with select countries. 18 publications have been reported from these projects.

The highlights of the research work in progress are:

- Developing enzyme supplemented Membrane based bio-reactor (MBR) for degradation of recalcitrant compounds from industrial wastewater.
- Treatment of arsenic, fluoride, pharmaceutical waste water and mining waste water.
- Soil and Water Assessment Tool (SWAT) hydrological modelling to estimate nutrient and sediment loads and to quantify the effects on water quality of downstream river reaches and reservoirs, including the identification of pollution sources.
- Approaches for Nano particle based light-activated decontamination
- Efforts to develop the guidelines for marginal quality water.
- Development of Advanced Modelling, control and decision support tools for municipal wastewater treatment plants
- Experimental investigations on dairy waste SWAT hydrological modelling to estimate nutrient and sediment loads and to quantify the effects on water quality of downstream river reaches and reservoirs, including the identification of pollution sources.
- Efforts to develop the guidelines for marginal quality water, textile waste and car washing waste.
- Process of primary anaerobic treatment and post anaerobic studies for nutrient removal and the addressing the challenges in analysis of pharmaceutical and personal care products.
- Preparation of Fe-embedded membrane and its use in removal of microbes from natural water

### **2.2 Dutch India Water alliance for Leadership Initiative (DIWALI)**

Dutch Indian Water Alliance for Leadership Initiative (DIWALI) envisages cost optimization of Dutch solutions for application in Indian context through vibrant Public-Private-Partnership (PPP). Both Indian market and innovation systems offer opportunities for cost optimization of designed solutions in the widely varying societal contexts of India. There remains an untapped opportunity for both The Netherlands and India to forge an alliance in the water sector in developing affordable innovations for

applications in both emerging and developing economies. After signing of a Memorandum of Cooperation between India and the Dutch, open call was issued for submission of project proposals, which include formulating project ideas, involving potential partners from industry and user community. The first such proposal has been developed by Oxive and Vadodara Urban Development Authority (VUDA) on new urban sanitation. The concept of new urban sanitation system, which essentially involved electro coagulation with anaerobic digestion with energy recovery, can run in continuous mode. The project partners were carrying out more detailing of project to consider it further.

### 3. R&D Projects initiated during the year

Some significant R&D Projects initiated during the current year are:

- ❖ Mapping of Seawater Intruded Zones (with special reference to chloride) in coastal aquifers of Digha-Shankarpur beach, Purba Medinipur Dist, West Bengal.
- ❖ Developing Computer Based Model for Impact Assessment of Watershed Development and Building Capacity in Tamil Nadu.
- ❖ Removal of Herbicides from Water by Advanced Electro-oxidation Processes.
- ❖ High performance multifunctional modified guar gum for wastewater and industrial effluent treatment.
- ❖ Development and Evaluation of Automatic Timer Based Variable Speed Device for Sprinkler System.
- ❖ Development of macrocyclic ligands and dendritic wedges intercalated layered double hydroxide-based water filters for affordable potable water.
- ❖ Study to assess the performance of bio sand filter and available technologies for the removal of iron, suspended impurities including pathogens from drinking water in Khordha District of Odisha.
- ❖ Ground water modeling for hydro geological characterization of Hazardous substance release sites- A case study of Pydibhimavaram Industrial area, Srikakulam, A.P.
- ❖ Sustainable decentralized waste management in urban residential areas.
- ❖ Development of integrated membrane process for wastewater treatment and reuse.
- ❖ Scientific Evaluation of Water Purification System in the State of Sikkim- Phase-II: Selection, Installation and Assessment).
- ❖ Development of Precise and Real Time Simulation Watershed Modeling System Using Advanced Geospatial and Soft Computing Methods.
- ❖ Highly efficient and cost-effective preparation of nano-porous carbon by microwave pyrolysis water purification.
- ❖ Treatment of reject water from defluoridation units that are based on reverse osmosis units.

- ❖ Development of Novel Artificial Naked Eye Fluoride ion Receptors.
- ❖ Development of column adsorption media with enhanced fluoride removal capacity by mixed metal oxyhydroxide-bio polymer composite beads.
- ❖ Development of multi-pollutant removing, water distillation and purification system using solar energy.
- ❖ Development of Dielectric Barrier Discharge based plasma system for portable water purification.
- ❖ Utilization of Plant Bioresource for biosorptive removal of dyes from water.

## **TECHNOLOGY SYSTEMS DEVELOPMENT PROGRAMME (TSDP)**

Technology Systems Development (TSD) programme supports activities aimed at developing and integrating technologies to evolve technology systems both in the advanced/emerging areas and in traditional sectors/areas. Under the programme, feasibility of fresh ideas/ concepts is assessed for their potential conversion into useful technology/product. **The focus is on inter-disciplinary, multi-institutional technology feasibility and development of technologies in certain identified areas.**

The primary objective of the programme is to facilitate and support development of products or techniques/technology aimed at specific end use. The programme stresses on clearly identifying the needs for development of the technology so that the developmental effort could be useful to the target beneficiary. **It envisages active user involvement and association in the development effort.** The intention is that the products/technologies developed under the programme become useful for the benefit of the people at large.

### **New Projects supported**

Thirty six new projects under Alternate Fuels and Technology Systems Development have been supported.

#### **1. Alternate Fuels (8 new projects were supported):**

The focus of activities under this programme is mainly on technology related applications and system integration in bio-fuels. The department has the mandate to support R&D related to development, demonstration and field trials of various technologies related to bio-fuel for various applications and activities to promote the use of bio-fuels and utilization of their by-products to produce value added chemicals. Following projects were supported in this area during the year:

#### **2. Technology Systems Development Programme (28 new projects were supported):**

Technology systems for areas like sensors, biosensors, medical applications, software and hardware for detection and monitoring, material development, civil engineering, energy storage etc. The two major initiatives taken under the programme include:

##### **a.) Generation of Hydrogen**

In order to develop a practical and economically viable device for the production of Hydrogen from photolysis of water using solar energy, a programme for generation of “Solar Hydrogen :

Energy from Water” was initiated during the year with an objectives to build a solar energy regime in India with Solar Hydrogen Technology, a clean source of energy, as an important supporting pillar. The solar Hydrogen technology will ultimately reduce India’s dependence on coal, oil and natural gas, providing energy security. A major project entitled “Generation of Solar Hydrogen” was sanctioned during the year. This is a mutli-institutional project and IIT-Kanpur, Jodhpur, Chennai, CECRI-Karaikudi and BARC-Mumbai are associated in this project. Progress of this project was reviewed during the year and the Committee appreciated the progress of the project.

**b.) Development of “Ferro Fluids”**

In the quest for novel domains of S&T exploration, Ferro Fluids is found to be an exciting area of S&T pursuit with excellent academic interests, research opportunities, developmental challenges, application avenues, device innovation prospects, and business openings etc. Globally, monumental work is done in Ferrofluids, Flow behavior, Magneto Rheological Fluids, Magneto Rheological finishing, Electro Rheological fluids, Magneto-Hydro dynamics, Magnetic Ionic liquids and many associated areas of ferrofluids in terms of synthesis, characterization, application areas, device innovation and development. 6 new projects have been supported in this area.

**Major achievements: Technologies developed and undergoing trails**

**1. Distress dignostic performance evaluation for bridge management system for concrete bridges – phase-II i.e. Development of a prototype of visual inspection unit sponsored to CoEFM (MERADO), Ludhiana**

CoEFM, Ludhiana/CRRRI New Delhi has successfully developed the first indigenously developed Mobile Bridge Inspection Unit (MBIU) to enable the bridge inspectors for conducting 100 Percent bridge inspection within a stipulated time period. Currently no such device is available in our country which will facilitate the engineers for this purpose and thereby most of the bridge remains un-Inspected or partially inspected. The mechanism is purely electromechanical and endeavor has been made to



Mobile Bridge Inspection Unit (MBIU)

keep it simple. The design is completed to the satisfaction of the sponsor and a joint patent is filed for the designed MBIU. The mobile bridge inspection unit will provide access to the intricate part of the bridges within 25 minutes of Structure Un-folding time (the same activity earlier was done by locally assembling and erecting temporary structures and this takes approx. 15-20 days). The structural engineers / Operators with the help of machine can maneuver himself to a desired point for NDT test etc. The developed system was handed over to CSIR-CRRI, New Delhi for field trials etc during the year.

## **2. Design and Development of 42 GHz, 200 kW CW/Long Pulse Gyrotron**

A multi-institutional project titled “Design and development of a 42 GHz, 200 kW CW/Long Pulse Gyrotron”, has been sponsored by the TDT. CEERI-Pilani is the nodal centre and the participating institutions are BHU, Varanasi; IIT(R), Roorkee; SAMEER, Mumbai; and IPR, Gandhinagar. The IPR, Gandhinagar is the user of Gyrotrons for plasma heating applications. The Gyrotrons developed as the outcome of the present project will thus provide an import substitution and would create a scope for the export of the Gyrotron as well in future. In addition, the execution of the project would create a design base not only for the Gyrotron but also for its individual components/subassemblies. Furthermore, India joining the consortium of International Thermonuclear Experimental Reactor (ITER) has also added a value to the project. The project team will launch the developed Gyrotron soon.

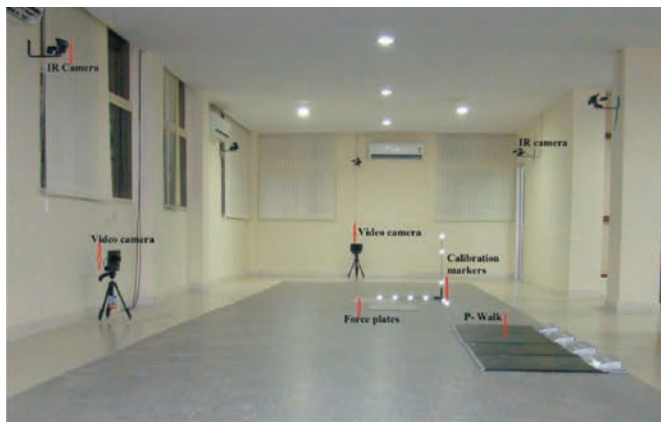
## **3. Holistic approach for commercial processing of fruits and vegetables grown in western Maharashtra sponsored to Institute of Chemical Technology (formerly UDCT/UICT), Mumbai**

A range of products from kokum and Jamun are developed at ICT-Mumbai with industry partners, M/s Three Pee solutions, Satara and M/s Trilok Food India, Satara. Fortification with calcium is successful. Cereal bar recopies are developed incorporating fruit pulp. Some trials were done at site. Dry products such as soup mixes with vegetable flex were exhibited in the Chemical Engineering Conference CHEMCON held at ICT-Mumbai during Dec 27-29, 2013, that was inaugurated in the hands of honorable President of India Shri Pranab Mukherjee. Another novel product – vegetable candies were prepared like tablets and trail marketing is done through pediatricians for consumption by children as healthy food.

## **4. Development of Ankle-Foot Orthosis (AFO) for pressure offloading using advanced technologies sponsored to CLRI, Chennai.**

Risk factors for developing diabetic foot ulcers include the presence of sensory peripheral neuropathy, peripheral vascular disease, Lower limb muscle dysfunction, altered biomechanics, elevated pressure on the sole of the foot, and limited joint mobility. The structural changes along with vascular insufficiency, infection and uneven pressure distribution under the foot predispose the person with diabetes to develop foot ulceration. Foot pressures, shock, and shear can be reduced with appropriately fitted shoes, insoles, and socks. Among the pressure offloading techniques, AFO offers lot of advantages for both physicians and patients. But the current design and materials used for fabrication of AFO make the treatment expensive which is not affordable by the patients in India. This project deals with the new design and development of AFO for patients with diabetes having diabetic foot ulcer. A movement analysis laboratory with four force platform and eight numbers of IR cameras to capture

the temporal- spatial human movement data has been established and studies of human ambulation is in progress.



Gait laboratory- Shoe Design & Development Centre, CLRI, Adyar, Chennai



Work station -Gait laboratory- Shoe Design & Development Centre, CLRI, Chennai.

## 5. Development of LTCC materials for general purpose applications sponsored to C-MET, Pune.

Low Temperature Co-fired Ceramic (LTCC) is one of the important multilayer circuit fabrication technology that allows multilayer microwave circuits with integrated passive components, creates high density circuits, multi-chip modules etc. C-MET-Pune through the joint funding from Technology Systems Development (TSD) programme of DST and C-MET, has undertaken a project for the development of indigenous LTCC materials for general purpose applications with an objective to develop indigenous, mutually compatible LTCC materials system at pilot scale. Under the project, the laboratory scale development of LTCC tapes completed by C-MET to be fine tuned and scaled-up to pilot scale.

## 6. Development of metal nanoparticles doped carbon aerogel based new H<sub>2</sub> gas storage system for fuel cell & other applications sponsored to Aerogel Lab., C-MET, Thrissur, Kerala

Hydrogen storage metal doped carbon aerogels has received considerable interest due to its potentiality to store H<sub>2</sub> via physisorption, which can be transported/delivered easily for specific applications. In this project, various aspects of metal nanoparticles doped carbon aerogels and their hydrogen storage capabilities were proposed and studied. C-MET-Thrissur has developed Ni, Co- & Pd-nanoparticles doped carbon aerogels, having the surface areas of 1600-2000 m<sup>2</sup>/g by sol-gel technique followed by supercritical drying, pyrolysis & surface treatment. Various aspects of aerogel synthesis were studied and optimized the process technology in lab scale. A prototype H<sub>2</sub> storage device was also fabricated and demonstrated its performance with different carbon aerogels including other carbons. Two Indian patents were applied under the project.



Prototype device for storage of H<sub>2</sub> in carbon aerogel (*in-set*: Pd-doped carbon aerogel)

## 7. Designed biomaterial devices for limb salvage implant for distal femur, proximal tibia and proximal femur sponsored to IISc, Bangalore

As the population ages, the number of orthopedic operations performed for human beings is expected to increase. Also, various diseases such as arthritis, cancer, and trauma can lead to skeletal defects, requiring the replacement or restoration of the lost bone. The autografts and/or allografts can be used to restore the areas of bone loss with limited supply of graft materials.

In the above context, an effort has been made to develop the surgical implants of bioactive materials (e.g. hydroxyapatite) in order to match requirements of Indian population. The development and biocompatibility assessment of 3D implant devices with gradient porous architecture, which should ideally exhibit excellent bone in growth properties with reduced elastic modulus was targeted. In the above perspective, the theme of this project is to develop patient specific implants based on the CT scan image of the specific anatomical part of the osseous system, followed by adoption of innovative processing strategy to obtain desired shaped implant materials.

## INSTRUMENTATION DEVELOPMENT PROGRAMME (IDP)

The Instrumentation Development Programme (IDP) promotes **R&D programmes** for indigenous development of instrumentation. The thrust areas include Medical and Healthcare; Analytical; Industrial; and Sensors & Allied Instrumentation.

### New Projects supported

Twenty new projects in the area of textile, quality control, agriculture, food processing, medical and healthcare, veterinary and sensor based instrumentation have been supported with industry collaboration at various National institutes/ Universities/ Engineering and Medical colleges.



## Major achievements: Technologies Developed, Transferred and Commercialized under IDP

1. AV Magnivisualizer, a device developed by Institute of Cytology and Preventive Oncology, Noida, Uttar Pradesh was dedicated to Nation by Honorable Health Minister Dr. Gulam Navi Azad on 23rd Dec. 2013. The low cost battery operated device was proven to be efficacious in screening of cervical cancer and trials are being done for screening of oral cancer.



AV Magnivisualizer, equipped to work on a 12-volt portable rechargeable battery

2. **Design & development of electro-active sensor fabrics for monitoring body kinematics and vital signs by Deptt of Textile Technology, PSG College of Technology, Coimbatore.**

The **strain sensor** is a unique device which can track the kinematic movements of elbow angle / knee angle. The elastic tape is fixed to elbow sleeve which in turn is put on patients for elbow angle measurement. The sensor is being validated against goniometer for live subjects as well as patients who are undergoing physiotherapy treatment. The **pressure sensor** is also a unique device for monitoring breath rate. The contraction / relaxation of heart muscles as a result of breathing can be recorded by the capacitive pressure sensor (Figure.2). The sensor has been validated for cardiac patients. The readings are compared with manual counting by cardiologist and are matching.



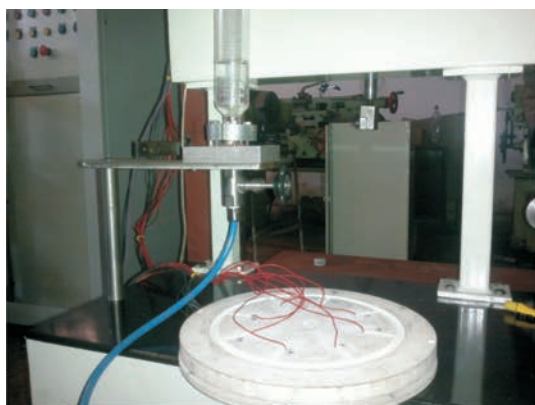
Elastomeric Tape Sensor



Capacitive Pressure Sensor

**3. Design and development of computerized instrument to measure the vertical and in-plane wicking characteristics of fabrics by Department of Textile Technology, IIT Delhi**

A fully computerized instrument has been developed to measure the vertical and in-plane wicking of fibrous materials. This instrument measures the rate of water transmission on the surface of fabric with the help of capacitance principle. The above instrumental set-up allows one to examine the rate of water flow, the amount of water spreading on the fabric surface and other important parameter in horizontal and vertical conditions.



Instrumental set-up for the in-plane wicking



Complete set-up with real time data recording

**4. Development of portable jute fibre strength tester by Indian Jute Industries Research Association, 17, Taratala Road, Kolkata 700088.**

The most important attribute of raw jute (which determine the price and end-use application), the fibre bundle tenacity, is often estimated objectively by hand and eye estimation, and rarely by an age old instrument which is tedious and time consuming. For quick and accurate strength estimation IJIRA, in a project sponsored by DST-IDP, with collaboration of industry partner C-Tronix, have developed two different electronic bundle strength testers: one portable and manually operable instrument for the farmers and another motorized version for quality control in jute industry. The promotional activities to market these instruments to industry and JCI are underway.



Portable jute fibre strength tester



Workshop for promotion of technology

**5. Indigenous development of table-top Surface Plasmon Resonance (SPR) set up by Department of Physics and Astrophysics, University of Delhi, Delhi.**

Delhi University has developed a low cost table-top Surface Plasmon Resonance (SPR) measurement setup as part of the instrumentation development programme of DST. The setup has the flexibility of measuring optical and dielectric properties of any metal/oxide thin layer in liquid, gas or vacuum media. The system can be modified to be used for gas sensing, biosensing, temperature sensing, magnetic field sensing etc.

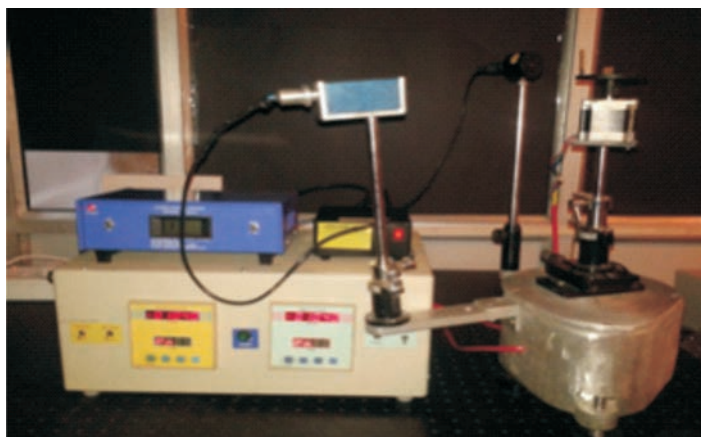


Table-top Surface Plasmon Resonance (SPR): a teaching aid

**6. Development of trace gas sensor using IR Laser absorption technique for environmental monitoring by Society for Applied Microwave Electronics Engineering & Research (SAMEER), IIT Campus, Mumbai**

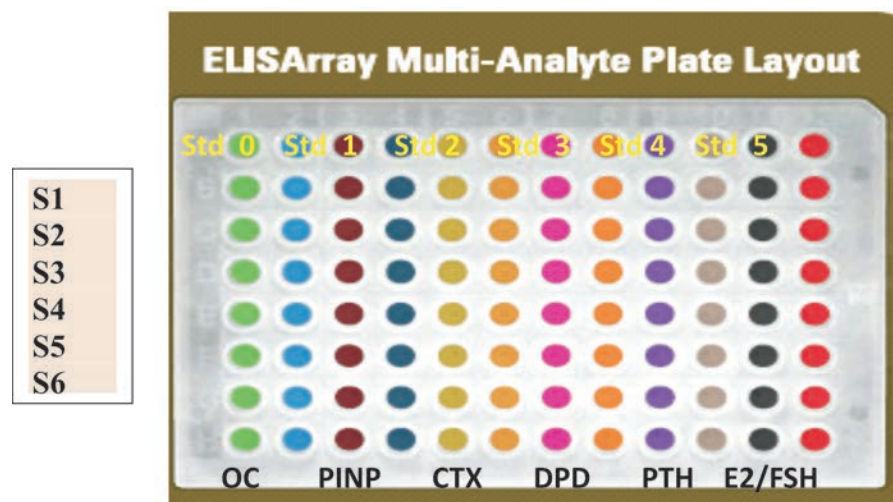
SAMEER Mumbai has developed a lab prototype trace gas sensor, which can detect the harmful gases from the atmosphere at sub ppm level. This instrument uses a tunable infra red laser source, which absorbs the gas molecule inside a multipass gas cell. The detection is done using IR detector and signals are acquired with high speed electronics using direct absorption and wavelength modulation technique.



Tunable Quantum Cascade Single Laser Trace Gas Sensor

**7. Preparation of a multianalyte ELISA based array of bone markers for the assessment of bone health by National Institute for Research in Reproductive Health, Parel, Mumbai.**

A battery of bone markers estimated by individual ELISAs is generally used as adjunct for diagnosis and management of osteoporosis. The measuring of these markers individually by ELISAs is not only time consuming but is expensive. Therefore an ELISA based array is being developed to measure these markers in single ELISA. This initiative would not only contribute towards reducing our dependency on imported and expensive kits but will ease performance.



Multianalyte ELISA based array of bone markers

**8. Healthy and safe home based on wireless sensor system for elderly people by Department of Electronics and Telecommunication Engineering, Center of Excellence for Green Energy and Sensor Systems, Bengal Engineering and Science University, Shibpur, Howrah.**

Owing to the globalization and rapid growth of nuclear families of the industry many parents are forced to stay alone. To guarantee a safe and healthy home, a non-invasive gadget which will monitor the regular activities indirectly without the use of any camera has been developed. If there is any deviation from the normal activity like lying in the bed for a prolonged time even in the day time or not going to the toilet for a long time, there will be a warning signal sent to the in-charge of the person or to the nearest relative via mobile phone. The organization can then immediately send a person to the concerned house to tackle the situation. This gadget does not disturb the privacy of the person since the regular activities of the person will never be exposed to anyone unless there is an emergency.

**9. Design & development of proto-type plasma treatment system and process optimisation to modify the surface of polyester & nylon fabric to improve its adhesion with polyurethane (PU) & polyvinyl chloride (PVC) coatings/lamination by F.C.I.P.T., Institute for Plasma Research, Gandhinagar, Gujarat**

Textile companies are continuously looking for innovative coating and laminating technologies that are economical, flexible and versatile to make novel products with high added values. In order to improve adhesion between textile substrate and deposited coating or laminate layer, plasma treatment is an

environment friendly and economical alternative. In the present project, a prototype plasma reactor is developed for fabric treatment and is installed at MANTRA, Surat. The polyester was treated in plasma for 1 minute and at different voltages. The treated polyester fabric was coated with PVC. The adhesion between fabric and coating was improved by 30 – 40% after the plasma treatment.



Plasma reactor developed by FCIPT, IPR and functioning at MANTRA, Surat

## **PATENT FACILITATING CENTRE (PFC)**

DST has initiated the Patent Facilitation Programme in 1997 to implement the patent regime through Patent Facilitation Cell (PFC) created under the umbrella of Technology Information Forecasting and Assessment Council (TIFAC, DST autonomous institute). PFP has been in the fore front of the national scene in creating awareness about Intellectual Property Rights (IPR) such as patent , geographical indicators , industrial design , copyrights , new plant varieties , electronic circuits and traditional knowledge etc in the country, assisting scientists and technologists in protecting their inventive work, spreading the IPR culture to the State level, evolving policies at the National level, providing technical input to the government on IPR related issues and interacting and supporting other government departments in protecting their innovations. PFP has a mechanism to extend full technical and financial support to R&D institutes, universities, educational institutions and schools in protecting their inventions in India and abroad.

Under this programme, department has also established the 26 Patent Information Centres (PIC's) in the various states to further expanding the network these PIC's have been assigned the task to open the Intellectual Property Cells in the Universities (IPCU'S ) so far 71 intellectual property cells has been opened at various state Universities.

## Major activities and achievements

- **IP Facilitation through PFC**

87 requests for patent filing were evaluated & reviewed. Out of these, eleven (11) cases were recommended for patent filing in India. Earlier patent filing in India were reviewed with respect to request for filing patent in other countries, eighteen (18) cases were recommended for foreign filing and 2 for PCT filing as per the details mentioned below:

S.No	Applicant and country of filing	Patent Filing request/cases received/handled	Evaluated and recommended for filing/filed
1.	Universities/Govt R&D Institute for Indian Patent filing	87	11
2.	Universities/Govt R&D Institute for Patent filing in other countries	25	18

- **Supporting IP Facilitation of INSPIRE Projects**

PFC sent team of IP experts, PFC officers and women scientists to INSPIRE exhibition held in New Delhi during October 2013 to study about 950 models/projects demonstrated by students from all over India for possible patentability of project exhibits.

S.No	Applicant and country of filing	Patent Filing request/cases received/handled	Evaluated and recommended for filing/filed
1.	INSPIRE project for patent filing in India 2011	509(only complete filing this year)	85 provisional out of which 10 complete
2.	INSPIRE project for patent filing in India 2012	1100	33 provisional
3.	INSPIRE project for patent filing in India 2013	950	230 cases Under process

- **Establishment of New Patent Information Centers:**

Patent Information Centres (PIC's) have been established at Srinagar , J&K and at Mumbai, Maharashtra

## INTER-SECTORAL SCIENCE & TECHNOLOGY PROGRAMME

### National Programme on Carbon Sequestration Research (NPCSR)

The programme which was initiated in 2007 continued during the year. The geneses of this program were global concern about GHG emissions especially CO<sub>2</sub> emissions which is a major contributor to GHG emissions responsible for global warming. The current measures to adopt green technologies alone may not be sufficient to address the problems of CO<sub>2</sub> build up. This has led to increased interest in a new strategy termed **Carbon Capture and Sequestration (CCS)**. Under this programme four broad thrust areas were identified for R&D support initially which enlarges into 12 areas over the period of time.

During the year, 45 proposals were mobilized, evaluated and sent for peer review by the experts. Programme Advisory and Monitoring Committee recommended fourteen new projects received from various universities, national laboratories etc. The programme has expanded in 21 States across the country. During the year four Programme advisory and Monitoring Committee Meetings were held. Total **35 new** proposals were evaluated and reviewed the progress of **41 ongoing R&D projects** so as to assess the quality of work, research output and advice on mid-course changes based on the R&D outputs and technological changes. The specific achievements of the project/programme during the current year are given below:

### I. Mechanism and the dynamics of carbon storage in the Sundarban Mangrove:

The dynamics of carbon storage in the different compartment such as soil, water, forest in the Sundarban Mangrove Ecosystem and their respective turn over time has been studied at Calcutta University, Kolkata. Developed Allometric model for total carbon stocks of mangroves and filed patent. Nine research papers are published in the journal of repute. Allometric equation derived from the data collected from Sunderban mangrove forest could be applied to other mangrove areas in India.

### II. Carbon dioxide Capture, Sequestration and Production of Multipurpose fuels

Hydrogen, Methane and Bio diesel through Algae route through Post combustion CCS on a fossil fuel fired Plant has been successfully demonstrated at the Carbon dioxide sequestration Pilot Plant at the State Technological University Bhopal. This pilot project revalidated the possible use of the amine absorption system to strip the CO<sub>2</sub> from the flue gasses and also validated the data on its efficiency for a Power Plant. The pilot plant together with the Combustion Gas Analyzer & Data Acquisition System is being used for 4000 hrs trail run. A CO<sub>2</sub> Capture of over 93% has been achieved using MEA solvent of 20% concentration. The required heat for stripping captured CO<sub>2</sub> is 3.88 MJ per kg of recovered carbon dioxide, which is provided by the low pressure steam about 150°C and 2 bar pressure from the associated boiler of 100 kg/hr capacity. Hydrogen formation to the extent of 21% by volume is also achieved.

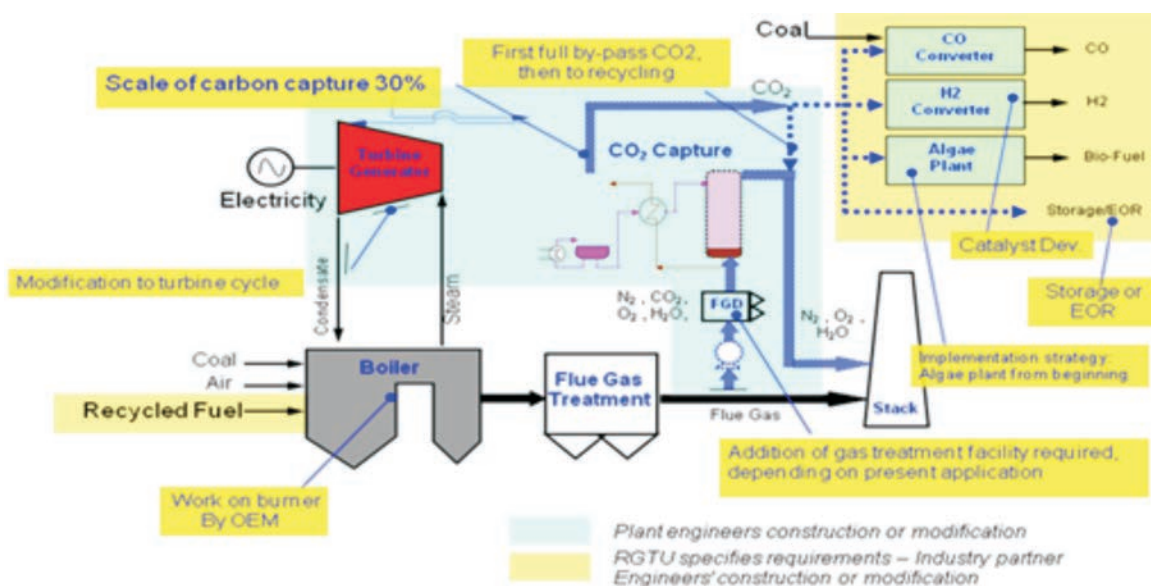


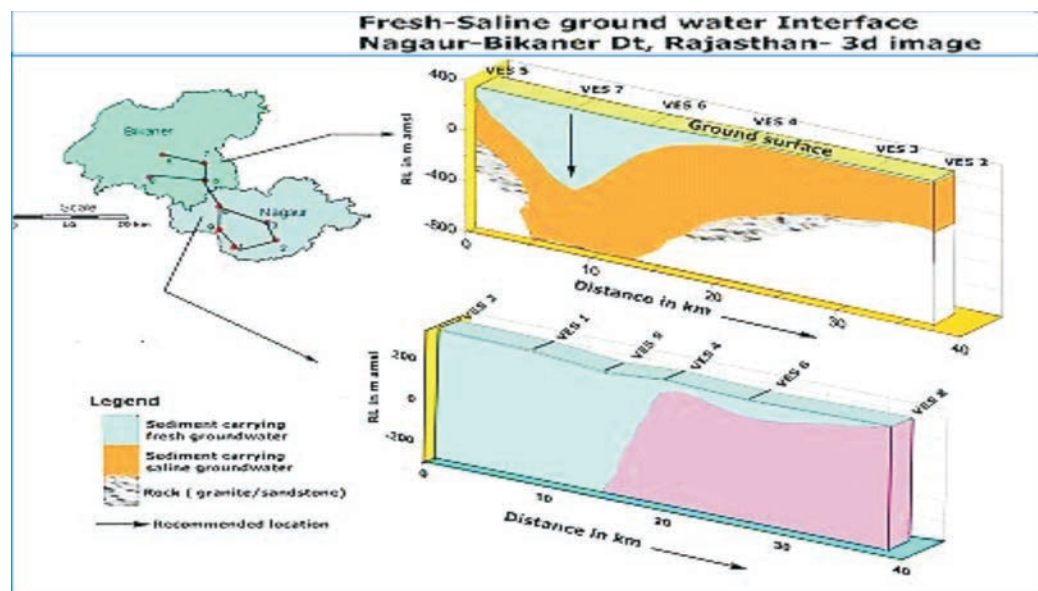
Fig.: RETROFITTING ON A 500 MW THERMAL UNIT

This interdisciplinary Project is expected to resolve certain frontline issues in CO<sub>2</sub> sequestration such as Energy intensive process optimization in terms of cost of generation and development of effective Catalyst for Methane, Hydrogen and Bio diesel recovery through Algae route.

### III. Development of Screening Criteria for Saline Aquifers and other Geological Sinks in Ganges Basin adjoining Rajasthan and Vindhayan Basin for CO<sub>2</sub> Sequestration / Storage:

Mapping of Global Hydro-geological Solutions, New Delhi studied and mapped the deep saline aquifer in part of the Ganga Basin, Vindhayan Basin and Bikaner-Nagaur Basin of Rajasthan upto the depth of 1100 m bgl. The mapping of deep saline aquifers provide the basic information of the cap rock and the presence of deep saline aquifers, thus it is the first important step towards compiling information for total screening criteria. The important highlights are:

- i. The Vindhayan Basin does not have the deep saline aquifer therefore do not represent the feasible area for the future study
- ii. Ganga Basin, though have deep saline aquifers in the quaternary alluvial formation but they are above the basement rock therefore does not meet the basic screening criteria unless the deep saline aquifer below the Shiwalik rocks which are more than 1200m deep are mapped.
- iii. Nagaur-Bikaner Basin in Rajasthan has the deep saline aquifers below the sedimentary formation as such meet both the screening criteria i.e. Cap rock and the deep saline aquifers below it. The first approximation gives that storage of 500 Mt CO<sub>2</sub> is possible. The fresh-saline groundwater interface of **Bikaner- Nagaur** is shown in the panel diagram below.



### IV. Carbon Sequestration Studies in Forest and Agro ecosystems:

Carbon sequestration potential in plantation forestry and agricultural land uses are studied at different locations and good amount of data being generated on soil carbon, improved management of cropland and grazing land, better agronomic practices including application of fertilizers, tillage and incorporation of crop residues into soil, restoration of organic matter and amelioration of degraded lands, improved



water management, crop rotations, change in land use (such as conversion of cropland to grassland), agro-forestry and improved livestock & manure management were studied in GBPUA&T, Pant Nagar, Central Soil and Salinity Research Institute, Karnal etc.

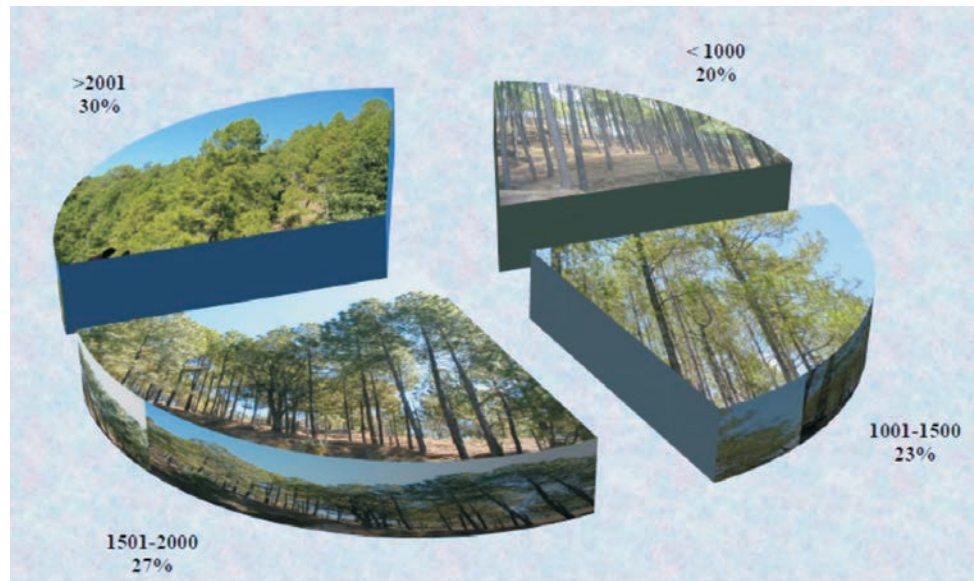


Figure 1: Share of total SOC pool occupied at different altitudes

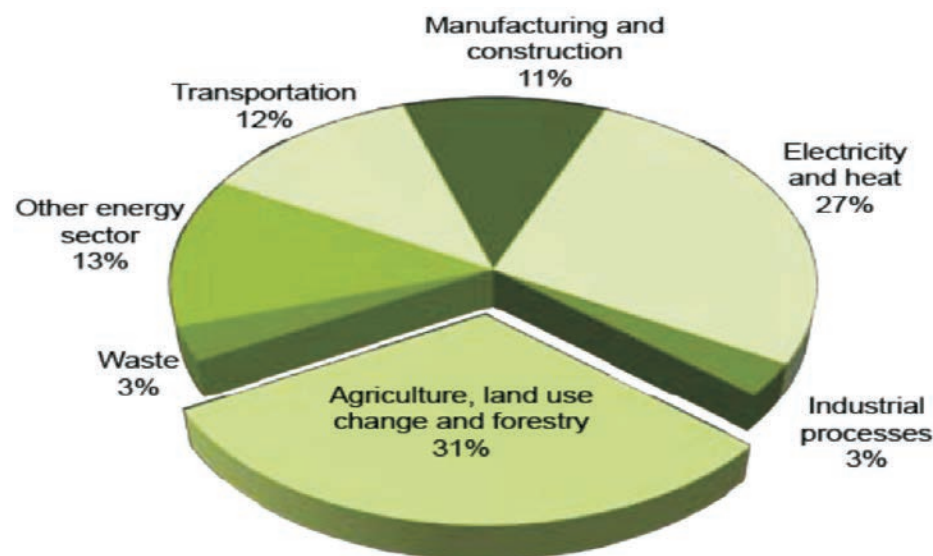


Figure2: Sector wide global anthropogenic GHG emissions

The findings of the present study will contribute to biodiversity conservation and sustainable management of the temperate forests. These anthropogenic disturbances not only influence the soil, nutrient and water conditions, but also influence climatic conditions. The conservation and management of biodiversity of these forests will be important for the sustainability and improvement of soil carbon and water conditions of the region.

### Significant projects supported under NPCS during the year 2013-14 are listed below

- Carbon-Silica composite material from rice husk for CO<sub>2</sub> capture.
- Evaluation of Carbon Sequestration ability plantation crops in Bastar region of Chhattisgarh.
- Synthesis and characterization of high adsorbents for CO<sub>2</sub> capture
- An integrated green process for biological carbon sequestration coupled with domestic sewage remediation by algae in closed photo bioreactor and subsequent utilization of biomass as biofertiliser.
- Aqueous mineral carbonation of magnesium silicates and mineral trapping of CO<sub>2</sub> in the ultramafic suite of rocks, Sukinda, India, petrological and experimental studies.
- Development of Surface functionalized polymers (SFPs) for highly efficient separation and capture of carbon dioxide.
- CO<sub>2</sub> sequestration using hyper saline micro algae: Selection, optimization and large scale demonstration through raceway pond cultivation.
- Evaluation of indigenous freshwater algal species from southern Assam (Northeast India) for Carbon Sequestration.
- Techno-economic Assessment of CO<sub>2</sub> capture and storage potential in India.
- Mapping Sundarbans Algae for CO<sub>2</sub> sequestration in in-situ and in-vitro condition.
- Development of green process for CO<sub>2</sub> sequestration using high rate algal ponds.
- Discovery of novel absorbents for enhanced CO<sub>2</sub> capture.
- CO<sub>2</sub> sequestration in Marine Hydrate Sediments with simultaneous CH<sub>4</sub> Recovery.
- Life Cycle and techno-economic assessment of algae-based CO<sub>2</sub> sequestration and conversion to value-added products(food, feed and fuel)

The mechanism called Science and Technology Advisory Committee which was initiated with the initiative of the department under the Ministries namely Steel, Coal , Mines and Environment & Forest continued during the year. The salient features of business transacted in these STACs is given below:

#### Ministry of Steel :

**Empowered Committee (EC)**, met once during the year under the chairmanship of Secretary, Steel. The Secretariat participated in this meeting and facilitated decision making through evaluation of the R&D projects by the experts in the area. Total 10 new projects were discussed and 9 new were approved. The progress made in 8 completed projects were discussed. The progress of 8 on going projects were also reviewed.

**Evaluation Group (EG)** Empowered Committee is serviced by the Evaluation Group which peer review the proposal received for funding from Steel Development Fund and recommends the proposals for

approval of EC, met four times during the year . The secretariat participated in these meetings and provided their inputs in the form of comments on number of projects discussed in these meetings. Total 37 new projects were discussed and 19 new were recommended. 5 completed projects were also discussed. The progress of 2 projects were also reviewed.

#### **Ministry of Mines:**

**Standing Scientific Advisory Group (SSAG)** under Min. of Mines met two times during the year under the chairmanship of Secretary, Mines. IS-STAC secretariat, DST participated in these meetings and provided their suggestions / comments on various projects discussed. Total 16 new projects were discussed and 10 new were recommended. 8 completed projects were discussed. The progress of 2 projects were also reviewed.

#### **Ministry of Coal:**

**Standing Scientific Research Committee(SSRC)** under Min. of Coal met two times under the chairmanship of Secretary, Coal. Total 12 new projects were discussed and 6 new were recommended. 5 completed projects were also discussed.

#### **Min. of Environment and Forests (MoEF):**

**NATIONAL CLEAN DEVELOPMENT MECHANISM AUTHORITY (NCDMA)**, IS-STAC secretariat participated in the meetings of the CDMA as a member and offered comments / suggestions on 450 proposals discussed in the six meetings held during the year.

### **SECURITY TECHNOLOGY INITIATIVES**

Research programmes under Security Technology Initiatives were launched under the aegis of Centre for Strategic Initiatives in Indian Institute of Science, Bangalore. Eight projects were supported in the areas of Video Analytics and Sensor Development. The projects are in the advanced stages of completion.

The Department in association with Federal Ministry of Education and Research (BMBF) Germany organised a workshop on “Civil Security Research” at Indian Institute of Science, Bangalore. The workshop was conducted with the objective of mutual understanding of the scientific and technical capabilities in the areas of civil security and to identify future areas of collaboration and initiate joint projects in the areas of civil securities. It was envisaged that the projects would be, at a later date, be considered under the bilateral norms of Indo German S&T corporation programme.

The background work for the project was done by the Indian Institute of Science, Bangalore and BMBF, Germany. Centre for Strategic Initiative at Indian Institute of Science, Bangalore is coordinating this activity under DST’s Security Technology Initiative. Subsequent to the workshop both Indian and German sides collaborated and evolved research proposals in Collaborative mode. The following three areas of research in the Civil Security has been identified -

1. Vulnerability of Transportation Structures, Warning and Evacuation in case of Major Inland Flooding (FloodEvac)
2. Vulnerabilities and Volunteerism
3. Sensor based Security and Emergence Management System for underground Metro (Sense4Metro)

## **FLY ASH UTILIZATION & MANAGEMENT**

In India, almost two-third of electricity demands is still met by Coal and the trend is expected to continue in the foreseeable future. Generation of Fly Ash, which is produced when coal is burnt in a Thermal Plant to produce electricity, has been on a steady rise and more so in the past twenty years. Presently, annual Fly Ash generation from various thermal power plants in Central, State, Private, and Captive sectors is estimated to be over 200 million tonnes and it is expected to rise to over 300 million tonnes by end of XII Plan. However, the concerted efforts of various stakeholders and pioneering initiatives catalyzed by Fly Ash Unit (FAU), an offshoot of the erstwhile Fly Ash Mission, have resulted in treating Fly Ash as a useful & usable resource from an environmentally hazardous waste material.

Fly Ash Mission was commissioned in Department of Science & Technology (DST) in 1994, at the behest of many stakeholders but primarily Ministry of Power (MOP) and Ministry of Environment & Forests (MoEF). Their focussed actions have resulted in gainful utilization of Fly Ash to the extent of about 100 million tonnes per annum currently from a meager 1 million tonne two decades ago. This has also, in turn, substantially reduced annual CO<sub>2</sub> generation besides considerable reduction in consumption of various mineral resources as Fly Ash has been found to be a good substitute.

### **Objectives:**

The term of the Fly Ash Mission got over in 2002 but DST opted to continue the good work because even though it was successful in meeting most of its stated objectives, the Mission also brought forth many new challenges for Research & Development (R&D). Thus Fly Ash Utilization Programme was launched based on the experience garnered during the currency of the Mission, which was later renamed FAU that is now a constituent of the Department. The broad objectives of the FAU can be summarized as:

- To promote maximum utilization of Fly Ash
- To foster mutually beneficial interactions between the producers, regulators, facilitators and the users of Fly Ash
- Use of Fly Ash in cement, concrete, bricks, boards, pavement blocks, structural fills, embankments, filling & reclamation of mines, source of micro-nutrients in agriculture, and so on
- To belie various myths & arguably false propaganda against Fly Ash as a toxin and environmentally hazardous product
- Introduction of Fly Ash in academic curriculum to generate awareness about its various aspects amongst students pursuing degrees in engineering, to start with
- Preparation of baseline documents, technology forecast reports for identified areas of Fly Ash utilization and management
- To prepare a roadmap for future activities and to aid the policy and strategy planning

### **Activities & Achievements:**

In about two decades, over 80 projects aimed at addressing a broad spectrum of issues related to utilization and safe management of Fly Ash have been commissioned in many leading academic institutes

and R&D organizations, among others, who have joined hands with industry to find lasting solutions. They have also been encouraged to create awareness among stakeholders by conducting workshops and organizing conferences.

The major utilization areas of Fly Ash are outlined below:

- Manufacture of Portland Pozzolana Cement (PPC) and concrete
- Manufacture of building products such as, Fly Ash lime/cement bricks/blocks, tiles, clay-ash bricks, etc.
- Back filling/reclamation of open cast mines which have either been exploited and/or abandoned and also for stowing of underground mines
- Construction of road embankment, low lying area development, structural fills, and so on
- As a source of micro nutrients/ soil amendment in agriculture and wasteland development
- Economical source of valuable metals, minerals, chemicals, etc.

FAU has been able to bring academia & industry together on common platform to examine & analyze the practices currently in vogue, assess their suitability in the light of the existing regulations and propose end-to-end solutions, develop cost effective & environmentally sound techniques & strategies, forecast the much needed technological interventions and share such experiences & expertise.

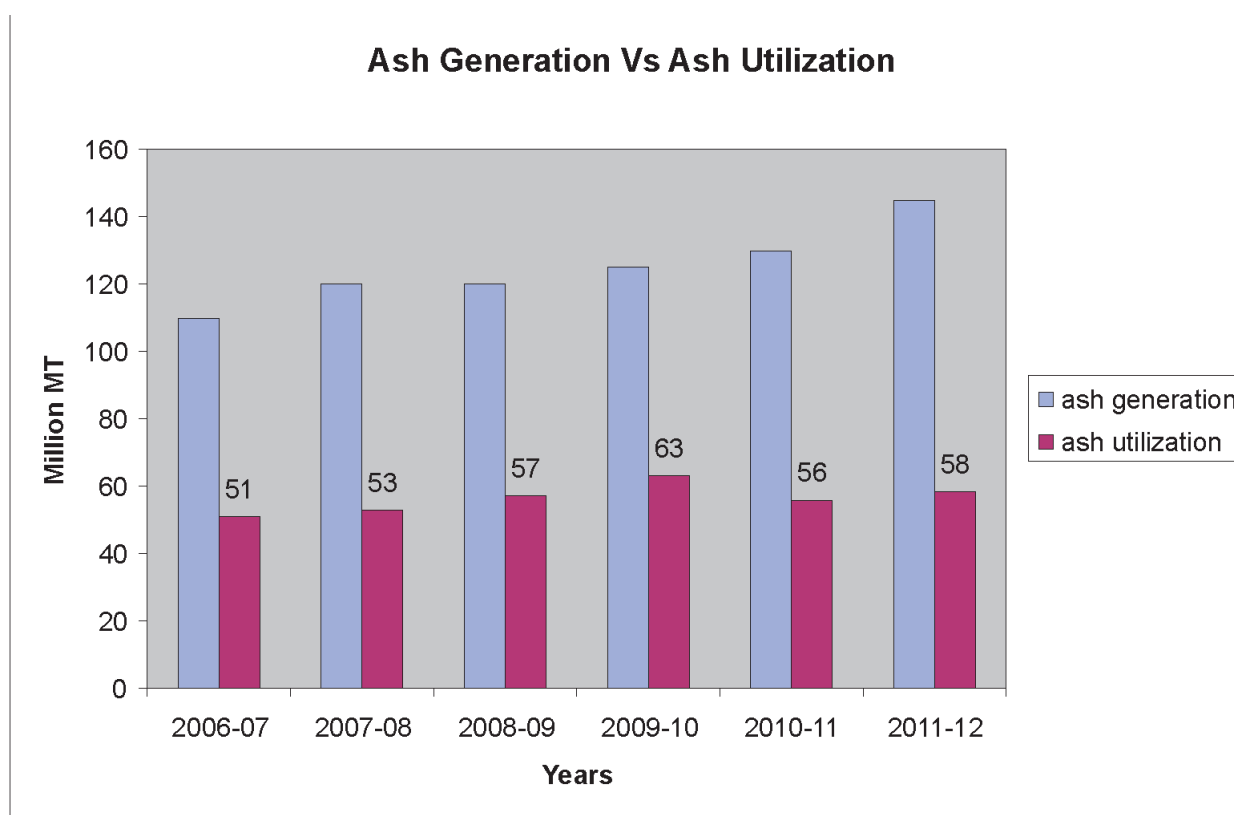
In addition, during the year under report, some of the major projects supported by FAU that were completed are outlined below:

- “Baseline Document for Fly Ash Utilization / Management Areas in Coal & Mining Sector”
- “Technology Forecasting & Assessment of Future Fly Ash in India”
- “Technology Forecasting and Assessment for the Area ‘Fly Ash Utilization for Extraction of Minerals, Materials and High Value-added Products’”
- “Evaluating Fly Ash Zeolites for Soil, Water and Nutrient Use Efficiency of Sweet Potato”
- “Management of Nematode Fungal Disease Complex of Tomato using Fly Ash”
- “Baseline document for fly ash utilization/safe management in agriculture and waste land development”
- “Exploration of potentials & feasibility of fly ash for Agricultural applications in Assam”
- “Synthesis, characterization and application of several catalytic materials based on coal generated fly ash”
- “Studies on the influence of fly ash seed pelting on growth and yield parameters in sesame”
- “Application of Fly Ash on Farmers’ Fields in Rice-Wheat Cropping System for the Assessment of Technology”

These reports and documents have provided the much needed missing links that may enable stakeholders to gain insights into the current status of technology, existing practices, available expertise in the domain, future trends, challenges & opportunities for R&D, and so on. For example, report of ‘Technology Forecasting and Assessment of Fly Ash Utilization in Mining Sector’ by Indian School of Mines, Dhanbad has given information on the future opencast mining technology, future methods for transportation of Fly Ash, technology of the thermal power generation for reduction of coal consumption which will ultimately lead to lower emission of Fly Ash and also on policies regarding subsidies/incentives to mining sector for using it in place of any other material currently being used. The report also contains relevant information that may help the stakeholders to extract insights for taking appropriate strategies on the basis of forecasted technology in future, particularly after 5, 10, 20 years.

Further, 3<sup>rd</sup> meeting of Indo-Russian Joint Working Group (JWG) was conducted during 17-21 September 2013 New Delhi as part of Protocol of Intentions on Fly Ash Utilization and Safe Management that was signed between DST and Inter-regional Association “Siberian Accord”, Siberian Federal District, the Russian Federation in December 2011. During their visit, Russian delegates interacted with experts from academic institutes as well as industry. They also visited the National Council for Cement & Building Materials (NCB), Ballabgarh and evinced interest in facilities & expertise available there, particularly for R&D and manpower training.

FAU also supported Workshops, Conferences and *Kisan Gosthis* not only to generate awareness but also build capacity amongst various stakeholders on utilization and management of Fly Ash.



*Source: cea.nic.in*

## **NORTH EAST CENTRE FOR TECHNOLOGY APPLICATION AND REACH (NECTAR)**

NECTAR is an autonomous body of the Department of Science & Technology. Its primary mandate is to deliver and deploy useful technologies, emanating from the public funded research institutions and other sources, in consultation with the respective State Governments, after assessing their application potentials. The activities of the National Mission on Bamboo Applications and the Mission on Geospatial Applications have also been subsumed into the Centre.

Nectar has taken up technology delivery projects in the areas of bamboo applications, establishing MESHNETS as high speed wireless connectivity solutions for medical, educational and safety applications, deployment of software defined radios for improved connectivity among the security and safety infrastructure, android based thin client products for educational purposes etc. Further, it has initiated projects in the fields of processing technologies for ginger and turmeric, preservation of natural dyes etc

A major collaborative initiative with the Meghalaya Basin Development Authority aims to implement sustainable watershed management in the State. A similar programme has been started with the Assam Water Research & Management Institute for the Brahmaputra River. NECTAR has entered into partnership with Columbia Water Centre, University of Columbia, USA to address the water and flood concerns of the North Eastern Region. Another activity has been started to find and implement solutions for the acid mine flow related pollution of ground water in Meghalaya.

Nectar has launched projects in the sectors of natural dyes, bamboo boards, incensing technology etc with the overall objective to integrate technology, training and markets in order to improve income levels and productive capacities of the local people.

NECTAR has also piloted a project for the setting up of a Gene Bank to document and harness the rich bio-diversity of the North East Region in collaboration with Bose Institute, Kolkata.

NECTAR is presently assisting the Government of Assam in the setting up of a Bio-technology Park and Science City in the State.

## **SYNERGY PROJECTS**

Under Synergy Projects scheme, following activities were continued / initiated by Office of PSA to the GoI.

- National pilot programme for “Identification of Giftedness in children with special Focus on Science & Mathematics”. Institutions viz. NIAS, Bangalore, University of Delhi and Agastya Foundation, Bangalore is implementing the projects. The programme has been successful in developing multiple models for identification of gifted children in science and maths.
- Initiated few integrated research projects towards developing specific devices, systems such as Router System, Network Management System, Integrated Thread Management Appliance for secure data transfer.
- Constituted the Apex Committee for an Integrated Photonics Initiative and identified the thrust areas for research viz. Laser diodes & laser Diode arrays, Plasmonics & Fibre lasers.

- Integrative research “Science in Ayurveda”, studying basic concepts of Ayurveda & exploring experimental models, protocols etc. has been formulated. Ten research projects exploring Bhasma, Panchakarma, Rasayana & Dosha Prakriti concepts have been carried out.
- Rural Technology Action Groups (RuTAGs) have been conceptualized as a mechanism to provide higher level of S&T intervention and support. It’s an open platform innovation strategy and centres in eight IITs have been established. Several projects have been undertaken.
- Programme on Green Chemistry have been initiated and under this five sectors of Indian Chemical Industry e.g. Paper & Pulp, Distillery, Dyes & Dye Intermediate, Drugs & Pharmaceuticals and Bulk inorganic chemicals have been identified for implementing Green Chemistry concepts. Two projects under Dyes & Dye Intermediates were developed. Scoping studies were underway in Pulp & Paper as well as Distillery sectors.
- To enhance academia-industry interactions Core Advisory Groups (CAGs) have been established in the area of machine tool development, electronics hardware indigenization. Under these CAGs projects have been catalysed for pre-competitive applied research.
- Programme on R&D in Medical Devices has been initiated
- R&D programme in Advanced Ultra-Supercritical Thermal Plants (AUSCTP) which are relatively lower carbon–emission technologies and are important in the context of the climate change threat is underway.
- Identified and nurtured latent capabilities and initiated project with DRDO and HESCO for development of low cost steel versions of foot bridges for use by the civil population. These can be used during natural calamities for movement in mountainous terrain. Project to identify various technologies required for handling terrorism and low intensity conflicts has been initiated along with DRDO.

**Brainstorming sessions:** Brainstorming meetings were held on the following topics:

- Quantum Matter Physics in India
- Food Processing industries
- Energy storage devices (batteries)
- Additive manufacturing & Allied technologies
- Cyber Security

## TECHNOLOGY COMMERCIALISATION

The Government of India constituted the **Technology Development Board (TDB)** in September 1996, under the provisions of the Technology Development Board Act, 1995. The mandate of the TDB is to provide financial assistance to the industrial concerns and other agencies attempting development and commercial application of indigenous technology or adapting imported technology for wider domestic application.



The financial assistance from TDB is available in the form of loan or equity; in exceptional cases, it may be grant. The loan assistance is provided up to 50 percent of the approved project cost and carries 5 percent simple rate of interest per annum. In the alternative, TDB may also subscribe by way of equity capital in a company, subject to maximum up to 25 percent of the approved project cost. The financial assistance is provided during the commencement, start-up or growth stages of an industrial concern. The website of TDB is [www.tdb.gov.in](http://www.tdb.gov.in).

In addition to the direct support to industries for commercialization of indigenous technologies, TDB continued to network with technology focused Venture Capital Fund (VCF) to support technologically innovative viable ventures with the objective to spread itself by providing support to early stage ventures for SMEs having innovation and innovative products/services.

TDB also took growth-oriented initiative and provided financial assistance to Technology Business Incubators (TBIs) and Science & Technology Entrepreneurs Parks (STEPs) under Seed Support System for Start-ups in Incubators to incubate technological ideas. The assistance is positioned to create techno-entrepreneurs apart from acting as a bridge between development and commercialization of the technologies. The scheme has progressed well and is being continued.

So far TDB has provided financial assistance of Rs. 100 lakh each as grant to 36 (Thirty Six) Technology Business Incubators (TBIs) and Science & Technology Entrepreneurs Parks (STEPs) aggregating Rs. 3600 lakh under Seed Support Scheme. This scheme has benefited entrepreneurs from STEPs and Incubators in various fields.

During the year, TDB signed 15 agreements with industrial concerns with commitment of Rs. 83.73 crores out of total project cost of Rs. 302.65 crores and disbursed Rs. 76.76 crores to the assisted companies for implementation of the projects. TDB's support covers the sectors of economy namely, Health, Biotech, Chemical, Engineering, Agriculture, Energy & Waste Utilization, Telecommunication, Information Technology and others i.e. Seed Fund to incubators and investment in Venture Capital Funds.

### **New Initiatives During the Year**

#### **(a) MoU between TDB, India and bpifrance, France**

During the visit of the French President in February, 2013, Technology Development Board (TDB), India and OSEO, France which is now merged in bpifrance, France has entered into a Memorandum of Understanding (MOU) on 14.02.2013 to promote technological innovation collaborations between the companies/ organizations and institutions of both India and France.

#### **(b) Innovative Ventures for Technology Development (INVENT) with DFID**

Technology Development Board (TDB), Government of India in partnership with DFID India has agreed to implement the incubation support component of 'Innovative Ventures for Technology Development (Invent)' programme.

The INVENT is basically about Inclusive Innovations and will address challenges and barriers across the inclusive innovation lifecycle, for the benefit of up to 1m poor people at the bottom of the economic pyramid in the low income states of India and in low income countries.

Under the incubation component, crowd sourcing of about 250 potential innovative business ideas or enterprises will be done and then support to provide them with brick & mortar and virtual incubation to ensure at least 50 ‘scalable and investment ready’ social enterprises are generated in Low Income States of India especially in the sectors such as agri-food, health, energy and education.

### **Technology Day Function**

The President of India, Shri Pranab Mukherjee gave away National Awards, on Technology to the industrial concerns for developing indigenous technology on the occasion of Technology Day, instituted by Department of Science & Technology on 11<sup>th</sup> May, 2013 at New Delhi.

## **DRUGS AND PHARMACEUTICALS RESEARCH**

The Drugs and Pharmaceuticals Research Programme (DPRP) was initiated in 1994-95 for promoting Industry – Institution collaboration in drug and pharmaceuticals sector. This programme aims at enhancing capabilities of institutions and Indian drugs & pharmaceuticals industry towards development of new drugs in all systems of medicine. Important activities and achievements of the programme during 2013-14 are as following:-

### **New Projects Supported**

- **Collaborative projects:**
  1. Development of targeted stealth nanocarrier for dual delivery in the treatment of oral cancer sanctioned to Sastra University, Thanjavur and M/s. Orchid Chemicals and Pharmaceuticals Ltd., Chennai
  2. Development of novel mycotoxin binders for the management for mycotoxicosis in animal and human sanctioned to Tamil Nadu Veterinary and Animal Sciences (TANUVAS), Chennai and M/s. Neospark Drugs and Chemicals Pvt. Ltd., Hyderabad.
- **Loan projects:**
  1. Development of new drug delivery systems (NDDS) for analgesic, anti-inflammatory and muscle relaxant agents for novel Paracetamol injection and Dynapar AQ in European countries by M/s. Troikaa Pharmaceuticals Limited, Ahmedabad
  2. Clot specific streptokinase (SMRX11), a novel thrombolytic for the treatment of cardiovascular disease: Human clinical trial on SMRX11 safety and efficacy by M/s Symmetrix Biotech Pvt. Ltd., Chandigarh
  3. Non-clinical and early clinical development studies of PNQ-201 (A2BAdoR antagonist), a new chemical entity discovered in India, for effective oral treatment of patients suffering from Inflammatory Bowel Disease (IBD)” by M/s Advinus Therapeutics Limited, Bangalore
- **Facility project:**
  1. National facility on community based cancer tissue bio bank for drug targets by Indian Institute of Technology (IIT), Chennai

## Achievements

### • Projects

1. A new innovative drug Mycidac-C for the treatment of lung cancer was developed by M/s. Cadila Pharmaceuticals Pvt. Ltd., Ahmedabad through public-private-partnership of Drugs and Pharmaceuticals Research Programme was launched on November 21, 2013.
2. Under the project “Clot specific streptokinase (SMRX11), A novel thrombolytic for the treatment of cardiovascular disease: human clinical trial on SMRX11 safety and efficacy” to M/s. Symmetrix Biotech Pvt. Ltd., Chandigarh, phase-I clinical trials were successfully completed and the industry received permission from DCGI to conduct phase II clinical trials.
3. A grants-in -aid project entitled, “A clinical drug development programme to evaluate and compare safety and efficacy of new regimens of Lifecare’s liposomal Amphotericin B (Fungisome TM) against currently accepted therapies for the treatment of Kala Azar : Phase II- A prospective, open label, non-comparative, sequential, phase –II, multi-centric study to assess safety of single dose regimen at two dose levels of Fungisome TM in treatment of Visceral Leishmaniasis (Kala Azar)” sanctioned to M/s Lifecare Innovations Ltd Gurgaon has been completed. The study has provided evidence for favorable efficacy, safety and tolerability profile of single dose administration of Fungisome TM i.v. 10 mg/kg and 15 mg/kg for visceral leishmaniasis treatment. Studies were conducted at one site- Kala Azar Research centre, Muzaffarpur, Bihar.

### • Facilities

1. The facility project entitled, “Strengthening of existing facilities with a special emphasis to bioequivalence study of drug and metabolites in plasma” by Jadavpur University, Kolkata has resulted in several publications in national/ international journals with Impact Factor 1 to 4. Facility has ISO and DCGI approval. Facility created is extended to other institutions/ companies on chargeable basis.
2. A National Facility for Drug Development (NFDD) has been created at Saurashtra University, Rajkot (2007-2012) with contribution from DST, Government of Gujarat and Saurashtra University. The NFDD complex is spread over 35,000 sq ft. All sophisticated instruments from DST grant are fully functional at NFDD Centre which include NMR instrument, Single crystal XRD facility, GC, UPLC, HPLC, Elemental analyzer, Flash chromatography, TGA/ DTA/DSC, Water purification system, Stability chambers, etc. Many small, medium and large Pharmaceutical companies in Gujarat & other places have been benefited by this facility. Achievements during the project tenure with help of this facility:
  - Several lead molecules have been identified for treating cancer inflammatory, TB and HIV and further studies on going for optimizing these lead molecules.
  - More than 31 research publications have been published.
  - More than 800 students has been trained and got opportunity to study abroad for pre doctoral, doctoral and post doctoral studies.

- Faculties, students, industrial & pharma chemists were trained in these sophisticated instruments.
  - PG Diploma in sophisticated instruments related to Pharma industries was started and first batch of 32 students have got training on available instruments.
3. The facility project on neurotoxicity research to assist drug development sanctioned to University of Madras, Chennai has been completed. Establishment of this facility with infrastructure is essential to assess neurotoxicity that can assist in development of not only modern medicine but also in scientific evaluation of medicinal preparations of Indian traditional medicine so that they can be made acceptable at international arena. The facility has several specialized equipments like Transmission Electron Microscope (TEM) and ICP-MS. The facility was inaugurated by Secretary, DST on 7.8.2010. Specific labs have been established which include: Molecular toxicology lab, Neuro & nano toxicology lab, Aquatic toxicology lab, Behavioural toxicology lab, Biochemical toxicology lab and Toxicopathology lab. Several personnel have been trained on the project through human resource training workshops. One research paper has been facilitated. To accomplish the task of self sustenance, investigations/ analysis of sample is done at reasonable charges in adherence with rates approved by the University.
  4. The facility for the development of herbo- metallic preparations of Ayurveda, Unani & Siddha established at SASTRA University has been put to use for researchers within SASTRA and for other users. Some of the sophisticated equipments procured through DST grant are available only at SASTRA in this region. Several companies/ industries, research laboratories and educational institutions are benefited by this facility. The facility has resulted in seven research publications. 3 Research Scientists/ Research Associates and several other technical personnel have been trained in the facility.

## S&T COMPETITIVENESS THROUGH ALLIANCES, PARTNERSHIPS AND R&D MISSIONS

### ENHANCING S&T COMPETITIVENESS THROUGH INTERNATIONAL COOPERATION

#### INTERNATIONAL BILATERAL COOPERATION

International Division of DST has the mandated responsibility of (i) negotiating, concluding and implementing S&T Agreements between India and other countries; (ii) providing interventions on S&T aspects in international forums. This responsibility is carried out by the Division in close consultation on the Indian side with the Ministry of External Affairs, Indian Missions Abroad, S&T Counselors posted at Germany, Japan, Russia and USA, stakeholders in scientific, technological & academic institutions, concerned governmental agencies and with various industry associations in India.

#### Guiding Principles for International S&T Cooperation

DST is able to strategically leverage ‘international collaborative advantage’ by building chosen international alliances and partnerships with selected countries that can have perceptible yields, such as:

- (i) R&D outputs through international alliances which can contribute directly to national R&D priorities and outcomes;
- (ii) Accelerating institutional and human capacity building through international exposure and linkages;
- (iii) Enable new paradigms being practiced by other emerging economies for sustainable adoption by Indian R&D and innovation systems;
- (iv) Evolve modalities and mechanisms for seamlessly connecting Indian research with global efforts particularly in the frontier areas of S&T and in areas addressing global challenges;
- (v) Absorbing experience of existing global research facilities in fine-tuning and/or coupling with upcoming or existing Indian research facilities;
- (vi) India’s contribution in international mega-science projects;
- (vii) Empowering developing countries in S&T; and
- (viii) Promoting innovation and techno-entrepreneurship through Global Innovation & Technology Alliance (GITA).

#### Spectrum of Cooperative Activities undertaken

During the year, DST undertook a spectrum of bilateral cooperative activities such as: (i) Scientific and ministerial missions; (ii) Joint workshops; (iii) Joint research projects; (iv) Support to and creation of

Bi-national S&T bodies, (v) Joint R&D centers, (vi) Virtual Networked centers; (vii) Utilization of large scale research facilities abroad; (viii) Advanced training programs; (ix) Participation in international mega-science projects; (x) Contributions to international non-governmental scientific bodies; (xi) Technology summit, industrial fairs, S&T exhibitions; (xii) Fellowships and Visitation programs for both Indian and foreign researchers and (xiii) Promoting academia-industry partnerships on international level, etc.

## **SALIENT ACTIVITIES CARRIED OUT DURING THE YEAR**

**New/ Renewal of Inter-Governmental S&T Cooperation Agreements /MoU/ Programs of Cooperation** were concluded by India with Argentina, France, Japan, Republic of Korea, Kuwait, Portugal, South Africa, Tunisia, Turkey and the United Kingdom (on Industrial R&D)

**Joint S&T Committee/Council meetings** were held with Argentina, Australia, Belgium, Brazil, Canada, China, Hungary, Japan, Netherlands, New Zealand, Portugal, Russia, Sri Lanka, and Ukraine. Governing Body meeting of the Indo- French Centre for Promotion of Advance Research (IFCPAR) and Indo-German Science & Technology Centre (IGSTC) were held during this year.

**About 450 Joint R&D projects and over 60 Joint workshops/ seminars** were supported. More than 700 exchange visits took place under various bilateral programs for joint research, information exchange and joint use of facilities and seminars/ training schools supported.

**New programs of cooperation were** initiated with United Kingdom on Mathematics; Netherlands on Smart Energy Grids and Functional Materials; New Zealand on Food Technologies; Russia on Innovative R&D; Japan on Materials Science; South Korea on Applied R&D; Applied and Industrial R&D programs with Finland, Spain and UK.

**Africa S&T Initiative:** This initiative is aimed towards capacity building and developing research linkages with African countries through fellowships, training, twinning and technology transfer with African countries. Department in partnership with MEA awarded Sir CV Raman Fellowship to 135 Researchers from 36 African countries to work in Indian laboratories for periods up to six months. Two training programs on Sustainable Development and Traditional Knowledge Systems were conducted by TERI, Delhi and JSS College of Pharmacy, Ooty during the period of report. These training programs were attended by more than 20 participants drawn from nearly 10 African countries. As a part of the twinning program aimed towards strengthening of selected African institutions, IISc Bangalore and ICGB Delhi were identified to work with IMSP, Benin and Pasteur Institute, Tunisia for preparing a detailed DPR.

### **Bilateral Research Projects**

International interactions through joint collaborative projects with countries mentioned below have been instrumental in accelerating outcome and adding value to national science, technology and innovation enterprises at large. Spectrum of impact can be gauged from illustrations such as (i) creation of new knowledge and research tools captured in co-authored papers with foreign scientists published in world class scientific journals; (ii) joint patents have been filed with foreign scientists; (iii) project based mobility has provided opportunities to Indian scientists for joining international R&D projects; (iv) absorbing experience of existing global research facilities in fine-tuning and/or coupling with upcoming or existing Indian research facilities; (v) building extended and stable institutional tie-ups with foreign partners to incubate feasibility of and/or scaling up of research, pilot scale production and high tech competence in India; etc.

**Argentina:** The 3rd meeting of India-Argentina Joint Committee on Science and Technology was held on October 02, 2013 at Buenos Aires. It was agreed to step up the cooperation particularly in the areas of Biotechnology, Ocean Science and Polar Research, Medical Sciences and Health, Agriculture and Food Technology, Information and Communication Technology, Renewable Energy Sources and Manufacturing Technologies. A Programme of Cooperation (POC) for the period 2013-15 was also concluded during the meeting. In addition to the ongoing ten projects in the areas of structural chemistry, bio-pesticide, health, and food industry, five new bilateral R&D projects were approved for implementation.

**Australia:** The 6<sup>th</sup> meeting of Indo-Australia Joint Science and Technology Committee was held in New Delhi on 6<sup>th</sup> August 2013. The Joint Committee recommended supporting 7 new joint projects and 5 joint workshops under Australia-India Research Fund. It also gave the future directions of S&T cooperation for the period ending 2015-16.

Under the Australia-India Strategic Research Fund (AISRF), fifty Indo-Australian research projects were supported in the areas of agricultural research, astronomy & astrophysics, microelectronic devices & materials, nanotechnology, renewable energy and marine sciences. 150 exchange visits of scientists were undertaken under these projects. Under the Indo-Australia Strategic Grand Challenge Round 2, four projects were supported in the areas of Health and Energy. Support was continued to 3 on-going major joint projects in the areas of food sciences and water security.

**Austria:** Support to 13 joint research projects was continued. Under a new MoU, DST and Austrian Research Fund (FWF) launched a new call for proposals Three collaborative projects research have been supported under this programme.

**Brazil:** The 9<sup>th</sup> India-Brazil Science Council (IBSC) meeting was held on September 27, 2013 at Rio de Janeiro. Chairman, Scientific Advisory Committee (SAC) to the PM led the delegation from Indian side whereas President, Brazilian Science Academy, led the delegation from Brazilian side. IBSC took stock of the developments and status of on-going activities and future cooperation in the priority areas such as biomedical sciences, computer sciences, material sciences, mathematical sciences, physical sciences, ocean and marine sciences and renewable energy.

Considering the considerable national interest on both sides and the need to step-up the R&D cooperation under a new MoU between DST and Brazilian CNPQ, 14 projects were selected for support in the areas covering earth and ocean sciences, biotechnology, medical and physics and materials research.

**Bulgaria:** the 7<sup>th</sup> meeting of the Joint S&T Committee was held at Sofia in December 2012 which reviewed activities under bilateral cooperation programme. Besides the ongoing 36 projects, the Committee considered 58 joint proposal submissions and approved 10 new joint R&D projects in areas covering biomedical research, biotechnology, high energy physics and food technology.

**Canada:** The 4<sup>th</sup> meeting of Indo-Canada Joint S & T Committee was held in New Delhi on 5<sup>th</sup> April, 2013. The committee reviewed the progress of the on-going S & T activities and finalized the Action Plan for the 2013-2014. The activities with Canada mainly involves support to industrial R&D, organization of joint workshops, establishment of virtual centres and support of project based mobility etc.

**Finland:** Support was continued to 11 Joint projects in the areas of green chemistry and nano-materials. Three joint networking workshops were also organized.

**France:** New targeted programmes in focused areas enabling research funding agencies of both the nations have been launched. These include (i) Indo-French Centre for Applied Mathematics (IFCAM), between DST and Centre National de la Recherche Scientifique (CNRS); (ii) DST-INRIA joint targeted program in Information and Communication Science & Technology; (iii) DST-ANR joint call for proposals in the areas of Neuroscience and Engineering Sciences was launched. 4 joint projects were supported against the first DST-ANR joint call.

**Germany:** DST-DAAD project based personnel exchange program: Support to 20 on-going joint research projects was continued and 10 new projects were approved in the various areas of basic research which includes areas of advance-materials, physical and chemical sciences; biotechnology, earth and atmospheric sciences.

DST-DFG Program: Support was extended to the 25 on-going projects. A joint call for proposals in the thematic area of applied chemistry was launched and 4 new joint research projects have been approved for support.

DST-AvH Program: The 5th Indo-German (DST-AvH) Frontiers of Engineering symposium was held in Hyderabad Germany in March 2013 June 2012. This symposium was attended by 35 young engineers from each side to deliberate upon the ongoing cutting edge research across engineering disciplines with the aim to develop new collaborations in promising areas of engineering sciences.

DST-MPG Partner group program: Four new partner groups and 5 DST-MPG Fellowships were awarded during the year, in addition to the ongoing partner groups in the areas of atmospheric chemistry, plant-insect interaction, tumor specific drug delivery system, cosmology & gravity, mass black holes in gravitational wave window, human genetic diversity, health sciences and evolutionary biology and structure-function relationship in protein machinery.

**Hungary:** 8<sup>th</sup> meeting of the Indo-Hungarian Joint Science & Technology Committee was held at New Delhi on 14<sup>th</sup> October 2013. Joint Committee reviewed the progress of ongoing six projects as well as finalized new schedule for the fresh call, which got closed in January 2014 against which 32 new proposals have been received.

**Israel:** Support continued to on-going eight joint projects in the areas of information technology, imaging sensor and robotics and solar energy (solar thermal & photovoltaic).

**Italy:** Support to 17 joint projects was continued. Under the India Trento Program for Advanced Research (ITPAR), 4 new projects in the areas of nano-photonics, computer sciences, telecommunication and cognitive science were approved. In addition, about 20 Indian scientists visited Trieste to perform experiments on Elettra Synchrotron Beam-line. Two training schools in the areas of cognitive science and nano-materials were organized.

**Japan:** Under cooperative programme with JSPS, 21 new projects, 3 workshops, 20 exploratory visits were supported in the areas of molecular structure, spectroscopy & dynamics; advanced materials; surface and interface sciences including catalysis; modern biology and biotechnology. Support continued



to 42 on-going joint projects. About 150 exchange visits of scientists were taken place under the joint projects. A Mizushima-Raman Lecture was delivered by eminent Japanese scientist in India under this program. India participated in the Asia Heads of Research Council meeting organized by JSPS in Indonesia. ADST-JSPS Asian Academic Seminar on “Mathematical Science” was held in Japan during November, 2013. Support continued to 40 ongoing projects the area of information and communication technology under DST-JST S&T Cooperation Programme.



**Republic of Korea (South Korea):** Support continued to 21 on-going joint research projects. Two joint workshops on Bioenergy and Robotics were held in India and Korea respectively.

**Mauritius:** Mauritian scientists participated in a training course on “Remote Sensing for potential Fishing Zones and Ocean State Forecast” organized by the Indian National Centre for Ocean Information Services (INCOIS) Hyderabad during March 24-29, 2014 in Hyderabad.

**Mexico:** 15 ongoing joint projects in areas of seismicity, physics, water, statistics, chemistry, and health sciences were continued for support. Two workshops in the areas of Water Science and Biotechnology were held in India and Mexico.

**Netherlands:** 8 joint projects in the area of bio-medical devices are being supported. Following holding of bilateral workshops in the areas of Smart Materials and Smart Grids, call for new proposals was launched against which 38 joint proposals were received. Three projects each in functional materials as well as smart grid energy have been identified for implementation. A new programme called Dutch India Water Led Initiative (DIWALI) was launched and an interaction meeting with Indian and Dutch water scientists and industry were organized. A project on waste water treatment has been launched.

**New Zealand:** Following the first meeting of the India New Zealand Joint Science & Technology Committee held in Wellington, two projects were approved for implementation in the areas of food technology. Natural hazards & resilient structures, post-harvest technologies and healthy citizens were identified as future areas of cooperation to be embarked after holding scoping workshops.

**Norway:** Support to 2 new collaborative projects in the area of Changes in Mass Balance of Glaciers and Rivers were continued.

**Portugal:** 4th Indo-Portuguese Joint Committee on S&T was held in New Delhi on May 08, 2013. A Protocol for implementing 17 projects in areas of nano-materials, smart textiles, microelectronics, mechanical engineering, health and biotechnology rated high on both sides was adopted by both sides.

**Republic of Korea (South Korea):** 5<sup>th</sup> Joint S&T Committee was held in December 2012. Support to 20 on-going joint research projects was continued and 6 new projects were approved in the areas covering Energy and Environment. It was decided to launch a new program on industrial R&D.

**Russia:** Cooperative activities continued under basic science research programme. Fresh call for proposals was made and 103 proposals were received for assessment. These are in addition to 42 ongoing projects being implemented in the areas of Physics & Astrophysics, Chemistry, and Biological Sciences. The 7<sup>th</sup> meeting of the Indo-Russian Working Group on Science & Technology was held at Moscow in October 2013. A new call between DST and the Russian Ministry of Education & Science was announced with a focus on applied areas of research.

**Singapore:** First joint call for proposals under the Indian-Singapore Programme of Cooperation was launched with A-STAR. Two joint workshops in the area of Advanced Materials and Advances in Chemistry, Biology & Technology for Medicine were organized in India and Singapore respectively.

**Slovenia:** 13 joint R&D projects in areas of health & biomedical sciences, metallurgy & new materials, polymer chemistry, mathematics, electronics, and alternate energy sources were continued to be supported.

**South Africa:** Support to 3 mega networked project in the area of HIV/AIDS and Tuberculosis with involvement of multiple institutions and 15 ongoing joint research projects on both sides was continued. A joint Call for proposals was launched in May 2013. Out of 74 proposal submissions received against the call, both sides agreed to support 12 projects for implementation in the area of health science & biotechnology, indigenous knowledge systems, astronomy and green chemistry.

**Spain:** Support continued to 20 ongoing joint research projects in the areas covering renewable energy, information technology (including computer science), health and medical research, life science and biotechnology (including pharmaceuticals), agriculture technology & food processing, nanotechnology continued. About 80 exchange visits of scientists took place under these projects.

**Sweden:** A maiden joint call for proposals with Swedish Research Council (VR) was launched. About 80 proposals on basic science research have been received against this call for technical evaluation by both sides.

**Switzerland:** Support to 11 projects was continued. In addition, 10 new joint projects in basic research were also jointly awarded.

**Thailand:** Under the Indo-Thai Programme of Cooperation, 11 new joint projects were funded.

**Tunisia:** 5 ongoing projects and 11 new projects were supported in various areas of science & technology.

**UK:** Two new major initiatives were launched between DST-RCUK. These include joint projects on Bridging the rural/urban divide and Next generation fuel cell technologies for application towards renewable and clean energy source. Three workshops were supported to develop future collaborative programmes on advanced manufacturing, applied mathematics and smart grids. New proposals have been invited for joint collaborative research in the fields of smart grid, materials and mathematics.

The program on India UK Science Networking between DST and Royal Society was renewed under which joint workshops, seminars and meetings would be supported in either country. Under this program, 15 bilateral events have been already supported.

Under DST-UKIERI program, 25 ongoing projects were continued in the areas of nano-science & technology and advanced materials, biotechnology including stem cell research, telecommunications, climate change and weather forecasting, new energy sources including hydrogen. 70 exchange visits of scientists from both sides have taken place under these projects. DST-UKIERI program was renewed and the new call for proposals has been also launched.

**Ukraine:** The 5<sup>th</sup> meeting of the India Ukraine Joint Science & Technology was held at New Delhi. Following the meeting, 14 new joint R&D projects were approved for implementation.

**USA:** The governments of India through the Department of Science & Technology and the US Department of State have established the United States-India Science & Technology Endowment Fund for promotion of joint activities that would lead to innovation and techno-entrepreneurship through the application of science and technology. The aim of the Fund is to support and foster joint applied R&D to generate public good through commercialization of technology achieved through sustained partnerships between US and Indian researchers and entrepreneurs. The second and third request for proposals (RFP) was issued in the priority areas of Healthy Individuals and Empowering Citizens and about 400 proposals were received. A multi-step rigorous evaluation process was adopted involving joint Indo-US expert panels and 8 joint projects were selected for award for the commercialization of technology-based innovative ideas aimed towards benefiting society and people.

The Joint Clean Energy R&D Centre (JCERDC) is a strategic joint initiative of the Ministry of Science & Technology and the US Department of Energy to facilitate joint research and development on clean energy technologies and their deployment with the greatest impact using a PPP model. Both governments have pledged US \$5,000,000 (about Rs. 26 crore) per year for five year duration. In addition, the Center will receive matching private sector funding from both sides. After an intensive multi-level review and evaluation process, three consortia, one each in the three priority areas: Solar Energy, Second Generation Biofuels and Energy Efficiency of Buildings were selected for award for a period of five years. Both of the programs are implemented through the bi-national Indo-US S&T Forum (IUSSTF) established by DST.

**Vietnam:** Support to ongoing joint research projects was continued in the areas of smart antennas for mobile communications; power source converter for AC photovoltaic etc.

## Bilateral Workshops

Nearly 40 joint S&T workshops/ symposia and training programs were supported in India and abroad in partnership with Australia, Brazil, Bulgaria, Finland, Germany, Italy, Japan, Mexico, Myanmar, New Zealand, Russia, Singaore, South Korea, South Africa, Spain, Switzerland, Taiwan, and UK. These activities were aimed towards information dissemination, networking and human capacity building and also helped to define the common areas of mutual interest for initiating cooperation with these countries.

## Industrial R&D Programs

For ensuring that R&D output is translated beyond the realms of the laboratories and the outcome reaches the market, bilateral initiatives directed towards scaling and commercialization of R&D outputs by providing financial assistance as well as networking with appropriate R&D organizations and industry partners on bilateral level have been initiated with chosen partner countries like Israel, Canada, Finland, Germany, South Korea, Spain Sweden. These programs are being implemented through the Global Innovation and Technology Alliance (GITA) platform of CII & TDB.



## Joint R&D Centers

Thirteen joint virtual R&D centers with networking between Indian and institutions abroad were continued to be supported. These Centers have been built on complementarity around existing capabilities, strengths and infrastructure towards optimal utilization of resources and also build human capital through seamless networking and mobility. These centers are basically meant for facilitating focused and integrated interaction and collaboration through networking of capabilities and infra-structure between Indian and

partner country (Russia, France and Germany) institutions in identified fields of mutual interest so as to leverage each other's strength to address research problems in quick and holistic manner.

### **Fellowships/Internships**

#### **Outgoing Fellowships for Indians:**

Nine PhD students in the area of Life Sciences, Chemical Sciences and Physical Sciences were sent to Japan for interaction meetings with Japanese Nobel Laureates under the HOPE meeting. Twenty PhD and Post Doctorate researchers in the areas of Physics and Chemistry participated in the 63rd Meeting of Nobel Laureates and students at Lindau, Germany. Twenty five undergraduate science students from across the country along with three supervisors participated in the 7<sup>th</sup> Asian Science Camp with Nobel Laureates held at Tsukuba, Japan during August 2013.

Ten Indian PhD students were awarded fellowships to work in Swiss R&D institutes for up to 12 months duration under Indo-Swiss Research Fellowship program. 104 Indian young scientists were supported under DST-MPG Fellowship program to conduct research in Germany. Eight Indian Ph. D students have visited South Korea under the India-Korea Research Internship Programme. 9 Indian PhD students have been selected and deputed to France under the Raman-Charpak Scholarship.



#### ◆ **Incoming Fellowships for Foreign Scientists to India:**

Against the 3rd call of the CV Raman International Fellowship for African researchers, 135 fellowships were awarded from 33 countries across Africa covering the broad areas of science, technology and medical research. Against the 4th call launched in 2013-14 about 466 applications were received from 38 African nations. Four Myanmar researchers have been awarded the P.C. Ray Fellowship program launched during this period.

Under other bilateral schemes, 10 Swiss PhD students were awarded fellowships to work in Indian research institutions; 3 Korean students were selected under India-Korea Research Internship Programme; and 5 French PhD students have been awarded the Raman-Charpak Fellowship to work in Indian laboratories and R&D Institutes.

A new Fellowship program for providing opportunity for young researchers from neighbouring countries to work in India has been approved. Six fellowship slots each for seven neighbouring countries will be covered under this new fellowship program.

#### **Bi-national Centres**

DST currently supports four bi-national R&D Centres which are independent entities established under inter-governmental bilateral agreements. The activities undertaken by these Centres are as follows:

**Indo-French Centre for Promotion of Advanced Research (CEFIPRA):** Under the core programmes of CEFIPRA, during 2013-14, 16 new projects in the areas of Life and Health Sciences, Pure and Applied Physics, Pure and Applied Chemistry, Earth and Planetary Sciences, Environmental Science and Biotechnology had been initiated under the Collaborative Scientific Programme, while support was continued for the 68 ongoing basic and applied science projects. Knowledge-product pathway had been catalyzed through six ongoing projects in the areas of ceramic, catalysis, financial inclusion platform, air-pollution monitoring, colorectal cancer diagnosis and Tilling in cucurbits under the Industrial Research Programme. The programme had further been strengthened through newly recommended three projects for finding solutions for the inspection of bond quality in aerospace composite joints, for enhancement/modifications of Sensing algorithms for existing wireless networks and to design and performance evaluation for Device-to Device communications for Advanced Cellular networks. The bilateral knowledge space had been further catalyzed through supporting seven seminars/workshops/training schools in the areas of Information Communication Technology, Proteomics, Materials for future, Earth and Planetary Science, Atmospheric Sciences, Design and Networking Models. Through these events, the Centre brought around 200 scientists from India and France together to share the knowledge in the advanced areas and plan for future collaboration.

The Centre expanded its activities introducing three new Non-core programmes viz. Targeted program, Innovation program and Dedicated Mobility Support to Students. Targeted programs provide a platform to the research funding agencies of both the nations to support collaborative research in specific thematic areas. The targeted programs operational during this year were (a) DST-INRA project on “Adaptation of Irrigated Agriculture to Climate Change”; (b) DST-ANR programme in the areas of Infectious diseases, Neuroscience and Engineering Sciences, (c) DST-INRIA programme in the areas of Big Data, Cyber Physical Systems (including Embedded systems) and High Performance Computing. Additionally, CEFIPRA

also facilitated implementation of Indo-French Centre for Applied Mathematics (IFCAM) established by DST and Centre National de la Recherche Scientifique (CNRS).

A new Innovation Programme had been launched through PPP mode. Saint-Gobain Research India (SGRI) and CEFIPRA launched a programme on “Sustainable habitat for hot and/or humid climates”. Expression of Interest was signed between EADS, a world leader in Aeronautics, Space, Defense and related services and CEFIPRA, to launch a new innovation program on Aerospace. In order to catalyze the ST&I ecosystems connections between India & France, CEFIPRA launched a Region-to-Region cooperation programme on a pilot scale between the State of Karnataka, India and Region of Aquitaine, France which will synergize the knowledge and business cooperation between two regions. In order to strengthen the human resource supply-chain Raman Charpak Fellowship launched in partnership between DST and the French Embassy, Delhi 10 students from India and 5 students from France were selected and are already undertaking their visit to the laboratories of the partnering country. CEFIPRA also supported participation of 6 Indian doctoral students in the prestigious training programme of European School on Nano-sciences and Nanotechnologies, Grenoble, France.

During the Indo-French Global Technology summit organized by CII and DST, held on 23 and 24 October, 2013, CEFIPRA highlighted its role as the fulcrum of Indo-French S&T cooperation through a display booth and three parallel sessions on Knowledge forward chain, Indo-French Collaboration Opportunities for SMEs in the Aerospace Sector and emerging opportunities through Indo-French Design collaboration. The second CEFIPRA Lecture-series was delivered by the Principal Scientific Adviser to the Government of India in Saclay, France on 2<sup>nd</sup> December, 2013.

**Indo US Science & Technology Forum (IUSSTF):** established under support from DST and the US State Department has a dynamic program portfolio that helps to catalyse and support bilateral science, technology and innovation programs involving government, academia, enterprises and industry from both countries. During the period, IUSSTF has supported over 30 bilateral Indo-US workshops. To foster linkages between the outstanding next generation of scientists and technologists from India and the US, the 5th Indo-American Frontiers of Science Symposium was organized. Two training schools on topical and thematic areas of interest were also organised. Under the Khorana Technology Transfer training program in biotechnology, 17 Indian scientists were supported to attend the course at the Univ. of Wisconsin. Support was continued to the 4 ongoing Indo-US Joint Centers of Research Excellence (CRESE); Ten new R&D Knowledge Networked Centers were awarded towards promoting collaborative research activities. Visitation programs enabled through Fellowships and Internships included : 49 Fellowships under Indo-US Research Fellowship for Indian Faculty; 20 internships for US students under Research Internship in Science and Engineering; 30 internships for Indian students under the Khorana Program for Scholars at Univ. of Wisconsin, Madison and partner US universities; launch of the new S.N. Bose Program for Indian and US students, under which 50 undergraduate students from India interned in US Universities and 30 US interns at Indian academic institutions were supported; Cornell University-State Agriculture Universities International Agriculture and Rural Development Exchange Program 7 students from Cornell and 8 from India were supported; Under Viterbi-India Internship program 20 Indian students interned at the University of Southern California in the areas of Computer Sciences, Electrical Engineering and Computational Sciences; Under the new 5 Indians were selected for the Indo-US Public Health Research Fellowship; Visiting Professorship awards for Physics and Microbiology were continued in partnership with American Physical Society and American Society of Microbiology.

In the space of Innovation and Technology Entrepreneurship the DST- Lockheed Martin 'India Innovation Growth Program', 30 business ideas have been identified, awarded and mentoring has been initiated for their rapid commercialization. Under the Stanford-India Biodesign Program for biomedical device innovation in partnership with DBT, 4 fellows were selected for the award. IUSSTF is also implementing the US-India Science & Technology Endowment Fund for Innovation created by DST and the US State Department. The second and third request for proposals (RFP) was issued in the areas of Healthy Individuals and Empowering Citizens and about 400 proposals were received. A multi-step rigorous evaluation process was adopted involving joint Indo-US expert panels and finally 8 joint projects were awarded for the commercialization of technology-based innovative ideas for the benefit of society.

The Joint Clean Energy R&D Centre (JCERDC) is a joint initiative of the Ministry of Science and Technology and the US Department of Energy implemented through IUSSTF. The aim is to facilitate joint research and development on clean energy technologies that may be deployed rapidly with the greatest impact. The JCERDC is based on a consortia model with equal funding from government and participating industries and academic institutions from both countries. After an intensive multi-level review and evaluation process of the 19 proposals received, three consortia- one each in the three priority areas: Solar Energy, Second Generation Biofuels and Energy Efficiency of Buildings were selected for award in April 2012. This first-of-its-kind initiative has brought together more than 100 Indian and US institutional and industrial partners is being supported to work jointly in the space of clean energy research.

In addition, the IUSSTF has launched three new programs on (i) India-U.S. Grand Challenge: Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in India and the US in partnership with SERB, India and US NIH; (ii) Graduate Research Opportunities Worldwide Program in partnership between the SERB, India and US, NSF to enable American post-doctoral fellows to undertake research work in India. As a part of the Solar Mission of DST, the Bhaskara Advanced Solar Energy (BASE) Fellowship Program has been launched to enable Indian research scientists to work in the United States and foster closer cooperation in the field of solar energy research.

**Indo-German Science & Technology Centre (IGSTC):** established between DST and BMBF, Germany, witnessed its journey from a nascent stage to a youthful phase in establishing an ecosystem and support structure for bilateral research partnerships of industrial relevance by connecting academia and industry across the borders on a PPP model. The Centre is currently supporting eleven ongoing joint projects in the applied areas of energy technology, nanotechnology, advanced materials & manufacturing, biotechnology and information & communication technology. All these projects are partnered by Indian and German industries in consortium mode with Indian and German research institutes with industry contributing 50% of the cost of the projects. Besides creating new knowledge, these projects are aimed to generate IP, patents and processes with a potential for commercial application. In the year under report, seven new Indo-German 2+2 projects were selected jointly for support. These projects were in the areas covering material sciences and nano-technology; clean energy technologies and information and communication technology.

In 2013-14, both the Governments constituted an expert group to review the mission and activities of IGSTC. The Review Report submitted in September 2013 appreciated the excellent efforts made by the Centre and strongly recommended IGSTC's continuation as an unique model in promoting innovation centric R&D partnership by effectively connecting academia and industry from both the countries.



IGSTC was also entrusted the responsibility for implementing the DST-Max Planck Agreement on behalf of DST. This program has provided an excellent opportunity to the Indian young scientists to partner with the global leaders at the Max Planck Institutes in Germany. The scheme so far has established 15 Partner Groups at newly established IISERs, IITs and Central Universities. Currently, largest number of Max Planck Partner Groups are now located in India.



**Solar-Thermal (CLFR Technology) demonstration unit at Thermax, Pune established under IGSTC project**

**Indo-Russian Science & Technology Centre (IRSTC):** The Centre has identified two technologies which are being negotiated for transfer. This includes ‘Over-the-Horizon and UHF, VHF Radars’ developed by Moscow Radio Technological Institute. These radars are capable for detecting objects like small boats etc. upto 40 kms range in the coastal sea and for low flying targets, for detecting somewhat larger boats and ships beyond 40 kms using over the horizon radar principles and for detecting low flying objects to protect key land installations. Because the technology is for strategic applications involving security aspects, IRSTC will initiate dialogue with appropriate agencies in the country towards the modalities of its transfer. A Joint venture for producing titanium and titanium based products for strategic and civilian sectors in India is being negotiated. Discussions between Mishra Dhatu Nigam (MIDHANI), Hyderabad and VSMPO-AVISMA, Ekaterinburg, to meet the desired goal have been embarked. The two parties have recently signed a Memorandum Understanding and constituted separate committees for preparing a feasibility report for realizing JV establishment.

## **INTERNATIONAL MULTILATERAL & REGIONAL COOPERATION**

International Multilateral Regional Cooperation Division (IMRCD) of Department of Science and Technology (DST) continued to play its mandated role in fostering India’s regional and multilateral science and technology cooperation frameworks at inter-governmental level with a view to make a positive contributions, gainful consequences and spin offs in:(i) Enlarging India’s pursuit of influence in global arena/ platforms and mainstreaming Science, Technology and Innovation (STI) into international science diplomacy and foreign relations; (ii) Moving up the ranks for India’s scientific excellence in the global research landscape; (iii) Leveraging foreign alliances and partnerships to accelerate key priorities and programs devoted to

strengthening India's national science and technology (S&T)/Research and Development (R&D) competencies-capabilities-access to technologies.

India's regional and multilateral S&T cooperation related functions performed during the year included the following:

- Coordination of negotiation, conclusion, implementation and monitoring of India's international regional and multilateral S&T cooperation agreements/frameworks and related S&T Program of Cooperation's **(India's S&T Cooperation with EU, ASEAN, e-ASIA JRP, BRICS, IBSA, SAARC, ACD, BIMSTEC, ASEM, EAS);**
- India's engagements vis-à-vis S&T aspects of UN and other international organizations **(India's S&T engagements with NAM S&T Centre, UNESCO-TWAS-ICTP, UNCSTD, OECD, IOR-ARC);**
- Indian perspectives at S & T Ministerial Multilateral Platforms and its spin offs **(Carnegie Group Meetings and its spin offs like GSO-GRI, Science and Technology for Society Forum) ;** and
- Strategies, opportunities for India's engagements with Indian S&T Diaspora (STIOs abroad) and related collaborative R&D activities/projects **(MOIA Global INK Platform, PM Global Advisory Council-Overseas Indians Steering Committee's HRD-KBE component).**

These functions in sync with India's overall foreign policy were carried out by IMRCD, DST in close consultation with Ministry of External Affairs, Ministry of Commerce and Industry, Ministry of Human Resources Development (MHRD), Scientific Ministries/Agencies, National Scientific Expert Committee on the Indian side and with DST (IMRCD) counterparts abroad for regional-multilateral entities-UN and international organizations dealing in S&T.

### **India's Multilateral and Regional STI Collaboration**

India is currently member of several international multilateral and regional organizations / entities/ bodies dealing with STI matters. India has been successful in moving its own STI agenda during negotiation processes and extensive debates on STI issues; getting unanimous and willing acceptance by diverse countries to move forward collectively. Thus. demonstrating India's global presence and leadership amongst the developing countries.

Key achievements that stand out in the recent past and have promise in future for India in its international STI alliances and partnership are as follows:

- Adoption of shared vision at the Ministerial Level; Finalization of MoU for STI Cooperation amongst BRICS Nations; and Assigning of Thematic leadership for building Research and Innovation Cooperation to each BRICS Nation. BRICS as such pitches on expanding technology trade and Economic growth driven goal post.
- Devising Ministerial and Institutional framework to take the current 30% share of India's S&T cooperation with ASEAN to the next level on topics such as public health challenges (Malaria R&D), and quality system in manufacturing (Laboratory Accreditation Services). ASEAN India dialogue partnership stands strong through the growing volume of trade in goods and services.

- Establishing an effective governance system for Indo European research and Innovation partnership to resolve key common societal challenges through India's collaboration with EU and Its Member States in variable geometry format and co investment of resources by any of the two or more Member States. India- EU/MS strategic partnership has gained strength through ever increasing volume of trade/commerce wherein research to innovation to business links are becoming important.
- India destination International research fellowships hosted by Indian universities and research labs (Research Training Fellowship for Developing Country Scientist RTF-DCS) sponsored by DST and implemented through NAM S&T Centre are gaining popularity across the developing countries especially from African region. India's Science Diplomacy initiatives are amplifying India's scientific footprint and South-South Cooperation

## **STRENGTHENING S&T IN STATES/UTs**

Department of Science & Technology (DST) has established 35 State Councils for S&T including those in 7 Union Territories (UT's) in the country. This programme was initiated by the Department for the promotion of Science & Technology and building strong base for providing S&T intervention in country. Department has played a catalytic role by facilitating the State Governments in establishing and developing the State Councils on S&T and by providing support for their technical secretariats. Concurrently, DST, in collaboration with respective State Councils, is organizing all India thematic seminars/workshops whose recommendations helped to identify some activity-areas for promotion by the State Councils. DST also organized periodic review meetings to discuss the status of various S&T programmes and to plan the strategy for future. Regional meetings organized by DST facilitated review of state S&T structures and identification of areas of mutual cooperation between States for implementation of project and programme to address the location specific issues through Science & Technology interventions. The support provided under SSTP can be classified as:

- Core support to S&T Councils
- Support to creation of patent information centers
- Location Specific Research and Technology Development (LSR&TD)
- Pilot scale technology demonstration and replication of successful models
- S&T studies , surveys , information exchange and joint programming

### **New Projects supported**

During the year 2013-14 following activities were carried out under the Programme :

- **Core Support**  
27 State Councils for S&T were supported in the tune of Rs. 13.99 Crore for their technical secretariats to implement S&T activities in the country.
- **Location Specific Research and Technology Development (LSR &TD) programme** 14 new projects were supported for specific S&T intervention in the following areas:

1. **Health and Medical Science:** Development of low cost weaning foods and mechanism for its application in combating malnutrition in rural area among weaker section; Biochemical, enzymological, antagonistic and antimycotic studies on fungal infection in mammal; Community awareness project for prevention of Zoonoses; Comparison of stability with two times use of platelet rich growth factor verses one time use of platelet rich growth factor in immediate placement of dental implant in infected socket.
2. **Agriculture:** Development and validation of microbial consortium as single window delivery system for growth promotion of summer muga bean in rice wheat system in Punjab ; Seed production of potato through tissue culture technique.
3. **Waste Management / Water purification:** Development and demonstration of bioremediation of indigo dye containing textile effluents using microbial bio films with adapted microorganism; Assessment of Arsenic in the water of the Simri village in Bihar specifically in a school.

- **Technology Demonstration**

17 new projects were supported with typical examples like: Popularization and dissemination of technology of bio-pesticide formulations among the poor and marginal (ST) farmers of weaker sections in North East region at Indian Institute of Horticultural Research (IIHR), Bangalore; Socio-economic upliftment of farmers through Mithun based farming system at National Research Centre on Mithun (ICAR), Dimapur; Awareness & training (TRG) – Capacity building of fabricators, Cupola owners & their workforce at St. Xavier’s College, Palayamkottai , Tamilnadu; Tricycle rickshaw operated paddy thresher at Manipur Science & Technology Council, Imphal; Dori Micro-hydel project(3 X 100kw) at Dokoputu village, West Siang district, Arunachal Pradesh; Development of a robust, high performance and field ready rural lighting solution using rapidly rechargeable hybrid at Indian Institute of Science, Bangalore; Pilot scale optimization for standardization of processing and agro technologies of selected high value aromatic and medicinal plants including technology demonstration and extension for socio-economic up-liftment at CSIR IIIM Sanatnagar, Srinagar etc.

- **The other important meetings and activities supported and organized :**

1. The meeting of SAC to PM with State S&T Department /Councils organized at Indian Institute of Science , Bangalore on 06.07.2013 wherein representatives from 33 Councils /Department across states were gathered to participate in the event. The need for research relevant to local problems in the farm sector, water, energy, popularization of rural technology and encourage innovation from grass root emerged from the discussions.
2. In order to enlarge the infrastructure base of R&D across the country as wide array of technologies have been developed by various R&D institutions under the Centre and State Governments and their full potential remains untapped for various reasons. Therefore to implement State Centre partnership a new programme has been initiated i.e. State Centre Resource Institute for Partnerships in Technology (SCRIPT) programme. A MoU has been signed with Kerala Govt. on 04<sup>th</sup> March’2014.

**Major achievements: Technologies developed and undergoing trials**

Some of the projects implemented in various part of the country have generated promising outcome and have potential for applications in the various parts of the country. The outcome is as follows:

**1. Plus tree selection and development of *Ailanthus excelsa* based agro-forestry systems for south-west Haryana implemented at CCS Haryana, Agricultural University, Regional Research Station Bawal (Rewari), Haryana**

- Thirty candidate plus trees were identified after conducting a survey in the state of Rajasthan and the seeds were from these trees. Twenty progenies based on growth performance in nursery from these trees have been planted in the field for further studies. The height varied from 32.57 (P-21) to 47.00 cm (P-8) after 6 months of planting.
- The yield of pearl millet and clusterbean crops was not affected by different spacing of *Ailanthus excelsa* as compared to control (with out trees) during the 1<sup>st</sup> year of plantation. However average yield of pearl millet and clusterbean was 32.0 q/ha 10.5 q/ha respectively that was at par with open field. Same trend was observed for Rabi crops (Raya and Wheat)
- *Ailanthus* plantation done in both the directions (N-S and E-W) on bunds of field did not affect the yield of crops raised during the Kharif and Rabi season 2014



Wheat and Raya raised in the inter spaces of *Ailanthus excelsa*

**2. Assessment of copepods as bio-control agents of mosquito larvae in standing water bodies of Punjab implemented at Punjab Agricultural University, Ludhiana, Punjab.**

Survey conducted at various water bodies of three districts of Punjab from April to July, 2013 showed the prevalence of copepods in fish farm as compared to other water bodies. Monitoring of copepod population at monthly intervals (July to Dec., 2013) from fish farms showed optimum copepod count/L during the month of August, 2013. Three orders of copepods *i.e.* Calanoida (43%), Cyclopoida (56%) and Harpacticoida (1%) and three types of mosquito larvae *viz.*, *Culex*, *Aedes* and *Anopheles* were observed. The co-existence of copepods and mosquito larvae was found in

paddy fields, fish farms and other temporary water bodies except village ponds. The techniques for rearing of mosquitoes and culturing of copepods under laboratory conditions were standardized.

**3. Development of organic seedlings of horticultural crops by rural farmers and dissemination of the technology” is being implemented at HOPE First Foundation, Bengaluru , Karnataka**

- Generated awareness among farmers in Malur, Doddaballapur, Peeler and Gulburga region on the use of bio-pesticides for producing organic seedlings of horticultural crops.
- Took up the mass production of bio-pesticides such as *Trichoderma harzianum*, *Peacilomyces lilacinus*.
- Developed protocols of organic seedlings production in capsicum, tomato, cabbage and cauliflower. These organic seedlings were distributed near Madure village, Chikaballapur district to evaluate the efficacy of bio-pesticides in the farmers fields. Farmers used only bio-pesticides till completion of the crop period.
- Demonstrated the organic seedlings production methods and distributed the bio-pesticides to the farmers in Karnataka
- Farmers also observed a tremendous difference between chemical input grown crops and organic seedlings grown crops which were easily grown, sustainable against plant infections and gave more yield in each crop.
- **Patent application filed through DST – PFC on “A microbial consortia formulation with bio-bactericide (*Pseudomonas fluorescens*), bio-nematicide (*Pochonia chlamydosporia*), bio-fungicide (*Trichoderma harzianum*) and Phosphate solubilizing bacteria (*Bacillus megaterium*)”.**



Distributed cabbage and cauliflower organic seedlings grown in the farmers’ main field.



Training and distribution of bio-pesticides to the farmers to produce organic seedlings

**4. Effect of parental psycho education, ethics of research participation, and array comparative genomic hybridization in subjects with Mental Retardation (MR) and/or Autism, a collaborative project is being implemented at Ram Manohar Lohia (RML) Hospital, Park Street, New Delhi and Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad, Andhra Pradesh**



**6. Freeze restriction studies for frost protection in subtropical fruit plants at Dr YS Parmar University of Horticulture and Forestry Institute of Biotechnology and Environmental Science Neri, Hamirpur (HP).**

In the low hill and valley region of Himachal Pradesh Frost is a serious threat, therefore efforts have been initiated to mitigate the impact of frost induced freezing in subtropical fruit plants which are highly vulnerable to this stress. The method for frost detection has been named as dry and rehydration method. This method has high reproducibility and is very accurate in accessing frost damage. One of the photograph of the frost damaged leaf visualized after drying and rehydration method is shown in photograph No. 1. It has been seen that in most of the fruit tree species like mango, litchi, papaya, guava etc., intrinsic ice nucleation is there instead of extrinsic one. Photograph No. 2 shows the freezing of bud and subsequent spread of freeze damage to the vascular system. Further, the work has been initiated on freeze restriction practices. It is for the first time that frost damage score has been assigned to the damaged species and a methodology has been standardized for quantification of frost damage in the subtropical regions. Delineation of the frost sensitivity of the different agro-ecological situation occurring in the zone-1 on Himachal Pradesh has been done.



Illustration of frost damage spread across the vascular system of mango shoot



Visualization of frost damage through drying and rehydration method



**7. Development and transfer of technology of mass production of *Bacillus spp.* with nematophagus fungi for the management of disease complex in certain vegetable crops and dissemination of technology among farmers at Indian Institute of Horticulture Research , Bangalore**

A liquid and talc based formulation has been developed for *Bacillus subtilis* and the toxicological and shelf life data is generated for the same. Its bio-efficacy was tested against the disease complexes in papaya (open field conditions) and capsicum (protected cultivation). It was found to be effective against disease complexes. Study on the biochemical interactions in the plant rhizosphere showed that this combination formulation has an increased plant defensive enzyme production under glass house conditions. The combination formulations that were developed out of the project have been demonstrated successfully to the farmers by conducting on farm trails under farmers' field conditions. Training programs were conducted and awareness was generated among few hundreds of farmers in several places of Karnataka.



Evaluation of *Bacillus subtilis* bio-efficacy under shade net

**Two Patent applications were filed through DST-PFC on: (1) Identification of *Bacillus subtilis* strain with bio-nematicidal, bio-fungicidal and bio-bactericidal properties. (2) The combination formulation of *Bacillus subtilis* and *Paecilomyces lilacinus*. An effective mass production protocol has been developed for the combination formulation with shelf life of 16 months.**

### **BUILDING NANO S&T CAPACITY**

The Mission on Nano Science and Technology (Nano Mission) — an umbrella programme - was launched in the year 2007 to promote R&D in this emerging area of research in a comprehensive fashion. The main objectives of the Nano Mission are — basic research promotion, research infrastructure development, nano applications and technology development, human resource development, international collaborations and orchestrating national dialogues. During the year 2013-14, India secured 3<sup>rd</sup> position in

the world in terms of scientific publications in nano science and technology. It is widely acknowledged in the country that Nano Mission's activities played an important role in achieving this milestone. Towards the end of 2013-14, the Union Cabinet also approved continuation of the Nano Mission in its Phase-II in the 12<sup>th</sup> Plan Period with an allocation of Rs. 650 crores. Nano Mission continued to record expansion in its activities which are summarized in brief below.

### Basic Research Promotion

24 new individual scientist-centric R&D projects were funded this year which focused on fundamental scientific studies of nano-scale systems. Some of these projects dealt with: investigation and analysis of nonequilibrium quantum transport and magnetization dynamics in magnetic molecular nanoelectronic devices with optimized electrode topology; theoretical exploration of optical properties and photovoltaic application possibilities of carbon based nanostructures; studies on the dynamic behavior of water in carbon nano tubes and application to filtration; design, synthesis and application of new classes of easily recoverable and reusable transition metal nanocatalysts; development of peptide based immunogen using E1, E2, E3 and capsid proteins of chikungunya virus using nanoparticles as delivery vehicle; targeted delivery of nanoconjugated methylglyoxal to cancer cells and understanding the bioenergetic difference between normal and malignant cells at the molecular level; nanomolecular aggregates from glycolipid mimics and cyclic peptides with application in drug delivery, membrane engineering and vaccine development; nanotechnological strategies for seed invigouration in rainfed groundnut; design and development of intelligent catalytic nanobots; synthesis of metal oxide - graphene based nanocomposites for its energy related supercapacitor application.

The ongoing individual scientist-centric R&D projects, Centres, Units, Thematic Units of Excellence and other programmes continued to receive support during the year. Some important achievements of these ongoing projects were:

- Nano-herbicide to kill one of the most notorious weeds "*Cyperus rotundus*" in rainfed areas has been designed and fabricated for effective weed control.
- Efficient, economically viable and cost-effective nanoadsorbents for removal of toxic metal ions and bacterial pathogens from waste have been developed.
- Efficient drug delivery magnetic nanocarrier and hyperthermia agent for combined therapy of cancer has been developed.
- Solid-state synthesized nanoarchitected electrodes consisting of transition-metal phosphide (TMP) supported on copper nanorods as negative electrode for next generation Lithium-ion battery (LiB) have been developed: The copper nano rods have been synthesized by means of simple template electrodeposition technique (Fig. 1). Aluminium oxide layer is used as a template over the copper current collectors. The TMPs are synthesized either by direct electrodeposition or through a two-step process which involves first the electrodeposition of the metal and then conversion of the metal to phosphides by a solid state technique..

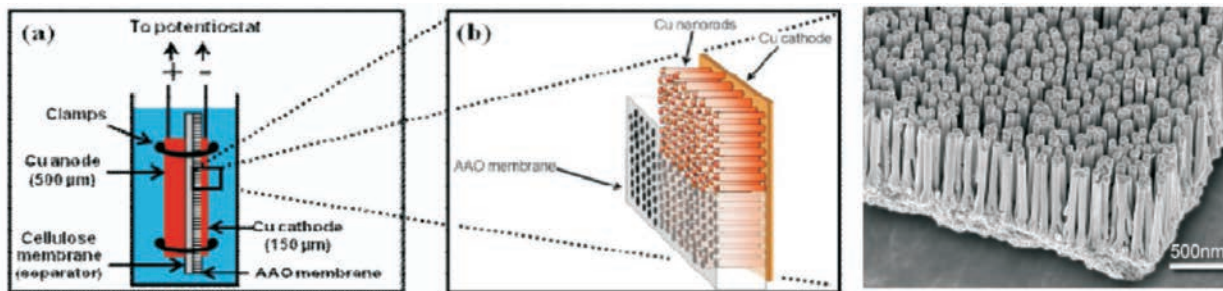


Figure 1. (a) Electrochemical cell used for the template synthesis of the Cu nano rods. (b) Cu nano rod before and after the AAO removal (c) SEM image of the Cu nano rod.

- Electrospinning has been developed as a versatile technique for preparing scaffolds for engineering bone tissues, skin, cartilage, cardiac, etc with improved cellular adhesion and penetration into the scaffold interiors by adopting a novel multiscale geometry for the electrospun fibers (Fig. 2). Bioactive hydroxyapatite, bioglass, nanosilica,  $\text{TiO}_2$ ,  $\text{ZrO}_2$ , nanoclay, etc. have been mixed with biodegradable polymers of PCL, PLGA, PLA, Chitin, Chitosan, Alginate etc. and 3D scaffolds of the mixture have been fabricated.

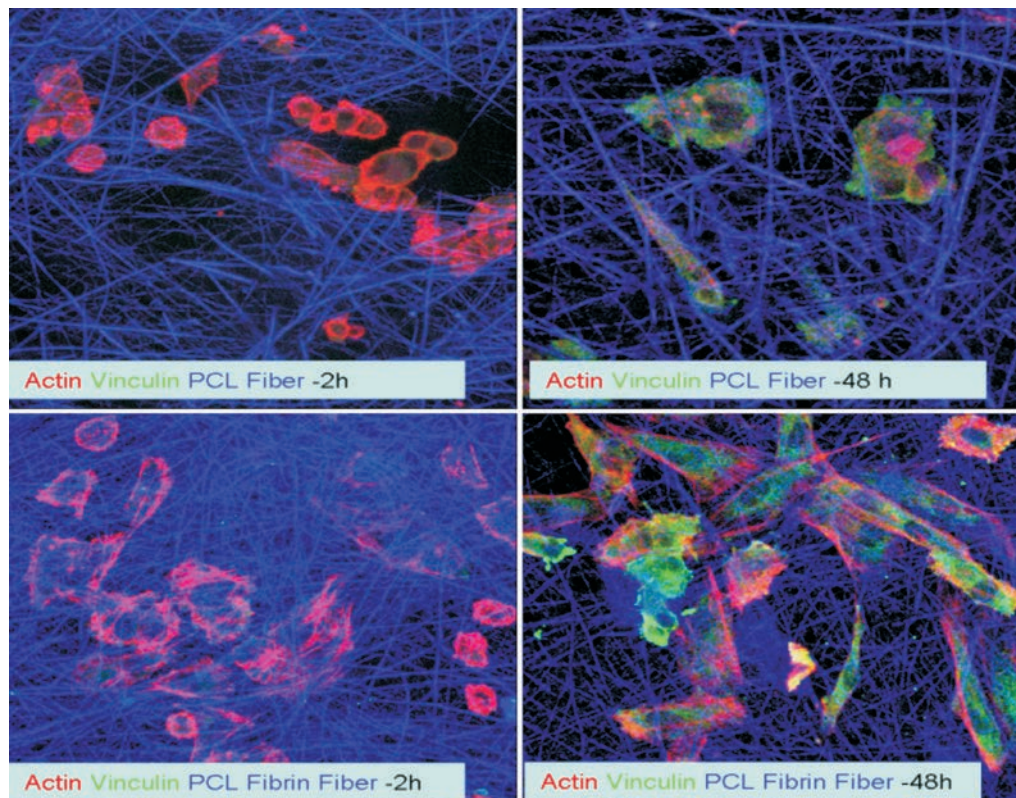
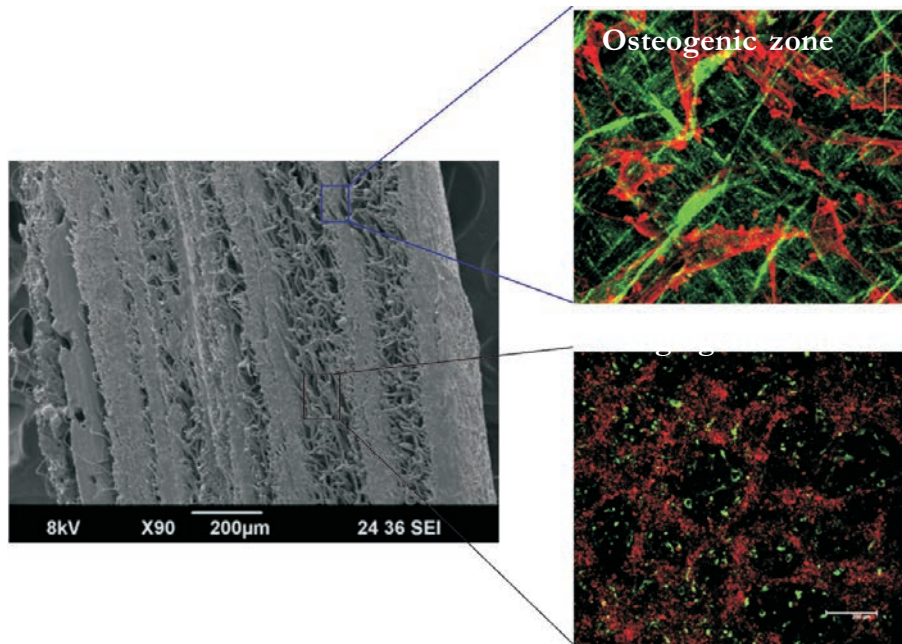


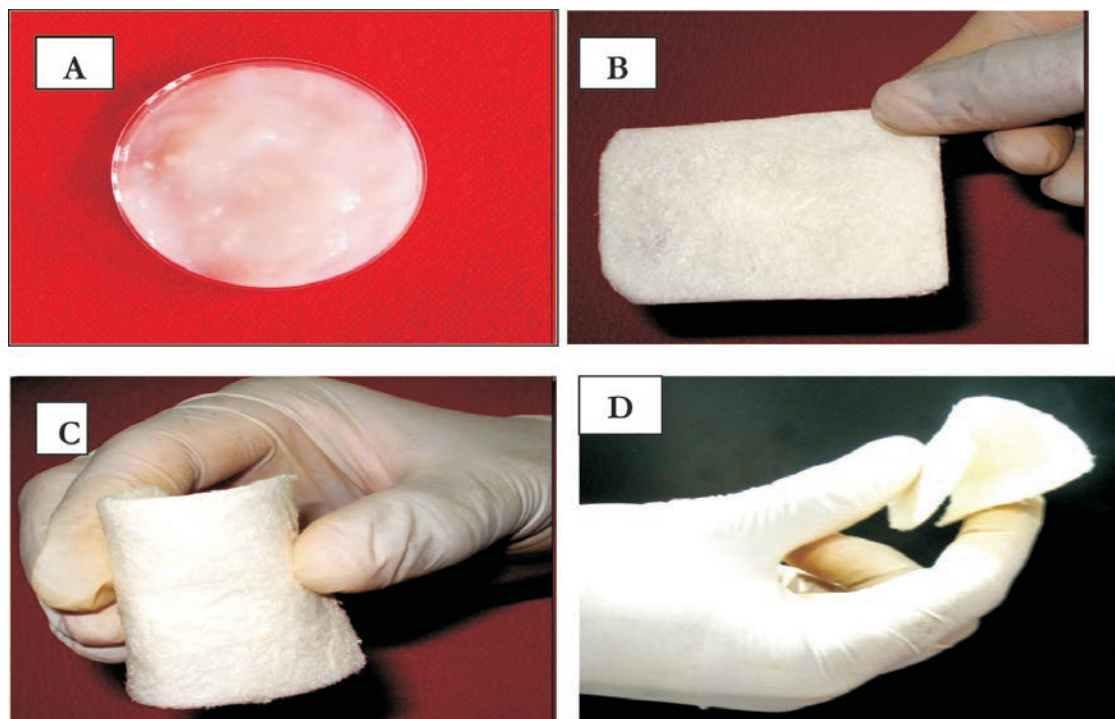
Fig 2: Confocal images of hMSCs seeded on a&b) PCL Micro-nano fibers and c&d) PCL Fibrin fibers stained with TRITC Phalloidin and FITC conjugated anti vinculin. Fibers are shown in blue.

- A novel scaffold has been developed (Fig. 3) for vascular tissue engineering using electrospinning in multilayers, with an axial layer for endothelial cells and a circumferential layers for smooth muscle cells all integrated into a single structure.

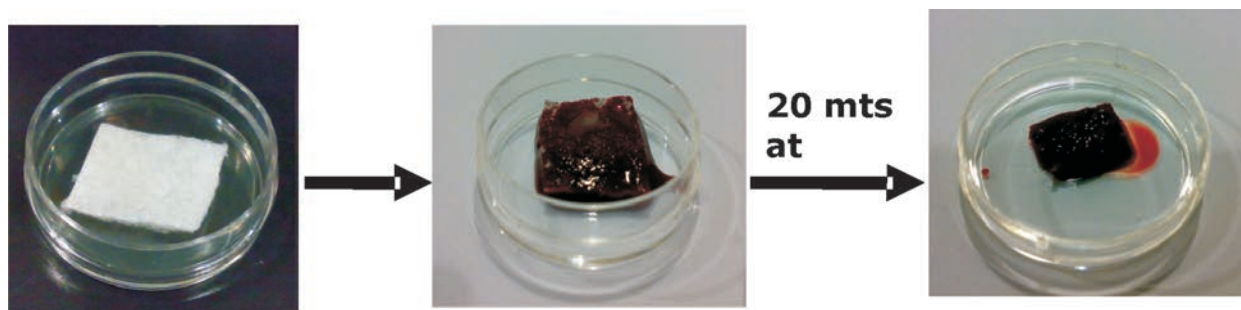


**Fig. 3.** SEM image of the layer-by-layer electrospun vascularized bone construct (left); Confocal images of cell seeded osteogenic zone (upper right) and angiogenic zone (lower right).

- Porous nanocomposite sponges (bandage) were developed for burn, chronic and diabetic wound. The prepared sponges showed adequate cell adhesion, blood clotting and antibacterial activity (Fig. 5 & 6).



**Fig. 5.** A) Chitosan/ZnO Hydrogel, (B), (C) & (D) Chitosan/ZnO Hydrogel nanocomposite Sponge



**Fig. 6. Blood clotting studies of Chitosan/ZnO Hydrogel nanocomposite Sponge (Bandage)**

- A prototype motor fabricated with stator has been developed using high performance Fe-P.
- A water purifier named AMRIT (Arsenic and Metal Removal by Indian Technology) for arsenic and iron free drinking water, based on nanomaterials has been developed (Fig.7). About 100 units of AMRIT serving 30,000 people have already been installed at affected places in Murshidabad District of West Bengal.



**Fig.7. AMRIT (Arsenic and Metal Removal Technology) water purifier developed by Indian Institute of Technology-Madras.**

The Centre for Knowledge Management of Nanoscience and Technology (CKMNT) at ARCI, Hyderabad continued monitoring, searching, compiling and analyzing the developments taking place globally in the area of nanoscience and technology using state-of-the-art databases and disseminating the information to different stakeholders in the form of value-added techno-commercial reports, market research reports, technology briefs, white papers and thematic databases. CKMNT is becoming highly visible as a nano-knowledge management centre of excellence through its output and services. CKMNT has brought out the following techno-commercial reports:



Fig. 8. List of techno-commercial reports brought out by CKMNT, Hyderabad

### Development of R & D Infrastructure

After the appointment of its Director, activities of the Institute of Nano Science & Technology (INST), Mohali, have gained momentum. Foundation stone for the institute building was laid by Prof. C.N.R. Rao on March 2, 2014 (Fig. 9.).



Fig 9. Foundation stone laying ceremony of the Institute of Nano Science & Technology (INST), Mohali

Good progress has been reported towards establishment of low-energy ion-beam facility at Kurukshetra University. Construction of a new building for housing the proposed accelerator facility at Kurukshetra University has been completed.

Support for High Performance Computing Facility at IUAC continued this year and significant increase in number of users has been reported.

### **Nano Applications & Technology Development**

A programme for promotion of nano applications and technology development was finalized this year which focused on employing special instruments of funding for various stages of technology development.

Support to the ongoing joint institute–industry linked projects continued during the year and very good progress was reported from these projects.

### **Human Resource Development**

Support to ongoing Post Graduate programmes (M.Tech/ M.Sc. in Nano Science & Technology) continued during the year. About 200 students received M.Tech and M.Sc from these programmes.

Post-doctoral fellowships to attract talented young researchers towards advanced research in Nano Science & Technology continued to be offered through Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore.

ICONSAT-2014, a flagship event of the Nano Mission, was organized at Chandigarh. About 900 participants from India and abroad attended this mega event. Partial support to 4 other International /National Conferences was also provided. The National Research Award in Nano Science and Technology for the year 2014 was awarded to Dr. Goutam De, CSIR-CGCRI, Kolkata and the Young Career Awards in Nano Science and Technology for the year 2014 were awarded to Prof. Arindam Banerjee, IACS, Kolkata and Prof. Umesh Waghmare, JNCASR, Bangalore.

### **International Collaborations**

Support for using the India-Japan beamline established at the Photon Factory, KEK, Tsukuba, Japan continued and Indian scientists from all over the country carried out their experiments using this facility.

Also, support to the PETRA III project continued and several important and novel experiments were carried out by Indian scientists using this facility.

Under the Indo-Canada collaborative programme, Faculty-to-Faculty collaboration continued and a School on ‘Nanofabrication and Characterization’ was organized at NINT / University of Alberta during the year with participation of 17 Indian participants.

### **Orchestrating National Dialogues**

The Nano Mission continued to forge linkages with other government agencies and industry organizations in promoting nano science and technology in the country and also orchestrate national dialogues on issues which are manifestly multi-agency issues. A draft guideline entitled ‘Guidelines and Best Practices for Safe Handling of Nanomaterials in Research Laboratories and Industries’ has been evolved.

Support to the project for development of Standards for Nanotechnology implemented by National Physical Laboratory, New Delhi, also continued this year.

## **DEVELOPING STRATEGIC KNOWLEDGE FOR CLIMATE CHANGE**

Two national missions on climate change i.e. National Mission for Sustaining the Himalayan Ecosystem [NMSHE] and National Mission for Strategic Knowledge on Climate Change [NMSKCC] launched under National Action Plan for Climate Change [NAPCC] are under implementation by the Department.

### **Highlights of activities of the scheme during 2013-14:**

- A Major climate change research programme on ‘Building Human and Institutional Capacities for Sustaining Himalayan Ecosystem’
- Strengthening of existing Knowledge Centres of Excellence and institutions
- Thematic Knowledge Networks on the key areas of climate change impacts
- Technology Watch Groups in Climate Change on identified areas of climate change adaptation and mitigation
- Capacity building programmes/Training of research professionals in climate change related areas.
- Formation of an Inter-university consortium for study on Himalayan Cryosphere
- International bi-lateral and Regional cooperation

### **Major Initiatives Undertaken**

As part of deliverables of these national missions, the CCP division has initiated and supported 6 major research programmes during the period 2013-14. These include:

- i. Socio Economic Vulnerability of Himachal Pradesh to Climate Change, at Integrated Research for Action and Development (IRADe), New Delhi;
- ii. Strengthening of existing Centre of Excellence in Climate Change – Divecha Centre for Climate Change, IISc, Bangalore;
- iii. Inter-University Consortium on *Himalayan Cryosphere: Science, and Society, coordinated by JNU, New Delhi and participated by three other universities;*
- iv. Madhya Pradesh State Climate Change Knowledge Management Centre (MP SCCKMC) at EPCO, Bhopal, and
- v. Building an International Research Network on Sustainability to Enhance Strategic Knowledge for Climate Change” at Indo-German Centre for Sustainability, IIT, Chennai
- vi. National Knowledge Networks on Climate Change- two networks one each on Climate Change Science and Modeling and Climate Change Science and Human Health coordinated by IIT, Delhi and participated by a number of institutions.



Brief scientific summaries of these programmes are given below

**(i) Socio Economic Vulnerability of Himachal Pradesh to Climate Change at Integrated Research for Action and Development (IRADe), New Delhi**

The main aim of this study is to develop methods to identify and assess scientifically the impacts of climate change and variability on agriculture and forestry of Himachal Pradesh, statistical synthesis of Climate parameters projections made by international researchers and establish relevance to the region to assess current vulnerability and changes by taking into account economic activities that may take place over the next 30-50 years (when climate impacts will become critical). Another objective of the study is to carry out literature survey and identify gaps in knowledge, data having relevance to the region. The Project is also expected to explore possible linkage of the project outcome to decision making and policy development.

**(ii) Strengthening of existing Centre of Excellence in Climate Change - Divecha Centre for Climate Change, IISc, Bangalore;**

This programme has been supported by DST for capacity building and to expand and enrich climate change research activities at the Divecha Center for Climate Change, Indian Institute of Science. The research activities under this proposal are mostly related with global modeling of climate change and carbon cycle, monitoring and modeling of Himalayan glaciers, impact of aerosols on Indian monsoon, impact assessment for forests, water resources, mitigation of climate change using solar power, and assessment of geo-engineering methods. This programme is expected to bring significant advances in the understanding of all three aspects of climate change: science, impacts and vulnerability assessment and mitigation.

**(iii) Inter-University Consortium on Himalayan Cryosphere: Science, and Society, coordinated by JNU, New Delhi and participated by three other universities;**

An inter-university consortium on Himalayan cryosphere has been set up with the participation of four Universities i.e. Jawaharlal Nehru University, University of Kashmir, Jammu University and Sikkim University. This programme proposes research on glaciological studies that may be applied and required the analysis and interpretation of the myriad data on various aspects of the Himalayan cryosphere dynamics. The applications and use of the would-be-generated data are expected to form an important input for formulation of research strategy and for decision makers in the country in various sectors since existing data on the Himalayan cryosphere and the impact of climate change on these resources is very limited. The data thus generated would help in formulating national programmes on climate and climate change impact and essential/necessary mitigation measures for the future. It could, in turn, be useful for similar cryosphere regions in the world.

**(iv) Madhya Pradesh State Climate Change Knowledge Management Centre (MP SCCKMC) at EPCO, Bhopal**

A State Climate Change Knowledge Management Center for Madhya Pradesh has been strengthened as MP-SCCKMC with the aim to serve as a functional knowledge hub, catering to the information and knowledge needs of policy makers, scientific community and general public on climate change issues. To achieve its mission, the MP SCCKMC will include provisions for information generation and knowledge sharing on multiple dimensions.

**(v) Building an International Research Network on Sustainability to Enhance Strategic Knowledge for Climate Change” at Indo-German Centre for Sustainability (IGCS), IIT, Chennai**

The programme on “Building an International Research Network on Sustainability to Enhance Strategic Knowledge for Climate Change” at the Indo-German Centre for Sustainability (IGCS) at IIT Madras has been supported by CCP to serve as a Centre for Strategic Knowledge on Climate Change. It will conduct research, technology development, training and knowledge dissemination in a set of five priority areas relevant to a changing climate in India. The Centre will aim to direct its activities towards building resilient systems in the face of climate change as well as enhance strategic knowledge on climate change in key areas. The IGCS will host German scientists from their top universities who will work in identified areas related to climate change. These scientists will work on the research projects jointly with their Indian counterparts.

**(vi) National Knowledge Networks on Climate Change- two networks one each on Climate Change Science and Modelling and Climate Change Science and Human Health coordinated by IIT, Delhi and participated by a number of institutions**

Two knowledge network programmes i.e. climate change science and modelling and climate change science and human health involving 7 institutions/Universities and 10 institutions/Universities, respectively have been set up under NMSKCC mission. A review meeting in this regard has already been convened during 9-10 January 2014 at IIT, Delhi to monitor the progress of these networking partners. It is expected to generate knowledge and information in the emerging areas related to climate change from the networks.

**R&D manpower trained/generated (PhDs etc.)**

CCP initiated a number of R&D programmes on some key areas of climate change science, adaptation and mitigation. The broad objective of these programmes is to build human and institutional capacities in climate change. These programmes employ a number of research students. The programmes are expected to generate trained manpower in the area of climate change sciences and technologies in such institutions that include; IITs, Bombay and Delhi; International Crops Research Institute for Semi-Arid Tropics (ICRISAT), Hyderabad; Indian Agricultural Research Institute (IARI), Delhi; Birbal Sahni Institute of *Palaeobotany* (BSIP), Lucknow; Institute of Rural Management (IRMA), Anand; National Institute of Oceanography (NIO), Goa; Tamilnadu Agricultural University (TNAU), Coimbatore; etc.

**Important Achievements of supported projects**

A gist of important findings/outcomes/achievements of some of the programmes supported by Climate Change programme of DST is given below:

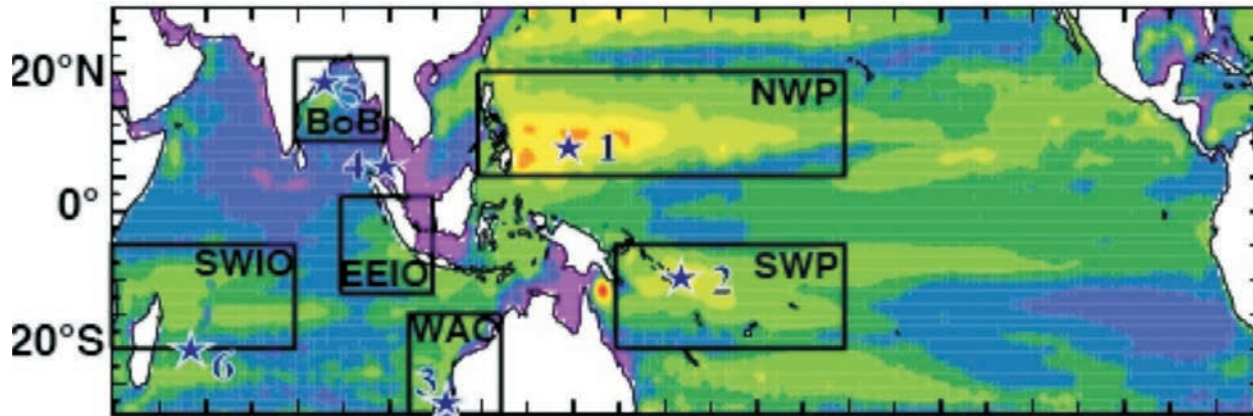
**(i) Centre of Excellence in Climate Studies, IIT, Bombay**

- Launch of Interdisciplinary PhD programme in Climate studies
- Three new PhD level core Climate Studies courses in the programme started- 11 PhD students given research guidance

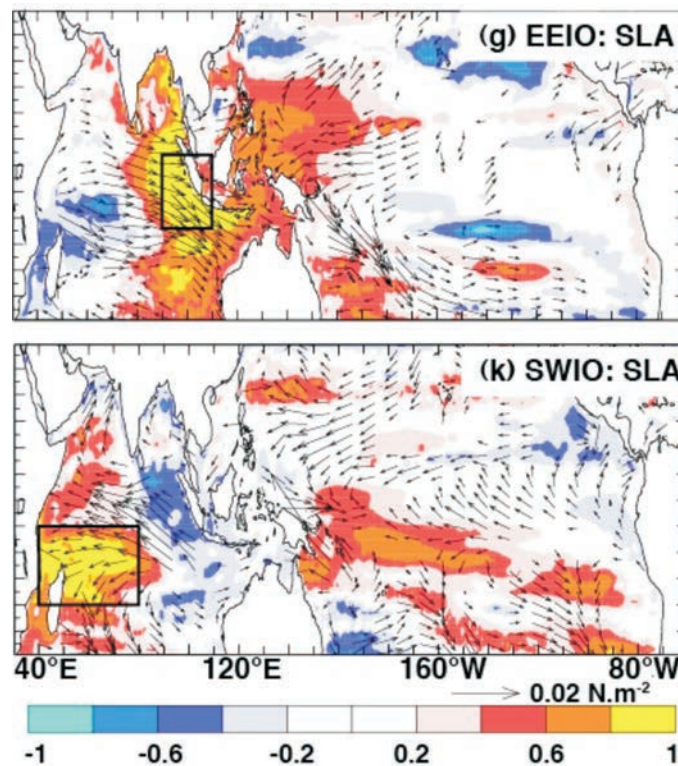
- Two workshops were conducted.
- Collaboration has been established with Centre for Development of Advanced Computing (CDAC, Pune) and Centre for Mathematical Modeling and Computer Simulation (CMMACS, Bangalore). Two PhD students have undergone training.

**(ii) Decadal and long-term sea level variability in the tropical Indo-Pacific Ocean, at National Institute of Oceanography, Goa**

Sea level observations from satellite, tide-gauges and simulations from an Ocean General Circulation Model were used to investigate the decadal sea level variations. Initial results indicate that sea level changes are showing significant decadal time scale variations.

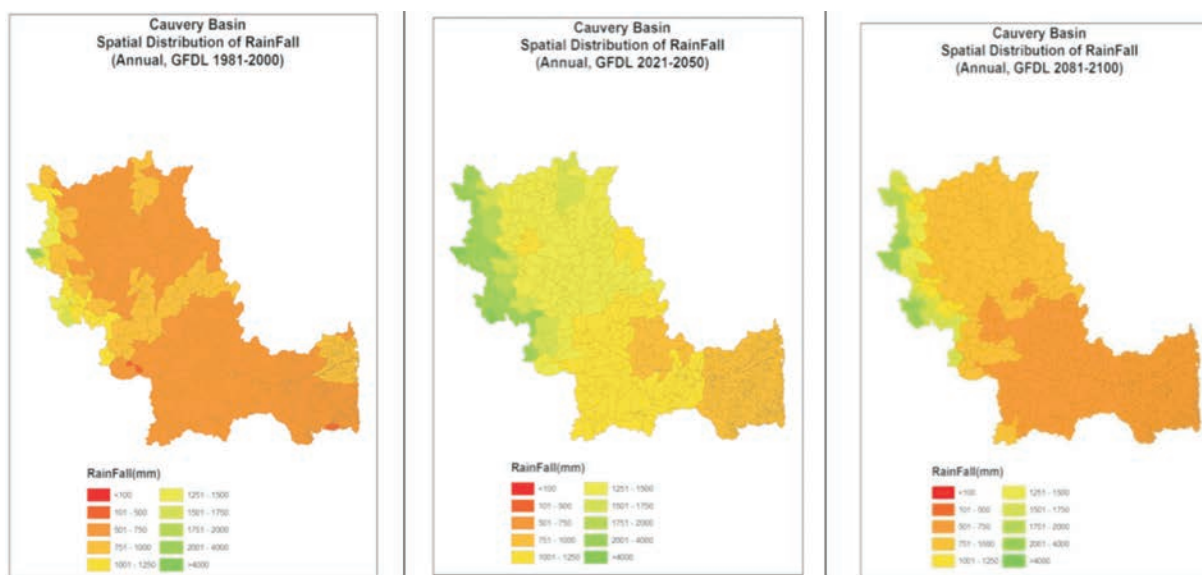


The study also shows that the wind is the main forcing field that drives sea level at decadal level.



**(iii) Climate Change: Assessing Impacts and Developing Adaptation Strategies for Agriculture in Tamil Nadu at Tamilnadu Agricultural university, Coimbatore**

Annual precipitation over the Cauvery basin is expected to increase in the mid century compared to current level. The rate of increase would be higher in the upper Cauvery region and rainfall is expected to be 150 % of the current quantity. While in the mid Cauvery, there is possibility for 25% more rainfall compared to current condition. In the delta region, not much change in annual rainfall is expected.



**(iv) Center of Excellence on Climate Change Research for Plant Protection, ICRISAT, Hyderabad**

The Centre has established advanced facilities like Open Open Top Chambers (OTC), Free Air Carbon Enrichment Facility (FACE), CO<sub>2</sub> Plant Growth Chambers, etc to study the impact of climate change variables (CO<sub>2</sub> and Temperature) on host, pathogen/pest and their interaction.





Free Air Carbon Enrichment Facility (FACE)



CO<sub>2</sub> Plant Growth Chambers

### Mega events organized

1. Indo Swiss Training Programme- “Capacity Building to train manpower in Himalayan Glaciology” Jawaharlal Nehru University, New Delhi
2. Regional Consultation Workshop on State Action Plan of Climate Change [SAPCC] for Himalayan Region was organized on 18 -19 September 2013 in collaboration with MOEF in, New Delhi

### ATTRACTING TALENT TOWARDS SCIENCE THROUGH STATE/UT PARTNERSHIPS

**Innovation in Science Pursuit for Inspired Research (INSPIRE)** is a national programme for attraction of talent amongst the students to study Science and pursue career with research. The basic objective of the programme is to communicate to the youth of the country the excitement of creative pursuit of science, attract talent to the study of science at an early age and thus build the required critical human resource pool for strengthening and expanding the science and technology

system and R&D base. The programme was launched by the Hon'ble Prime Minister on 13<sup>th</sup> December 2008. The implementation started during 2009-10.

INSPIRE Programme covers students in the age group 10-32 years, and has five components: INSPIRE Award (for 10-15 age group), INSPIRE Internship at a science camp with opportunity for interaction with global science leaders (for 16-17 age group), INSPIRE Scholarship for Higher Education (SHE) ₹ 80000/ per year for continuing education at B.Sc. and M.Sc. levels (for 17-22 age group), INSPIRE Fellowship for doctoral research (for 22-27 age group) and INSPIRE faculty for assured career opportunity (for 27-32 age group).

While the first component of the Scheme i.e. INSPIRE Award is being implemented centrally through the States / UTs. the other components of the Scheme are being implemented centrally by Department of Science & Technology (DST) through the concerned academic/research institutes & Universities etc.

### **INSPIRE Award**

Under this scheme, during the five year plan period two students are selected from every middle and high school of the country for an INSPIRE Award of Rs.5000/- each for preparing a Science Project / Model. These awardees, who are students from classes 6<sup>th</sup> to 10<sup>th</sup>, participate in a three tier competition: District, State and National Level. The projects exhibited are evaluated by a jury of experts. All the 28 states and 7 UTs are participating in the scheme. The scheme is continuing in the 12<sup>th</sup> Five year Plan. All the 28 states and 7 UTs are participating in the scheme. INSPIRE Award Warrant is issued directly in the name of selected student and sent to him/her through State/school authorities. Award amount includes cost of making a science project / model as well as cost of bringing the project / model at District level Centre for Exhibition Display Competition.

All Awardees under the scheme participate in the District Level Exhibition and Project Competition (DLEPC). Best 5 to 10 per cent entries from the district are selected for participation in a State Level Exhibition and Project Competition (SLEPC). Best 5 per cent entries from the State/UT, subject to a minimum of 5, are selected to participate at the National Level Exhibition and Project Competition (NLEPC). At all levels, the projects are evaluated by a Jury of experts. Participation/merit certificates are issued to the selected awardees of DLEPC, SLEPC and NLEPC, as well as, mentor / teachers who guided them for the preparation of the projects. The entire cost of organizing exhibitions at district, state and national level is borne by the Department of Science & Technology (DST).

Merit based nomination of the students for INSPIRE Awards is done by Head Master/Head Mistress/ Principal of each school, who is required to send nomination of best children having aptitude for science with requisite details, giving also the criteria adopted by the school for nomination and selection. District education authorities compile details of the schools in their jurisdiction in the prescribed format and send the proposal to DST through the State education authorities for final selection.

All schools in the country, recognized by the District / State Education authorities, whether Government or private, aided or un-aided, run by Central Government or State Government or local bodies and having classes 6 to 10 are eligible to participate in the scheme.

Proposals so received from the State authorities are processed in DST in accordance with the norms of the scheme and the list of the selected students is sent to the banker of DST for preparation

of Award Warrants in the name of selected students. The Award Warrants so received from the bank are sent to State authorities for onward delivery to the selected awardees through district education authorities/ concerned schools.

### **Present Status of Implementation**

The INSPIRE Award scheme envisaged selection of one million (10 lakh) students during the Five Year Plan period @ 2 lakh awardees per year. There are about 4.5 to 5 lakh schools in the country which would have classes 6 to 10. The scheme was launched during December, 2008. However, implementation could start only in 2009-10. In so far as INSPIRE Award component is concerned, 10.41 lakh INSPIRE Awards have been sanctioned till date. About 47.85% of awardees are girls, and 25.7% SCs/STs.

Under the INSPIRE Award Scheme, more than 6 lakh awardees have participated in the DLEPCs and 45000 best entries of DLEPCs have participated in the SLEPCs. The Department has so far conducted three National Level Exhibition and Project Competitions (NLEPCs) starting from 2011, every year. A total of 2573 awardees have so far exhibited their projects/models in these three exhibitions held so far. A number of projects have been shortlisted by the Patent Facilitating Centre of TIFAC for detailed examination for possible patenting in some cases and a small number has been finally selected for filing patent application. In the last NLEPC which was held during 8-10 October 2013 at Pragati Maidan, New Delhi, Shri M.Hamid Ansari, Hon'ble Vice President of India was the Chief Guest for the National Award presentation ceremony held on 10<sup>th</sup> October 2013. He not only gave away National/Regional/State Awards but also awarded a child from A&N Islands who was adjudged the one millionth awardee, under the Scheme.

Entire expenditure in connection with conduct of DLEPCs, SLEPCs and NLEPCs is borne by DST. As on date, an amount of ₹ 619.46 crore has been spent so far on the scheme, out of which ₹ 101.52 crore has been released to the States/UTs to meet the expenditure in connection with DLEPC SLEPC/ NLEPC.

### **E-management of the INSPIRE Award Scheme.**

Under the Scheme, large number of nominations, running into lakhs, have to be processed for selection of the students for INSPIRE Award. DST has started to e-manage the entire INSPIRE Award Scheme by using State-of-Art latest Information Technology which would enable e-filing of nominations by the schools across the country, its processing by the District and State authorities as well as DST in accordance with the norms of the scheme, transmission of data of selected students to the banks, credit of Award amount to the bank accounts of selected Awardees (wherever notified) or preparation of INSPIRE Award Warrants by the bank and their dispatch to the selected Awardees and all such related activities concerning implementation of the scheme, management of the data, generation of various MIS returns etc.

**INSPIRE Internship** component provides opportunities for young students to interact with leading researchers and scientists and experience joys of innovation. Under the aegis of INSPIRE Internship, residential science camps are organized for meritorious students who are top 1% in Class X examinations and pursuing science in Class-XI. Since its initiation in the year 2009, more than 800 Science Camps have been organized across various regions of the country, covering about 2.10 lakhs students. In the current

year 2013-14 (i.e. till December 2013), 216 science camps have been organized wherein around 44000 students have participated in these Camps. 14 Nobel Laureates and more than 2000 resource persons from India and abroad have also participated in such Camps organized in the current year. The number of Science Camps and the participating Interns are expected to increase and the annual target of 50,000 students is likely to be achieved at the end of this financial year.



Prof. Dr. Ivar Giaever



Prof. Dr. Richard R. Ernst

**Noble Laureate interaction with students at INSPIRE Science Camp**

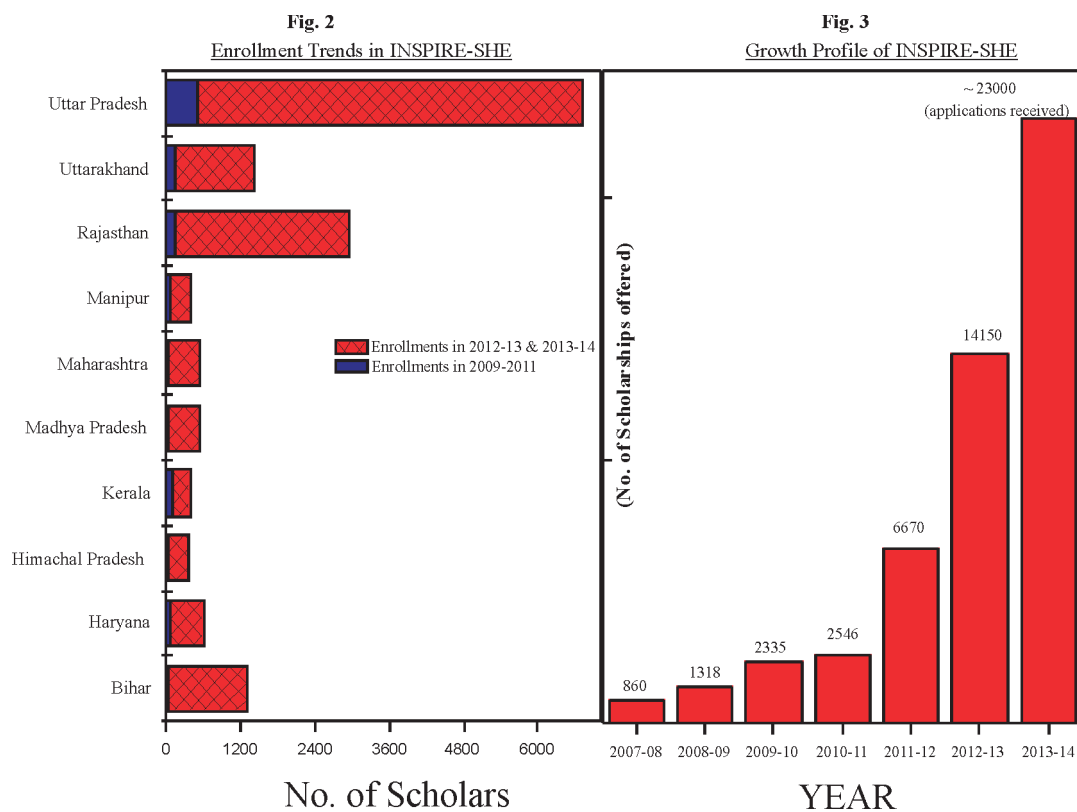


Workshop for INSPIRE Science Camp

**Scholarship for Higher Education (INSPIRE - SHE)** aims to enhance rates of enrollment of talented youth in science intensive higher education programs. The scheme offers 10,000 Scholarship every year @ Rs 0.80 lakh per year to students who are top 1% in Class XII examinations, for undertaking Bachelor and Masters level education in basic and natural sciences.

Presently about 29,000 scholars are availing INSPIRE-Scholarship. With a view to increase the enrollment of students in this component scheme, the Department has formally engaged with the State and Central Boards in the country. Through this institutionalization mechanism, the student is informed by the respective State/Central Board of his/her eligibility to apply for the scholarship. The outcome of this initiative has shown positive trends, with significantly higher enrollment into the scheme during the past three years of implementation. In current year around 23000 applications have been received from students who have passed Class-XII Boards Examination and pursuing science at the undergraduate level in different colleges. These are presently under evaluation for the offer of INSPIRE Scholarship. A comparative analysis of the enrollment of students in INSPIRE-SHE is given in **Fig. 2 and Fig. 3.**





It is evident that the enrolment of top 1% students into the INSPIRE-SHE scheme has improved drastically in the past three years. In the last year alone, 14150 scholarships were offered, out of which, 75% scholars belong to states such as Bihar, Manipur, Rajasthan, Uttarakhand and Uttar Pradesh alone.

**Kishore Vaigyanik Protsahan Yojana (KVPY)** is an on-going programme of the DST with parallel objectives and targeting at similar benefits as INSPIRE-SHE. This Scheme is being implemented by the Indian Institute of Science, Bangalore and it aims at to encourage students to pursue a career in research by granting Fellowships and Contingency grants up to the pre-PhD levels, starting from Class XI. In one case (INSPIRE-SHE), the selection is done by respecting the existing examination system of the country, while in the other (KVPY), by a written examination followed by an interview. Under the aegis of KVPY, 1401 ongoing and fresh fellowships have been offered in this year to students across all regions of the country. In addition to this, 100 Fellows belonging to bright SC & ST students have been offered KVPY Fellowships towards Empowerment Initiative of the Department.

**INSPIRE Fellowship**, a component scheme under INSPIRE-AORC, offers 1000 fellowships every year to First Rank holders in the Master’s level University examinations, for carrying out doctoral degree in both basic and applied sciences including engineering and medicine. Since its implementation in the year 2010, about 3300 students pursuing their doctoral degree in the country have been offered this Fellowship including 940 Fellows in the year 2013-14 alone. As an indication for the vertical growth of the component schemes under INSPIRE, 133 INSPIRE Scholars have joined into INSPIRE Fellowships component, to pursue their doctoral studies in the current year. One of the many redeeming factors in INSPIRE Fellowship as evident from the enrollment trends is the fact that more than 60% of INSPIRE Fellows are females. **Fig. 4 & 5** represents the enrollment trends observed this year in INSPIRE Fellowship. 20 INSPIRE Fellows

have availed the opportunity to represent the country to participate in the HOPE Meetings organized by Japan Society for Promotion of Science (JSPS) at Japan.

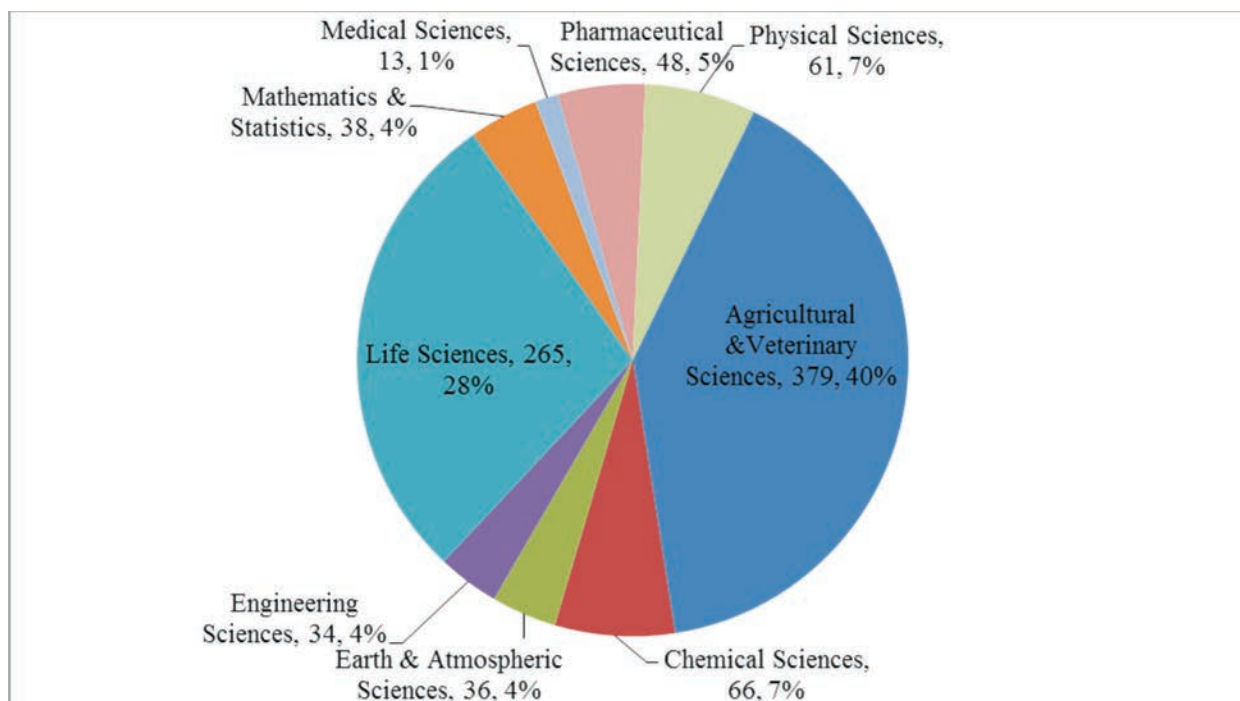


Fig. 4: Subject-wise enrollment trends observed in INSPIRE Fellowship in 2013-14

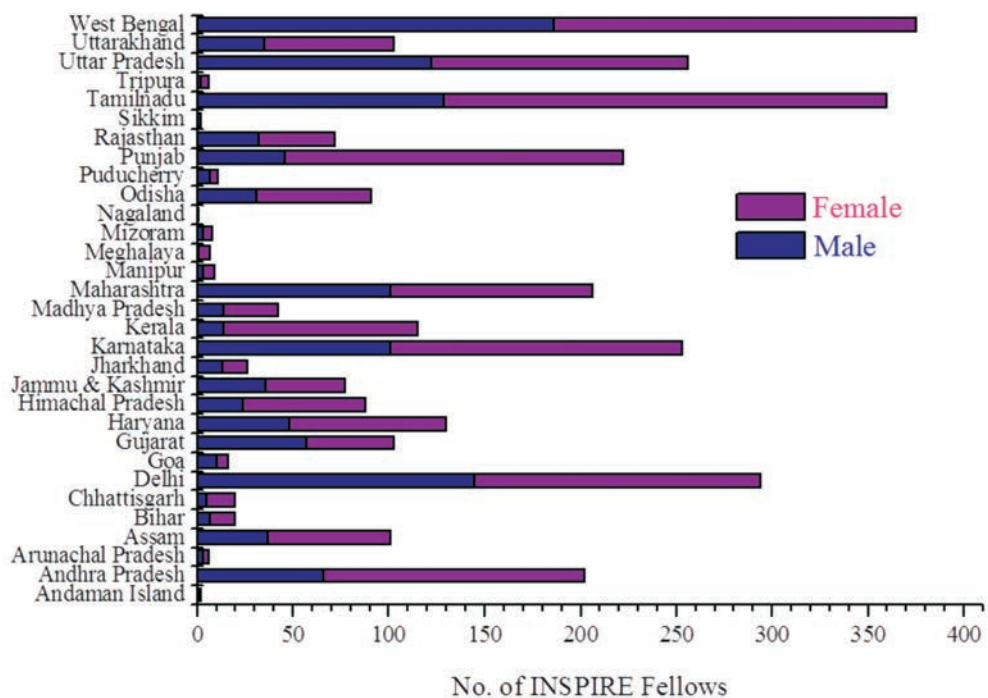
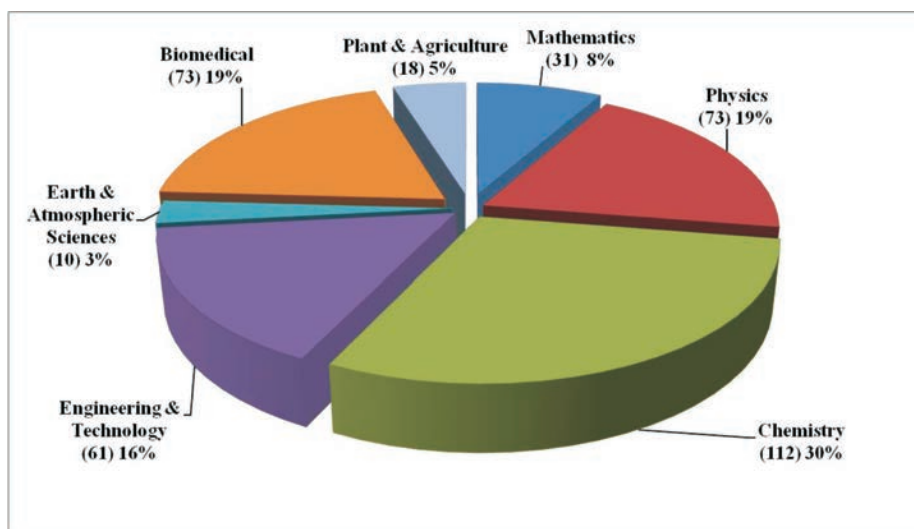


Fig. 5: State wise & Gender Distribution of INSPIRE Fellows

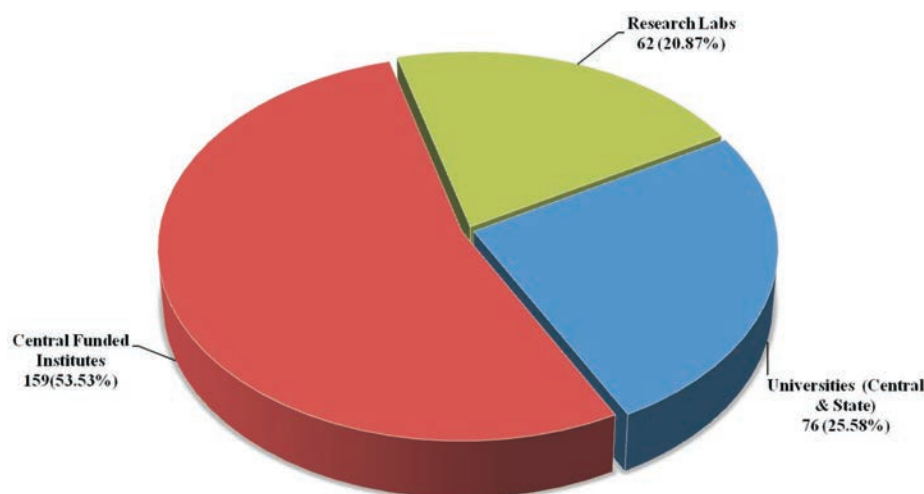
**INSPIRE Faculty Scheme:** another component under AORC, offers a contractual and tenure track positions to the doctoral students in both basic and applied sciences including engineering, agriculture, veterinary and medicine areas for pursuing 5 years independent research activities at any recognized University/ academic Institutions/ Laboratories in the country.

Under the INSPIRE Faculty Award, 378 individuals have been offered the INSPIRE Faculty Award for pursuing their career in research activities independently at different recognized Universities, Research Laboratories and Academic Institutions across the country. Out of 378 candidates to whom the INSPIRE Faculty Award have been offered, presently around 297 candidates have already been positioned themselves at their chosen Host Institutes for the implementation of the Faculty Award and also received the award grant as well. In the 5th round another 95 candidates have been selected for this Faculty Award and offer to these candidates is being made now.

**Fig. 6 & 7** indicate the distributions with respect to various Subjects and positioning of INSPIRE Faculties at different Host Institutions so far in last four rounds of selection.



**Fig. 6:** INSPIRE Faculty Award- Subject-wise Distribution



**Fig. 7:** Positioning of INSPIRE Faculty Awardees at Host Institutions

**E-Governance module of INSPIRE:** To subsume manual handling and ensure real time deliverance of information to the stake holders, the Division has initiated a web based software application for INSPIRE. The e-Management of INSPIRE programme was inaugurated by Honorable Minister for Science & Technology, Shri S. Jaipal Reddy on 6<sup>th</sup> August 2013.

The web application covers the four components of INSPIRE - Internship, Scholarship, Fellowship & Faculty Award. This module enables the students to apply to the different component schemes of the INSPIRE programme and takes care of the complete life cycle of the aspirant's application with different roles being played by different users. The web application, in addition to subsuming manual handling of data, also provides various statistical details for better analysis and implementation. The redeeming feature of the e-management module is the identification of beneficiaries across different components of the programme. This helps one to seamlessly monitor vertical migration of students from Internship component (age group 15-16 years) to INSPIRE Faculty Award (age group 32-37 years), thereby providing insights into the outreach and effect of INSPIRE.

**Outreach of INSPIRE:** Since its initiation of this Scheme in the year 2009, the INSPIRE Scheme has grown manifold with its each sub-component scheme and attained the targets envisioned initially. The Division has planned to commission study of its Social Impact Analysis of the INSPIRE programme to gauge the impact of the outreach across all regions of the country. The assessment is deemed essential for identification and implementation of directional changes that may be required. The report is expected to be tabled before a standing review committee comprising eminent academicians and scientists.

## SOCIETAL CONTRACT OF S&T

### SOCIEO-ECONOMIC EMPOWERMENT THROUGH S&T INTERVENTIONS

Science for Equity, Empowerment and Development (SEED) Division has been playing an important role in promotion of science and technology (S&T) for social good. It supports such initiatives through S&T based voluntary organizations, institutions, Colleges and Universities throughout the country to take up action oriented developmental projects to address location specific problems with S&T applications. In this process, focus is laid to create S&T based potential models to facilitate employment opportunities at the grassroots level for better livelihoods and improved quality of life. Equal emphasis is being given on providing technological solutions to location-specific problems through technology modulation, field testing and transfer involving community as major stakeholders to ensure sustainability with inclusive growth. Major initiatives/achievements made during the year under various schemes are listed below:



- 1. SCIENCE AND SOCIETY PROGRAMME (SSP):** This scheme aims at facilitating development of promising S&T based field groups and innovative technologies for addressing societal needs. Projects operational under this programme are listed below:

#### 1.1. Long Term Core Support - Technological Advancement for Rural Areas (TARA)

Technological Advancement for Rural Areas (TARA) is a unique scheme under societal programme mainly provides long term core support to S&T based voluntary organizations/field level institutions and currently, 22 national level organizations are supported to develop and deliver need based S&T interventions at the grass roots level. These groups are reliable vehicles for transfer and delivery of new and improved technologies for rural application through identification of problems on the ground and converting them to challenges for providing technological solutions. The technologies developed and innovations made by the core supported groups are demand driven and have been well received by the people in rural areas. Some of the models of technology delivery have been demonstrated to entrepreneurs in setting up a profit making sister organization and creation of NGO-led enterprises, as shown in table below:

**Table 1: Technology Adaptation and Up-scaling by Core Supported Organizations under TARA Scheme**

S. No	Core groups	Technology Interventions, Innovations and Packages Developed with Impact Benefits
1.	Himalayan Research Group (HRG), Shimla, HP	<ol style="list-style-type: none"> <li>1. Simplification in Chirayita cultivation (seed sowing, weeding, harvesting and drying).</li> <li>2. Technology package of Shiitake mushroom (<i>Lentinula edodes</i>) has been standardized for cultivation.</li> </ol>

S. No	Core groups	Technology Interventions, Innovations and Packages Developed with Impact Benefits	
2.	Appropriate Rural Technology Institute (ARTI), Pune, Maharashtra	Biogas based power generation for household level application. Farmers can adopt this technology as the gensets are available from 500 watts to 2.5 kilo watt range. It can be used for pumping water and electricity generation.	
3.	Vigyan Ashram, Pune, Maharashtra	(i) Dry fruit roll cutting machine. (ii) Hand Operated fruit cutter. (iii) Ambient temp dryer-New dryer for drying of fruits and vegetables based on principle of dehydration of agro produce.	
4.	Society for Development Alternatives (DA), New Delhi	(i). TARA Eco Kiln Package. (ii). TARA Paper Recycling Package. (iii). Jal TARA Arsenic Solution Package. (iv). Ecologically sound packages with local enterprises creation using local resources and skill. For instance, from the 25 Eco-Kilns under operation, more than 1,000 people have been benefited directly through employment in the operational units.	
5.	Vivekananda Kendra, Kanyakumari, TN	Software package for cost-effective construction technologies to designing of compute embedded energy efficient structural and functional components of the building.	
6.	Society for Rural Industrialization(SRI), Ranchi, Jharkhand	Steam Jacketed Kettle: A laboratory prototype or Steam generator cum cooking vessel, for use in rural food processing Centre, was designed, fabricated and tested at SRI. This is a multi fuel cooking vessel which does not require a boiler.	
7.	Technology Informatics Design Endeavour (TIDE),Bangaluru, Karnataka	1. Development of energy efficient design and fabrication of tea kettle, multi-purpose stove, tava stove, and pyro mini stove without chimney. (ii)Dissemination package for farmers on ground water management including recharge techniques. (iii) CO <sub>2</sub> mitigation through fuel savings in stoves promoted by TIDE. (iv) Created livelihoods for 27 women entrepreneurs using various technologies promoted by TIDE.	
8.	Integrated Rural Technology Centre (IRTC), Mundur, Palakkad, Kerala	(i) Introduced “Microwavable Terracotta” in the market after proper testing, analysis and quality control. (ii) Introduced various drudgery removing equipments like pugmill (for grinding of clay), and electric wheels (for shaping articles) for the benefit of artisans.	<p><b>Microwavable Terracotta</b></p> 
9.	Peermade Development Society (PDS), Peermade, Kerala	<ol style="list-style-type: none"> <li>1. Cardamom Washing machine: machine washes 100 kg of cardamom capsules in five minutes.</li> <li>2. Nutmeg decorticator which can decorticate 80 kg nutmeg in an hour with 80% efficiency.</li> <li>3. Quality of the dried cardamom has increased with additional income.</li> </ol>	<p><b>Cardamom Wahsing Machine</b></p> 

## 1.2. Technology Interventions for Addressing Societal Needs (TIASN)

This scheme aims at developing and facilitating research and application of S&T based solutions to identified problems and societal needs. Some specific projects covered under this scheme are as follows

**1.2.1 Co-ordinated Research Programme on Non-Edible Oil:** A major programme on Non-Edible Oils (NEO) was evolved and demonstrated as a viable and replicable technology package and rural enterprise model for its extraction from Tree-borne Oilseeds (TBOs) along with distilled oils from some aromatic plants. A generic technology package for utilization of non-edible oil seeds from 19 TBOs and 8 aromatic plants has been adapted/optimized covering ten locations under diverse field conditions across 8 States to meet the demand of NEOs especially for Apricot, Jojoba, Tung and medicinal oils from plants, like, Malkangni and Eucalyptus by industrial units making soaps, paints, varnish, ayurvedic medicines, etc. A business model, which includes Nodal Unit with Expeller, networked in a cluster with Village-level “satellite” units, covering primary processing, storage of Seeds, de-shelling and timely supply of kernels to the Nodal Unit for expression of Oil, has been standardized in decentralized way of oil production in various project sites.

### 1.2.2 Individual Projects:

- **Rainwater harvesting for School in Rural Area:** To promote rainwater harvesting in schools, a technology demonstration project has been taken up at Gogalgaon, Adgon, Pimpri Lokai, Nimsewadi, Ruatwadi, Lohare, Korale villages of Ahmednagar District, Maharashtra to meet the minimum daily requirement of drinking water. The project has enabled students to work out the quantum of water that can be harvested and develop rainwater harvesting structures for their own houses. Demonstration on working model has helped the students, especially girls, to understand the actual working of rainwater harvesting system, possible problems and solutions for its maintenance.
- **Co-management of Artisanal Fisheries along the Coromandel Coast:** This project seeks to contribute to sustainable management of marine fisheries resources by strengthening initiatives in fisheries co-management, involving artisanal fishing communities (locally known as Pattinavar), of coastal areas from Tamil Nadu and Puducherry. Project has contributed to the scientific co-management of fisheries through specific inputs that could be made at the policy level for linking it with the credit and marketing sectors. Efforts are being made for promoting local level practical interventions, such as, reef units and Fish Aggregating Devices (FADs). No fishing periods will be advocated as part of the fisheries management process thus encouraging and enhancing the participation at the community for better livelihoods.

## 1.3 Technology Intervention for Disabled and Elderly (TIDE)

In order to supplement the efforts made by various institutes and organizations for elderly care and differently able persons, the programme “Technology Interventions for Disabled and Elderly (TIDE)” has been strengthened further. Keeping in view, the National Policy on Older People (NPOP) and

other initiatives of the Ministry of Social Justice and Empowerment (MoSJE), the programme has been specifically mandated to promoting basic research, development and adaptation of technology for improving quality of life for the benefit of elderly population and disabled people in the country through application of S&T inputs. Outcome of some of the interventions in this programme are as under:

- **Development of Indigenous Low Cost Press Mat Based Gait Analyzer:** This project is being implemented by National Institute for the Orthopedically Handicapped (NIOH), Kolkata to develop an inexpensive, robust, indigenous and reliable pressure mat based system which can be used for rehabilitation of disabled and elderly people and as a diagnostic tool for neurological diseases and to minimize risks of injury due to incidence of fall of elderly. Proposed technology can provide affordable clinical analysis about diabetic offloading, analysis of gait asymmetry, diagnosis of posture related complaints, sports kinematic analysis, pre and post treatment evaluation, etc.

Design and testing of capacitive type pressure sensing system, calibration of individual sensors, designing a proper code to interface the entire mat, design the graphic user interface for displaying 2D and 3D image from the acquired pressure data are being carried out to calculate gait and sway analysis parameters from the acquired pressure data. The entire system would be calibrated with standard clinical pressure mat and will be tested on patients having gait abnormality for clinical trials followed by hands on workshop for system familiarization and wider dissemination.

- **Vardaan - An independent stair climbing wheel chair (manual) for up/down climbing:** This innovative project, implemented at Indian Institute of Technology, Kanpur, aims to design a safe, economic, efficient, user friendly independent stair climbing wheel chair (up/down climbing) for the adaptation in the larger existing environment for physically challenged people. In this project, design of basic component of the stair climbing wheelchair, like, stair climbing wheel, convertible mechanism, stair climbing wheel shape and overall dimension to improve safety, efficiency factor, etc, are incorporated. The design had been made simple further for ease of user groups from adaptation and manufacturing point of view. In order to reduce the effort of climbing stairs with steeper heights, bigger wheels have been introduced. A combination of 3 wheels would be used in the final stage of the design. This is the first model of convertible wheelchair that can work on normal floor as well as on stairs. The design of wheel chair is shown below.

An intense user testing of the current design is being done at Artificial Limb Manufacturing Corporation (ALIMCO), Kanpur for load testing, brake testing, etc. This product can be commercialized in Indian as well as international market for different target user group for elderly, kids, and users within various economic layers.





Figure A, B, C, D describing sequence of convertible mechanism from flat floor to stairs and then from stairs to flat landing space

#### 1.4 Scheme for Young Scientist and Technologists (SYST)

This Scheme under SEED Division is operational with an aim to encourage young scientists to provide technology based solution on societal problems. The scheme has been able to nurture the ideas of the young investigators on socially relevant issues. Achievements of some projects accomplished during the financial year are:

- Under the project “**Design of polyelectrolyte coated multi-layered liposomes (stable liposomes) for oral insulin delivery**” insulin pill that could relieve pain of daily shots can be realised as the delivery system “layersomes” have shown to lower the blood glucose levels for longer duration than that of injected insulin in rats. Development of oral insulin has been a challenge due to two major reasons (i) it used to break down by the body’s digestive enzymes before it can act, and (ii) it doesn’t get easily absorbed through the gut into the bloodstream. To overcome these hurdles, two approaches to shield insulin from the digestive enzymes and then get it into the bloodstream have been used. In order to protect insulin from digestion liposomes, which are already being used for treatment, were wrapped in layers of protective molecules, called polyelectrolyte. To enhance the transportation of these “layersomes”, across the intestinal wall into the blood, it is attached with folic acid. Such initiative and innovative concepts can help to address one of India’s biggest health challenges on diabetes as by the year 2030 it is expected that the India’s diabetes burden will cross the 100 million mark.
- Under another project entitled “**Identification of alternative animal health delivery system through folkloric claims**”, selected practices of the healers, who are the custodians of the knowledge, were value added and developed into a two independent products which have

shown effectiveness as compared to conventional therapy to mitigate Ephemeral fever and Bacterial Mastitis in the livestock. A unique lactogogue formulation has also been developed under this project which has shown significant impact over the milk yield and fat percentage. The technologies developed were recommended by the National Research Advisory Committee for National Honour in 6<sup>th</sup> and 7<sup>th</sup> Grass Root Award Function of 2012 and 2013, respectively. Patent application has also been filed on the healer's names who have shared the knowledge for the development of the products (Patent application filed no. 1013/CHE/2011 and 1117/MUM/2011).

- To address the growing incidence of decline plant biodiversity and natural habitats of many species in Garhwal region of North Western Himalaya due to anthropogenic pressure, a project “**Conservation of some economically important plant species with participatory approach of local community: A case study of the Srinagar hydroelectric power project in Garhwal Himalaya**” has been supported. The project has helped towards the conservation of some economically important plant species (*Bauhinia purpurea*, *B. variegata*, *Boehmeria arugulosa*, *Celtis australis*, *Ficus auriculata*, *Grewia optiva*, *Madhuca longifolia*, *Morus alba*, *Ougeiniaoo jeinensis*, *Syzygium cumini*, *Terminalia alata*) through plantation of nursery raised seedlings in the village community and waste land (approx. 20 hectare land) in the vicinity of power plant affected areas with the involvement of local people.

## 2. TECHNOLOGICAL INTERVENTION FOR TRIBAL EMPOWERMENT (TITE)

This Scheme under “Tribal Sub Plan” aims at improving living conditions of Scheduled Tribes based on sustainable S&T interventions. The focus is on creating sustainable livelihood base through use of locally available resources and materials by introduction of need based technology in traditional skills as well as new vocations. During the year, twenty one projects were sanctioned in the technology areas, such as, skill improvement and efficiency of traditional occupations, introduction of alternative vocation and entrepreneurial skill development, products from agro-processing/horticultural produce, production of non-traditional fibre composite, medicinal and aromatic plants cultivation mainly in tribal pockets etc. Outcome of some of the ongoing/completed projects which have shown visible impact are:

- **Improvement of Livelihood and Socio-Economic Status of Tribal Community in Dry Temperate Zone Of Himachal Pradesh through Oyster Mushroom Cultivation :** Under this project, efforts are being made to evaluate the performance of different oyster mushroom species on locally available flora as substrates in the Spiti valley of Himachal Pradesh. This project is being implemented through research station of Dr. Y S Parmar University of Horticulture and Forestry located at Tabo, Lahul & Spiti. Fallen and dried leaves of *Salix fragilis* (willow vern. changma), *Lactocera sericola* (vern. nechaapa), *Populus ciliata* (poplar) and *Malus domestica* (apple); whole aerial plant parts of *Pisum sativum* (pea), *Iris* sp. (vern. thehma) and *Triticum vulgare* as well as used and dried tea leaves were tested for their suitability as a substrate for cultivation of four species of oyster mushroom. Capacity building and training on cultivation of oyster mushroom has enabled 160 tribal farmers of the valley to supplement their income for better livelihoods using local resources.
- **Exploration and Utilization of Wild Edible Plants consumed by ST people of Arunachal Pradesh for Socio-Economic Development:** This project implemented by North East Institute

of Science and Technology (NEIST), Itanagar has led to prioritization of wild edible plants used/consumed by Nyishi community of Papum Pare district of Arunachal Pradesh, which have medicinal and nutritional properties. The plant species were prioritized for mass cultivation based on analysis of nutritional value, mineral contents and anti-oxidant properties to improve nutrition status as well as provide alternative livelihood option to tribal community for socio-economic development.

- **Empowerment of Tribal Women towards Livelihood Improvement through Sustainable Sericulture and Associated Integrated Farming System(IFS) Practices:** Project envisaged an approach of ‘Lab to Land Programme’ for capacity building and technical empowerment of users group through various training programmes in Challakere and Molkalmur Taluk of Chitradurga District, Karnataka. This project, being carried out jointly by Karnataka State Sericulture Research and Development Institute and BAIF Institute for Rural Development, Tiptur, has enabled to bridge the technological gaps between lab and land towards improvement in quality, enhanced productivity and crop stability involving tribal community. Ten tribal families have been supported to adopt IFS model in one acre each with plantation of forest species and fruit bearing plants. One farm pond has been excavated in each IFS model to harvest excess runoff water. To ensure sustainable implementation of the project activities and proper benefit sharing of income, two self help groups (SHGs) have been formed involving tribal families.
- **Innovative Use of Undulating Drought Prone Fragile Lateritic Wastelands in the remote Tribal Belt Recourse to Large Scale Production of a Kharif Minor Oil Seed Crop like Niger *Guizotia abyssinica* L.f (Cass):** This project, being implemented by IIT, Kharagpur, in three blocks Kharagpur, Keshiary and Sankrail in West Midnapore District of West Bengal, envisages employment generation and income of tribal community through utilization of cultivable wastelands under rainfed conditions by cultivating Niger seed and other companion crops. During the project implementation, efforts have been made for generating awareness among the tribal and general farmers about the Niger crop production technology and processing of the oil seeds. Relevant package of practice for field level application was transferred to 50 farmers.
- **Popularize Scientific and Cost Effective Bulb Production Technologies in *Lilium* through Training in Tribal Areas of Himachal Pradesh:** Under this project, being implemented by a field station of Indian Agricultural Research Institute (IARI) at Kullu, complete scientific package of practices for commercial cultivation of *Lilium* has been standardized and transferred to more than 100 tribal farmers from Keylong, the tribal district of Lahaul - Spiti Lahaul valley. In addition, tribal youth have also been provided technical know-how on the potential of *Lilium* and other bulbous crop (*Tulip*, *Daffodils*, *Iris*, *Hyacinths* and *calla lily*) cultivation and their bulb production to create micro-enterprise. For better hand-holding and sustain the project activities, a society of 50 growers has been formed at the local level.

### 3. SCHEDULED CASTE SUB-PLAN FOR THE DEVELOPMENT OF SCHEDULED CASTE POPULATION (SCSP)

Social Equity principles demand special attention and careful intervention to facilitate the overall development of scheduled caste community in their developmental aspirations. This scheme focuses on enabling these communities to realize their aspirations that needs to be developed with sufficient

measure of empathy and sensitivity backed up by the supply of adequate resources. Over the years, the scheme with a view to empower SC population through S&T inputs, has achieved significant breakthroughs in developing and demonstrating technology packages in several sectors with the association of S&T based field groups and S&T institutions. Specific achievements made under the scheme are:

- **Co-ordinated Programme on Capacity Building and Livelihood Generation Activities for marginalized SC Population:** This programme is being implemented through networking of community based organizations working in different parts of the country and projects are being implemented in 93 villages across Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Tamil Nadu, Uttarakhand and West Bengal, where selected SC communities are mostly engaged in unskilled labour located in coastal villages, hilly areas, and plain/drought areas. S&T interventions under this programme were in the area of water, sanitation, health, education and adoption of technologies for livelihood and micro enterprise development using local resources. Community mobilization and building new/strengthening the existing people's institutions or groups are integral part of this programme leading to its sustainability in terms of reduction in poverty, unemployment and improvement in the basic amenities.



Soak pits



Construction of biogas plant



Household level composting

- **Improving Crafts Technologies of Six Less-intervened Crafts: (1) Aligarh and Dindigul Lock Making, (2) Andhra (Budithi) and Odisha (Kantilo) Bell Metal Craft, (3) Firozabad Glass Craft, (4) Gaduliya Lohar Craft, (5) Kannauj Itr Making and (6) Kashmir and Rajasthan Namda Craft:** A study was conducted to identify a set of technological innovations in the six relatively less-intervened crafts and found that all these crafts are facing various problems that include: use of age-old technologies; low incomes; products not meeting the Bureau of Indian Standard (BIS) specifications, acute competition from factory made implements/Chinese products; absence of any product development/branding/promotion; serious health and safety concerns; ergonomically unsound workstation; and lack of interest among the children of the artisans in learning the trade. The artisans are, therefore, ill-equipped to face up to the challenges of the changed scenario in world trade and in view of WTO regime. The study worked out an action plan for each selected craft for strengthening the position of the artisans in the globalize market place by enhancing their access to better technologies, development of new designs/products and identifying suitable technology

developers and disseminators for the new technologies. **Leather bottles where residual water is dried from the final product**

#### **Bhormara or carving rings on the bowl Carving imprints on the bell metal ware**

Study under the project indicates that all the above crafts require development of distinct visual identity along with the GIS and handmade branding, product diversification; links as suppliers to public and private sector industry; display and publicity to brands; and improving packaging standards. A set of potential technology developers and disseminators have also been identified for the above crafts. A network programme on the identified crafts will be taken up shortly, involving the technology developers, experts, industries and institutions/organizations with product diversification and value addition, to revive and nurture the skill of artisans engaged in such traditional crafts.

- **S&T Planning for the Grassroots: Identifying Development Needs of Scheduled Caste Population in Selected States and Developing Strategic Action Plan for an Integrated Mission on S&T driven Sustainable Development:** This study oriented project, based on the perceptions of the target SC beneficiaries, local voluntary organizations and field investigations, has identified a comprehensive package of S&T interventions for exclusive/nearly exclusive SC clusters (villages/hamlets/urban wards) in 27 districts in the top seven SC populated states (Andhra Pradesh, Bihar, Madhya Pradesh, Odisha, Rajasthan, Tamil Nadu and Uttar Pradesh) for meeting their developmental needs in network project mode with the appropriate S&T delivery system (technology developers and technology/skill disseminators) for each of the following interventions:

- Habitat Improvement with local resources
- Enhanced Livelihood opportunities (Improvement in productivity, tools and implements)
- Health and Nutrition (Monitoring and tackling anemia, Vector control with community participation, nutritional and health gardens)
- Fodder/Feed production linked to small animal husbandry
- Agriculture (improved technology, tools and implements, integrated pest management, diversification)
- Energy solutions (access to energy - Energy for household and occupational needs)
- Technology inputs for artisanal sectors (conventional and new trades)

Based on the study, a net work programme viz. “Technology Application for Livelihood Improvement of Scheduled Caste Population (TALIM-SC)” is being implemented in 15 locations of above mentioned states.

#### **4. SCIENCE AND TECHNOLOGY FOR WOMEN**

The Scheme “Science and Technology for Women” is being implemented with the aim of promoting gender equality, empower women with inputs of S&T to promote development and adaptation of appropriate technology, transfer of proven technologies and demonstration of live technology models. Apart from continuing ongoing All India Coordinated Research Programmes on Manufacturing of

Low Cost Sanitary Napkins, Biomass Tray Dryers, etc., during the course of the year, about 30 individual projects in technology sectors, such as, women health and nutrition, agriculture and animal husbandry, including post harvest technologies, modern agricultural practices, nursery techniques for cultivation of aromatic and medicinal plants, watershed based soil and water conservation, tissue culture technology, alternate livelihoods, natural resource management, occupational hazards, etc., were supported to make a distinct impact in the socio- economic status of women. Achievements made, specifically related to involvement of women in project mode support, are as under:

- **Development of Low Cost Value Added Processed Products from Ripe Pumpkin (*Cucurbita moschata*) and Dissemination of Technology to the Farm Women of Himachal Pradesh:** Under this project, value added processed products from ripe pumpkin were developed and standardized. Further, analysis of physico-chemical parameters of pumpkin fruit, kernel of seeds and value added products were carried out which helped in pre-treatment for drying of pumpkin and standardization in production of pumpkin flour/powder. Recipes for the preparation of weaning mix and cookies, supplemented with pumpkin flour, have also been standardized. Shelf life studies, up to a period of three months, along with cost of production, were also conducted. The technology package for different value added products would be documented and disseminated among the farm women through training and demonstration so that more women can benefit from these technologies and become entrepreneurs.
- A variety of convenient processed products, retaining the antioxidant properties and dietary fibers of carrot and carrot pomace, are being developed under the project “**Instant products of carrot for nutrition, income generation and self-employment of the farm women of Himachal Pradesh**”. Standardizing the dehydration techniques for optimal colour, texture and  $\beta$ -carotene retention and determining the suitability of different types of dehydrated carrots like shreds, sticks and roundels and carrot pomace for processing into value added products will help the local women and self help groups establish processing centers for carrot, thus, reducing the unemployment and gain sustainable income and livelihoods.
- Realizing the importance of ensuring quality and safety of the products in fisheries sector a project “**Food Safety Interventions for Women in Fishery based Microenterprises**” has been taken up in Coastal Kerala. This ensures safety of the products developed by women microenterprises, through skill development and capacity building, which lays importance on food safety and its actual requirement, to produce a quality and safe product under hygienic and sanitary conditions without bacterial contamination to enable better income with quality produce. Capacity building programmes for women entrepreneurs, in coordination with Central Institute of Fisheries Technology, Kochi and Matsya Fed, have been organized at various coastal locations of Kerala.
- In a project “**Extension of quality seed production techniques and fast grow-out of Indian and exotic carps in Terai region of West Bengal**”, being implemented in rural areas of Coochbehar district, emphasis is being laid on dissemination of quality seed production techniques of carps through creation of more number of quality fish seed production centers and their proper grow-out culture utilizing potential water bodies. There is a sustainable income generation for women through quality seed production and grow-out. Extension of improved techniques of induced breeding for quality

seed production of Indian and exotic carps and subsequent rearing of fish seed, using local feed components, including dried muga silk worm pupae, a protein rich component, reflecting its superiority over other live feed components for fish growth had culture of carps, muga silk thread reeling and other muga farming activities. The spawn production and revenue status for a few villages in the target areas is given in the following table.

- A project “**Empowering Rural Women of Himachal Pradesh Sustainable Dairy Entrepreneurship**” was taken up in to systematically ascertain the reproductive, productive, managerial and physiological status of rural cattle vis-à-vis available resources of women farmers in different regions of Himachal Pradesh. The project aims in propagating and analyzing the effect of scientific rearing, including breeding, housing, health and management, in consonance with certain sustainable nutritional interventions in rural cattle involving farm women of Himachal Pradesh. This also generates geographical information system mapping and spatial information for development of region specific packages and practices on scientific rearing of rural cattle in Himachal Pradesh.

## 5. WOMEN SCIENTIST SCHEME – B (WOS-B)

An initiative Women **Scientist Scheme** (WOS-B) to encourage and involve women scientists and technologists with a “break in career” due to social responsibilities, but have desire to return to mainstream science and work on societal problems, has been launched in 2003. The scheme has been restructured and reenergized during 12th plan to provide a long term option as an alternate career path in basic and applied sciences for societal applications. The training will focus on sharpening their skills in research areas and implementing the projects of societal importance.

During the year, 45 new projects were sanctioned in various areas, like, sericulture, value addition for livelihood security, socio-economic upliftment of the rural poor through use of natural/local resources, health, agriculture, fisheries, etc. Orientation programmes have also been conducted for Women Scientists/technologists whose projects have been recommended for financial support for proper implementation. Highlights of some projects are reported below:

- **Revival and Sustenance of Traditional Construction Technology and Ornamentation Techniques of Shekhawati Rajasthan:** This project, undertaken by Women Conservation Architect with the support of UNESCO, aims at adaptation of traditional technology to facilitate scientific and authentic repair and maintenance of traditional buildings in Shekhawati, and development of a mechanism for sustenance and providing opportunities to local construction workers for income generation as part of a larger vision of saving the rich built heritage of the region. Publications ‘Haveli Owners Manual’ and ‘Conservation Notes’ were prepared to actively involve owners and caretakers in conservation works, persuading them and providing them technical advice for undertaking periodic repair and maintenance of their properties. A Craftsmen Training kit was also developed to help local craftsmen in scientific understanding of traditional construction processes and knowledge of traditional construction. The code of practice for undertaking traditional lime plastering works, prepared as part of the project, is a novel achievement. The manuals prepared under the project have been made available for Haveli owners, craftsmen and Government of Rajasthan for future use.



Local Craftsmen engaged in adopting scientifically validated Technique to sustain traditional buildings

- **Sustainable Rural Livelihood- Adoption and Refinement of improved technologies of Eri culture in Brahmaputra Valley of Assam:** The main focus of this project is empowerment of women, drudgery reduction and income generation and employment, so that overall objective of societal development is fulfilled through technological intervention. Project intervention and capacity building at local level has led to adoption of Eri culture as primary venture of livelihood among marginalized rural poor mostly women farmers.
- **Composite Lac and *Stevia rebaudiana* cultivation with value addition for livelihood security and socio-economic upliftment of rural poor in Allahabad, Uttar Pradesh:** The concept of proposed project is for livelihood generation and establishment of marketing linkages for the rural women by imparting training in the field of lac and lac products. A nursery of *Stevia rebaudiana* as an income generation activity has also been added to this initiative.



Different value added lac products prepared by trained women for alternative livelihood

## 6. WOMEN SCIENTIST SCHEME – C (WOS-C)

This scheme has special focus to provide opportunity to women scientist for self-employment by utilizing their specialized domain knowledge in areas such as patenting, Intellectual Property Rights (IPR). During the year, 95 women scientists were imparted training with involvement of various agencies, like, Intellectual Property Agencies of government bodies, patent attorney law firms, Knowledge process outsourcing agencies, IITs, R&D Institutes, Pharma companies, etc., at Delhi, Chennai, Pune and Kharagpur. Out of these 95 women, 16 women have cleared the Patent Agent



Examination and are now registered Patent Agents with the Indian Patent Office. Workshops on 'Patent Drafting', 'Intellectual Property Rights and related aspects' were also conducted. 40 patent analysis reports on various technology areas have been prepared by the trained women scientists.

#### **7. COUNCIL FOR SCIENCE AND TECHNOLOGY FOR RURAL INDIA (CSTRI)**

Two centers of Council for Science and Technology for Rural India were established at Indian Institute of Technology-Madras (IITM), Chennai and North East Institute of Science and Technology (NEIST), Jorhat to involve mainstream scientists in developing technologies having application for rural India. In this initiative, centre at NEIST is working on "Rural Resources and Need Appraisal" in the rural areas of New Sonowal (Assam-Nagaland Border) aiming 50% growth in per capita income of rural poor in the area. The Centre at IIT-Madras is working on Decentralized Solar PV Generation and Distribution Systems, where the importance of combining energy efficient lighting systems, DC motor technology and off grid solar power to meet the current demand of rural India, will be highlighted.

#### **8. INDO – UK COLLABORATIVE RESEARCH INITIATIVE IN 'BRIDGING THE URBAN AND RURAL DIVIDE (BURD)'**

DST and the Research Councils UK (RCUK) have funded collaborative research projects that tackle the challenges in 'Bridging the Urban and Rural Divide'. First ever integrated system (Biomass, CPV and Hydrogen) for provision of electricity in rural India, along with high efficiency hydrogen generation and storage, will be developed by IIT-Madras, Vishwa Bharathi University, Shantiniketan and IIT-Bombay, in collaboration with Heriot-Watt University and other UK Institutes. Supply and demand potential of existing rural biomass and renewable energy resources, while engaging communities through bottom-up approach, is being worked on another project, both in India and in UK, by IISc, Bengaluru as lead Institute from Indian and University of Nottingham from the UK.

### **S&T LED ENTREPRENEURSHIP AND INNOVATION PROMOTION**

The National Science & Technology Entrepreneurship Development Board (NSTEDB), established in 1982 by the Government of India under the aegis of Department of Science & Technology, is an institutional mechanism to promote knowledge driven and technology based entrepreneurship among S&T persons through its programmes and activities.. The Board, aims to integrate innovation and entrepreneurship in academia, through various initiatives with a view to translate knowledge to wealth and convert "job-seekers" into "job-generators". The programmes and other facilitating mechanisms of the Board are structured to foster ideas and innovations into successful start-ups and to create techno-entrepreneurs among the S&T persons. The programmes of the Board and the related achievements during F.Y 2013-14 are summarized below.

- 1. Technology Business Incubators (TBIs):** Technology Business Incubator (TBI) is a programme of NSTEDB for fostering innovative and knowledge based start-ups into sustainable businesses by involving interactions from academia and providing specialized support services, early stage financing, networking among stake holders etc. 75 TBI's have been so far supported which are usually located in and around an R&D or academic institution. Three new TBIs established during the F.Y.2013-14 are at TBI at Sathyabama University, Chennai focusing on Marine Bio-resource utilisation, TBI at National Institute of Design, Bangalore and at IIT Madras.

2. A publication “**Fuelling Entrepreneurship**” on DST supported Technology Business Incubation Landscape in India , its salient details and overall impact in nurturing the ecosystem for techno-entrepreneurship in the country, has been brought out in March 2014. As per the report , DST supported Indian Incubation snapshot is given below.

### **Incubation in India- A Snapshot**

A dedicated cumulative incubation space of around 585,700 sq.ft. Around 2,000 new ventures have been incubated out of which 950 ventures have already graduated. These enterprises have cumulatively generated approximately 32,000 new jobs and an turnover of Rs. 1500 crore in 2012-13. The incubated innovative start-ups have resulted in generation of around 450 patents/ copyrights. An annual footfall of nearly 14,750 high-end innovative entrepreneurs has been reported which approach various incubators across the country.

3. **National Award for Technology Business Incubators for the year 2012** – In order to recognize and reward the remarkable work done in the area of techno-entrepreneurship development through value added business support by specialized facilities such as Technology Business Incubators and Technology Parks, a National Award for Technology Business Incubators for the year 2012 was presented to the “Technology Business Incubator at Kongu Engineering College, Perundurai on the Technology Day, 11<sup>th</sup> May 2013. “
4. **Seed Fund to Incubators** : The Seed fund provided by the Department equips the STEP/TBI with the much needed early stage financial assistance to be provided timely to deserving start-ups under incubation in a relatively hassle free manner. 4 new TBIs namely, Start up Village, Cochin, Rural technology Business Incubator , IIT Madras, Centre of Innovation and Business Acceleration(CIBA) , Goa and Manipal University- TBI were provided seed funding during 2013-14.
5. **Innovation and Entrepreneurship Development Centres (IEDCs)**: Innovation and Entrepreneurship Development Centre (IEDC) have been promoted in education institutions to develop institutional mechanism to create entrepreneurial culture in academic institutions to foster growth of innovation and entrepreneurship amongst the faculty and students. During 2013-14 , nine new IEDCs have been supported at various academic institutions across the country.
6. **i-STED (Innovation, Science and Technology led Entrepreneurship Development): Programme**: The new program, i-STED initiated in FY 2013-14 aims at inculcating strong entrepreneurial orientation in people to translate already developed innovative /S&T solutions in the market. Four new projects have been recommended for financial support during F.Y.2013-14 focussing on various technologies i.e. green construction , cane & bamboo processing and value addition , agricultural implements and solar based products for lighting and electrification being implemented at Jharkhand , Madhya Pradesh, Maharashtra, Gujarat and Assam State.
7. **STED Programme**: The programme on Science & Technology Entrepreneurship Development (STED) aims to promote micro-enterprises leading to local area development. During the current F.Y., nine new STED projects have been sanctioned at the locations viz; Alwar, Rajasthan; Churachandpur, Manipur; Haldwani, Uttarakhand; Amreli Distt, Gujarat; North Goa; Amethi, Uttar Pradesh; Kanpur, Uttar Pradesh , Puri, Odisha and Satara, Maharashtra . Training for 22 STED

project co-ordinators was organised at Institute of Rural Management , Anand during 17-20 Dec. 2013.

8. **Training Programmes on Entrepreneurship:** For sensitization, awareness creation, capacity building and knowledge enhancement on various aspects of entrepreneurship , NSTEDB supports organizations for conducting various modules of training programmes across the country. In F.Y. 2013-14 a total of 1,528 training programmes of 5 different modules have been supported to train 85,534 participants.
9. **DST-Lockheed Martin India Innovation Growth Programme (IIGP) 2013:** The India Innovation Growth Programme (IIGP) 2013 added further impetus to the ongoing efforts through knowledge partnership from Stanford Graduate School of Business(GBS), Stanford Univ.,USA. A total of 996 applications were received under the programme as a result of conducting 19 pan India road shows. 50 innovators underwent week long training and mentoring through GBS team. At the end of the competition, 20 best innovations were awarded a cash prize of INR One Lakh each. 10 Innovators and 5 incubation managers were selected for a week long Silicon Valley Ecosystem Exposure visit in USA during 26-30 Aug. 2013. Two technology expo were held at Ahmedabad and Patna to showcase the innovations tapped under IIGP 2013.



**Indian Innovators interacting with Silicon Valley Entrepreneurs and VCs**

10. Support has been extended to NSRCEL, IIM Bangalore for organization of Next Big Idea 2013, a Nation wide innovative idea competition in collaboration with Intel. The top three entries out of 330 were awarded with Cash prize and the first entry **ttatva innovations** from NSRCEL, IIM Bangalore was selected for the Global Entrepreneurship Challenge 2013 organised in UC Berkeley USA during November 2013.
11. **Next wave of Technology - Innovative Product Development by Start ups from TBIs**  
**FIN**, A wearable smart ring that can turn your palm into a gesture interface to control multiple devices is promising to be the next revolution in wearable technology. Developed by robotics start up RHL

Vision being incubated at the start up Village, Kochi, a DST supported TBI.. Fin is fitted with a bunch of sensors that can detect finger taps, swipes and identify various parts of the palm by calculating their distance from the thumb. It uses smart Low Energy Technology such as Bluetooth for communication with connected devices. Fin can transmit these natural gestures as commands to any connected Bluetooth device, such as a smartphone, a music player, a gaming console, a digital interface inside a car, a television set or a home automation device. Made out of durable, waterproof and dustproof material, a single Fin will be capable of supporting up to three devices at a time. It will come with a custom Lithium ion battery with micro-USB charging dock and last more than one month (Smart Saving Mode) on full charge. One of the most valuable applications of Fin, will be as a companion for the physically challenged, provided they have a functional thumb. The palm can be a touch interface for the visually impaired and Fin can be used to control disability aids with the least amount of physical stress.



**Fin: A Wearable Ring that turns your palm to Numeric Keypad and Gesture interface**

## **DEVELOPING SCIENTIFIC TEMPER IN SOCIETY**

The **National Council for Science & Technology Communication (NCSTC)** is mandated to communicate science & technology to masses, foster scientific and technological temper and coordinate and orchestrate such efforts throughout the country.

### **1. INITIATIVES & PROGRAMMES FOR MASS AWARENESS: Field & Outreach**

#### **Activities**

**1.1 Science Express** has successfully concluded sixth phases of its journey in 2013. More than twenty lakhs people have visited the Science Express: Biodiversity Special including students,

teachers and general public. In this phase, Science Express crossed the 10 million visitations mark.



Science Express: Biodiversity Special (SE:BS)

## 1.2 National Children's Science Congress (NCSC)

This year the 21<sup>st</sup> National Children's Science Congress 2013 was organized in Bhopal from 27<sup>th</sup> – 31<sup>st</sup> December, 2013 by Madhya Pradesh Council of Science & Technology. It started with "Walk for Science" on 27<sup>th</sup> December including 183 Escort Teachers, 77 State Coordinators/State Academic Coordinators/Team Coordinators, 75 Evaluators, 93 Resource persons/Exhibitors, 10 Key resource persons, 31 NCSTC Network members, 300 organizers, volunteers, invitee guests and general public. 643 projects from 35 States and UTs of India including Kendriya Vidyalaya Sanghan (KVS) and Navodaya Vidyalaya Samiti (NVS), 21 projects from the United Arab Emirates (UAE) and 3 projects from Association of South East Asian Nations (ASEAN) were presented based on the theme "Energy: Explore, Harness and Conserve". 21<sup>st</sup> NCSC has witnessed a team from ASEAN Countries, comprising of three supervisors and eight child scientists under the guidance and supervision of Shri Dimas Adekrisna from ASEAN Secretariat, Indonesia.

**Database Creation, Software Development, Web Designing and Web Hosting of NCSC** web portal has been done i.e. [www.ncsc.in](http://www.ncsc.in), user manual for effective guidance regarding operation and to avail features available on NCSC web portal is ready to use.

**Internship Programme for the child scientists:** Twenty two projects were adjudged as outstanding projects in 20<sup>th</sup> NCSC at Banaras Hindu University, Varanasi and participated in the 1<sup>st</sup> Internship programme during 9-24 December, 2013 at IIT, Kharagpur and a fellowship Rs. 1000/- cash prize.



Inauguration of 21<sup>st</sup> National Children's Science Congress

### 1.3 National Science Day (NSD)

The theme of NSD-2013 was 'Food security – Technological Paradigm'. Prof Govindarajan Padmanaban, distinguished Scientist, Department of Biochemistry at IISc, Bangalore, delivered a lecture on "Food security – Technological Paradigm" at Jawaharlal Nehru University, Delhi on 28th February 2013. NCSTC supported a number of events in throughout the country in scientific institutions, research laboratories and autonomous scientific institutions associated with the Department.

### 1.4 7th National Teacher's Science Congress (NTSC)

More than 2500 school teachers were orientated about focal theme and sub themes in the 7<sup>th</sup> National Teachers' Science Congress started with two major activities i.e., (i) Brain storming workshop at Doon University during 5-6 May, 2013 on development of resource material built around the focal theme "Science Education for Sustainable Development" for conducting regional workshops in the country and (ii) Regional orientation workshops conducted at Rohtak (5-6 July, 2013), Pondicherry (20-21 July, 2013), Raipur (24-25 July, 2013) and Guwahati (4-5 August, 2013). 610 papers were received, evaluated by the experts and 293 papers were selected for presentation.

### 1.5 Empowering the Next Generation of Innovators – IRIS

The Initiative for Research and Innovation in Science (IRIS) has been nurturing the spirit of innovation amongst school students in India since 2006 in association with the Confederation of Indian Industry (CII) and Intel Corporation with an aim to infuse spirit of discovery in school children, increase their

interest in science and technology, and build a robust scientific temper among the youth of the country. A National Fair of IRIS at CHRIST University Bangalore was organised in which 126 research based science projects exhibited across 17 subject categories and over 7,000 visitors came to the Fair, including student groups from more than 35 schools in around Bangalore.

### 1.6 India Innovation Initiative – i3

In India Innovation Initiative - i3 which is initiative of CII, DST & Agilent Technologies Ltd, around 600 innovations were received from across the country from students, industry professionals, individual & grassroots innovators in various fields after first level of screening top 45 innovations were selected to participate at the i3 National Fair held on 17 December 2013 at New Delhi. The top 5 innovations were awarded with a certificate & cash prizes.



Awards Distribution at National Programme of India Innovation Initiative

### 1.7 Regional Innovation Science Hubs for Innovators (RISHI)

The project was initiated with an aim to identify innovators who have the willingness and capacity to pursue new ideas as well as to provide suitable platform to young innovators of 9<sup>th</sup> to 12<sup>th</sup> class to encourage them to identify community related problems and make effort to find solution. Around 464 entries from the different parts of Northern region were received and 86 innovative ideas were short-listed for presentations before the panel of experts. Four internship camps had been conducted successfully wherein 28 innovative ideas of the potential innovators were pursued. The support was provided to 3 more RISHI programme at Tezpur University, Gujarat Science City & G.B. Pant Institute of Himalayan Environment & Development, Almora, Uttarakhand.

## **1.8 Awareness Programmes on Health & Nutrition**

With the objective of creating health awareness among adolescent girls and newly married/women belonging to rural farming community and semi urban community, number of workshops were organised at different villages of various districts. Experts from the field and resource persons interacted with the participants in all the workshops. Brain storming workshop on future strategies of science communication programme on malnutrition for 11 Hindi speaking states was organised by Voluntary Institution for Community Applied Science (VICAS) at Allahabad during October, 2013. Around 65 participants from Uttar Pradesh, Bihar, Jharkhand, Madhya Pradesh, Chattisgarh, Rajasthan, Uttarakhand, Delhi, Haryana, Himachal Pradesh and Odisha participated. Issues like women's health situation in India and access to health care, population control and women's health, declining sex ratio and sex selective abortions, health concerns of girls and adolescents, Nutrition & food security were addressed and discussed.

## **1.9 Mathematics Awareness**

A series of mathematics awareness programmes focusing on life, works of Ramanujan and importance of mathematics were organized. in the remote village schools. The activities included photo exhibition, songs based on mathematics, documentary, mathematics in play way, lectures, quiz, etc. The programmes enabled to take importance of mathematics in remote areas near Chambal valley.

## **1.10 S&T Exhibitions & Demonstration**

**1.10.1** Science exhibition is one of the most important activities to create and enhance scientific knowledge among children; teachers, parents and general public. It is participatory in nature where number of activity corners based on different scientific topics including vermi composting, soil & water testing, explaining science behind miracles, detection of food adulteration, low – cost teaching aids, hydroponics, etc are organised. NCSTC supported a series of science exhibitions in different parts of the country. NCSTC also participated in the popular Perfect Health Mela in Delhi, organized by Heart Care Foundation of India, New Delhi. More than 1110 students representing 34 schools of Delhi participated in the interschool competitions.

### **1.10.2 Science Exhibition on Wheels**

The main objective of the exhibition is to generate awareness among the masses especially the students community, villagers, cultivators etc. and to disseminate scientific information, know how on various aspects of Physics, Chemistry, Maths & Astronomy. The activities include science model exhibition, regular sky gazing camps through telescope and scientific explanation to miracles etc. Around 6 lakhs people visited the exhibition. Second phase (6th September 2012 to 5th September 2013) of Mobile Science Exhibition mounted in a Bus covered 26 districts in Madhya Pradesh.

### **1.10.3 Visit to Establishments where S&T is at work**

The main objective of the programme is to expose young minds to S&T, create their interest in new S&T subjects and develop their curiosity as well as creativity. The industrial tours were organized at several places including Bihar (Vaishali, Samastipur), Uttar Pradesh



(Ghaziabad, Kanpur, Deoriya, Khushinagar, Gorakhpur), J&K (Jammu) and Andhra Pradesh (Rangareddy, Adilabad, Karimnagar).



Students at CCMB Hyderabad

## 1.11 Eco & Wash (WATER, SANITATION & HYGIENE) Futures

- 1.11.1 Jal Sutra: Outreach Initiatives** - Case studies have been documented for interventions in villages like Sherikantha (Uttarakhand), Dhaloi (Tripura), Hindoli (Rajasthan), Rikkipurwa & Shankargarh (U.P), etc. Several new interventions are being supported in districts including Kendrapara (Odisha), Tamilnadu, Karnataka, Andhra Pradesh, Almora (Uttarakhand), (Chhatisgarh), Faridkot (Punjab), Banswara (Rajasthan). Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai is implementing through Department of Soil and Environment aiming to assess the existing knowledge of rural women population of three blocks of Madurai district about Eco-WaSH literacy through Self help groups, creating awareness about health risks of unhygienic water usage, present and future water demand, etc. Nagaland University & PSN College of Engineering & Technology has taken up trainings for youth and outreach programmes on rural awareness respectively.
- 1.11.2 Eco & WASH Literate Model Villages & Habitat:** Interventions were made for remote, inaccessible, marginalized, challenging, tribal areas. Efforts are being made to promote *Eco & WaSH Literate Model Villages & Habitat*, employing various methodologies in S&T Communication Research & Innovations.
- 1.11.3 Information, Education & Communication (IEC) Material:** Resource material like flip charts, CDs & community videos (Jal Chaupals) have been brought out and disseminated. A manual on communicative guidance on water quality monitoring has been

brought out with Shri Ram Institute for Industrial Research, Delhi. Consequently, resource material on relative utility of test kits and lab methods is being brought out.

**1.11.4** A pan-India plan for *Cultural Heritage & Water Values-Communicating Science*, entitled as the *Dabhoi Initiative*, has been outlined. Workshops have been designed on **“S&T Communication & Interpretive Capacity Building on Eco & WaSH issues”** for 6 months - 2 yrs duration for a series of workshops inclusive of site recording tools & A/V aids. The initiative is youth centric and adopts an eco-regional/ eco-habitat oriented, heritage, culture and science based approach to understand & interpret Eco & WaSH issues.

**1.11.5** A **“Sensitization Meet”** on water borne disaster in Uttarakhand was organized at Forest Research Institute, Dehradun, where about 100 participants from Educational Sector actively participated. It was hosted by Uttarakhand State Council for Science & Technology (UCOST).

### **1.12 Motivational Programme**

1.12.1 North East Institute of Science & Technology (NEIST), Jorhat, Assam organized four one week and eight one day programmes for the students from north eastern states to popularize science among students and to motivate them to take up science as careers. In the motivational programmes students were exposed to various laboratories in the NEIST.

1.12.2 Loyola College, Chennai organized 10 motivational programmes on Climate Change for students from different districts of Tamil Nadu. Exhibitions, demonstrations and interactions with scientists were also organized.

### **1.13 Conservation, Biodiversity, Medicinal Plants, Energy Management & Nature Camps**

Awareness is being created for conservation of the agro – biodiversity, adoption of organic farming & save forest including other natural resource among farmers, women and youth of gram panchayat of Kalwari, Srikot and Mashiar of Great Himalayan National Park, Kullu, Himachal Pradesh. Students are being provided understanding of scientific methodology – observation, experimentation, recording data, analysis and presentation to other groups and people. Four workshops of seven days each will be organized in four schools of Jagatsingpur & Cuttack district of Odisha. Students of class seventh to ninth standard and teachers from fourteen schools of Digha district, Medinipur, West Bengal are being trained in five day residential camp using hands on activities about the biodiversity of life forms in the coastal area. Science teachers of secondary and higher secondary school of Muzaffarpur, Danapur and Patna in Bihar are being trained in biodiversity conservation. Nature study camps are being organized for students of 7<sup>th</sup> to 9<sup>th</sup> standard in Kishanganj, Katihar district of Bihar and Darjeeling district of west Bengal.

## **Manpower Development**

### **2.1 Training Programmes in Mathematics**

Number of training programmes for popularization of mathematics were initiated in different parts of the country. More than 300 teachers were trained in seven states namely Punjab , Haryana, H.P., etc.

at the Regional level training programmes organized by the Punjab State S&T Council for Science & Technology, Chandigarh. Pushpa Gujral Science City, Kapurthala organized a three day workshop for teachers training wherein 50 teachers from Punjab and neighboring states got hands on training in mathematics. Vikram A. Sarabhai Community Science Centre, Ahmedabad organized series of training programmes in different districts of Gujarat for popularization of Mathematics. Innovative approaches, models and kits were used to popularize difficult concepts of Mathematics in an easier way. More than 900 teachers of 6-8th standard participated in 21 workshops organized in various districts of Gujarat under “Joy of Mathematics”. SUPRATIVA, Cuttack has been sanctioned one state level and 5 regional workshops for popularization of Mathematics in Orissa.

### **Field Programmes**

#### **Awareness Programmes**

In continuation of the National Year of Mathematics and International Year of Mathematics for the Planet Earth, S.D.Public School, New Delhi in association with many other schools organized number of programmes, workshops with Mathematics experts to popularize mathematics among students and remove its phobia during October 3-5, 2013. The students and teachers were also given exposure on “Mathematical Modeling”, Case Studies, etc. Around 60 schools from Delhi participated in the three days’ programme. Shwetambra Shodh Evam Shaikshanik Sanmsthan, Ujjain(M.P.) also organized a series of mathematics awareness and popularization programmes in the remote village schools of district Mandasor and Neemach in Rajasthan, Madhya Pradesh border. In all 20 school programmes focusing on life, works of Ramanujan. The programmes enabled to take importance of mathematics in remote areas near Chambal valley.

#### **Exhibitions & Rally**

Vikram A Sarabhai Community Science Centre, Ahmedabad organized a four day event titled , “Mathemagic” wherein mathematical quizzes, puzzles, competitions etc. were organized for B.Ed and PTC students. More than 150 exhibits on mathematics and Teaching Learning Materials were on display. Manthan Yuva Sansthan , organized series of awareness programmes on Life and works of Ramanujan in Jharkhand. Shri Vijaysinha Yadav Arts & Science College, Kolhapur organized a science exhibition wherein debates, elocutions and competitions were organized , 43 models were examined in the exhibition. A science rally was organized in Peth Vadgaon, 1200 students from senior secondary and B.Sc level participated which depicted scientific messages.

#### **National Mathematics Day**

December 22 is now celebrated as the National Mathematics Day (NMD) through out the country, state S&T Councils. In the states the day was the culmination or beginning of the activities related to mathematics popularization. A few states which supported the activities are: Nagaland, Mizoram, Arunachal Pradesh, Karnataka, etc.

- 2.2 Water Educators/ Jal Shikshaks** : A national initiative for capacity building has been formulated & implemented to cover the capacity scarce regions in the country, by grooming *Water Educators/ Jal Shikshaks* at regional & state levels. Initiatives have been supported in Rajasthan, Odisha & Gujarat.



Awareness programme on Ramanujan

- 2.3 Networking for WaSH :** “Networking for WaSH:Communicating Science” in Garhwal and Kumaun Regions of Uttarakhand State was supported to Council for S&T, Uttarakhand targeting at Postgraduate Students and Teachers from technical and higher educational institutes of the state. A project on ‘*Eco-Water Literacy Campaign - Networking for WaSH*’ is being implemented by Punjab State Council for Science & Technology, Chandigarh, Punjab for 2014.
- 2.4 Eyes on ISON:** Three days National training workshop on the ‘Eyes on ISON Campaign’ was held at Indian Institute of Science, Bangalore; National Institute of Technical Teachers’ Training and Research (NITTTR), Bhopal by BGVS, Karnataka; MPBGVS, MP Vigyan Sabha, Bhopal respectively. Around 50 participants having astronomy background were selected for workshops.
- Lectures and interactive sessions were held by some of the eminent resource persons. Two activities involving Making a comet model from a ping-pong ball and Making a ‘ply-poi’ comet with ribbon tails were demonstrated in it.
- The workshops were conducted with its objective to train the master resource persons to expand the access of science and astronomy.
- 2.5 Science Behind Miracles:** The Akhil Bharatiya Andhashraddha Nirmoolan Samiti has organized 12 ‘Training Workshops for Resource Persons for Explaining Science behind Miracles’ in five states Maharashtra, Chhattisgarh, Madhya Pradesh, Gujarat, and Goa. These workshops proved very beneficial in imparting training to remove superstitions and to propagate the spirit of scientific enquiry in the society. Karnataka Rajya Vijnana Parishat (KRVP), Bangalore organised an advance level workshop and brought out resource materials which was used in national orientation workshop and trained master trainers.
- 2.6 Social Insects :** Social insects have great value in maintaining ecological balance of nature. They provide great service to human beings, too. It is extremely interesting for school children to know about the biology and behaviour of some of these social insects as many lessons could be from them.

The Society for Environment and Development (SED) was entrusted to organize series of Teachers Training Programme in Rajasthan, Delhi, Haryana, Punjab, Himachal Pradesh, Chandigarh and Jammu & Kashmir. Under each programme 30 selected science teachers were trained for four day & programme on ants, bees, termites and wasps were conducted. 160 teachers from Rajasthan, Delhi and Punjab have been trained.

**2.7 Academic/ Training Courses in S&T Communication:** A variety of programmes, activities and courses were organized/ conducted to develop trained manpower in the area of science communication and science journalism. Different mass media were used for organizing some 20 training programmes at grass root level in different parts of country including remote, troubled and difficult areas. These training programmes in different parts of country have been able to arouse millions of science enthusiasts to bridge science-society gap. The students were able to participate in various science communication activities of NCSTC/ DST.

**2.8 Science & Technology in Indian Languages:** The programme has helped develop contents for science communication to students and researchers. The trends emerging out of the studies are encouraging and motivating to young science communication enthusiasts to take up science communication as a career and hobby too. It will also help develop future plans and campaigns for effective science and technology communication in the country.

**2.9 The 6<sup>th</sup> Science Communicators' Meet** was organized during January 04-05, 2013 at Kolkata as part of 100<sup>th</sup> Indian Science Congress attracting over 50 national and international delegates offering a dynamic forum for researchers and practitioners of science communication.

**Capacity Building:** The programmes on science through folk media and digital media were continued and offered advancement in the field of capacity building amongst masses towards enhancing science literacy and inculcating scientific temper. Some 10 such programmes were organized in different parts of the country and were taken into advanced level.

### **2.11 Simple Tasks, Great Concepts and making life science learning livelier**

Simple Tasks Great Concepts workshops were conducted for the teachers of South India [Andhra Pradesh (AP), Karnataka (KA), Kerala (KE), Pondicherry (PY) and Tamil Nadu (TN)], which included 106 educational districts. The entire programme was divided into TEN clusters, each cluster comprising of 10 to 11 educational districts corresponding to 30 to 33 teachers in each cluster.

339 teachers were trained and who interact with 1760 children.

**2.12 Science behind making of energy efficient lights** - Society of Pollution & Environmental Conservation Scientist (SPECS) organized two workshops-cum training programmes on Science behind making of energy efficient lights during June-August 2013 at Chamoli and Pithoragarh, Uttarakhand. The main objective of the programme was to make the scheduled tribe and schedule caste population of the area aware about energy conservation and train them in making of energy efficient lights. Around 40 participants from each of the areas were trained. The hands-on activity was very successful in generating curiosity while making electronic circuit, bamboo carving and assembling of bamboo lamps.

## 2.13 Training Workshops on Detection of Adulteration in Food Stuffs

Ten three days' each workshops to train teachers, voluntary activists, women on topics like various adulterants, their detection and diseases caused by their consumption, food safety laws, nutrition, etc. were covered in these workshops. The workshops were organized in Varansi, Lakhimpur Kheri, Shikohabad, Agra, Allahabad, Bulandshahar, Hapur, Rampur, Mirzapur and Pratapgarh districts of Uttar Pradesh. The workshops were organized by the Voluntary Institute of Community Applied Sciences (VICAS), Allahabad.

## 3. SCIENCE COMMUNICATION RESOURCES

### 3.1 Science on Radio

**3.1.1 *Ankon ke Khiladi*** : A 26-part radio serial on biographies of mathematicians was produced and broadcast from 117 AIR stations in 19 Indian languages throughout the country. It was jointly produced by NCSTC, Vigyan Prasar and All India Radio. The biographies of Srinivasa Ramanujan, ancient and medieval mathematicians of India, Archimedes, Pythagoras, Carl Friedrich Gauss, Niels Henrik Abel, Evariste Galois, Asutosh Mukherji, Subramanyam Chandrashekar, Harish Chandra, etc. were the highlights. Interested children were registered.

**3.1.2 **Radio Mathematics**** : To create curiosity and interest among the school going children in Mathematics and to find the efficacy of community radio in creating an interest among the rural children and urban poor pilot programmes of 90 episodes each were done by (i) IIT Kanpur, (ii) JUCR - Jadavpur university Kolkata, (iii) MUST Radio - Mumbai university, Mumbai and (iv) Shyamala vani - Subbalakshmi Lakshmi pathy College of Science, Madurai in Hindi, Marathi, Tamil, Bengali and English languages in the first phase targeted at pre primary, secondary and higher school mathematics syllabus.

## 4. SCIENCE COMMUNICATION RESOURCES

**4.1 Science for women's health and nutrition through Community Radio** - The objectives of the programme are to disseminate information to community women about their health and nutrition; to help adapt scientific temper among women who are in need of better medical and nutritional training and help etc. Supported by NCSTC, seven community radio stations are producing and broadcasting radio programmes on the topic. They are **PARD Vaanoli** in Madurai, **Radio Manav Rachna** (Manav Rachna Educational Society), Faridabad, **Radio JU** (Jadavpur University), Kolkata; **Hamara 90.4 MHz** (M S Panwar Institute of Communication & Management) Solan; **Radio Sarang 107.8 MHz**, (St. Aloysius College), Mangalore; **Radio Mattoli 90.4 MHz** (Wayanad Social Service Society, Wayanad) Kerala; and **Radio Namaskar**, 90.4MHz, Konark. Each of them is producing 365 episodes of 15 minutes duration each, in local language and broadcasting four times daily. The episodes are focused on issues like anemia, non communicable diseases, HIV & TB, menstrual hygiene and low birth weight. Made by the community for the community (participatory mode) in radio magazine format, these programmes are very popular in the community.

### 4.2 Monitoring (Exploring) Nature through Birds

Exploring Nature through Birds (ENTB) is aimed to develop a module for science communication which includes a web portal to collate and present the data, connect and coordinate the teams

working in various parts of the country and an activity-based-learning kit that could be used in class rooms as well as in field by students. A Brain Storming Workshop was organized on 18th and 19th June 2013 at SACON, Coimbatore. In this workshop the content of the module and fifty two species of common and indicator birds were selected as target taxa which fall under the following four specific habitats to which children have access. (1) Human Associated birds, (2) Agricultural /grass land birds, (3) Wetland birds, (4) Woodland birds & Scrub jungle birds.

#### **4.3 Capacity Building of teachers associated with Mobile School system of Jammu and Kashmir**

Jammu and Kashmir has Mobile Schools for nomadic Communities. Around 150 such schools are working effectively. In all the schools usually two teachers are responsible for teaching language, social studies, Mathematics, Science ,etc. from Preprimary to Upper Primary level. In practice the teachers are also moving with the communities with their school tent and start their school where ever the community stays.

A brainstorming workshop on Capacity building of teachers associated with mobile school system was organized during 12-13 September, 2013 at School of Innovation & Community Development, Shri Mata Vaishno Devi University, Katara, Jammu and brought out a module for conducting capacity building of teachers.

**4.4 Development of resource material for teachers training** - Department of Physics, IIT Kanpur developed resource materials for teachers training in experiment based Physics teaching in rural areas of Hindi belt. With the help of Shiksha Sopan, Talent Development Council and Anveshika, it conducted a number of sessions with teachers in various districts near Kanpur. 24 teachers have been registered for the workshop. A workshop has also been conducted to emphasize the need to make science education more interactive and connect it to the local living environment.

**4.5 Mathematics kit:** Conceptualized by NCSTC, a comprehensive low cost kit on 28 simple activities of mathematics by a group of experts has been designed by Manthan Education Society, Ahmedabad in order to understand the complex topics like fraction, magic square, commercial mathematics, value of pi including puzzles & riddles, tangram, pattern, Fibonacci series etc. Presented in colorful sheets with graphics, the kit is targeted to students from primary to higher secondary. Even teachers may use it while teaching the complex topics.

**4.6 Development of video CDs:** Twenty video CDs on various topics of science and mathematics in Hindi have been developed by the Indian Institute of Technology, Kanpur. These video CDs have been further disseminated in the schools for easy learning of various topics like chemical bonding, atoms and molecules, fractions, geometry, Force, Skeleton system, etc. The video CDs were further field tested in schools near Indian Institute of Technology (IIT), Kanpur, Science Express - a mobile exhibition on train, Schools (Delhi) and received positive feed back.

**4.7. Interactive Web Portals:** An interactive Math portal has been supported to the Bannari Amman Institute of Technology, Erode, and Tamil Nadu by NCSTC. The portal is being designed to portray logic puzzles, mind puzzles, e-learning questions, etc.

## **5. INCENTIVE PROGRAMMES**

5.1 National Awards for Science & Technology Communication Central function of National Science day was celebrated on 28th February, 2013. Shri S Jaipal Reddy, Hon'ble Minister for Ministry of Science & Technology and Ministry of Earth Sciences, Govt. of India, was the Chief Guest. He honored the awardees of 2012 for their outstanding contribution in communication of science and technology and promoting scientific temper.

### **5.2 UNESCO Kalinga Prize**

Prof Xiangyi Li, resident of China has been awarded UNESCO Kalinga Prize for Popularization of Science for the year 2013 at the World Science Forum held in Rio de Janeiro, Brazil on November 24, 2013. This is for the first time the prize is awarded to a resident of China, with this the number of countries whose residents have been awarded the prize has gone up from 23 to 24. The Prize includes prize money of US \$ 20,000 and an Albert Einstein Medal. Mr Li is being presented Kalinga Chair.

Book entitled "UNESCO Kalinga Laureates for Universal Peace" was e-launched in the ceremony organized by Kalinga Foundation Trust, at Indian Institute of Physics, Bhubneshwar in the presence of Hon'ble Chief Minister of Orissa.

### **5.3 Rajat Jayanti Vigyan Sancharak Fellowship**

Nine out of ten Rajat Jayanti Fellows in the year 2012 started their project work in 11 states. Awareness generation among students of twelve higher secondary schools has been imparted in Rajouri district of Jammu region by enthusiastic young group.



## INPUTS TO SCIENCE, TECHNOLOGY AND INNOVATION (STI) POLICY

### STRENGTHENING STI INFORMATION SYSTEM

The National Science & Technology Management Information System (NSTMIS) division continued its efforts of generating and making available information on resources both manpower as well as financial devoted to scientific and technological (S&T) activities by conducting national surveys both through in-house as well as sponsored studies.

#### S&T Resources Studies

The document based on national survey 2009-10 titled 'Research and Development Statistics 2011-12' seventeenth in the series was brought out during the year. In this report, scope and coverage of the R&D activities has been enlarged substantially by including the expenditure of major multinational companies performing R&D activities and Industries other than those recognized by the Department of Scientific and Industrial Research (DSIR) in addition to (i) Higher Education Sector (ii) Central Sector (iii) State sector and (iv) Small Scale Industry (SSI) Sector.

The salient features of this survey are that the national investment on R&D activities attained at least a level of Rs.53,041.30 crores in 2009-10 which is 0.87% of Gross Domestic Product (GDP). The major share of R&D expenditure was met from Central Government sources (54.4%); State Governments contributed 7.3%, Higher Education 4.1%, Public Sector Industries 5.3% and the remaining 28.9% from the Private Sector Industries. Nearly 4.41 lakhs personnel were employed in the R&D establishments. There were 66,302 women employed in R&D establishments which works out to be 15.03% of the total manpower employed in the country in R&D establishments. Out of this, 27,532 were performing R&D activities which is 14.3% of total personnel performing R&D activities. The document also provides detailed information collected from secondary sources on patents, enrolment, out-turn, Full Time Equivalent Researchers per million population and R&D expenditure per capita etc.

Based on the national survey on resources devoted to S&T activities, the publication titled 'R&D Statistics at a Glance' September 2013, giving salient findings of the survey was also brought out. S&T Indicators Tables based on the survey have also been generated and uploaded on the NSTMIS website for quick and wider dissemination. Launching of the next national survey on R&D for the year 2012-13 is under progress.

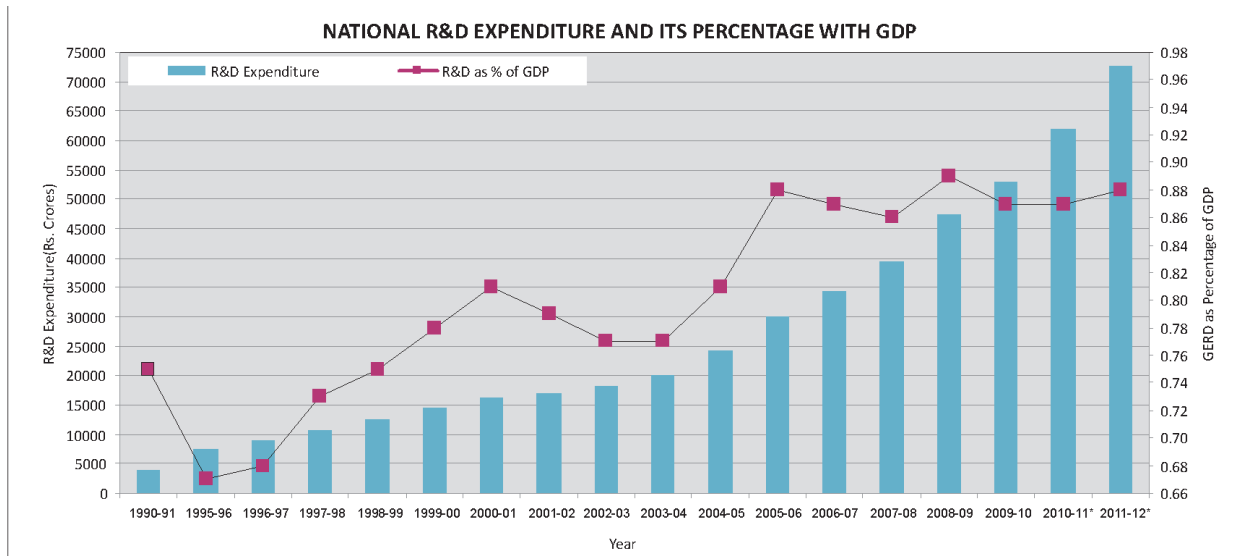


Fig 1.1: National R&D Expenditure and its Percentage with GDP

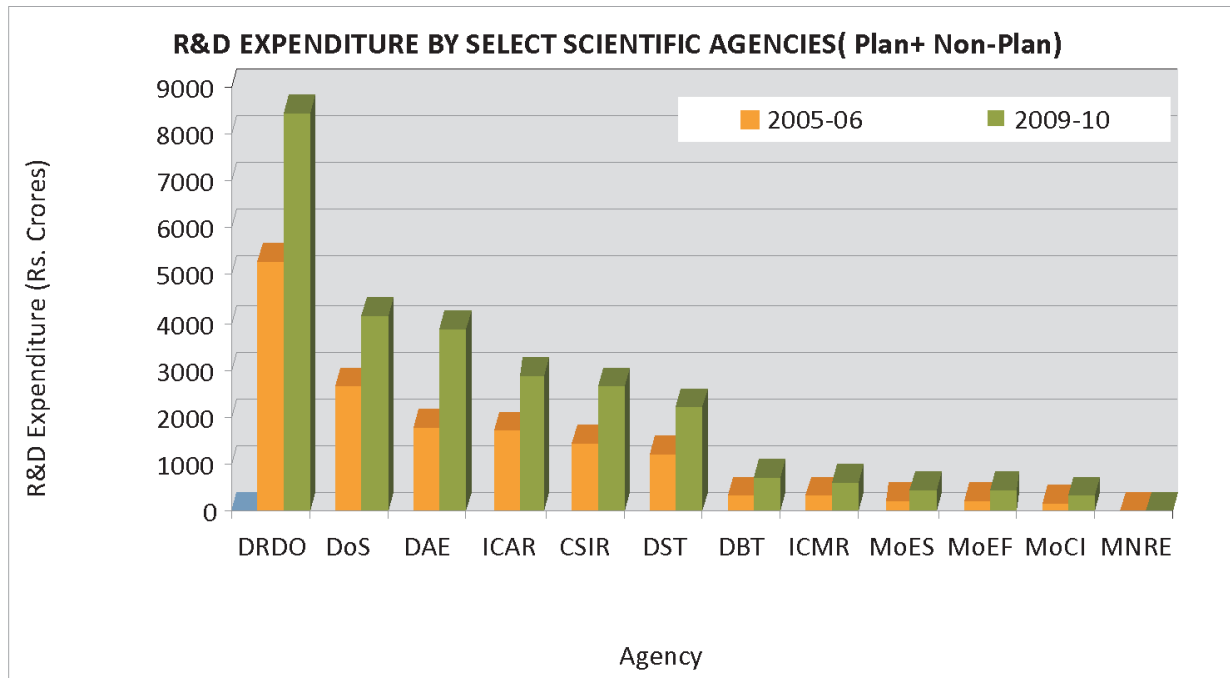


Fig 1.2: R&D Expenditure (Plan + Non-Plan) by select Scientific Agencies

The new initiative, ‘Science, Technology, Innovation and Creation of Knowledge (STICK)’ Programme is aimed at the development of Science, Technology and Innovation (STI) Indicators in Indian context. The framework to measure the innovation and knowledge creation capabilities of industrial enterprises at the national level was evolved by the NSTMIS with various stakeholders including international domain experts. Under the STICK programme, the national report entitled ‘Understanding Innovation: Indian National Innovation Survey’ would be finalised. The report is based on the analysis of a sample survey of 9,001 firms out of 2,08,415 as per the ASI 2009-10 database. The surveyed firms, largely MSMEs, were spread across 26 states and 5 Union

Territories covering 96 industrial sectors in the country. For evolving an effective STI strategy, the report would be made open for national discussion among the stakeholders in the country.

To provide evidence based evaluation and monitoring of scientific research, studies would be commissioned for the development of Bibliometric Indicators in Indian context based on the two globally popular databases namely SCI, Thomson Reuters and SCOPUS, Elsevier. This would provide the basis for evidence based evaluation and monitoring of scientific research for policy planning.

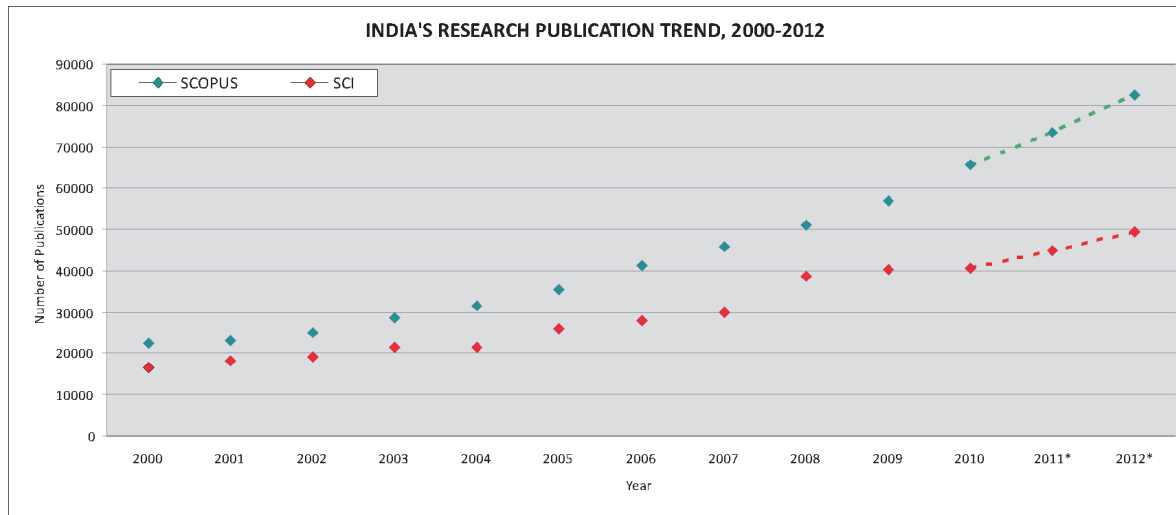


Fig 1.3: India's Research Publication Trend 2000-2012

### Information System/Database Activities

With a view to disseminate information on sponsored research and development (R&D) projects for the benefit of different interest groups, efforts were continued to compile information on extramural R&D projects funded by various central S&T agencies. Besides maintaining a computerised database on extramural R&D projects, the Department publishes annually a Directory of Extramural Research and Development Projects funded during the year since 1990-91. The directory for the year 2010-11, twenty-first in the series has been brought out during the year. To bring out the above annual directory on time, the work relating to the simultaneous preparation of Directory of Extramural R&D projects for the years 2011-12 and 2012-13 has been started.

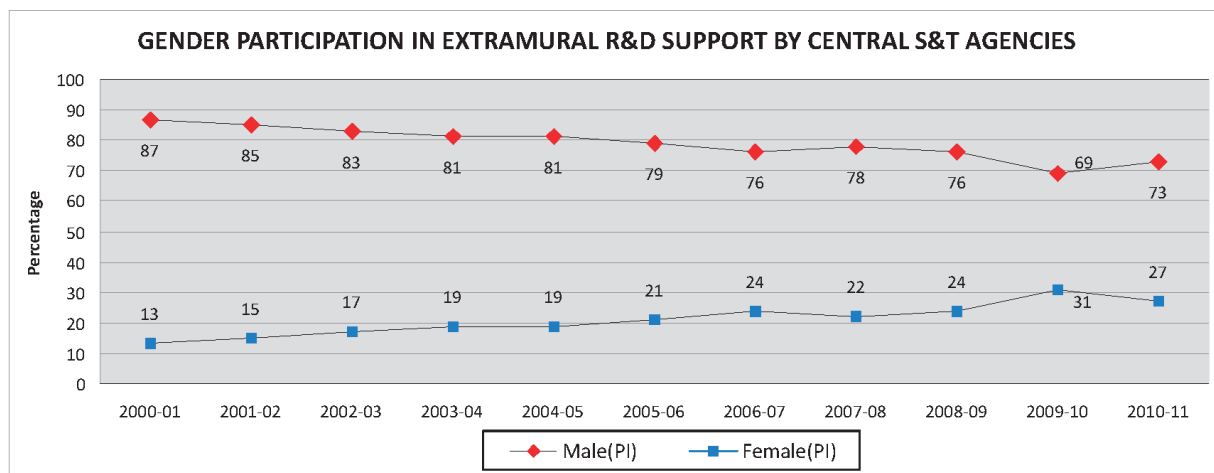


Fig 1.4: Gender Participation in Extramural R&D Support by Central S&T Agencies

Also based on the above mentioned database, the DST has been bringing out reports giving quick analyses on the extramural research support by the central government agencies in terms of funding pattern and its outcome. Four reports on the 'Funding Pattern of the Sponsored Research by Scientific Agencies' for the periods 1985-90, 1990-95, 1995-2000 and 2000-05 have already been brought out by the division. For the benefit of scientific community, the work to produce fifth report for the period 2005-10 initiated this year is under progress.

Second report on the analysis of outcome of the extramural R&D projects entitled "Analysis of Outcome of Extramural R&D (EMR) Projects during 2000-05" was brought out in the previous year. Further, for the benefit of scientific community, work to produce the third report for the period 2005-10 has been initiated.

### **Sponsored Studies**

Apart from the in-house efforts in bringing out the R&D statistics at national level, the NSTMIS division sponsored a number of studies to build databases on S&T investment, S&T manpower availability/deployment/gap and S&T indicators. The following studies were completed during the year:

- Development of a web based digital repository of NSTMIS research publications.
- Development of database of equipment funded under extramural R&D projects.
- Directory of R&D capabilities in the field of Tuberculosis (extended phase)
- Setting up of Indian Materials database centre
- Innovation in Agriculture
- Mapping foresight activities in Indian Biotechnology sector

### **International Collaboration**

The Department has actively participated and contributed in the UNESCO Institutes of Statistics (UIS) and Organization for Economic Cooperation and Development (OECD) meetings for the development and revision of standards/concepts/definitions used for collection of Science Statistics and development of Science, Technology and Innovation Indicators. The department also provided information for the country on Science & Technology Indicators to UNESCO Institute for Statistics for the Global database on S&T Indicators and other related publications such as UNESCO Science Report etc.

## **FORMULATION OF ENABLING POLICIES FOR S&T**

As a Twelfth Plan Initiative, Department has established a new dedicated Policy Research Division to develop and deliver public policy support for the promotion of research and development in the country and to carry out S&T Policy related evidence gathering exercise. The Division is actively engaged in strengthening the Policy Research Mechanism for providing evidence based planning approaches. As a major Policy initiative new Science, Technology and Innovation (STI) Policy 2013 has been enunciated.

Major objectives of the Policy Research Division include commissioning preparation of study reports of STI policies of developed and emerging economies, engaging in periodical dialogues and discussions with stake holders, national and international policy experts, socio economic ministries, industrial leaders and

develop policy papers for research and development sector as inputs for decision making and to advise general directions in policy environment for increasing the private sector investment into R&D, and for enhancing the absorption capacity for larger investment into R&D. Apart from preparation of performance reports on publications and patents for the science, technology and innovation output indicators, continuous studies of policy environments and suitable adjustments in the Indian policy framework to gain global leadership and India to emerge as one of the top five knowledge powers and to advise measures for re-engineering and rationalization governance processes to suit the special needs of the Indian science sector is the main function of the Division.



STI Policy workshop at Entrepreneurship Development Institute of India (EDII), Ahmadabad.

To translate highly laudable vision of STI Policy-2013 to reality, in the first phase, three Policy Research Centres (PRCs) in the public-funded academic institutions viz. IIT Delhi, Panjab University, Chandigarh, and Babasaheb Bhimrao Ambedkar University, Lucknow have already been established. The above Centres are expected to serve as a knowledge partner of DST in the development of (a) Human capacity for science policy research, (b) Policy papers for wider study among the stack holders and (c) Enabling tools for the implementation mechanism for STI policy 2013. The Department hopes to create evidence based documents through the above Centres which will help DST in designing new programmes and policies in the science, technology and innovation sector in the country.

The Division has organized 14 brain-storming sessions with the stakeholders in different parts of the country to seek their inputs in implementing objectives of new STI Policy. Sincere and focused efforts are being initiated to achieve goals of new STI Policy.

## ADMINISTRATION AND FINANCE

The administration and finance divisions of the Department continued to provide support and necessary administrative decisions for smooth functioning of the Department as well as its subordinate offices.

### STAFF POSITION

Department has a total number of 211 Group 'A' and Group 'B' (Gazetted) officers as per the break-up given below:-

Group 'A'	General	SC	ST	OBC	PH	Total
Scientific	98	08	02	-	04	112
Non-Scientific	32	-	01	-	-	33
<b>Group 'B'</b>						
Scientific	11	01	01	01	-	14
Non-Scientific	37	13	02	-	-	52
<b>Grand Total</b>						<b>211</b>

Department has a total number of 284 non-gazetted staff on its rolls as per the break-up given below:-

Group	General	SC	ST	OBC	PH	Total
Group 'B' (Non-Gazetted)	87	09	03	07	02	108
Group 'C'	81	71	09	12	03	176
<b>Grand Total</b>						<b>284</b>

### PARLIAMENTARY WORK

The Parliament Unit is assigned with the responsibility of handling entire parliamentary work of the Department. It ensures that the parliamentary work pertaining to the Ministry of Science & Technology is accomplished as per the prescribed schedule and procedures. The Unit maintains liaison with the Ministry of Parliamentary Affairs, Secretariats of Lok Sabha/Rajya Sabha, other Ministries/Departments (including Scientific Departments) with a view to fully discharge the parliamentary obligations of the Ministry of Science & Technology. The Unit also coordinates the visits of the Parliamentary Committees to various scientific institutions which are under the administrative control of this Department.

The Parliamentary Standing Committee on Science and Technology, Environment and Forests met on 16th April, 2013 to discuss the Demands for Grants for the year 2013-2014 of the Department and submitted its recommendation in its 240th report presented to the Parliament on 8th May, 2013. A Statement on the Status of Implementation was made/laid on both the Houses of the Parliament and the Action Taken Report on the recommendations of the 240th Report of the Parliamentary Standing Committee was also submitted to the Rajya Sabha Secretariat of the Committee as per schedule.

## **IMPLEMENTATION OF OFFICIAL LANGUAGE POLICY**

The Department of Science and Technology continued to make concerted efforts to promote the use of Hindi in official work and to ensure compliance with the provisions of the Official Language Act, 1963 as amended in 1967 and Rules 1976 framed thereunder as also the various orders/ instructions issued by the Department of Official Language from time to time with a view to ensure proper implementation of the Official Language Policy of the Government.

DST has a full-fledged Hindi Section consisting of a Joint Director (O.L.) assisted by an Assistant Director (O.L.) and other supporting staff which caters to the need of the Department of Science & Technology and also its Subordinate offices / Autonomous Institutions. Besides monitoring the implementation of the Official Language Policy and the Annual Programme, Hindi Section arranges for in - service training of the staff in Hindi Language, Hindi Typewriting and Hindi Stenography. It also undertakes translation of the material received from various Sections/ Desks of the Department from English into Hindi and vice-versa.

For promotion of use of Hindi in this Department and to create conducive environment for the officials to work more in Hindi, various programmes are being undertaken:

- All documents coming under Section 3(3) of the official language Act, 1963 like general orders, notifications, cabinet notes, annual report Parliament Questions, matter related to Parliamentary Standing Committee and all the papers which were laid before the parliament were issued bilingually in both Hindi and English. Letters received in Hindi were invariably replied to in Hindi.
- The officers of Hindi Section conducted inspections of Subordinate offices / Autonomous Institutions and sections of the department regarding progressive use of Hindi.
- Hindi Section also coordinated the visits of the Parliamentary committee on official language to D.S.T. and its scientific institutions which are under the administrative control of the Department and achieved the targets of fulfilling the assurances given to the committee at the time of its visit.
- During the year, quarterly meetings of Departmental Official Language Implementation Committee were organized regularly. Likewise, Hindi workshops were organized to encourage the officers / staff of the department to do their maximum work in Hindi.
- The Hindi Advisory committee has been reconstituted.

### **Cash Awards and Incentive Schemes**

An incentive scheme to encourage officers and employees to do their maximum official work in Hindi is in vogue in the Ministry. Under the scheme, cash award were given for doing nothing and drafting in Hindi.

## **Celebration of Hindi Pakhwara**

Hindi Pakhwara was organized from 13 to 27 September, 2013 in the Ministry of Science and Technology. Various Hindi competitions were organized and the successful participants were given cash awards and certificates.

## **RIGHT TO INFORMATION (RTI)**

A total of 805 applications and 76 Appeals were received by the Department during the year 2013-14. All applications have been responded to within the stipulated time frame by the CPIOs. Appeals have been disposed off as per the provisions of RTI Act, 2005.

## **PUBLIC GRIEVANCES**

A total of 713 public grievances were dealt with by different Sections/Divisions during 2013-14. Out of these, 631 were disposed off.

## **CITIZEN'S CHARTER**

Department has prepared a Citizen's Charter in consultation with the Performance management Division of the Cabinet Secretariat and uploaded on the department's website in December 2013.

## **EXHIBITION**

The Exhibition Cell was assigned a number of responsibilities of organization of exhibition, participation in the national and international exhibitions. In addition it has also responsibility of coordinating the work related to participation of Department of Science & Technology along with its organizations in the exhibition.

The Exhibition cell has participated in IITF -2013. The cell has also played an active role in Inspire Exhibition during 8<sup>th</sup> to 10<sup>th</sup> Oct 2013. The cell also participated in a number of other exhibition in various states.



## Results-Framework Document (R F D) Department of Science and Technology (2012-2013)

### Section 1: Vision, Mission, Objectives and Functions

#### Vision

To enable India becoming a global knowledge power by promoting basic research, development of cutting edge technologies and innovation for globally competitive and inclusive growth to power technology-led economic progress of the society.

#### Mission

To strengthen the R&D base of the country through funding, development and utilization of technologies, building entrepreneurship and innovation, fostering international S & T cooperation, popularization and demonstration, generating S&T database, mounting mission mode initiatives, attracting talent to science and rejuvenating research in university and promotion of public-private partnerships.

#### Objectives

- 1 Formulation of Science, Technology and Innovation policy and other enabling policies for the R&D sector
- 2 Strengthening Basic research and Expanding R&D base -Human Capacity
- 3 Strengthening Basic research and Expanding R&D base -Institutional Capacity
- 4 Implementing Technology Development Programs
- 5 Societal interventions of S&T
- 6 S&T co-operation / Partnerships and Alliance

#### Functions

- 1 Coordination and integration of areas of Science & Technology having cross sectoral linkages in which a number of institutions and departments have interest and capabilities.
- 2 Support and Grants-in-aid to Scientific Research Institutions, Scientific Associations and Bodies.
- 3 Matters regarding Inter-Agency/Inter-Departmental coordination for evolving science and technology missions.
- 4 Formulation of policies relating to Science and Technology.

- 5 Matters relating to the Scientific Advisory Committee of the Cabinet (SACC).
- 6 Promotion of new areas of Science and Technology with special emphasis on emerging areas. (i) Research and Development through its research institutions or laboratories for development of indigenous technologies concerning bio-fuel production, processing, standardization and applications, in co-ordination with the concerned Ministry or Department; (ii) Research and Development activities to promote utilization of by-products to development value added chemicals.
- 7 Futurology.
- 8 Undertaking or financially sponsoring scientific and technological surveys, research design and development, where necessary.
- 9 Matters commonly affecting Scientific and technological departments /organisations/institutions, e.g., financial, personnel, purchase and import policies and practices.
- 10 Management Information Systems for Science and Technology and coordination thereof.
- 11 Matters concerning domestic technology particularly the promotion of ventures involving the commercialization of such technology other than those under the Department of Scientific and Industrial Research.
- 12 All other measures needed for the promotion of science and technology and their application to the development and security of the nation.
- 13 Matters relating to institutional Science and Technology capacity building including setting up of new institutions and institutional infrastructure.
- 14 Promotion of Science and Technology at the State, District, and Village levels for grass-roots development through State Science and Technology Councils and other mechanisms.
- 15 Application of Science and Technology for weaker sections, women and other disadvantaged sections of Society.
- 16 All matters concerning: (a) Science and Engineering Research Board; (b) Technology Development Board and related Acts (c) National Council for Science and Technology Communication; (d) National Science and Technology Entrepreneurship Development Board; (e) International Science and Technology Cooperation including appointment of scientific attaches abroad (in close cooperation with the Ministry of External Affairs); (f) Autonomous Science and Technology Institutions relating to the subject under the Department of Science and Technology (g) Professional Science Academies promoted and funded by Department of Science and Technology; (h) The Survey of India, and National Atlas and Thematic Mapping Organisation; (i) National Spatial Data Infrastructure and promotion of G.I.S (j) The National Innovation Foundation, Ahmadabad.

**Section 2:**  
**Inter se Priorities among Key Objectives, Success indicators and Targets**

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%
[1] Formulation of Science, Technology and Innovation policy and other enabling policies for the R&D sector	13.00	[1.1] Submission of draft National Science, Technology and Innovation Policy to Cabinet	[1.1.1] Date of completion of National Science, Technology and Innovation Policy	Date	6.00	31/08/2012	07/09/2012	14/09/2012	21/08/2012	28/08/2012
		[1.2] Preparation of two performance reports on publications and patents for the science, technology and innovation output indicators (2000-2010) for India	[1.2.1] Date of publication of the reports	Date	7.00	28/02/2013	07/03/2013	14/03/2013	21/03/2013	28/03/2013
	17.00	[2.1] Number of INSPIRE awards released	[2.1.1] Number of students covered under INSPIRE award	Number	3.00	200000	190000	180000	170000	160000
		[2.2] Number of INSPIRE internships covered through summer/ winter camps	[2.2.1] Number of youth attracted to summer /winter camps	Number	2.50	55000	50000	45000	40000	35000
		[2.3] Number of scholarships for Higher Education awarded	[2.3.1] Number of scholarships released	Number	2.50	4500	4200	4000	3800	3600
		[2.4] Number of INSPIRE Fellowship awarded	[2.4.1] Number of fellowships released	Number	3.00	800	700	600	500	400
[2.5] Institution of INSPIRE faculty position	[2.5.1] Number of INSPIRE faculty position	Number	2.50	180	175	160	150	140		
[2.6] Mapping of the publications/ patents of the Indian researchers in Indexed Journals as an indicator of	[2.6.1] Number of status reports prepared per year	Number	1.50	5	4	3	2	1		

**Section 2:  
Inter se Priorities among Key Objectives, Success indicators and Targets**

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%
[3] Strengthening Basic research and Expanding R&D base -Institutional Capacity	13.00	competitiveness of India [2.7] Completion of EFC for the programme for the employed women scientists for mid-career mobility within the country [2.8] Strengthening of Human Capacity in research in identified thrust areas in Atmospheric Sciences [3.1] Capacity building through Fund for infrastructure strengthening S&T (FIST)	[2.7.1] Date of completion of the EFC process	Date	1.50	28/02/2013	07/03/2013	14/03/2013	21/03/2013	28/03/2013
			[2.8.1] Number of Scientists benefited	Number	0.50	100	80	60	50	25
			[3.1.1] Level of utilization of competitive grants	%	4.00	100	90	95	92	90
			[3.2.1] Number of packages delivered	Number	4.00	1	1	1	1	1
			[3.3.1] Number of Centers Established	Number	2.00	2	1	1	1	1
[4] Implementing Technology Development Programs	18.00	[3.4] Launch of Programme for Research initiatives in Mathematics Education Science (PRIME) [3.5] Preparation of DPR for Super Computer facility and Capacity building [4.1] Number of technologies assisted for application	[3.4.1] Date of launch of the programme	Date	2.00	31/12/2012	07/01/2013	14/01/2013	21/01/2013	28/01/2013
			[3.5.1] Date of completion of the report	Date	1.00	28/09/2012	05/10/2012	12/10/2012	19/10/2012	26/10/2012
			[4.1.1] Number of technologies assisted for application	Number	2.00	40	35	30	25	20

**Section 2:**  
**Inter se Priorities among Key Objectives, Success indicators and Targets**

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value								
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%				
		and absorption	applied and promoted											
		[4.2] Number of convergent technology solutions for water challenges identified and selected	[4.2.1] Number of technology solutions for water found out	Number	2.00	4	3	2	1					1
		[4.3] Initiation of Programmes envisaged in Detailed Project Report for indigenous Solar Energy Research initiative	[4.3.1] Number of R&D projects supported	Number	2.00	8	6	5	4					2
		[4.4] PhD/M.Tech. students trained in the area of nano science and technology in the country under nano mission	[4.4.1] Quantitative number of PhD/PG outputs	Number	2.00	200	180	160	140					120
		[4.5] Implementing new thrust areas: Cognitive science	[4.5.1] Number of researchers supported	Number	2.00	60	50	40	30					20
		[4.6] R&D programmes for establishing knowledge networks in the areas of climate change and clean energy	[4.6.1] Number of programmes taken up	Number	2.00	8	6	5	4					3
		[4.7] Programme initiation for promotion of PPP for R&D areas and increased engagement of Private sector in R&D	[4.7.1] Number of projects initiated under PPP	Number	2.00	4	3	2	1					1
		[4.8] Demonstration and transfer of the test bed for potash technology from sea water to Ministry of Chemicals	[4.8.1] Date of transfer of the technology	Date	2.00	28/09/2012	05/10/2012	12/10/2012	19/10/2012					26/10/2012

**Section 2:  
Inter se Priorities among Key Objectives, Success indicators and Targets**

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value							
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%			
		and Fertilizers											
		[4.9] Preparing independent status report on impact/outcome of Technology Development Programmes	[4.9.1] Number of Projects reviewed and status reports submitted	Number	2.00	5	4	3	2	1			
[5] Societal interventions of S&T	14.00	[5.1] Assisting Technology Entrepreneurs under the National Science & Technology Entrepreneurship Development Board	[5.1.1] Number of entrepreneurs assisted	Number	2.00	130	120	110	100	80			
		[5.2] Assisting micro enterprises under the National Science & Technology Entrepreneurship Development Board	[5.2.1] Number of micro enterprises assisted	Number	2.00	2600	2550	2500	2450	2400			
		[5.3] Support to Women for gender parity in S&T	[5.3.1] Number of projects supported	Number	2.00	170	165	160	150	140			
		[5.4] Projects supported for S&T inputs for developments of weaker sections for equity	[5.4.1] Number of projects supported	Number	2.00	65	60	55	50	45			
		[5.5] Field projects and research programmes supported for science popularization and communication	[5.5.1] Number of projects supported	Number	2.00	225	220	215	210	200			
		[5.6] Child Scientists participation in National Children Science	[5.6.1] Number of children participating the	Number	1.00	1100000	1000000	950000	900000	850000			

**Section 2:  
Inter se Priorities among Key Objectives, Success indicators and Targets**

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value				
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%
[6] S&T co-operation / Partnerships and Alliance	10.00	Congress	event							
		[5.7] Implementation of programme on S&T backed interventions for tribal population	[5.7.1] Number of backed interventions for tribal population	Number	1.00	5	4	3	2	1
		[5.8] Launching of model demonstration projects through CSTRIs for rural application	[5.8.1] Number of demonstration projects launched	Number	2.00	4	3	2	1	1
		[6.1] Signing agreements, MOUs and protocols for S&T cooperation and partnership	[6.1.1] Number of agreements signed	Number	2.00	45	40	35	30	25
		[6.2] Development and synergy of National Knowledge Network for S&T cooperation	[6.2.1] Number of Nodes developed and synergized	Number	2.00	28	26	24	22	20
		[6.3] Exchange of professional for international cooperation	[6.3.1] Number of exchange visit facilitated	Number	2.00	1200	1150	1100	1050	1000
		[6.4] Developing State S&T Councils mechanisms for S&T outreach	[6.4.1] Ratio of programmatic fund released to state S&T Councils as a percentage of core grants sanctioned for manpower	Ratio	1.00	1.10	1.05	1.0	0.5	0.25
		[6.5] Projects sanctioned through the Joint	[6.5.1] Number of research Projects	Number	1.00	15	12	10	8	6

**Section 2:  
Inter se Priorities among Key Objectives, Success indicators and Targets**

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value								
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%				
		research fund	funded under the joint research fund											
		[6.6] Investment through India Innovation Fund	[6.6.1] Number of companies supported	Number	1.00	3	2	1	1					1
		[6.7] Design of a scheme for fostering international S&T co-operation for Indian universities	[6.7.1] Preparation of DPR for the scheme	Date	1.00	31/12/2012	07/01/2013	14/01/2013	21/01/2013	28/01/2013				
* Efficient Functioning of the RFD System	3.00	Timely submission of Draft for Approval	On-time submission	Date	2.0	05/03/2012	06/03/2012	07/03/2012	08/03/2012	09/03/2012				
		Timely submission of Results	On-time submission	Date	1.0	01/05/2012	03/05/2012	04/05/2012	05/05/2012	06/05/2012				
* Administrative Reforms	6.00	Implement mitigating strategies for reducing potential risk of corruption	% of implementation	%	2.0	100	95	90	85	80				
		Implement ISO 9001 as per the approved action plan	Area of operations covered	%	2.0	100	95	90	85	80				
		Timely preparation of departmental Innovation Action Plan (IAP)	On-time submission	Date	2.0	01/05/2013	02/05/2013	03/05/2013	06/05/2013	07/05/2013				
* Improving Internal Efficiency / responsiveness / service delivery of Ministry / Department	4.00	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	2.0	100	90	80	70	60				
			Independent Audit of implementation of public grievance redressal system	%	2.0	100	90	80	70	60				
* Ensuring compliance to the Financial Accountability	2.00	Timely submission of ATNs on Audit paras of C&AG	Percentage of ATNs submitted within due	%	0.5	100	90	80	70	60				

\* Mandatory Objective(s)



**Section 2:  
Inter se Priorities among Key Objectives, Success indicators and Targets**

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value							
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%			
Framework			date (4 months) from date of presentation of Report to Parliament by CAG during the year.										
		Timely submission of ATRs to the PAC Sectt. on PAC Reports.	Percentage of ATRs submitted within due date ( 6 months) from date of presentation of Report to Parliament by PAC during the year.	%	0.5	100	90	80	70	60			
		Early disposal of pending ATNs on Audit Paras of C&AG Reports presented to Parliament before 31.3.2012.	Percentage of outstanding ATNs disposed off during the year.	%	0.5	100	90	80	70	60			
		Early disposal of pending ATRs on PAC Reports presented to Parliament before 31.3.2012	Percentage of outstanding ATRs disposed off during the year.	%	0.5	100	90	80	70	60			

\* Mandatory Objective(s)

**Section 3:  
Trend Values of the Success Indicators**

Objective	Action	Success Indicator	Unit	Actual Value for FY 10/11	Actual Value for FY 11/12	Target Value for FY 12/13	Projected Value for FY 13/14	Projected Value for FY 14/15
[1] Formulation of Science, Technology and Innovation policy and other enabling policies for the R&D sector	[1.1] Submission of draft National Science, Technology and Innovation Policy to Cabinet	[1.1.1] Date of completion of National Science, Technology and Innovation Policy	Date	--	--	07/09/2012	--	--
	[1.2] Preparation of two performance reports on publications and patents for the science, technology and innovation output indicators (2000-2010) for India	[1.2.1] Date of publication of the reports	Date	--	--	07/03/2013	--	--
[2] Strengthening Basic research and Expanding R&D base -Human Capacity	[2.1] Number of INSPIRE awards released	[2.1.1] Number of students covered under INSPIRE award	Number	180000	200000	56409	200000	200000
	[2.2] Number of INSPIRE internships covered through summer/ winter camps	[2.2.1] Number of youth attracted to summer /winter camps	Number	50000	50000	35000	60000	65000
	[2.3] Number of scholarships for Higher Education awarded	[2.3.1] Number of scholarships released	Number	1300	1900	2500	5000	5000
	[2.4] Number of INSPIRE Fellowship awarded	[2.4.1] Number of fellowships released	Number	640	750	430	850	900
	[2.5] Institution of INSPIRE faculty position	[2.5.1] Number of INSPIRE faculty position	Number	--	48	103	200	225
	[2.6] Mapping of the publications/ patents of the Indian researchers in Indexed Journals as an	[2.6.1] Number of status reports prepared per year	Number	--	--	4	--	--

**Section 3:  
Trend Values of the Success Indicators**

Objective	Action	Success Indicator	Unit	Actual Value for FY 10/11	Actual Value for FY 11/12	Target Value for FY 12/13	Projected Value for FY 13/14	Projected Value for FY 14/15
[3] Strengthening Basic research and Expanding R&D base -Institutional Capacity	Indicator of competitiveness of India							
	[2.7] Completion of EFC for the programme for the employed women scientists for mid-career mobility within the country	[2.7.1] Date of completion of the EFC process	Date	--	--	07/03/2013	--	--
	[2.8] Strengthening of Human Capacity in research in identified thrust areas in Atmospheric Sciences	[2.8.1] Number of Scientists benefited	Number	--	--	54	--	--
	[3.1] Capacity building through Fund for infrastructure strengthening S&T (FIST)	[3.1.1] Level of utilization of competitive grants	%	--	--	90	--	--
	[3.2] Expanding S&T infrastructure through special state specific package	[3.2.1] Number of packages delivered	Number	1	1	-	1	1
	[3.3] Establishment of new Centers under the SAIF programme	[3.3.1] Number of Centers Established	Number	--	--	1	--	--
	[3.4] Launch of Programme for Research initiatives in Mathematics Education Science (PRIME)	[3.4.1] Date of launch of the programme	Date	--	--	07/01/2013	--	--

**Section 3:  
Trend Values of the Success Indicators**

Objective	Action	Success Indicator	Unit	Actual Value for FY 10/11	Actual Value for FY 11/12	Target Value for FY 12/13	Projected Value for FY 13/14	Projected Value for FY 14/15
[4] Implementing Technology Development Programs	[3.5] Preparation of DPR for Super Computer facility and Capacity building	[3.5.1] Date of completion of the report	Date	--	--	28/09/2012	--	--
	[4.1] Number of technologies assisted for application and absorption	[4.1.1] Number of technologies applied and promoted	Number	--	--	35	--	--
	[4.2] Number of convergent technology solutions for water challenges identified and selected	[4.2.1] Number of technology solutions for water found out	Number	--	--	3	--	--
	[4.3] Initiation of Programmes envisaged in Detailed Project Report for indigenous Solar Energy Research initiative	[4.3.1] Number of R&D projects supported	Number	--	--	6	--	--
	[4.4] PhD/M.Tech. students trained in the area of nano science and technology in the country under nano mission	[4.4.1] Quantitative number of PhD/PG outputs	Number	110	120	284	220	240
	[4.5] Implementing new thrust areas: Cognitive science	[4.5.1] Number of researchers supported	Number	50	55	30	65	75
[4.6] R&D programmes for establishing knowledge networks in the areas of climate	[4.6.1] Number of programmes taken up	Number	--	--	6	--	--	

**Section 3:  
Trend Values of the Success Indicators**

Objective	Action	Success Indicator	Unit	Actual Value for FY 10/11	Actual Value for FY 11/12	Target Value for FY 12/13	Projected Value for FY 13/14	Projected Value for FY 14/15
	change and clean energy							
	[4.7] Programme initiation for promotion of PPP for R&D areas and increased engagement of Private sector in R&D	[4.7.1] Number of projects initiated under PPP	Number	--	--	3	--	--
	[4.8] Demonstration and transfer of the test bed for potash technology from sea water to Ministry of Chemicals and Fertilizers	[4.8.1] Date of transfer of the technology	Date	--	--	28/09/2012	--	--
	[4.9] Preparing independent status report on impact/outcome of Technology Development Programmes	[4.9.1] Number of Projects reviewed and status reports submitted	Number	--	5	3	5	5
[5] Societal interventions of S&T	[5.1] Assisting Technology Entrepreneurs under the National Science & Technology Entrepreneurship Development Board	[5.1.1] Number of entrepreneurs assisted	Number	100	123	60	135	140
	[5.2] Assisting micro enterprises under the National Science & Technology Entrepreneurship Development Board	[5.2.1] Number of micro enterprises assisted	Number	2200	2500	1200	2650	2700

**Section 3:  
Trend Values of the Success Indicators**

Objective	Action	Success Indicator	Unit	Actual Value for FY 10/11	Actual Value for FY 11/12	Target Value for FY 12/13	Projected Value for FY 13/14	Projected Value for FY 14/15
	[5.3] Support to Women for gender parity in S&T	[5.3.1] Number of projects supported	Number	--	--	165	--	--
	[5.4] Projects supported for S&T inputs for developments of weaker sections for equity	[5.4.1] Number of projects supported	Number	50	55	30	70	75
	[5.5] Field projects and research programmes supported for science popularization and communication	[5.5.1] Number of projects supported	Number	--	--	220	--	--
	[5.6] Child Scientists participation in National Children Science Congress	[5.6.1] Number of children participating the event	Number	1000000	1050000	400000	1200000	1250000
	[5.7] Implementation of programme on S&T backed interventions for tribal population	[5.7.1] Number of programme on S&T backed interventions for tribal population	Number	--	--	2	5	5
	[5.8] Launching of model demonstration projects through CSTRl for rural application	[5.8.1] Number of demonstration projects launched	Number	--	--	3	4	4
[6] S&T co-operation / Partnerships and Alliance	[6.1] Signing agreements, MOUs and protocols for S&T cooperation and partnership	[6.1.1] Number of agreements signed	Number	40	42	28	50	55

**Section 3:  
Trend Values of the Success Indicators**

Objective	Action	Success Indicator	Unit	Actual Value for FY 10/11	Actual Value for FY 11/12	Target Value for FY 12/13	Projected Value for FY 13/14	Projected Value for FY 14/15
	[6.2] Development and synergy of National Knowledge Network for S&T cooperation	[6.2.1] Number of Nodes developed and synergized	Number	22	23	20	30	32
	[6.3] Exchange of professional for international cooperation	[6.3.1] Number of exchange visit facilitated	Number	1100	1150	600	1250	1300
	[6.4] Developing State S&T Councils mechanisms for S&T outreach	[6.4.1] Ratio of programmatic fund released to state S&T Councils as a percentage of core grants sanctioned for manpower	Ratio	1	1.05	1.10	1.2	1.2
	[6.5] Projects sanctioned through the Joint research fund	[6.5.1] Number of research Projects funded under the Joint research fund	Number	--	10	25	18	20
	[6.6] Investment through India Innovation Fund	[6.6.1] Number of companies supported	Number	--	3	1	3	3
	[6.7] Design of a scheme for fostering international S&T co-operation for Indian universities	[6.7.1] Preparation of DPR for the scheme	Date	--	--	07/01/2013	--	--
* Efficient Functioning of the RFD System	Timely submission of Draft for Approval	On-time submission	Date	05/03/2010	07/03/2011	05/03/2012	--	--
	Timely submission of Results	On-time submission	Date	02/05/2011	30/04/2012	03/05/2012	--	--

\* Mandatory Objective(s)

**Section 3:  
Trend Values of the Success Indicators**

Objective	Action	Success Indicator	Unit	Actual Value for FY 10/11	Actual Value for FY 11/12	Target Value for FY 12/13	Projected Value for FY 13/14	Projected Value for FY 14/15
* Administrative Reforms	Implement mitigating strategies for reducing potential risk of corruption	% of implementation	%	--	--	50	--	--
	Implement ISO 9001 as per the approved action plan	Area of operations covered	%	--	--	50	--	--
	Timely preparation of departmental Innovation Action Plan (IAP)	On-time submission	Date	--	--	02/05/2013	--	--
* Improving Internal Efficiency / responsiveness / service delivery of Ministry / Department	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	--	--	100	--	--
		Independent Audit of implementation of public grievance redressal system	%	--	--	50	--	--
* Ensuring compliance to the Financial Accountability Framework	Timely submission of ATNs on Audit paras of C&G	Percentage of ATNs submitted within due date (4 months) from date of presentation of Report to Parliament by CAG during the year.	%	--	--	41	--	--
	Timely submission of ATRs to the PAC Sectt. on PAC Reports.	Percentage of ATRs submitted within due date ( 6 months) from date of presentation of Report to Parliament by PAC during the year.	%	--	--	100	--	--

\* Mandatory Objective(s)



**Section 3:  
Trend Values of the Success Indicators**

Objective	Action	Success Indicator	Unit	Actual Value for FY 10/11	Actual Value for FY 11/12	Target Value for FY 12/13	Projected Value for FY 13/14	Projected Value for FY 14/15
	Early disposal of pending ATNs on Audit Paras of C&AG Reports presented to Parliament before 31.3.2012.	Percentage of outstanding ATNs disposed off during the year.	%	--	--	100	--	--
	Early disposal of pending ATRs on PAC Reports presented to Parliament before 31.3.2012	Percentage of outstanding ATRs disposed off during the year.	%	--	--	100	--	--

\* Mandatory Objective(s)

## Section 4:

### Description and Definition of Success Indicators and Proposed Measurement Methodology

A total number of 39 activities are given in Results-Framework Document (RFD) for 2012-13 including 9 new initiatives under all the six objectives of the Department. Accordingly, a total of 39 success indicators have been selected with 38 non-financial and 1 financial targets. Out of the total 38 non-financial activities, 30 activities have a number target which indicates Department's commitment for moving towards measurable performance. The department has proposed preparation of the Detailed Project Report (DPR) /Expenditure Finance Committee (EFC) for the new programmes in the first year of the 12th Five Year plan period. In such cases, date/time line has been chosen as success indicators.

#### Objective-wise Measurement System

1. Keeping in view the process involved in the submission of draft National Science, Technology and Innovation Policy to cabinet, a submission date has been selected as the success indicator. Department is committed for preparation of two performance reports on publications and patents for the science, technology and innovation output indicators (2000- 2010) for India, hence a date target (date of publication of the reports) is chosen as unit for success indicator.
2. In the category of strengthening basic research and expanding R&D base with human capacity all existing activities show number as their success indicators while, one new activity regarding completion of EFC for the programme for the employed women scientists for mid-career mobility within the country has date as the success indicator as it may require the consultation process among stake holders. The implementation of Innovation in Science Pursuit for Inspired Research (INSPIRE) Awards, INSPIRE Internships, Scholarships for Higher Education (SHE), INSPIRE Fellowships and INSPIRE Faculty positions are captured by number of awards/ internships/scholarships/ Fellowships/ faculty positions awarded. In order to seed and experience the joy of innovation, every year 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. Each INSPIRE Award envisions an investment of Rs.5,000/- per child. The basic objective of INSPIRE internship is to attract and motivate young talent to the study of science at an early age and to take-up research as a personal undertaking and thus build the required critical human resource pool. This scheme attracts youth to summer /winter camps for 5 days in which they get opportunity to interact with eminent scientists and academicians of all science subjects. The SHE scheme offers 10,000 scholarships every year @ Rs.80,000/- each for undertaking Bachelor and Masters level education in the Natural & Basic sciences. The INSPIRE Fellowship scheme aims at enhancing research fellowships for doctoral studies and opening up partnerships with private sector for topping the Government's efforts in nurturing talents for scientific research. INSPIRE Faculty Scheme opens up an 'Assured Opportunity for Research Career (AORC)' for young researchers in the age group of 27-32 years. It is expected to augment high quality scientific manpower in scientific and educational institutions. It provides attractive opportunities to young achievers for developing independent scientific profiles and intends helping them emerge as S&T leaders in the long term. The Scheme offers contractual research positions. The number of such components clearly demonstrates the depth of penetration and reach of these schemes across the country. Selection is done through a competitive process with transparency. Mapping the scheme on quality outcome would be integrated

into the system in a long run. To measure the R&D competitiveness of the country, the Department generates some status reports on mapping of the publications/patents of the Indian researchers in Indexed Journals. A number of status reports prepared per year as an indicator of competitiveness of India will give the right measurement method. For the programme of strengthening of human capacity in research in identified thrust areas in Atmospheric Sciences, number of scientists benefited is appropriate success indicator.

3. Apart from a financial delivery target, there are number and date indicators used in the category of strengthening basic research and expanding R&D base with institutional capacity. To rebuild the S&T infrastructure in the country, Department support the universities and related academic institutions who are in dire need for strengthening the existing S&T infrastructure with adequate funding and associated flexibility. A developmental programme like Fund for Improvement of S&T infrastructure (FIST) in universities & higher educational institutions where the infrastructure building is a centre of concern, the level of funds utilized is appropriate success indicator. A proactive initiative to offset the setting of regional imbalances in the S&T system is proposed to be tackled by introducing special packages for less endowed regions for strengthening S&T education and research. The package focuses the augmentation of S&T education infrastructure, and enrichment of research efforts through exchange fellowships/ Summer School / Winter School. One regional package per year is envisaged. Hence the number of the Generated on 27/06/2014 11.49 Page : 20 of 24 package is set as a success indicator. Department proposes to establishment some new Centers under the Sophisticated Analytical Instrument Facility (SAIF). The programme provides facilities of sophisticated analytical instruments to researchers so as to help them in R&D activities. It has been proposed to launch a Programme for Research initiatives in Mathematics Education (PRIME). A date target has been fixed to launch the programme. The Department has been assigned a new programme on Super Computer facility and Capacity building during the 12th plan period. Preparation of DPR will become an activity and date target has been set up for this.
4. The Department is implementing Technology Development Programmes aimed at technology development and transfer in identified niche areas. The programme supports activities at developing and integrating technologies to evolve technology systems both in the advanced/emerging areas and in traditional sectors/areas. Under the programme, feasibility of newer ideas/concept is assessed for their potential conversion into useful technology/product. In order to train and nurture human resource in the area of Nano Science and Technology, the Nano Mission provides effective education and training to researchers and professionals in diversified fields through its Ph.D./M.Sc./M. Tech. programmes. A special initiative has been taken to revolutionize research in Cognitive Science. In implementation of technology development programmes, all activities have the number target as success indicators except one activity on demonstration and transfer of the test bed for potash technology from sea water to Ministry of Chemicals and Fertilizers. This activity has been assigned a date target for the transfer of the technology. Using a number target in technology assisted, convergent water technology solutions, projects supported under Solar Energy Initiative, Cognitive science and Nano Mission programmes, knowledge networks in climate change and clean energy will clearly demonstrate the progressive development, reach and depth of penetration of the programme. Initiative has been taken for promotion of PPP for R&D areas and increased engagement of Private sector in R&D. Number of projects initiated under PPP is the suitable success indicator. The Department has committed to preparing independent status report on impact/outcome of Technology Development Programmes. Number of Projects reviewed and status reports submitted is the right measurement method.

5. The National Science & Technology Entrepreneurship Development Board (NSTEDB) promotes and develops highend entrepreneurship for S&T manpower as well as self-employment by utilizing S&T infrastructure and by using S&T methods. NSTEDB networks agencies of the support system, academic institutions and R&D organizations to foster entrepreneurship and self-employing using S&T with special focus on backward areas as well. The broad objectives of the Science for Equity, Empowerment and Development (SEED) Division are providing opportunities to motivated scientists and field level workers to take up action oriented and location specific projects aiming towards socio-economic upliftment of poor and disadvantaged sections of the society through appropriate technological interventions especially in the rural areas. Under this program efforts have been made to associate concerned National Labs or other specialist S&T institutions with each major program so as to build-in expert input, utilize national S&T infrastructure and link it up with grassroots S&T interventions/initiatives. All activities under the societal interventions are measured in number terms which show a visible impact of the objective. The number of entrepreneurs assisted, support to women, field projects for science popularization, projects developed for tribal and other weaker sections and S&T backed entrepreneurship for tribal population indicates the reach of the programme. New programme viz. launching of model demonstration projects through Council of Science & Technology for Rural India (CSTRI) for rural application included under this objective also have the number target as the success indicator.
6. International S&T cooperation was well captured in terms of the number of MoUs signed, project sanctioned through Joint research fund and exchange of professional for international cooperation. For improving State-Center cooperation in S&T, a parameter like ratio of programmatic fund to core fund has been designed for measuring S&T outreach. Investment through India Innovation Fund can be suitably measured by a number of companies supported hence a number target is assigned for this activity. It has been proposed to design a scheme for international S&T co-operation for Indian universities. Preparation of a DPR for this scheme is required and a date target has been assigned for this.

**Section 5:  
Specific Performance Requirements from other Departments**

Departments	Relevant Success Indicator	What do you need?	What do you need it?	How much you need?	What happens if you do not get it?
State Science & Technology Department	Number of Students covered across the country under INSPIRE and SHE	Partnership in implementation	They have presence at the implementation levels and are linked to the State mechanism	Their partnerships would enhance the effectiveness of the Programme	We will have to identify alternate mechanisms
State Science & Technology Education	Number of Students covered across the country under INSPIRE and SHE	Partnership in implementation	The are the controlling department for and would help in indentification of students to be supported	Their partnerships would increase the reach and spread of the Programme	Their support in vital and critical
Ministry of Human Resource Development	Number of Students covered across the country under INSPIRE and SHE	Partnership in implementation	The are the controlling department for and would help in indentification of students to be supported	Their partnerships would increase the reach and spread of the Programme	Their support in vital and critical
Ministry of Extenal Affairs	Number of International MoUs agreements and protocol signed	Partnership in implementation	The are the main Ministry for external relations and our agreements are within the frame work of country cooperation	For enhancing Technology Diplomacy with relevant Nations their support is required	The number of agreements, MoUs and protocols will get affected

Ministry of Chemicals & Fertilizers	Date of commissioning of the unit	Partnership in implementation	They are the main partner Ministry in Technology Transfer	Their full co-operation in implementing the project	The partnership will address subsidies in fertilizers
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**Section 6:  
Outcome/Impact of Department/Ministry**

Outcome/Impact of Department/Ministry	Jointly responsible for influencing this outcome / impact with the following department (s) / ministry(ies)	Success Indicator	Unit	FY 10/11	FY 11/12	FY 12/13	FY 13/14	FY 14/15
1 Global share of publications	R&D organizations, Universities, and Scientific institutions/ colleges research centers	% share of publication	%			TBD		
2 CAGR of S&T output in Publications	R&D organizations, Universities, and Scientific institutions/ colleges	% growth of publication	%			TBD		
3 CAGR of S&T output in Patents	R&D organizations, Universities, and Scientific institutions/ colleges	% growth of patents	%			TBD		
4 Ph.D. output in Science sector	R&D organizations, Universities, and Scientific institutions/ colleges	Total no. of Ph.D. produced	Number			TBD		
5 Private sector engagement in R&D	Industries/ Private Institutions and R&D organizations	% of Private sector investment in R&D	%			TBD		
6 Technology Scoping on per capita income (district level)	Central and State Government, NGO's, R&D organizations	% Growth in per capita income (district level)	%			TBD		
7 Technology commercialization for public funded R&D	Central Government, R&D organizations, Universities, Scientific institutions	% share of high technology content in import from India (US Index)	%			TBD		

## Performance Evaluation Report 2012-13

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value					Performance			
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%	Achievement	Raw Score	As Weighted Score	
1 Formulation of Science, Technology and Innovation policy and other enabling policies for the R&D sector	13.00	Submission of draft National Science, Technology and Innovation Policy to Cabinet	Date of completion of National Science, Technology and Innovation Policy	Date	6.00	31/08/2012	07/09/2012	14/09/2012	21/08/2012	28/08/2012	N/A	N/A	N/A	
		Preparation of two performance reports on publications and patents for the science, technology and innovation output indicators (2000-2010) for India	Date of publication of the reports	Date	7.00	28/02/2013	07/03/2013	14/03/2013	21/03/2013	28/03/2013	28/02/2013	100.0	7.0	28/02/2013
2 Strengthening Basic research and Expanding R&D base - Human Capacity	17.00	Number of INSPIRE awards released	Number of students covered under INSPIRE award	Number	3.00	200000	190000	180000	170000	160000	219403	100.0	3.0	55409
		Number of INSPIRE internships covered through summer/ winter camps	Number of youth attracted to summer /winter camps	Number	2.50	55000	50000	45000	40000	35000	55896	100.0	2.5	35000
		Number of scholarships for Higher Education awarded	Number of scholarships released	Number	2.50	4500	4200	4000	3800	3600	14050	100.0	2.5	2500
		Number of INSPIRE Fellowship awarded	Number of fellowships released	Number	3.00	800	700	600	500	400	871	100.0	3.0	430
		Institution of INSPIRE faculty position	Number of INSPIRE faculty position	Number	2.50	180	175	160	150	140	196	100.0	2.5	103
		Mapping of the publications/ patents of the Indian researchers in Indexed Journals as an indicator of competitiveness of India	Number of status reports prepared per year	Number	1.50	5	4	3	2	1	5	100.0	1.5	1
		Completion of EFC for the programme for the employed women	Date of completion of the EFC process	Date	1.50	28/02/2013	07/03/2013	14/03/2013	21/03/2013	28/03/2013		N/A	N/A	N/A



## Performance Evaluation Report 2012-13

Objective	Weight	Action	Success Indicator	Unit	Weight	Target / Criteria Value					Performance				
						Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%	Achievement	Raw Weighted Score	As Approved by HPC		
3 Strengthening Basic research and Expanding R&D base - Institutional Capacity	13.00	scientists for mid-career mobility within the country													
		Strengthening of Human Capacity in research in identified thrust areas in Atmospheric Sciences	Number of Scientists benefited	Number	0.50									54	
		Capacity building through Fund for infrastructure strengthening S&T (FIST)	Level of utilization of competitive grants	%	4.00										100
		Expanding S&T infrastructure through special state specific package	Number of packages delivered	Number	4.00										1
		Establishment of new Centers under the SAIF programme	Number of Centers Established	Number	2.00										2
		Launch of Programme for Research initiatives in Mathematics Education Science (PRIME)	Date of launch of the programme	Date	2.00										31/12/2012
		Preparation of DPR for Super Computer facility and Capacity building	Date of completion of the report	Date	1.00										28/09/2012
		Number of technologies assisted for application and absorption	Number of technologies applied and promoted	Number	2.00										25
		Number of convergent technology solutions for water challenges identified and selected	Number of technology solutions for water found out	Number	2.00										6
		Initiation of Programmes envisaged in Detailed Project Report for indigenous Solar Energy Research initiative	Number of R&D projects supported	Number	2.00										4

C O M M I T T E E F O R P E R F O R M A N C E M O N I T O R I N G A N D E V A L U A T I O N

## Performance Evaluation Report 2012-13

Success Indicator	Unit	Weight	Target / Criteria Value					Achievement	Performance		
			Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%		Raw Score	Weighted Score As Approved by HPC	
Quantitative number of PhD/PG outputs	Number	2.00	200	180	160	140	120	284	100.0	2.0	284
Number of researchers supported	Number	2.00	60	50	40	30	20	65	100.0	2.0	30
Number of programmes taken up	Number	2.00	8	6	5	4	3	8	100.0	2.0	4
Number of projects initiated under PPP	Number	2.00	4	3	2	1	1	2	80.0	1.6	2
Date of transfer of the technology	Date	2.00	28/09/2012	05/10/2012	12/10/2012	19/10/2012	26/10/2012	28/09/2012	100.0	2.0	28/09/2012
Number of Projects reviewed and status reports submitted	Number	2.00	5	4	3	2	1	3	80.0	1.6	3
Number of entrepreneurs assisted	Number	2.00	130	120	110	100	80	140	100.0	2.0	60
Number of micro enterprises assisted	Number	2.00	2600	2550	2500	2450	2400	2650	100.0	2.0	1200

Performance Evaluation Report 2012-13

Success Indicator	Unit	Weight	Target / Criteria Value					Achievement	Performance		
			Excellent	Very Good	Good	Fair	Poor		Raw Score	Weighted Score	
			100%	90%	80%	70%	60%			As Approved by HPC	
Number of projects supported	Number	2.00	170	165	160	150	140	332	100.0	2.0	140
Number of projects supported	Number	2.00	65	60	55	50	45	94	100.0	2.0	30
Number of projects supported	Number	2.00	225	220	215	210	200	225	100.0	2.0	125
Number of children participating in the event	Number	1.00	1100000	1000000	950000	900000	850000	1100000	100.0	1.0	400000
Number of programme on S&T backed interventions for tribal population	Number	1.00	5	4	3	2	1	5	100.0	1.0	2
Number of demonstration projects launched	Number	2.00	4	3	2	1	1	3	90.0	1.8	3
Number of agreements signed	Number	2.00	45	40	35	30	25	49	100.0	2.0	28
Number of Nodes developed and synergized	Number	2.00	28	26	24	22	20	30	100.0	2.0	20
Number of exchange visit facilitated	Number	2.00	1200	1150	1100	1050	1000	1300	100.0	2.0	600

## Performance Evaluation Report 2012-13

Success Indicator	Unit	Weight	Target / Criteria Value						Achievement	Performance	
			Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%	Raw Score		Weighted Score	As Approved by HPC
Ratio of programmatic fund released to state S&T Councils as a percentage of core grants sanctioned for manpower	Ratio	1.00	1.10	1.05	1.0	0.5	0.25	1.10	100.0	1.0	1.10
Number of research Projects funded under the Joint research fund	Number	1.00	15	12	10	8	6	25	100.0	1.0	25
Number of companies supported	Number	1.00	3	2	1	1	1	3	100.0	1.0	1
Preparation of DPR for the scheme	Date	1.00	31/12/2012	07/01/2013	14/01/2013	21/01/2013	28/01/2013		N/A	N/A	
On-time submission	Date	2.0	05/03/2012	06/03/2012	07/03/2012	08/03/2012	09/03/2012	05/03/2012	100.0	2.0	05/03/2012
On- time submission	Date	1.0	01/05/2012	03/05/2012	04/05/2012	05/05/2012	06/05/2012	30/04/2012	100.0	1.0	30/04/2012
% of implementation	%	2.0	100	95	90	85	80	100	100.0	2.0	50
Area of operations covered	%	2.0	100	95	90	85	80	0	0.0	0.0	50
On-time submission	Date	2.0	01/05/2013	02/05/2013	03/05/2013	06/05/2013	07/05/2013	12/04/2013	100.0	2.0	12/04/2013
Independent Audit of Implementation of Citizen's Charter	%	2.0	100	90	80	70	60	33	0.0	0.0	100

Performance Evaluation Report 2012-13

Success Indicator	Unit	Weight	Target / Criteria Value					Achievement	Performance		
			Excellent	Very Good	Good	Fair	Poor		Raw Score	Weighted Score	
			100%	90%	80%	70%	60%				
Independent Audit of implementation of public grievance redressal system	%	2.0	100	90	80	70	60	63.50	63.5	1.27	50
Percentage of ATNs submitted within due date (4 months) from date of presentation of Report to Parliament by CAG during the year.	%	0.5	100	90	80	70	60	100	100.0	0.5	41
Percentage of ATRS submitted within due date (6 months) from date of presentation of Report to Parliament by PAC during the year.	%	0.5	100	90	80	70	60	100	100.0	0.5	100
Percentage of outstanding ATNs disposed off during the year.	%	0.5	100	90	80	70	60	41	0.0	0.0	100
Percentage of outstanding ATRS disposed off during the year.	%	0.5	100	90	80	70	60	100	100.0	0.5	100

Total Composite Score : 85.27  
 PMD Composite 55.7