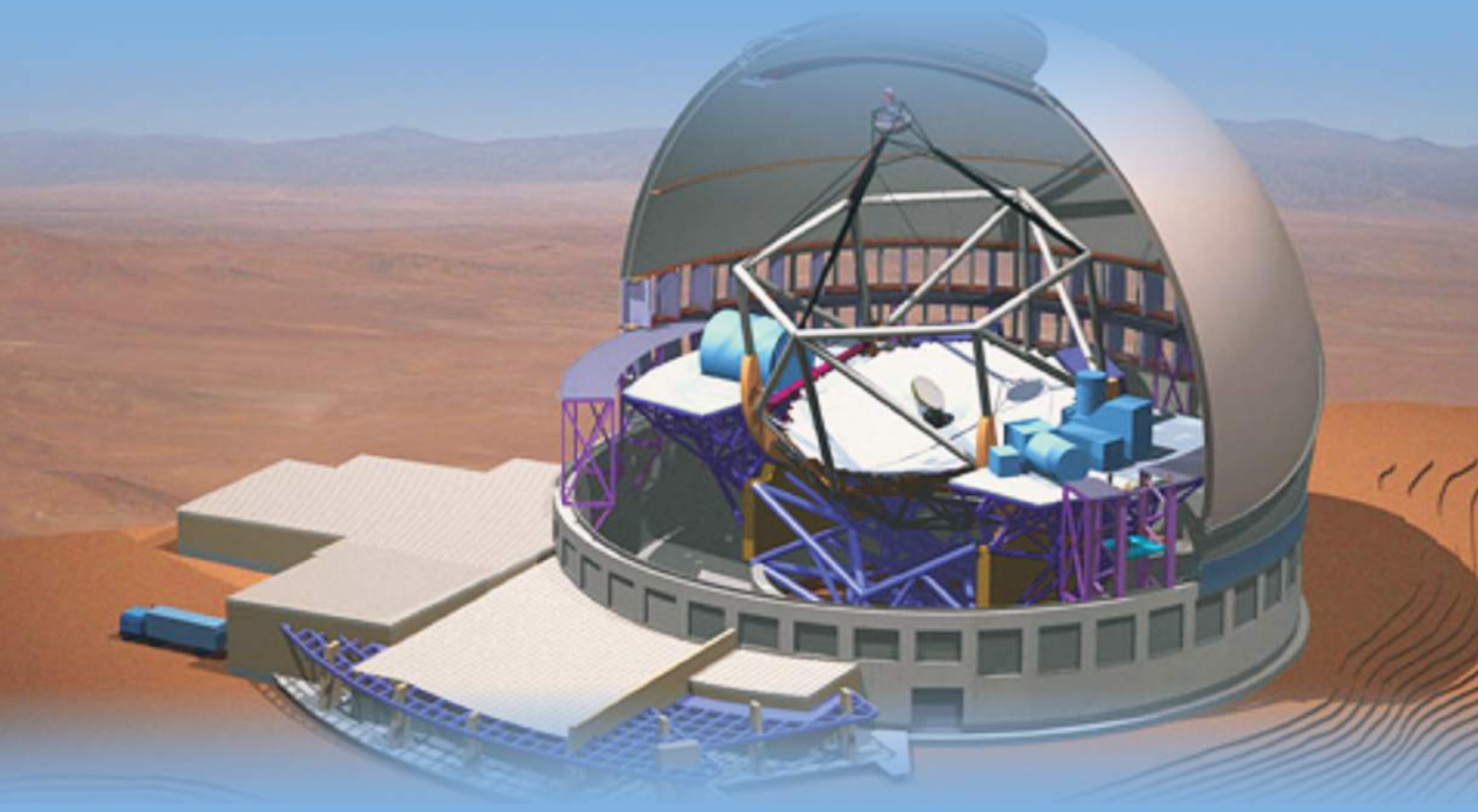
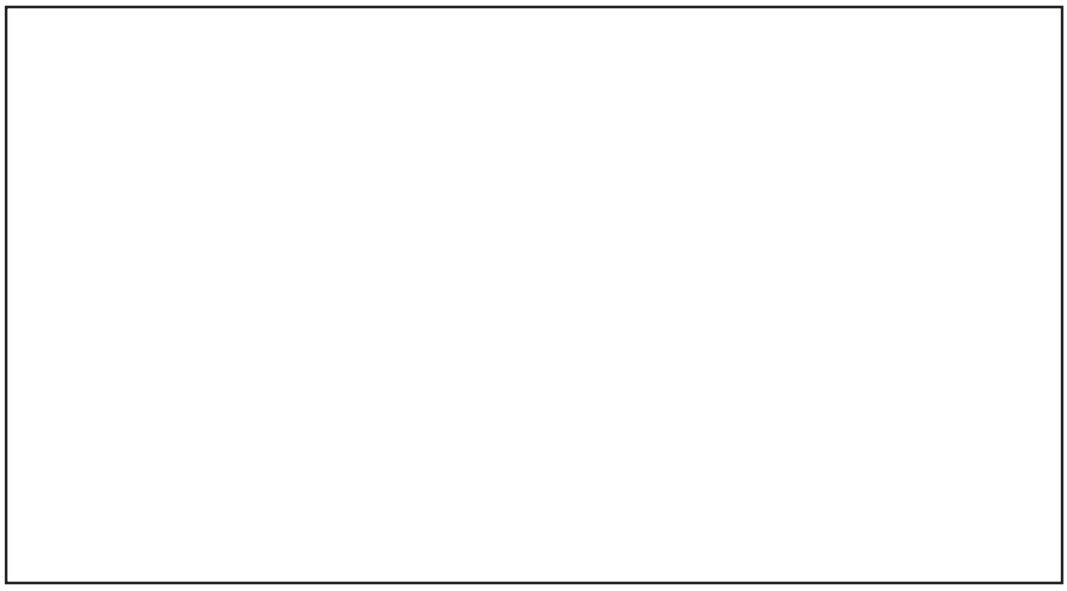
Annual Report 2014-15



DEPARTMENT OF SCIENCE & TECHNOLOGY

सत्यमेव जयते

Government of India
Ministry of Science & Technology
New Delhi



Artist Rendition of Thirty Meter Telescope

Annual Report
2014-15

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

CONTENTS

OVERVIEW

Department of Science and Technology with the overall mandate to strengthen S&T capability of the country pursued implementation of various plan schemes to meet the overall objective of the Department during the year under report.

Various activities of the Department, for the ease of understanding by the stakeholders and readers of the report, have been classified under the following sections: **Human Capacity Building in S&T; Institutional Capacity Building; Technology Capacity Strengthening; S&T Competitiveness through Alliances, Partnerships and R&D Missions; Societal Contract of S&T; Inputs to Science, Technology and Innovation Policy; and Administration and Finance.**

Several New Initiatives have been taken by the Department during the year. Some of important achievements of 2014-15 and new initiatives taken during the year are briefly described below:-

The research and development in frontier areas of science and engineering has received an overwhelming support with the establishment of the **Science and Engineering Research Board (SERB)**. The multifaceted programmes of the Board have ensured its reach among various segments of researchers. **Enhancement of fellowship** was approved during the year for DST sponsored R&D Programmes for JRF/SRF/RA categories of researchers with effect from 1st October, 2014. The fellowship of Young Scientists has been revised from Rs. 35,000/- to Rs. 55,000/- pm with effect from 1st October, 2014. With a view to support mathematical research, the Board approved a proposal to sign an MoU with International Centre for Pure and Applied Mathematics (CIMPA) to organise three CIMPA-India School per year in India and sponsor 15 doctoral/postdoctoral students per year to attend CIMPA Schools held abroad.

Innovation in Science Pursuit for Inspired Research (INSPIRE) is national programme to attract students to the study of science and pursue a career in research. INSPIRE has reached out to more than 1.5 million students so far.

Knowledge Involvement in Research Advancement through Nurturing (KIRAN) is a new initiative launched in 2014-15 that consolidates all **women-centric programmes** into a holistic scheme that (i) promotes gender equality, (ii) empowers women with S&T inputs to develop and adapt appropriate technology, (iii) enables transfer of proven technologies and demonstration of live technology models and (v) supports /encourages women scientists constrained with a break in their career to return to main stream science.

280 projects were approved for financial support to provide opportunities to women scientists and technologists for pursuing research in basic or applied sciences in frontier areas of science and engineering. Also, 65 new projects were sanctioned to women scientists working in the domain of lab-to-land technology transfer, its adaptation and scaling of location-specific interventions. One year training and internship in the area of Intellectual Property Rights (IPR) and their management was provided to 85 women scientists.

Fund for Improvement of S&T infrastructures in Universities and Higher Educational Institutions (FIST) supports / augments basic infrastructure facilities for teaching and conducting research in basic / applied sciences in Universities and other centres of higher learning. During current year, 167 proposals have been identified for financial support of varying quantum (from Rs.22 lakh to Rs.790 Lakh) at a total budget of about Rs.231.31 crores for 5 years.

44 universities have received support under the scheme for **Promotion of University Research and Scientific Excellence (PURSE)**. The scheme reinforces support from the UGC and has enabled major positive changes in the supported Universities. The national share of publications through PURSE supported universities is about 30 per cent.

Mega Science facilities and Mega Science projects of the DST improve access to state-of-the-art facilities to Indian scientists and researchers. Thirty Metre Telescope (TMT) Project at Mauna Kea, Hawaii will be one of the largest optical telescopes in the world based on segmented mirror technology. During the year, the Cabinet approved TMT project at a total cost of Rs. 1299.80 crores from the year 2014-15 to 2022-23. The project is jointly funded by DST and DAE and DST is the Lead Agency for this project. This will be a major international scientific collaboration for Indian institutions

National Spatial Data Infrastructure (NSDI) aimes to develop spatial information infrastructure with Collection of Technologies, Policies and Institutional arrangements. During the current year, the focus has been on suitably re-orienting NSDI towards developing and implementing GIS applications by providing processed information to its stakeholders for decision support.

A prototype application service has been developed and implemented using the **Web Map Services and Web Feature Services** from Surveykshan Geo-portal of Survey of India, Bhuvan Geo-portal of National Remote Sensing Centre, and the Indian Railways data services from the India Geo-portal. The application - 'Spot your train' - for the running trains of the Northern Railway has been hosted on the web (from Karnataka Geo-portal) and is useful in providing the passengers with actual departure and arrival information of the running trains of the Northern Railway.

Autonomous research institutions of the DST delivered significant and well acknowledged research and related communication output on various science and technology fronts. A road map has been prepared for setting up of five Technical Research Centres (TRCs) in the existing autonomous research institutions of DST.

The **National Good Laboratory Practice (GLP) Compliance Monitoring Authority (NGCMA)** was set up in August, 2002. The NGCMA provides GLP certification to the test facilities, which are involved in conducting safety studies on such chemicals in accordance with Organization for Economic Co-operation and Development (OECD) Principles of GLP. Six new test facilities were granted the GLP-compliance status during the year.

Clean Energy Research Initiative (CERI) is aimed at promoting research in the area of Clean Energy with focus on Solar energy. Some examples under this initiative are Development and Demonstration of Modular Light Weight Solar Aluminium Tubular Air Heater (SATAH) by Indian Institute of Technology, Bombay, Solar Cooling and production of potable water with two stage silica gel-water adsorption system by IISc, Bangalore and IIT Madras; and Energy Efficient Community scale PV powered Reverse Osmosis (RO) Desalination Unit at CSMCRI, Bhavnagar.

Water Technology Initiative (WTI) aims to develop and provide low cost convergent technology solutions for domestic application to ensure safe drinking water under real life conditions. During the year 2014-15, convergent solution for augmentation of water resources in Koraput region of Odisha; Chirawa block in Rajasthan; and Sabarkantha district in Gujarat were successfully provided. Convergent solutions in three clusters viz. Mamsapuram, Thirupattur and Buja Buja for drinking water purification and waste water treatment were successfully demonstrated incorporating a unique self sustainability model and were handed over to the local authorities in Tamil Nadu and Andhra Pradesh.

Transfer of know-how of Hybrid Ultra Capacitor (HUC) lighted solar/mechanical/grid chargeable lanterns with mobile charger, Design and Development of Portable Pain Relieving Instrument under Technology Development programs. Several other projects on technology development made a significant progress during the year.

Technology Development Board (TDB) is a statutory body that assists companies in commercializing technologies, indigenous development and import substitution. During the year 2014-15, TDB provided financial assistance of Rs. 650.83 lakhs to the industrial concerns. TDB's support covers the sectors of economy namely, Health, Biotech, Chemical, Engineering, Agriculture, Energy & Waste Utilization, Telecommunication, Information Technology and others like Seed Fund to incubators and investment in Venture Capital Funds.

International S&T Cooperation Programme creates strategically important links with countries around the world to help hybridize knowledge and enhance S&T competitiveness. Indicative trends in fostering international bilateral cooperation and partnerships during 2014-15 have been as follows:

- Joint research project based networking of researchers under active bilateral S&T programs of cooperation with more than 44 countries including substantive programs with 8 countries;
- Bilateral R&D joint projects including multi-institutional networked projects;
- Bilateral industrial and applied R&D projects involving industry as partner with Canada, Finland, France, Germany, Israel, Spain, S. Korea, United Kingdom and United States;

- Mobility through research fellowships and visitation programs for Indian and foreign young scientists and researchers (HOPE Meeting; Lindau Nobel Laureates meetings; Asian Science Camp; CV Raman Fellowships for African Researchers; Fellowship and Internship programs with Australia, France, Germany, S. Korea, USA) ;

- Launch of India Science & Research Fellowship for scientists from neighbouring countries to undertake R&D work in India.

- Launch of Fellowship for scientists from Belarus & Bulgaria to undertake R&D work in Indian institutions

- International partnerships for joint research and technology development in domains of national priority through engagement with Industry & Engineering Associations (like Technology Summit with USA as a partner country and Global R&D Summit) and Commonwealth Science Conference.

Concerted efforts were made by the Department to take forward the activities related to **S&T interventions for societal benefits**. In this endeavour, several initiatives having people centered approach to provide technological solutions at the grassroots level with special schemes for Rural Areas, Women, Scheduled Caste and Tribal populations, have been launched. Some projects related to societal benefits are: Development of interventions for manual load carrying on Indian farms; Packaged drinking water from dew and rain; Creation of sustainable livelihoods by enhancing economic viability of village level micro industries; and Assistive Device for Public Bus Access for the Visually Impaired

National Science & Technology Entrepreneurship Development Board (NSTEDB) has established number of Technology Business Incubators (TBI) and Science and Technology Entrepreneurs Parks (STEP) and several among them have matured and developed competence to become state-of-art Incubators. During the period 2014-15, nine new TBIs have been established. 18 STEPs/TBIs have been supported with the seed support since its initiation in the year 2008 and through timely support, 70 start-up companies have taken their ventures to the next level by way of validating prototypes, securing market orders and raising external funding through angels/VCs.

Science Express is a flagship initiative of the Department towards developing scientific temper in the society. **Science Express-Biodiversity Special (SEBS)** was flagged-off from Delhi on 28 July 2014. In the current phase, from 28 July 2014 to 06 February 2015, the Science Express has travelled to 57 locations across India. Biodiversity teachers' Kit, based on the theme of the SEBS exhibition, was distributed to schools. More than 1.30 crores people have visited science express so far including 23 lakhs during the ongoing run.

The **National Mission on Nano Science and Technology** is an umbrella programme to promote R&D in this emerging area. 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. Efforts for Development of Standards for Nanotechnology continued in association with National Physical Laboratory, New Delhi.

Under the **National Mission for Sustaining the Himalayan Ecosystem** [NMSHE] and **National Mission for Strategic Knowledge on Climate Change** [NMSKCC] as part of the National Action Plan for Climate Change (NAPCC), six major research programmes have been initiated / supported. It includes vulnerability assessment, sustainability and to enhance strategic knowledge in climate change. A number of detailed Technical reports about the R&D work were brought out on Climate Change.

The Department of Science and Technology is mandated to develop and deliver public policy support for the promotion of research and development in the country. Review of the already established 5 Policy Research Centres on various themes was carried out and brainstorming sessions on various policy related issues were organized.

In essence, the Department devoted its attention to fruitfully utilize the resources available to it and take Indian S&T system to a greater height and be relevant for various causes of the society at large.

CHAPTER 1

HUMAN CAPACITY BUILDING IN S&T

HUMAN CAPACITY BUILDING THROUGH SCIENCE & ENGINEERING RESEARCH

The research and development in frontier areas of science and engineering has received an overwhelming support with the establishment of the **Science and Engineering Research Board (SERB)**. The multifaceted programmes of the Board have ensured its reach among various segments of researchers. The Board met three times in the reporting period and has taken significant decisions. Some of the decisions taken by the Board are given below:

- Adopted revision of fellowship in SERB sponsored R&D Programmes for JRF/SRF/RA categories of researchers with effect from 1st October, 2014. The fellowship of SERB Young Scientist has been revised from Rs. 35,000/- to Rs. 55,000/- pm with effect from 1st October, 2014; and also the cost limit of Young Scientist Project from Rs. 23.0 lakh to Manpower cost + Rs. 20.0 lakh for Young Scientist in regular employment: and Fellowship + Rs. 20.0 lakh for other Young Scientist (not employed) excluding overhead charges with effect from 1st January, 2015. Board also approved enhancement of budget limit of approval of projects (excluding overhead charges) by Programme Advisory Committee from Rs. 50.0 lakh to Rs. 60.0 lakh with effect from 1st January, 2015.
- In a direction to support mathematical research, the Board approved a proposal to sign an MoU with International Centre for Pure and Applied Mathematics (CIMPA) to organise three CIMPA-India School per year in India and sponsor 15 doctoral/postdoctoral students per year to attend CIMPA Schools held abroad.
- In order to augment quality manpower in niche areas of research, Board approved continuation of 50 Indo-US Overseas Postdoctoral fellowships per year for a period of 3 years through Indo-US Science and Technology Forum (IUSSTF).

A wide variety of following ongoing schemes/programmes were supported in the reporting period:

Thirty nine fellowships have been approved in the Prime Minister's Fellowship Scheme for Doctoral research where an aspiring PhD scholar will be given double scholarship, 50% of which will be provided by government (Board) and the balance 50% by a sponsoring industry, for doing industrial research for four years. A total of 67 scientists were supported through projects worth Rs. 19.95 crore in the "Empowerment and Equity Opportunities for Excellence

in Science" Scheme. The scheme received overwhelming response from weaker sections of the society. "SERB Women Excellence Award" Scheme continues to support women scientists who are awardees of young scientist/associateship of any of the national academies. A total of 6 women scientists were conferred the Award. Seven Distinguished Fellows has been supported through the SERB Distinguished Fellowship Scheme. 50 students have been selected under SN Bose Scholars Programme in partnership with 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.

Eight scientists received Ramanujan Fellowship and eleven received JC Bose Fellowship. A recent study conducted by Thomson Reuters on JC Bose fellows' performance revealed that the Fellows publish more research that becomes highly-cited than either the Indian or world average. The citation impact of the Fellows was above that of the Indian research base as a whole and above the world average.

In recognition of the need to promote global competitiveness of Indian Science Sector, the Government has instituted Jawaharlal Nehru Science Fellowship for eminent scientist of the world. JN Science fellowship provides a personal honorarium of US $100,000 for a total period of 12 months work in India. JN Fellowship also provides a research contingency support of Rs.55 lakh. In addition, host institute will be provided Rs.10 lakh for extending support facilities including housing/transport, etc. The first batch of five fellows has been selected from a total of 162 responses/nominations received from different parts of the world.

Programme Advisory Committees continue to play a decisive role in moulding the core grant support to scientists. 495 scientists were supported through projects worth Rs. 174.65 crore under this segment of research support. Some of the projects identified for support were:

A project has been approved (IISc, Bangalore) to investigate Photoelectron Spectroscopy in liquid phase. The most direct method to access electronic structure of matter (atoms, molecules, clusters, nanostructures) is photoelectron spectroscopy [PES, or often called electronic spectroscopy for chemical analysis (ESCA)]. Thus far, PES in liquid phase or at liquid surfaces has surprisingly remained largely elusive and challenging due to a number of technical reasons. The project proposes how, by the coupling of liquid Microjet technique, high harmonic generation, and magnetic bottle photoelectron spectrometer, electronic structure measurements in liquid phase (or at surfaces) can be undertaken both in (MeV) energy and (fs to ps) time domains, for the first time, in India. The tool is expected to open up wide avenues of research in various high value industries, such as aerospace, semiconductors, pharmaceuticals, aeronautics, automotive industries, and in nanotechnology.

In a collaborative project between IISc, Bangalore and CDRI, Lucknow, it is proposed to develop sugar amino acid derived peptides self-assembling selectively on bacterial membranes, forming ion pores and killing bacteria including MTB. The study includes determining the anti-bacterial, especially the anti-tubercular activities of these molecules and MICs and screening the active molecules *in vitro* for cytotoxicity. The nontoxic molecules will be used to determine

their MBCs and then evaluated using *ex vivo* (macrophage) model of TB. Finally activities of the selected compounds will be tested against drug-resistant strains of MTB.

A project on *Magneto-functional properties of materials: exchange bias and magnetic refrigeration* was approved at Indian Association for the Cultivation of Science, Kolkata. The proposal aims at synthesis of films, multilayers, nanostructured materials and bulk materials, promising for exchange bias and magnetocaloric effects.

A project to study the factors controlling the mass balance and dynamics of *Chhota Shigri Glacier* and implication for downstream flows was approved for implementation in Jawaharlal Nehru University, New Delhi. The project looks into the interannual, seasonal and sub-seasonal variability of glacier surface mass balance and its relation to meteorological parameters and black carbon deposition on *Chhota Shigri Glacier*.

A few projects were identified for support under the Intensification of Research in High Priority Areas (IRPHA) Scheme. A *femtosecond laser facility to investigate confined media, biological assemblies, room temperature ionic liquids and nanomaterials* was sanctioned at IIT Kharagpur. The group at IIT Kharagpur proposes to investigate the solvation dynamics in IL containing mixed solvents and microheterogeneous systems containing IL using femtosecond fluorescence upconversion to capture the entire dynamics and study the ultrafast higher order optical nonlinearities of nanomaterials.

A project on *low temperature, spatio-temporal spectroscopy of nanocrystals and multifunctional nanoassemblies* was approved for implementation in Indian Institute of Science, Bangalore. It aims to investigate and develop novel colloidal nanomaterials for energy harvesting and conversion applications through fundamental studies of carrier and energy dynamics on the nanoscale and to study properties such as electronic relaxation, charge and energy transfer, and carrier-carrier and carrier-dopant interactions using temporally and/or spatially resolved optical techniques at variable temperatures.

In a special initiative on Cell Tower Radiation, a project on *statistical estimation of electromagnetic radiation using large data analysis of cell phone signal levels* was approved for implementation at Indian Institute of Technology Madras, Chennai. Through the project it was envisaged to arrive at statistical measurement of electromagnetic radiation level across various regions of interest in the country by doing a big data analysis of the signal level measurements available from multiple operators. Real measurements reported by the mobile handsets will be used to quantify the radiation power profile.

A few significant results from PAC projects are listed below:

Researchers from IISc, Banglaore discovered vanadia-based nanozyme (vanadium pentoxide nanowires, Vn) that specifically mimics the activity of glutathione peroxidase (GPx) and possesses a cytoprotective function in the cell. The study showed that these nanowires readily internalize in cells without altering the integrity of the biological membranes and exhibit remarkable GPx-like antioxidant activity by utilizing intracellular glutathione (GSH). This activity prevents Reactive

oxygen species (ROS)-mediated damage to DNA, proteins, lipids and mitochondrial complexes (Figure 1). In contrast, bulk V2O5 and vanadium (V) complexes results in high cell death due to the production of excess amount of ROS. It was found that the operational quantum confinement at the nanoscale alters the redox potential at the vanadium center, which leads to significant antioxidant activity of the oxidant type material.

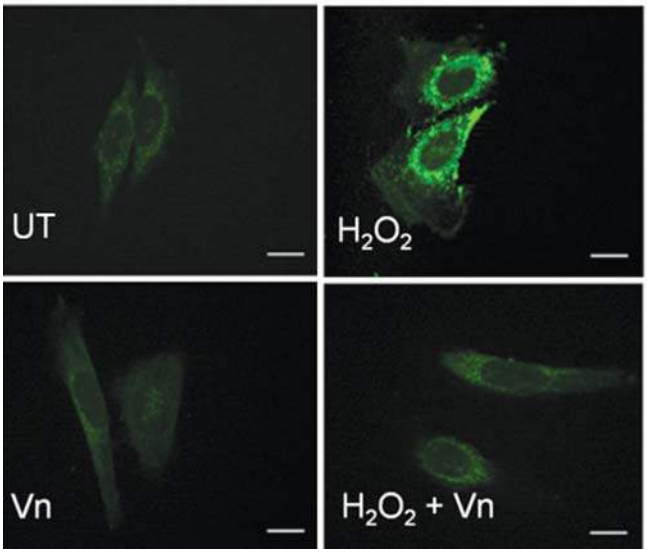


Figure 1: Fluorescence images showing ROS scavenging activity of V_2O_5 nanowires (Vn)

In an ongoing project at IIT, Chennai, a Cavity Ring Down Spectrometer, a super sensitive optical instrument was built to identify the fate of pollutants, aerosols, volatile organic compounds, and transient species in the earth's atmosphere and to detect the trace gases from the explosives in the war fields (Figure 2).

Figure 2: Cavity Ring Down Spectrometer

In another project, a broadband terahertz spectroscopic system has been developed at Indian Institute of Science Education and Research Bhopal to investigate the ultra-fast optical functionality and low-energy dynamics of strongly correlated systems.

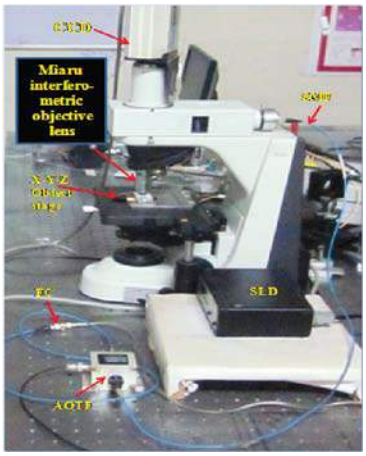


Figure 3: High-resolution Full-field swept source optical coherence microscope system

In a completed project at Indian Institute of Technology Delhi, New Delhi a swept-source optical coherence scanning microscopic (SS-OCSM) system for high-resolution and high contrast 3D-surface profilometry and tomography has been developed (Figure 3). The developed system is on mechanical scanning, non-contact, non-destructive and full-field SS-OCSM. The tunable light source system was realized using a broad-band super luminescent diode (SLD), and Fiber-Fabry Perot Tunable Filter (FFPTF) as frequency scanning device.

In a project in the area of Life Sciences, attempts were made to molecular characterization of the genes isolated from the

spermatozoa of water buffalo Bubalus bubalis and their expression across the tissues. The study has led to the finding of 65 mRNA transcripts from the spermatozoa of buffalo using different VNTR loci and reported molecular characterization of buffalo Hoxc11 gene. A computational model of 3D structure of the buffalo Hoxc11 protein is shown (Figure 4). The putative 3D structure of Hoxc11 protein of buffalo was not known earlier.

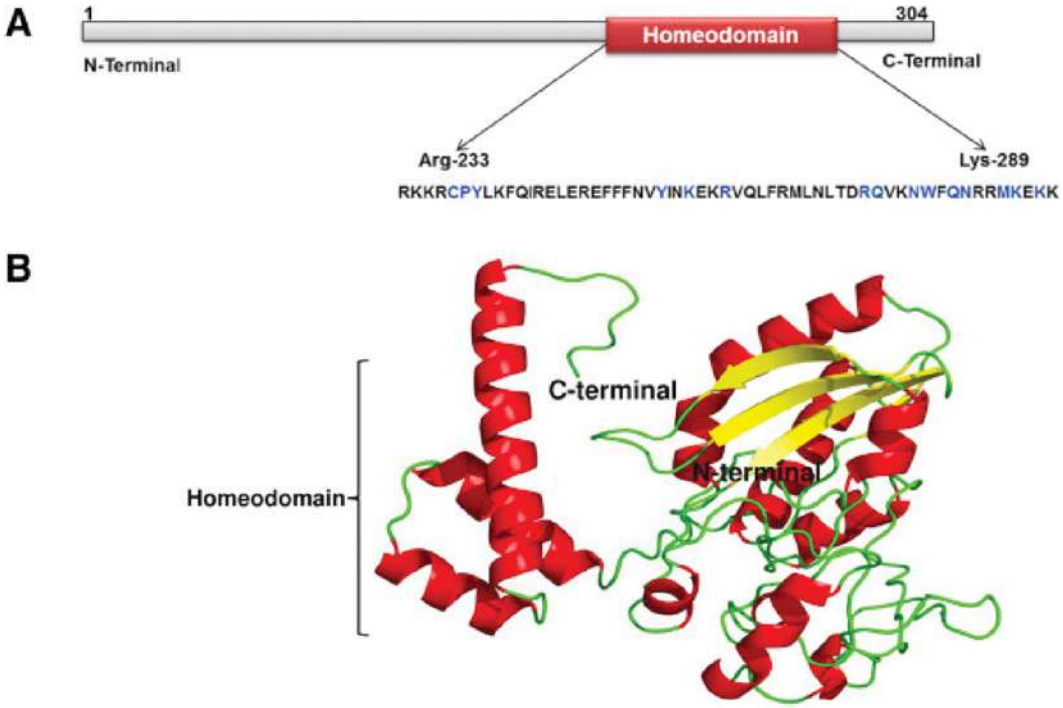


Figure 4. Modeled 3D structure of the buffalo Hoxc11 protein. A) Diagrammatical representation of homeodomain (56 aa long) and possible binding site residues (in blue) of Hoxc11 protein. B) The 3D structure of buffalo Hoxc11 was generated by I-TASSER and visualized by PyMol (version 1.7). Helix, beta sheets and coils/loops are shown in red, yellow and green, respectively.

Design and develop circuit elements such as filters (band pass, band stop), modulators and mixers for hybrid NRD guide based systems and characterized the circuits. Simulation study was carried out in millimeter wave frequency range and scaled prototypes at 17 GHz were developed for experimental purpose. All the four prototypes of Band pass filter, Band stop filter, QPSK Modulator and Active Mixer have been implemented at 17 GHz.

New Biogenic amine based adsorbents have been synthesized, characterized and evaluated for CO2 capture which enhance the CO2 adsorption capacity which are comparable with benchmark monethanol amine (MEA). The biogenic amine based adsorbents exhibit better adsorption capacities then MEA amines namely histamine, cadvarine and putricine were formed as degradation products and maximum amount was found for degraded cheese which increased with time and temperature which have confirmed that biogenic amines can be effectively immobilized on various porous supports namely zeolite 13X, activated carbon without blocking the pore openings and

negligible reduction in pore volume and surface area. The biogenic amines have affinities equal to the synthetic amines namely monoethanol amine which is presently used for CO2 capture.

A prototype ST Radar (Stratosphere Troposphere Wind Profiler) integrating 49 elements of Antenna sub-array (Figure-5), Transmitter Receiver (TR) module, Digital Signal Processing was developed, tested and validated the `Proof of Concept' of atmospheric profiling using 205 MHz frequency of operation at Cochin University of Science and Technology, Kochi.

Figure-5: A Prototype 49-element antenna sub-array of ST Radar developed at CUSAT, Kochi

In the reporting period 759 projects costing Rs. 164.13 crore were supported to Young Scientists under the Fast Track Scheme for Young Scientists. A significant number of high impact SCI publications are emanated from several projects in frontier areas of research. A few significant achievements are reported below:

In a project on study of light scattering properties of cosmic dust, the Investigator at Assam University built a dust model using available light scattering codes. The analysis of observed images of long period comet C/2009 P1 (Garradd) showed new information regarding the dust feature of long period comets. It has been found that the radial intensity profile of the comet is canonical in nature with a slope of -1 in log scale when the distance to the photometric centre is in between 2000 and 25,000km. The researcher built the negative polarization map of comet Garradd for the first time and studied the map thoroughly. It has been noticed from polarization map that innermost coma produces negative polarization of -1.6%, which is called circumnucleus halo.

In a project on development of inorganic nanophosphors, being implemented at Shri Mata Vaishno Devi University, Katra (J&K), preparations of an orange–red emitting NaSrBO3: Sm3+ and a yellow light emitting SrZnO2:Mn2+ nanophosphors by combustion method using metal nitrates as precursors and urea as fuel were reported. The particle sizes were in the range of 38–43 nm. The potential applications of this phosphor, as a down conversion phosphor with an excitation wavelength of 395 nm and good CL intensity, were evaluated for the possible use as a high color-purity phosphor in light emitting diodes (LEDs). These phosphors have potential applications in solid state lighting (LEDs) of white LED's, dosimetry etc.

In a project at Indian Institute of Technology Ropar, Punjab in the area of Mathematical sciences, a highly accurate numerical technique based on Fourier spectral method has been developed to simulate coupled nonlinear partial differential equations of convection-diffusion type.

A theoretical project on ultracold chemistry in the early universe revealed that reaction rates constants at ultracold temperature deviates from the usual Arrhenius behavior of exponentially decaying temperature dependence. The researcher found that in presence of threshold resonance, the low energy domain of the reaction cross section will split in two distinct regimes. In the log-log plot, (i) the total inelastic cross section will be proportional to k-3 (near threshold regime, NTR) and (ii) the well-known Wigner's regime (k-1) where, k represents the momentum.

In a completed project on synthesis of iminosugar variants of α-Galactosylceramide for tuning of selective cytokine release from natural killer T (NKT) cells, the investigator had discovered aromatization of carbohydrate lactam to 2-pyridone which was subsequently converted to 3,5-dihydroxy pyridines with ortho-O-alkyls (Figure 6). One of this molecule have shown strong inhibition against matrix metalloproteinases MMP2 and MMP9 which are implicated in various forms of cancer.

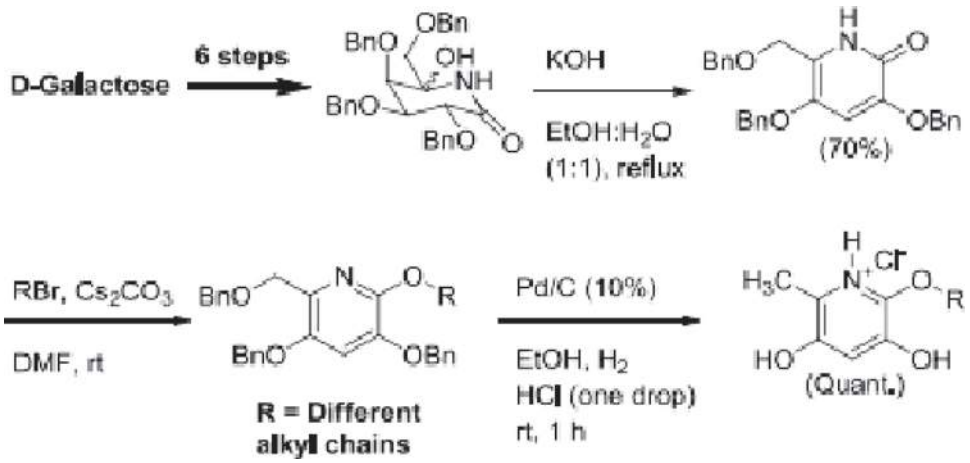


Figure 6: The process

In another ongoing project at Madurai Kamaraj University, metal organic frameworks has employed as a sustainable catalyst for various organic transformations like coupling reactions, condensation followed by cyclization and esterification reactions. Copper Metal-Organic Frameworks (MOFs) were used as catalyst in simple reactions which are having potential application in pharmaceutical industries for API synthesis and drug discovery reactions. Both the C-C and C-N bond forming reactions gave good response under mild reaction condition when MOFs are employed as catalyst.

The Board also conducted several training schools in various fields. These schools provide a platform to young researchers to think beyond their individual research fields and help understanding research through interdisciplinary approaches.

Figure 7: SERB Field training workshop on "Stratigraphy, Sedimentation and Tectonics along the Jammu-Leh-Shyok Transect" was organized in the Ladakh region of Jammu and Kashmir from 20th June 2014 – 7th July 2014.

More than 1300 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. More than 550 events were supported.

Utilisation of the Scientific Expertise of Retired Scientists (USERS) Scheme has continued to play a significant role in involving a large number of retired scientists in S&T developmental activities. Twelve books were published in the reporting period.

The online portal www.serbonline.in has been made operational for submission of R&D proposals under the PAC and Young Scientist Schemes.

SWARNAJAYANTI FELLOWSHIPS

The SwarnaJayanti Fellowship Award was initiated by the Government in 1997-1998 to commemorate 50th year of India's independence. The objective of this Fellowship Award Scheme was to award talented young scientists, upto 40 years of age, in their innovative and inter-disciplinary projects that may result in providing leadership to the country in advanced areas of science and technology.

During the year 2012-13, 261 applications covering all areas were received and scrutinized with rigour by the Subject Area Expert Committees. It recommended 16 candidates to the National Core Committee, which nominated the following 9 candidates for the SwarnaJayanti Award for the year 2012-13. After approval by the Empowered Committee of Secretaries, following candidates have been sanctioned project during the financial year 2014-15.

Sl. No.	Candidate	Discipline
1	Dr Kana Sureshan, IISER -Thiruvananthapuram	Chemical Sciences
2	Dr Venkatramanrao Anand, IISER - Pune	Chemical Sciences
3	Dr Ashwin Gumaste, IIT – Mumbai	Engineering Sciences
4	Dr Narendrakumar Ramanan, IISc – Bangalore	Life Sciences
5	Dr Ullas Seetharam, TIFR - Mumbai	Life Sciences
6	Dr Parthasarathi Chakraborty, IMSc - Chennai	Mathematical Sciences
7	Dr Nissim Kanekar, NCRA - Pune	Physical Sciences
8	Dr Vikram Tripathi, TIFR - Mumbai	Physical Sciences
9	Dr T.S. Mahesh, IISER – Pune	Physical Sciences

During the year 2013-14, against the advertisement 236 applications covering all areas were received and scrutinized intensively by the Subject Area Expert Committees. These Committees finally recommended 18 candidates to the National Core Committee. The recommendations of the National Core Committee have been sent to the Empowered Committee of Secretaries for its approval.

ATTRACTION OF TALENT FOR SCIENCE

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 in 2008 and 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 / U.Ts. 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 6th to 10th, participate in a three tier competition: District, State and National Level. The projects exhibited are evaluated by a jury of experts. All the 29 states and 7 UTs are participating in the scheme. The scheme is continuing in the 12th Five year Plan. 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 INSPIRE Award implementation

More than one million INSPIRE Awards have been sanctioned 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, 11.79 lakh INSPIRE Awards have been sanctioned till December 2015. About 47.6% of awardees are girls, and 25.8% 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 four National Level Exhibition and Project Competitions (NLEPCs) starting from 2011, every year. Out of the 3437 projects which participated in the four NLEPCs held so far 10 inventions from first NLEPC have been filed for complete specification and about 250 have been shortlisted by the Patent Facilitating Centre of TIFAC for detailed examination for possible patenting in some cases.

State/UT wise list of INSPIRE Awards sanctioned (As on 31.12.2014)				
S.No	State/UT/ Organisations	No. of Awards sanctioned	Total amount sanctioned for the awards (@ Rs. 5000/- per Award) (Rs. In lakhs)*	Amount released to States/UTs for organising competitions at various levels (Rs. In lakhs)
1	2	3	4	5
1	Andhra Pradesh	101347	5067.35	1203.55
2	Arunachal Pradesh	439	21.95	15.01
3	Assam	7755	387.75	139.19
4	Bihar	52191	2609.55	261.40
5	Chattisgarh	64194	3209.70	852.03
6	Goa	611	30.55	6.68
7	Gujarat	95755	4787.75	159.50
8	Haryana	22915	1145.75	262.82
9	Himachal Pradesh	14937	746.85	191.80
10	Jammu and Kashmir	13615	680.75	153.94
11	Jharkhand	33132	1656.60	248.18
12	Karnataka	130721	6536.05	1070.63
13	Kerala	14256	712.80	153.44
14	Madhya Pradesh	121897	6094.85	1583.43
15	Maharashtra	105056	5252.80	1317.08
16	Manipur	1375	68.75	24.49
17	Meghalaya	2817	140.85	28.63
18	Mizoram	3210	160.50	74.35
19	Nagaland	575	28.75	18.73
20	Orissa	32397	1619.85	379.11
21	Punjab	24204	1210.20	273.58
22	Rajasthan	126085	6304.25	348.88
23	Sikkim	973	48.65	14.91
24	Tamil Nadu	61906	3095.30	699.53
25	Telangana	12111	605.55	189.25
26	Tripura	1829	91.45	42.70
27	Uttar Pradesh	101860	5093.00	1742.38
28	Uttarakhand	5247	262.35	92.18
29	West Bengal	17895	894.75	180.13
30	A&N Islands	308	15.40	11.15
31	Chandigarh	544	27.20	10.10
32	Dadra and Nagar Haveli	381	19.05	9.17
33	Daman and Diu	302	15.10	5.37
34	Lakshadweep	33	1.65	1.73
35	NCT of Delhi	3703	185.15	36.68
36	Puducherry	1289	64.45	3.58
37	Kendriya Vidyalaya Sangathan	1542	77.10	22.38
	Total	**1,179,407**	**58970.35**	**11827.66**

*** INSPIRE Award Warrant is issued directly in the name of selected student and sent to him/her through the State Education machinery.**

INSPIRE Internship is the second component of the **Scheme for Early Attraction of Talent for Science (SEATS).** It aims at providing exposure to young science students by organizing Science Camps either in summer or winter days. Around 50,000 students of Class XI pursuing science in any school are invited every year to participate at the 5 days science camps and provided opportunity to interact with the Science Icons from India and abroad including Noble Laureates to experience the joy of innovations on an annual basis through **INSPIRE Internship**. So far nearly 2.5 Lakhs students are given such exposure in about 1180 Science camps. The growth profile of this component is given below (Figure-1):

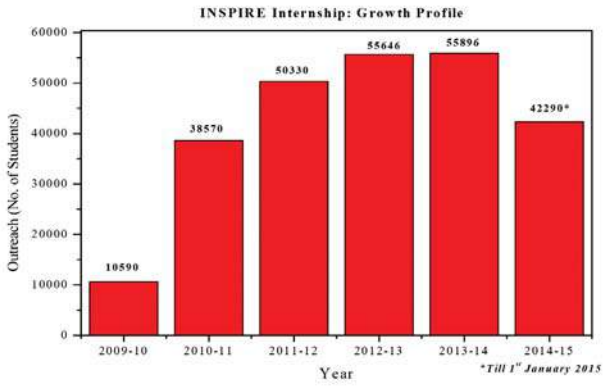
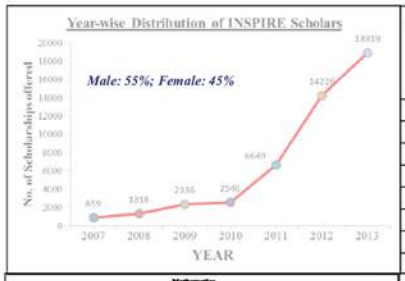
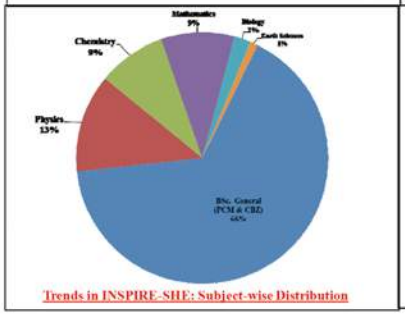


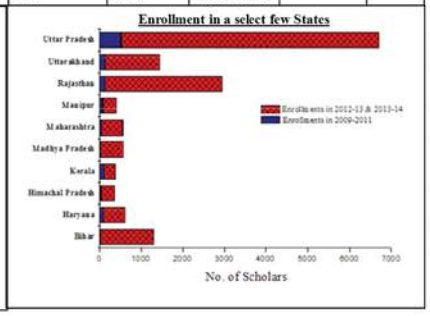
Figure-1

Scholarship for Higher Education (SHE) aims at for enhancement in rate of attachment of talented youth to undertake higher education in science intensive program by providing scholarships and mentoring through summer attachment to performing researchers. The scheme offers 10,000 Scholarship every year @ Rs 0.80 lakh per year for undertaking Bachelor and Masters level education in natural and basic sciences for the talented youth in the age group 17-22 years. The main feature of the scheme is in mentorship support being planned for every scholar through **INSPIRE Scholarship**. By now about 47000 INSPIRE Scholarships have been offered since the component is initiated (Figure-2).



Year of passing Class XII Exam	Number of Applications Received under Direct Mode	Number of INSPIRE Scholarships Offered		
		Through Boards	Through Competitive Examination	Total
2007	1177	430	429	859
2008	1504	807	511	1318
2009	1922	1483	853	2336
2010	2149	1661	885	2546
2011	8237	5717	932	6649
2012	19275	13118	1108	14226
2013	35032	18104	815*	18919
2014	*35999*	*Under Process*	*	*





INSPIRE – SCHOLARSHIP FOR HIGHER EDUCATION

Figure-2

Assured Opportunity for Research Careers (AORC) aims to attract, attach, retain and nourish talented young scientific Human Resource for strengthening the R&D foundation and base. It has two components. In the first component i.e. **INSPIRE Fellowship** in the age group of 22-27 years, it offers 1000 Fellowships every year for carrying out doctoral degree in both basic and applied sciences including engineering and medicine. In the second component **i.e. INSPIRE Faculty Scheme** assured opportunity for 1000 post- doctoral researchers every year in the age group of 27-32 years through contractual and tenure track positions for 5 years in both basic and applied sciences area.

INSPIRE Fellowship, the first component of AORC is offered only to students having secured 1st Rank in Basic & Applied Sciences including engineering, medicine, agriculture, veterinary at the University/ academic institute of national importance i.e. IITs, NITs, IISERs level examination which is eligible for admission to the PhD Program in any recognized University/ academic Institutions in the country. The Fellowship shall be tenable maximum for 5 years (2 years as JRF and 3 years as SRF) or completion of PhD, whichever is earlier to pursue full-time PhD program. The Fellowship amount including the contingencies is equivalent to CSIR-UGC NET Fellowship and is governed time to time as per GOI norms & regulations. In the current year 1000 Fellowships have been offered by January 2015. The Growth Trend, Subject-wise, Gender-wise and Institution-wise distribution of INSPIRE Fellowship is given below (Figure- 3 & Table 1). Besides this about 10 INSPIRE Fellows are selected for participating at the 4th HOPE meeting at Japan and 30 INSPIRE Fellows are also being sent to the various laboratories/Universities at UK for a short-term Research Internship through Newton-Bhabha program of DST and UK.

Table 1

Year	No. of Applications Received	No. of Fellowships Offered			Migration from INSPIRE Scholars
		JRF	JRF-P	TOTAL	
2010	1519	416	223	639	
2011	1123	536	244	780	
2012	1766	513	358	871	
2013	1830	663	527	1190	~135
2014	1726	564	436	1000	~282
TOTAL	7964	2692	1788	4480	~417

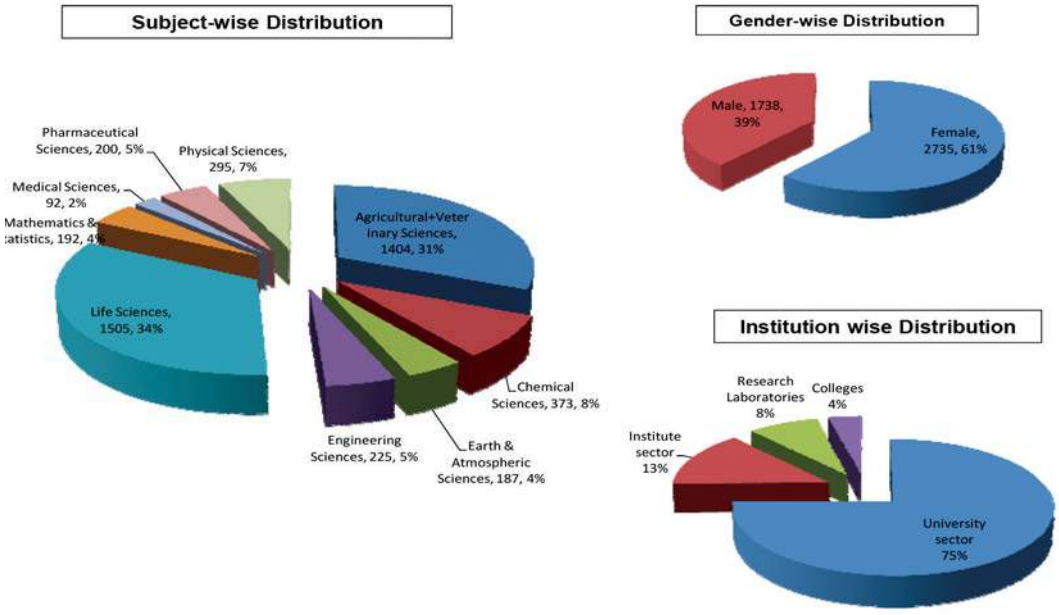


Figure-3

INSPIRE FACULTY AWARD, the second component **Assured Opportunity for Research Careers (AORC) is the INSPIRE Faculty Award Scheme** which assures opportunity for 1000 post- doctoral researchers in the age group of 27-32 years through contractual and tenure track positions for 5 years in both basic and applied sciences area including engineering, agriculture, veterinary and medicine. It has been initiated from July 2011. It aims at following:

- To provide attractive opportunities to young achievers for developing independent scientific profiles and launch them in fulfilling long term careers.
- Expected to augment high quality scientific manpower for scientific and educational institutions, specially the Central and State universities.
- While the vertical migration among students in different INSPIRE components would be encouraged, the Scheme would also provide opportunity to students for lateral entry into this component.
- This component would provide a career opportunity and not a guarantee for tenure positions after 5 years.

Since July 2011, nearly 670 Faculty Awardees have been selected and about 500 awardees have already positioned themselves at various academic Institutions/ Laboratories and Universities across the country. The Status, Subject-wise distribution, Gender distribution and Host Institution-wise distribution of INSPIRE Faculty Awardees are given below (Figure- 4):

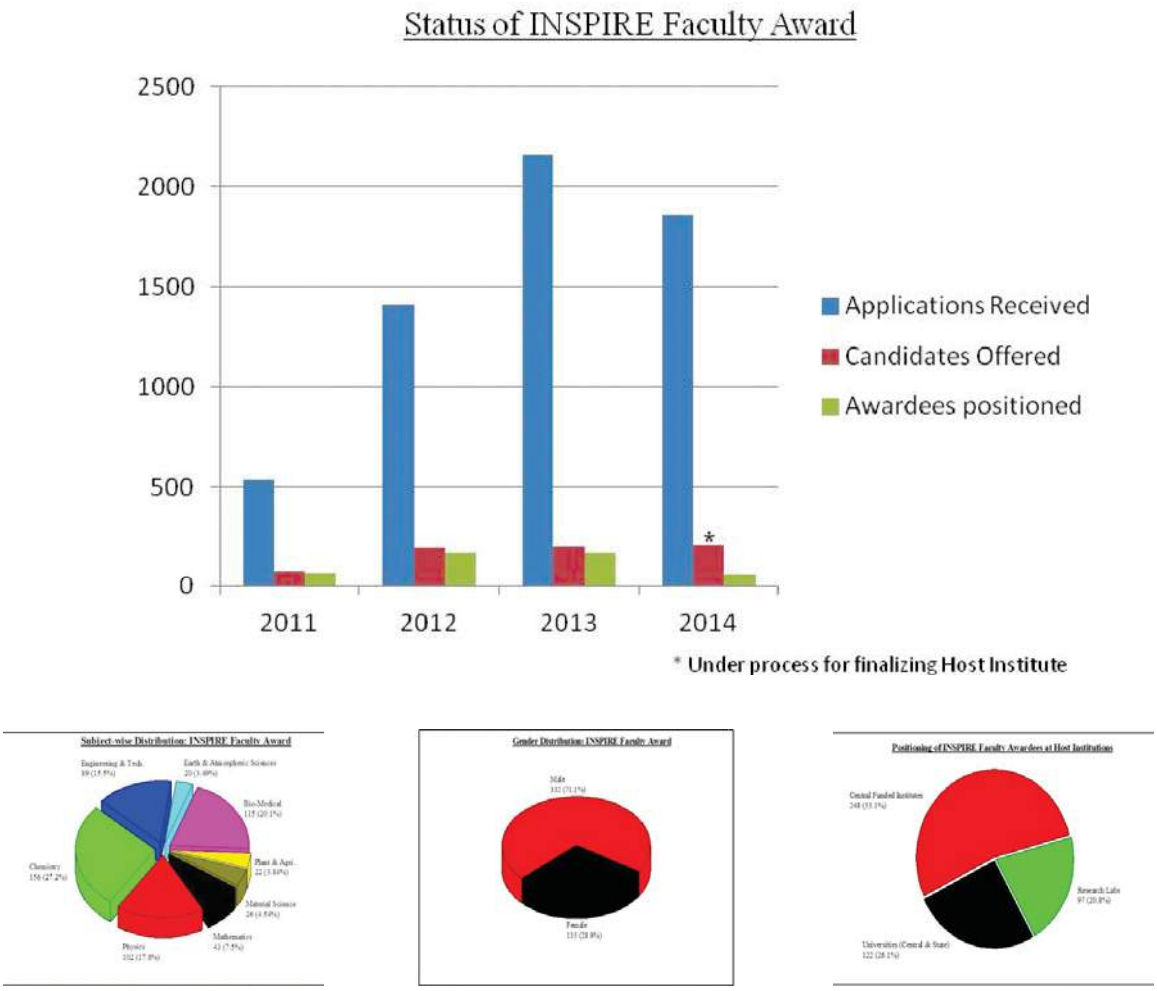


Figure-4

E-management of the INSPIRE Award Scheme.

Under the Scheme, large number of nominations, running into lakhs, have been 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 enables 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, 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.

EMPOWERING WOMEN SCIENTISTS

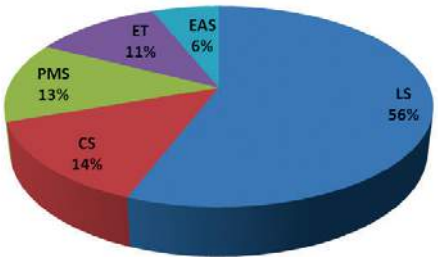
Knowledge Involvement in Research Advancement through Nurturing (KIRAN) programmme was launched in the year 2014 to bring gender parity in science through nurturing the research career of women scientists. The programme is aimed at providing opportunities to women scientists who had a break in their career primarily due to family responsibilities. The programme includes women-exclusive schemes and encourages them to foster their career by undertaking research not only in science & engineering but also for societal benefit besides making a career through entrepreneurship. The achievements of various schemes under KIRAN during the year 2014-15 are as follows -

WOMEN SCIENTIST SCHEME – A (WOS-A):

The 'Women Scientists Scheme (WOS-A)' is aimed to provide opportunities to women scientists and technologists **for pursuing research in basic or applied sciences in frontier areas of science and engineering**.

This year the Department received **1092** new proposals (Life Sciences (LS)–749, Chemical Sciences (CS)–118, Physical and Mathematical Sciences (PMS)–61, Earth and Atmospheric Sciences (EAS)–69, and Engineering Sciences (ET)–95 against which **280** projects were approved for financial support. The percentage of subject-wise distribution of such projects is given in the Chart.

Subject Wise Distribution of Sanctioned Projects



Approximately 40% women scientists received Ph.D degree with the help of WOS-A project which proves the relevance and popularity of the scheme. During the year, 210 ongoing projects, funded under this Scheme, were also monitored.

New Initiatives under WOS-A:

a. Sensitization Meetings: Three (3) Sensitization meetings were organized during 2014 at Punjab Technical University, Jalandhar; Sophitorium Institute, Bhubaneswar and DEI University, Dayalbagh, Agra to spread awareness about this unique programme.

b. Training Programme on "Photonics" for Women Scientists: Extending budgetary support for training programmes has now become a regular activity which is aimed at skill development. This year a training programme on 'Photonics" was supported which included fiber optic test and measurement techniques, fiber splicing and fiber characterizations. Hands-on practice of OTDR and on fiber based system simulation software were also the part of programme curriculum.

c. 'wosa' Portal for Online Submission of Proposals under WOS-A: 'wosa' portal for online submission of WOS-A Project Proposals has been successfully working since its inception. The portal is well accepted by Women Scientists.

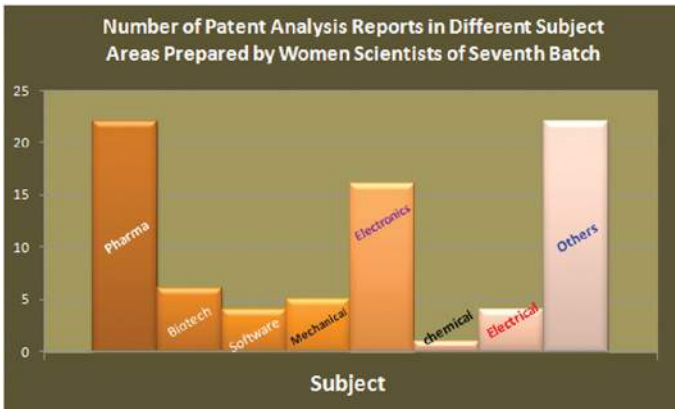
WOMEN SCIENTISTS SCHEME-B:

The Women Scientists Scheme-B is focused on S&T solutions of issues at the grassroots level for social benefit. Under this segment, women scientists are required to work in the domain of lab-to-land technology transfer, its adaptation and scaling of location-specific interventions.

During the year, a Web Portal was launched to receive online applications and processing of the same. Also, 65 new projects were sanctioned in different areas such as animal and human health & nutrition, natural resource management, sustainable agriculture, engineering, artisanal technology development and value addition. One year Internship has also been awarded to 106 women scientists having no previous experience to give them proper exposure in research and also train them in writing and implementing of projects. After internship, these candidates are expected to come with full proposal for consideration in project mode support. Four (4) Sensitization workshops have been organized at different locations namely, i) National Academy of Sciences India (NASI), Allahabad; ii) Visva Bharati, Shantiniketan; iii) Graphic Era University, Dehradun and iv) North-Eastern Hill University (NEHU), Shillong to popularize the scheme.

WOMEN SCIENTISTS SCHEME-C:

The scheme provides one year training and internship in the area of Intellectual Property Rights (IPR) and their management. During the year, 85 women scientists completed training and internship organized at Delhi, Chennai, Pune and Kharagpur in various agencies like IP Departments of Government Bodies, Patent attorney, Law firms, KPOs, PICs, IITs, R&D Institutes, Pharmaceutical companies, and so on. A total of 82 technology scan-cum-patent analysis reports were prepared by the women Scientists during the year. 17 women have cleared Patent Agent Examination and almost 55% get jobs in IPR sector.



Patent analysis reports with reference to subject is depicted in the Chart:

SCIENCE AND TECHNOLOGY FOR WOMEN:

S&T for Women scheme was started in 1981 with a focus to empower women through development and adaptation of appropriate technologies, transfer of proven technologies and demonstration of live technology models. The scheme is now come under KIRAN fold.

During the year under report, 20 projects were supported in diverse technology areas like agriculture (including fisheries, animal husbandry, horticulture, etc.), aromatic and medicinal plants, forestry, alternate livelihoods, post harvest technologies, natural resource management,

health and sanitation, occupational hazards, construction, energy including renewable energy, management of natural resources, rural development, rural industry, rural engineering, micro enterprise development, etc. Some such projects are outlined below:

Bone Health of Women in Punjab: A project on "Bone Health of Women in Punjab State" has been initiated to obtain baseline data on incidence of osteoporosis (based on BMD levels) among rural as well as urban Punjabi women. The project has been implemented by Department of Sports Medicine, Guru Nanak Dev University, Amritsar.

Food Safety Interventions for Women in Fishery based Microenterprises: This project has been taken up in Coastal Kerala to ensure the safety of the products developed by women microenterprise to enhance awareness about food safety.

Women and Nutrition: A programme on Women and Nutrition, initiated recently, to recognize the likely benefits of an improved and structured mechanism to combat the problems of malnutrition, throughout the trajectory of women's health was supported further. It involves the community by creating awareness regarding health & nutrition and utilization of the local resources through multidisciplinary approach.

CONSOLIDATION OF UNIVERSITY RESEARCH FOR INNOVATION AND EXCELLENCE IN WOMEN UNIVERSITIES (CURIE):

Department is providing support to 6 Women-only Universities under CURIE programme since 2009. On-site visits are undertaken regularly to monitor the progress of supported Universities and 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 of these Universities.

In 2nd Phase of CURIE Programme, Banasthali University, Banasthali, was extended budgetary support in order to maintain the pace of research while the proposal of Avinashilingam University, Coimbatore too was recommended for support. Department is also planning to extend CURIE support to Women Post Graduate Science Colleges to develop research culture.

WOMEN TECHNOLOGY PARK (WTP):

The Women Technology Parks have been established with an objective to provide information, create awareness, give training in appropriate location-specific technologies for rural women, leading to skill up-gradation and also possibly to help establish forward and backward linkages for income generation through micro enterprises. The WTPs also conduct field trials for R&D and modulation of the technology packages to address location specific needs.

Since inception of the scheme, 35 WTPs have been established in different geographic and agro-climatic zones of the country. In the year under report, 17 new WTP have been approved.

Modified Brick Kilns

Biomass Tray Dryers

Water technologies

TRAINING & CAPACITY BUILDING:

Training Programme for 'Leadership & Career Development': Two International training cum Workshops on 'Leadership and Career Advancement' have been organized in collaboration with Indo US Science and Technology Forum (IUSSTF) and COACh International, USA. These Workshops covered a range of topics like effective negotiation skills, successful leadership methods, communicating science effectively, working in a team environment, consensus building, publishing in reputed journals, grant writing, and job search. Over 100 Indian women scientists from several universities, R&D institutions, and so on were trained during these training programs.

NEW INITIATIVE UNDER KIRAN: MOBILITY SCHEME

The Department is exploring possibility to take initiative towards the sustenance of the career of women scientists working in Government Institutions, like, Universities/R&D labs by providing them with the opportunity to work in a different location in the following scenario:

1. Marriage, where husband is located in any other place within the country.
2. Transfer of husband to any other location within the country.
3. Accompany the children studying in a different city.
4. To take care of ailing parents.

The initiative intends to provide a harmonious environment during early phases of women scientist where they would like to stay active in research in addition to attending to their other responsibilities on the domestic front.

COGNITIVE SCIENCE RESEARCH INITIATIVE (CSRI)

Cognitive Science Research Initiative (CSRI) started during 11th Five Year Plan in the year 2008 to promote research, train and retain human resource in Cognitive Science. The Initiative

supports multi-centric mega projects, individual projects, Post Doctoral Fellowship Programme and also extends its activities through support for infrastructure development and other promotional activities.

During the year, Department received 172 individual proposals and 42 applications under Post Doctoral Fellowship programme. Department supported 41 individual projects and 11 Post Doctoral Fellowships in Cognitive Science.

During the year, 55 ongoing individual projects have also been monitored. Out of these, 4 were graded as Very Good, 19 as Good and 13 as Satisfactory. 11 PDF projects were also monitored and 4 graded as Very Good, 3 as Good and 1 as Satisfactory.

National Programme on Educational Neuroscience*:*

A co-ordinated project on '*Development and validation of screening tool to identify Learning Disability (Teacher Administered Screening Tool)*' has been supported under "National Programme on Educational Neuroscience" which has successfully completed in the year 2014. Under this project, Teacher Administered Screening Tool has been developed and validated on more than 10,000 children belonging to different school environments throughout the country. This tool has great social relevance as it will be helpful in identification of approx 5-17% of school going children suffering from Learning Disabilities (dyslexia, dysgraphia & dyscalculia).

Support for Conferences/Workshops:

Department has provided financial assistance to following Conferences and Brain Storming Meeting:

1. *IEEE Computational Intelligence Workshop*: It was conducted at Indian Institute of Information Technology, Allahabad with the themes on Perception and Cognition Engineering & Data mining and soft computing.
2. *3rd International Conference on Recent Advances in Cognition and Health*: The conference was organized by Banaras Hindu University, Varanasi. This conference was aimed to examine the knowledge and understanding of the global academic community about interface of cognition and health.
3. *Consciousness, Cognition and Culture: Implications for the 21st Century*: The said meeting has been conducted at National Institute of Advanced Studies, Bangalore. Broad themes for discussion at this meeting were 'Cognition and evolution of consciousness; Culture Cognition and Language; Mathematics, Physics and Consciousness; Brain Sciences; Phenomenology and Creativity; Decision-making and Social Cognition and Self, Mental Health and Consciousness'.

New Initiative:

A brain storming meeting has been organized in order to initiate another major project under top down approach on 'Dementia' in general and 'Alzheimer's Disease (AD) and Fronto Temporal Dementia (FTD)' in particular. During the meeting various research centres and investigators have been identified who are going to involve in the project. The project is aimed to identify early onset of AD in order to prevent people at high risk.

TRAINING 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 Government Sector" for scientific and technical personnel during the Xth 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 2014-15, 26 training programmes are to be held under "National Programme for Training of Scientists and Technologists working in the Government Sector" and a total number of 650 scientists will be got benefitted from these training programmes.

Under the Foreign Component of the Training Programme, 21 Junior and middle/Senior level Scientists were deputed for five day's Exposure Visit to China and 24 Junior and Middle/Senior Level Scientists were deputed for five day's exposure visit to Russia during the Financial Year 2014-15.

Women Component Plan:- Under Women Component Plan of the Training Programme '12' programmes are to be conducted exclusively for women scientists during 2014-15 in which 300 (appox.) Women Scientists would avail the opportunity.

CHAPTER-2

INSTITUTIONAL CAPACITY BUILDING

PROMOTING R&D THROUGH AUTONOMOUS INSTITUTIONS AND PROFESSIONAL BODIES

Agharkar Research Institute, Pune

Areas of focus: The Institute is committed to promotion of fundamental and application-oriented science for the benefit of human kind and the nation.

Current research activities of the Institute focus on six thematic areas, viz., Biodiversity and palaeobiology, Bioenergy, Bioprospecting, Developmental biology, Genetics and plant breeding, and Nanobioscience.

Major accomplishments during 2014-15:

Biodiversity and palaeobiology: In the area of biodiversity an entire gamut of organisms is being investigated, viz. bacteria, bacteriophages, viruses, fungi, lichens, diatoms, plants as well as animal and plant fossils.

Several new species of fungi, lichens, grass species, diatoms and fossils were discovered and identified.

Bioenergy:

A process for microbial conversion of lignocellulosic components of the agricultural residues, especially rice straw, into biomethane has been standardized.

Bioprospecting:ARI scientists have shown that an essential oil from the flower of *Swertia densifolia* (Gentianaceae) has a dose-dependent repellent activity toward Indian honey bee *Apis florea* F.

Developmental biology: The hydra homologue of the *NK-2* class of homeobox genes (important in heart formation in vertebrates) has been isolated and characterized from *Hydra vulgaris* Ind-Pune. To study the effect of FGF signalling on glial number and organisation, the embryonic central nervous system of FGF and FGFR mutants were examined with specific antibodies using immunohistochemistry and analysing the change in glial morphology using glial specific reporters.

Genetics and plant breeding:

A new black and brown rust-resistant wheat variety MACS 6478 has been notified for timely sown irrigated conditions of the Peninsular Zone. Thirty-nine grape varieties were evaluated for

quality and Madhu angoor, Cheema Sahebi, Carolina Black Rose, Black Damascus and Ribier showed significantly higher performance over mean+SD for bunch weight, 100 berry weight, berry size and T.S.S.

Nanobioscience:

A facile, green synthetic strategy has been developed to embed green fluorescent cadmium telluride quantum dots in biocompatible chitosan nanoparticles to obtain a stable, luminescent, biocompatible preparation with favourable toxicity profile and better cellular uptake for use in bioimaging and targeted detection of cellular components. Studies performed with seeds of *Aegle marmelos, Bauhinia variegata, Sterculia urens, Mimusops elengi, Oroxylum* and *Terminalia arjun* using nanoscale oxides of iron, zinc, titanium and multi-walled carbon nanotubes have shown significant enhancement in the germination efficiency.

Important highlights of major programmes:

Biodiversity and palaeobiology: Micropropagated plantlets of *Ceropegia maccannii*, *C. rollae, C. mahabalei* and *C. odorata* were re-introduced at different locations in Western Ghats considering their natural habitats.

Bioenergy: A consortium of four *Clostridium* strains growing optimally at 96°C was developed for the recovery of crude oil from depleted oil reservoirs with temperatures above 91°C. The consortium could enhance recovery of crude oil by 26.7% in sand pack trials.

Bioprospecting: A novel insulin-like protein (ILP) was purified from *Costus igneus* belonging to family Costaceae from Western Ghats of India. ILP showed a potent hypoglycemic activity in an *in vitro* assay and significant decrease in blood glucose levels when administered orally in oral glucose tolerance test.

Genetics and plant breeding: Bread wheat variety MACS 6478 developed by ARI has been notified by Central Sub-Committee on Crop Standards Notification and Release of Varieties for commercial cultivation in Peninsular Zone.

Nanobioscience: A new bi-layered composite that mimics the bone and cartilage has been explored. The composite is prepared using cellulose synthesized by an indigenous bacterial isolate *Komagataibacter kombuchae* MCMB-967.

Important output indicators for 2014-15

Sl. No.	Parameters	Output
1	Papers in refereed journals	43
2	Books	1
3	Numbers of PhDs produced	10
4	Indian patents filed	7
5	Number of technology leads awaiting transfer	3

Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital

Areas of research:

Astronomy, astrophysics and atmospheric sciences.

Major accomplishments:

i. The 3.6-m Devasthal Optical Telescope (DOT) is in the final stages. The enclosure building for the telescope is completed. The functioning of the dome structure was tested and found working well. The assembly and integration of the telescope by AMOS is currently in progress.

ii. The development of a Near Infrared Spectrograph as a second phase backend instrument for the 3.6 m DOT has been approved by TIFR and MoU between TIFR and ARIES has been signed.

iii. A class-10,000 clean room with a laminar flow unit providing air with class-100 specifications has been installed in the optics lab. This facility is used for assembly of the optics and the electronics (CCD camera, etc.) related to the instrumentation programs.

iv. A new GUI of Observatory Control Software (OCS) for 3.6m DOT has been developed and its interface with the TCS has been tested using the Telescope Control System (TCS) simulator.

v. The manufacturing of the optics of the Faint Object Spectrograph and Camera (FOSC), the first science instrument on the 3.6 meter telescope has been completed.

vi. Several experiments have been conducted with few clusters of ST Radar and test profiles have also been compared with balloon-borne winds.

vii. Measurements of ozone, CO, NO-NO_y, SO_2, and aerosols at surface show influences of the pollutants to the clearer environment of the central Himalayan region.

viii. ARIES is actively participating in the Thirty Meter Telescope project. The first science and instrumentation workshop regarding the TMT project was successfully hosted at ARIES in November 2014.

Important highlights of five major programs

i. The near completion of 3.6m DOT enclosure at Devasthal is one of the major highlights of this project. The installation of a coating plant is also in progress.

ii. ARIES have designed (optical) the high resolution spectrograph for the the upcoming 3.6-m telescope.

iii. A new 4K × 4K imager for the 3.6 m for verification and testing of the 3.6 m DOT is fully assembled and testing is in progress.

iv. First continuous measurements of SO_2 over the central Himalayan region are made using ultra trace level (50 pptv) instrument.

v. The contract for manufacturing the prototypes of Segmented Support Assemblies (SSAs) of TMT has been awarded to two Indian companies and the progress is being monitored by ARIES.

Major and unique facilities created

The enclosure building for the upcoming 3.6m DOT project is completed and the assembly and integration of the telescope is in progress by AMOS. A coating plant has been installed successfully to coat the M1 mirror of 3.6 m DOT. The development of an imager for performing testing and verification of the 3.6m DOT has been completed.

Important collaborations (national and international established)

i) A project entitled **"Time resolved photometric and spectroscopic study of the chemically peculiar stars"** was sanctioned jointly by DST, India and Russian Academy of Science.

ii) A project entitled **"Star formation history of OB associations and characterization of global properties of young open clusters"** in collaboration with Prof. N. Kobayashi, (Japan) and Prof. K. Ogura (Japan), was initiated with the aim to elucidate the global properties of young open clusters in the Galaxy as well as star formation history of the young open clusters/ OB associations associated with HII regions.

iii) A project entitled *"***Study of waves and eruptive phenomena in the solar atmosphere***"* has been initiated in collaboration with Dr. I. Zhelyazkov, Sofia University, Bulgaria intended to study the solar eruptive phenomena, wave phenomena, and coronal heating using recent multi-wavelength observations from space and complementary ground based observations (e.g., ARIES H-alpha, BBSO, Nobeyama Radio, etc.).

iv) A DST-FRBR project entitled **"Study of the role of magnetic field in the flaring and eruptive region of the solar atmosphere"** with Dr. Boris P. Filippov, Head of Laboratory, Pushkov Institute of Terrestrial Magnetism, IZMIRAN, Russian Academy of Science, Troitsk, Russia was initiated with the aim to study the onsets of solar flares, eruptions, related dynamical processes, and geomagnetic storms.

v) A project titled **"Short term optical variability of various classed of luminous AGNs"** was recently initiated between ARIES and Institute of Astronomy and National Astronomical Observatory, Sofia, Bulgaria.

vi) A project under the Indo-Russian DST-RFBR, collaboration was established with Russian scientists on the topic **"Magnetic activities in low mass stars"**.

vii) A project ***entitled*** **"Observations and analysis of stars in the /Kepler/ field"** in collaboration with Dr Chris Engelbrecht, University of Johannesburg, SA was initiated.

Important output indicators for 2014-15

S. No.	Parameters	Output
1.	Papers in refereed journals	48
2.	Chapters in Books	01
3.	Papers in Conferences	06
4.	Number of Ph. Ds. produced	Awarded-03; Submitted-04
5.	Research Manpower Trained(other than Ph. Ds)	03
6.	Technical manpower trained	35
7.	B. Tech/UG Project guided	29
8.	M. Tech/M.Sc./M. Phil project guided	06

Bose Institute, Kolkata

Areas of focus:

Improvement of plants: Biotechnological, genomic and proteomic approaches; 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.

Major accomplishments: Immuno-proteomic analysis to identify IgE reactive proteins has been performed on three predominant airborne pollen grains viz. *Helianthus, Lantana camara, Cocos* and *Peltophorum* and a mold *Curvularia*, and several allegens identified. A number of differentially expressed proteins were induced in chickpea roots upon challenging with *Fusarium oxysporium*. A novel protein structural motif, -(Gly_{PR})-*cis*Pro-, was discovered. IL-10-producing FoxP3 T cell populations have been found to contribute to IL-10-dependent type-2 cytokine bias in breast cancer patients. Rv2147c (or SepF), a septation related protein of *Mycobacterium tuberculosis* has been shown to interact with FtsZ through its C-terminus. It localizes to the site of division and also interacts with MurG, a peptidoglycan synthesizing enzyme. Community dynamics of various microbial groups that inhabit the boratic stromatolite-forming sulfur spring of Puga valley, Ladakh was found to depend on fluctuating geochemical parameters.

Important highlights of major programmes:

(i) **Improvement of plants: Biotechnological, genomic and proteomic approaches:** The effective exploitation of novel genes and regulatory elements are being continued to improve the plant performance in the field; and to combat biotic and abiotic stresses of crop plants.

(ii) **Protein structure, function and engineering:** Resolution of protein structure is the key criterion to determine functional organization of a protein. Study on the structure-function relation coupled with expression analyses have been undertaken to design therapeutically and other economically important protein molecules.

(iii) **Bioinformatics and computational biology:** Network analysis of microRNA and neurodegenerative diseases, ii) Therapeutic molecular design including genomics and proteomics approaches, iii) Comparative genome analysis and protein evolution, iv) Protein structure, dynamics and protein-protein interactions, v) Development of bioinformatics tools and web-based servers.

(iv) **Molecular medicine:** The primary focus of the division is to study molecules related to health and diseases and manipulating those molecules to improve diagnosis, prevention and treatment of diseases like cancer, diabetes, cardiovascular problems, leishmaniasis, tuberculosis, etc.

(v) Microbial genomics and infection biology: Genomic approaches have been taken to study the basic biology of microbes leading to useful insights into the mechanisms of their growth, proliferation and cell-cycle regulation. Identification of microorganisms with a potential for bioremediation is also under study.

(vi) **Development of systems biology:** In this programme scientists are working on various aspects of understanding disease processes and infections using systems biology approaches. Specifically, high throughput approaches have been taken to understand pathogen-tuned signalling networks in host cells. Mathematical modelling has been employed to understand stress responses in mammalian cells and in bacterial pathogens.

(vii) **Basic and applied problems in physical and environmental sciences:** The Department of Physics contributes both to fundamental knowledge as well as applications relevant to industry and society in general. Recently, research activities have also been initiated in millimetre-wave and microwaves and also in atmospheric sciences.

Major and unique national facilities created: Unified Academic Campus.

In order to bring all the laboratories under one roof a project sanctioned by DST Govt. Of India has been undertaken to build an unified campus at Sector V, Bidhannagar, Kolkata. The project is due to be completed in 2016 March.

Important collaborations (national and global) established:

(i) **A Large Ion Collider Experiment (ALICE)** at CERN, Geneva, to study the properties of matter at extreme conditions. (ii) **Indo-Korean collaborative programme (DST),** to understand the role of micro RNAs in regulating the immune response of macrophages. (iii) **Indo-Swedish Collaborative Programme,** to study the latency of *Mycobacterium tuberculosis* and evaluating drugs and drug targets using innovative methods.

Important Output Indicators for 2014-15

S.No.	Parameters	Output
1	Papers in refereed journals	195
2	Chapters in books	3
3	Papers in conferences	80
4	Number of Ph.Ds. produced	15
5	Number of Technology leads awaiting transfer	1
6	Research manpower trained (other than Ph.Ds)	240
7	Technical manpower trained	11
8	B.Tech/ UG projects guided	03
9	M.Tech/M.Sc./M.Phil projects guided	28

Birbal Sahni Institute of Palaeobotany, Lucknow

Areas of focus:

- Early life and environment: Evidence from Indian Precambrian basins.
- Phanerozoic terrestrial and coastal ecosystems: Biostratigraphical, palaeoenvironmental, palaeoecological and palaeogeographical aspects.
- Integrative marine micropalaeontology: Focus on high-resolution biostratigraphy, sea-level changes, palaeo-oceanographic and palaeoclimatic events
- Organic petrology: Characterisation of solid fossil fuel for depositional and utilisational aspects.
- Quaternary palaeoclimate reconstructions, vegetation dynamics and relative sea level changes.
- Domestication of plants, early farming and ecosystem dynamics during Holocene/Anthropocene.
- Geochronological and geochemical parameters for high-resolution dating, correlation, palaeoclimatic, tectonic and provenance studies.
- India-Asia collision and Himalayan uplift: palaeobotanical and associated biotic signatures from the sedimentary records of northwest Himalaya.
- Preparation of books, catalogues, atlases, databases, digitization of library, museum, herbarium and other holdings.

Major accomplishments:

Research on palaeobotany and allied disciplines is being conducted on sedimentary rock sequences ranging in age from Archaean to Recent (3200 million years BC to AD 400) for the

interpretation of past plant life, palaeoclimate, paleoecology and palaeobiogeography. Ongoing research also includes archaeobotany and dendrochronology. Emphasis has been laid on deriving knowledge about the diversification of Precambrian life, diversity, distribution and inter- and intra-basinal correlation of Gondwana and Tertiary floras, terrestrial and marine microfossils and their application in solving geologic problems and hydrocarbon exploration, coal/lignite quality and to understand the interaction between the climate and vegetational changes during Quaternary Period.

Important highlights of major programmes:

Precambrian palaeobiology — Fossil evidence of iron-oxidising bacteria preserved as filamentous iron oxides within phosphatic Palaeoproterozoic stromatolites of the Aravalli, Rajasthan. This study provides evidence concerning the evolution of oxygenated environment that led to the diversification of photosynthesizing organisms.

Phanerozoic ecosystems — Discovery of a rich Permian spore-pollen assemblage from the Permian–Triassic succession in the famous Guryul Ravine, Kashmir, India has provided a basis for regional as well as global correlation of Permian–Triassic boundary, as well as insights into Permo-Triassic climatic and tectonic events. A recently recorded ~ 65 million year old plant fossil, Sabalites dindoriensis, is the oldest record of a coryphoid palm from the Gondwana-derived continents. Another study shows that the genus Bridelia (Phyllanthaceae) evolved ~ 25 Ma in the Northeast India, and later migrated to Southeast Asia via Myanmar and Africa. Another very significant study demonstrated that Anthracobunidae, an extinct (middle Eocene, ~ 48 Ma) family of large mammals from Indo-Pakistan is actually the ancestors of perissodactyls, the order which includes modern horses and rhinos.

Quaternary Palaeoclimate — A CLAMP (climate leaf analysis multivariate program) analysis of fossil leaves indicates cool, equatorial (~10°N) temperatures and a monsoonal climate in western India (Rajasthan) during ~55-52 Ma; i.e., around the time of India-Asia collision. A collaborative study involving CLAMP analysis of fossil leaves from Darjeeling and Arunachal Pradesh suggests that there has been little change in the intensity of the monsoon in Arunachal Pradesh since mid-Miocene time, whereas in the Darjeeling area, monsoon has intensified since the mid-Miocene.

In a significant study, The presence of fossil grains of sorghum millet, little millet, finger millet, pearl millet and foxtail millet from various archaeological sites from the Early Harappan (3000-2500 BC), Mature Harappan (2500-2000 BC), and Late Harappan (2000-1400 BC) shows their dominant role in the Harappan agricultural system. The shift towards drought-resistant millet crops in peripheral region of the Indus/Harappan civilization is interpreted as a cultural adaptation in response to decline of SW monsoon during the late Holocene (~4ka), to which millets are better suited.

In a multi-proxy study of the mid-Holocene climatic fluctuation, and its possible impact on the Harappan culture, it was deciphered that the emergence of cultural complexity of Harappan civilisation is an initial adaptation to the earliest phase of dry climate in this region and that the fall of Harappan culture is probably linked to the excessive dry climate of later phase (~4200–4255 BC) of mid-Holocene.

Major and unique national facilities created:

New analytical infrastructure is in the process of being developed such as instrumentation for elemental, isotopic and organic geochemistry (ICPMS, IRMS, GC-MS), and for TL/OSL Dating. In addition, UV Spectrophotometer, used for the nutrient analysis in water/sediment samples, has been procured.

Important collaborations (national and global) established:

Integrated research activities with Institutions in India and abroad have been going on in several spheres. Institute is working in close collaboration with overseas institutions like Institute of Botany, CAS Beijing (China); University of Sao Paulo and Guarulhos (Brazil); Institute of Geosciences, RAS Moscow (Russia); University Innsbruck, Austria; Open University (UK); University of Bonn (Germany); University of Florida, American Museum of Natural History, New York (USA); Tribhuvan University (Nepal), etc., and with Indian institutions like GSI, WIHG (Dehradun), NIO & NCAOR (Goa), IIT Bombay, IIT Roorkee, ARI (Pune), PRL (Ahmedabad), Universities of Jammu, Delhi, Garhwal, Bangalore, Calcutta, Mizoram, Lucknow, etc. During 2014, Institute has signed Memorandum of Understanding with Geological Survey of India, Northern Region and Western Region for collaborative studies. Institute has been recognized by the Universities of Panjab, Kumaun, and Lucknow for registration of the Research Scholars of the Institute for the award of Ph.D.

Important Output Indicators for 2014-15

S.No.	Parameters	Output
1	Papers in refereed journals	136
2	Books and edited volumes	02
3	Chapters in books	08
4	Papers in conferences	52
5	Number of PhDs produced	02
6	Research manpower trained (other than PhDs)	01
7	Technical manpower trained	02
	Other products/ Indicators	
	Symposium/Workshop organised	02
	Help to industry	01
	Collaborative research	13
	Consultancy services (in carbon dating, SEM and palynology)	107
	Extra-mural research projects awarded	10
	Research projects completed	02

Centre for Nano and Soft Matter Sciences, Bengaluru

Areas of focus: The Centre was established to focus on basic and applied research in liquid crystals. Presently, it has broadened its scope in Nanoscience and soft matter to include polymers, gels, membranes, and so on.

Major accomplishments

A photo-driven dual-frequency addressable optical device of banana-shaped molecules was developed. Influence of polarisation-tilt coupling on the ferroelectric properties of smectic gels was studied. Composites of a ferroelectric LC (FLC), with an organic gelator showed the interesting feature of transfer of chirality from FLC to fibre strands, as exemplified by the creation of nano-rope structures. Novel columnar-calamitic phase sequences in a binary system of bent-core and rod-like mesogens were studied. Thirty-two new optically active nonsymmetric dimers were investigated. These dimers comprise pro-mesogenic cholesterol and short bent-core chalcone, interlinked covalently through an ω-oxyalkanoyl spacer. Double exchange driven electroresistance in manganese perovskites thin film was studied. Polycrystalline $La_{0.67}Ca_{0.33}MnO_3$ (LCMO) thin film on n-type Si (100) substrate was prepared. Electrical resistance with temperature from 15 to 300 K in in-plane (*IP*) and out-of-plane (OP) configurations were measured. Branched gold nanostructures were synthesised on reduced graphene oxide (rGO) layers by *in situ* reduction assisted by binary surfactant mixtures containing tetraoctylammonium bromide (TOABr) with cetyltrimethylammonium bromide (CTAB). The hybrid material self-assembles at a liquid/liquid interface forming a free-standing film. Polarity sensitive electric responses in a twisted smectic C liquid crystal were studied. The investigation revealed the first observation of two polarity sensitive electrical responses in low frequency (<1 Hz) regime of a square wave field in an achiral SmC liquid crystal in the 90◦-twisted configuration.

Important highlights of major programmes

(i) **Polarisation-tilt coupling on the ferroelectric properties of liquid crystal gels:** Composites of a ferroelectric liquid crystal (FLC) with a gelator were studied. Structural and other probes were employed to investigate the influence of coupling between polarisation and tilt angle on the ferroelectric properties of gels. They have potential application in memory devices.

(ii) **Columnar-calamitic phase sequences in a binary system of bent-core and rod-like mesogens:** Achiral bent-core and chiral rod-like components were studied. While the bent-core exhibits a B2 phase, the rod-like compound shows smectic A and smectic C* phases. A mixture, exhibits a novel sequence involving three columnar phases. The structural studies revealed that all the columnar phases possess a rectangular lattice.

(iii) **Nonsymmetric dimers comprising chalcone and cholesterol entities:** Optically active nonsymmetric dimers belonging to four series were investigated for their electrical switching studies. These dimers comprise pro-mesogenic cholesterol and short bent-core chalcone, interlinked covalently through an ω-oxyalkanoyl spacer.

(iv) **Double exchange driven electroresistance, anisotropic electrical transport and magnetic properties of manganese perovskite thin film:** Polycrystalline $La_{0.67}Ca_{0.33}MnO_3$ (LCMO) thin film on n-type Si (100) substrate was studied. Electrical resistance with temperature from 15 to 300 K in in-plane (IP) and out-of-plane (OP) configurations were studied in detail. **Gold nanostructures on reduced graphene oxide films formed at a liquid/liquid interface:** Branched gold nanostructures were synthesised on reduced graphene oxide (rGO) layers by *in situ* reduction assisted by binary mixtures containing tetraoctylammonium bromide (TOABr) with cetyltrimethylammonium bromide (CTAB). When TOABr-CTAB mixture is used, the film shows irregular shaped, possibly twinned, particles of gold with stunted tip growth along with psuedopods.

Major and unique national facilities created: Field Emission Scanning Electron Microscope Facility

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

Global: Wigner Research Centre 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, and so on.

Important Output Indicators for 2014-15

Sl. No.	Parameters	Output
1	Papers in refereed journals	26
2	Books	1
3	Papers in conferences	3
4	Number of Ph.Ds. produced	2
5	Research manpower trained (other than PhDs)	10 (from other institutions)
6	Other products/ Indicators (Lectures given at schools/ colleges under popularisation of science)	25 lectures

Indian Association for the Cultivation of Science (IACS), Kolkata

Area of focus: The activities are carried out in four umbrella areas – Molecular Science, Material Science, Theoretical Sciences, and Biological Sciences

Major accomplishments: Fellow of National Academy (FNA): 2,; SERB Distinguished Fellowship: 2; Tata Chemical Distinguished Professorship: 1, Fellow of Indian Academy of Sciences (FASc): 2; Fellow of National Academy of Science (FNASc): 1; The/SSP/JPP Young Investigator Award: 1; CRSI Silver Medal: 1; Young Career Award in Nanoscience and Technology: 1; CNR Rao National Prize for Chemical Research Award: 1; MRSI Medal: 2; ACCMS Award: 1; Editorial Board Member of International Journals: 3; International patent granted: 1.

Important highlights of major programmes:

(i) Theoretical science: Probing the possibility of having two Higgs bosons in supersymmetry with masses 98 GeV and 125 GeV, consistent with the recent discovery of Higgs Boson at CERN Large Hadron Collider. Highly accurate spin-free robust non-perturbative coupled cluster electronic structure methods for balanced treatment of dynamic and non-dynamic electron correlation were developed. Theoretical state-to-state reaction dynamics, molecule-surface scattering and development of beyond Born-Oppenheimer theories were performed. Using density functional techniques extensive studies were conducted on degradation of pollutants and insecticides; devising new strategies for hydrogen storage; magnetic properties and band structures of novel materials; aggregation of bio and organic materials; unravelling reaction mechanisms relevant to catalytic processes and tunnelling effects on reaction rates in chemical reactions.

(ii) Materials science: Design and synthesis of various nanomaterials and thin films for gas storage, metal ion sensing, solar cell, optoelectronic devices, luminescent devices, photodetectors, catalysis and biomedical applications. Graphene-based composite systems are synthesized and used for drug delivery, catalysis and water purification and for electronic and optical applications. Magnetic, dielectric and multi-ferroic materials are investigated both in bulk and thin film forms to exploit their functional properties.

(iii) Molecular science: A family of biomimetic iron (II) complexes were developed which can catalyse a number of oxidative transformation reactions using dioxygen as the terminal oxidant. Metal-based complexes for O_2 activation/reduction and H_2 production were synthesised and spectroscopically characterised. Strategies were developed for anionic recognition of fluorides and arsenates in aqueous medium and for trapping of sulphates. Orthogonal hydrogen bonding and charge-transfer between donor and acceptor species were exploited to achieve a novel phase transition mimicking the Venus fly trap effect in supramolecular assemblies. Through drug design oxyindole derivatives were synthesized, which displayed remarkable anticancer activity against breast cancer cells. A magnetoclick approach was developed for a reusable catalyst synthesis that can facilitate asymmetric 1,3-dipolar cycloaddition between nitrones and α,β-unsaturated aldehydes. An alumina supported Cu (II) catalyst was developed for a general reaction protocol effectuating the synthesis of unsymmetrical organomono- and bis-selenides. Natural product Ibogaine based analogue has been discovered as a substitute of morphine with pain-killing power.

(iv) Biological science: Crystal engineering design of topical gels derived from non-steroidal anti-inflammatory drugs (NSAID) was achieved and successfully applied to treat inflammation induced skin conditions in mouse models. Carbon nanotube-amphiphile hybrids were designed and developed as functional delivery vehicle.

Important collaborations (national and global) established: IACS has continuous collaboration in India-US solar energy project (SERIIUS) and in IACS-BARC Initiative for Research in Quantum Structures (IBIQuS). Japan-Indo Collaborative Research Projects in Molecular Science between Institute for Molecular Science (IMS), National Institute of Natural Sciences (NINS) and IACS.

Important Output Indicators for 2014-15

Sl.No.	Parameters	Output
1.	Papers in referred journals	493
2.	Book	01
3.	Chapters in books	08
4.	Papers in conferences	63
5.	Number of Ph.Ds. produced	55
6.	Foreign patents filed	03
	Foreign patents granted	01
7.	Indian patents filed	04
	Indian patents granted	01
8.	Research manpower trained (other than Ph.Ds.)	71
9.	Technical manpower trained	15
10.	B. Tech/UG projects guided	26
11.	M. Tech/M.Sc./M. Phil projects guided	46

International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad

Areas of focus:

Nanomaterials; engineered coatings; ceramic processing; laser processing of materials; sol-gel coating; fuel cells; solar energy materials; automotive energy materials; carbon materials

Major accomplishments:

- Transferred technology for the 'manufacture of nano-titania for photo-catalytic self-cleaning textile applications' to M/s Resil Chemicals Pvt. Ltd, Bangalore.

- Developed and supplied a tailored micro arc oxidation (MAO) system to Annamalai University, Tamil Nadu for R&D purposes.
- Developed and demonstrated decorative scratch-resistant sol-gel nanocomposite coatings on glass. Know-how transfer to industry is under negotiation.
- For the first time in the country, a DC room, wherein all appliances (fan, light, air conditioner and refrigerator) are powered by low-temperature PEM fuel cell has been established. The DC room has now been operated for 100 hours.
- Developed prototype ODS 9 Cr steel blades for ultra-super-critical steam turbine blades.
- Laser hardening for improved surface property and laser cladding for re-building damaged areas of dies made of hot work die steel H13 used in pressure die casting has been developed.
- Developed thermal barrier coatings (TBC) on HP vanes and blades of aero engines by EBPVD technology and supplied the same to the end user.
- Developed wide array of hybrid TBCs using Solution Precursor Plasma Spray (SPPS).
- Developed Ni-W alloy/composites by pulsed electro deposition (PED) to replace hexavalent hard chrome coatings.

Important highlights of major programmes:

Automotive energy materials: Established a pilot scale facility to develop lithium ion cells and battery packs for electric vehicles (EVs) and hybrid electric vehicles (HEVs). State-of-art facilities for thermoelectric materials fabrication and for characterization for waste heat recovery applications have been established.

Solar energy materials: The pilot plant facility for fabrication of CIGS thin film solar cell modules has been established and is operational. Solar functional coatings for solar absorption, dust repellency and anti-reflection for solar thermal applications are also being developed.

Laser micromachining: ARCI and National Research Council (NRC)-Canada have jointly established the ultrafast femto-second laser micromachining facility. Micro machining of micro-heaters, cutting of layered PCBs and cutting PCB elements on printed PTFE sheets have been successfully completed.

Nano materials: Activities were initiated to synthesize uniform carbon coating on $LiFePO_4$ and production of 100gm/batch was achieved.

Major and unique national facilities created:

Several facilities were created which included SiN lined grinding unit for Zoz simoloyer CM-08 mill; Large-scale Spark Plasma Sintering; Micro focus XRD, Ellipsometer, Quantum Efficiency Measurement System; and Nano indenter system with impact testing facility.

Important output indicators for 2014-15

S. No.	Parameters	Output
1	Papers in refereed journals (SCI)	68
2	Books/chapters in books	1
3	Papers in conferences (with or without proceedings)	38
4	Foreign patents filed	0
	Foreign patents granted	1
5	Indian patents filed	6
	Indian patents granted	0
6	No of technologies transferred/ applications developed/products supplied *	14
7	Number of technology leads awaiting transfer*	15
8	Research manpower trained (No of SRF/JRF)	36
9	Technical manpower trained	251
10	B.Tech/ U.G projects guided (including ongoing)	68
11	M.Tech/M.Sc./M. Phil projects guided (including ongoing)	62
12	Number of current Ph.D. scholars (Non ARCI- regular employees)	34
13	Training provided to fresh post graduates/graduates/diploma holders	61

Important collaborations (national and global) established:

Global:

Advance Materials Corporation-USA, Corning Incorporated-USA, Fraunhofer Institutions-Germany, NRC-Canada, Toda Kogyo Corporation-Japan, PACT- France, REOSC-France

National:

Collaboration with 20 Indian companies/organisations was established. They include BHEL, CSIO, DRDO, HAL, Indian Air Force, Infinity Microsystems, Larsen Toubro, Natco Pharma Ltd, North East Institute of Science and Technology, Tata Steel Ltd, Thermax Ltd, Titan Industries Ltd, TVS Motor Company Ltd, and Wheels India Ltd

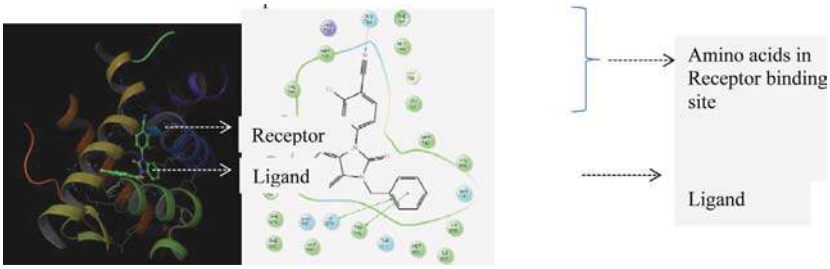
Institute of Advanced Study in Science & Technology (IASST), Guwahati

Areas of focus:

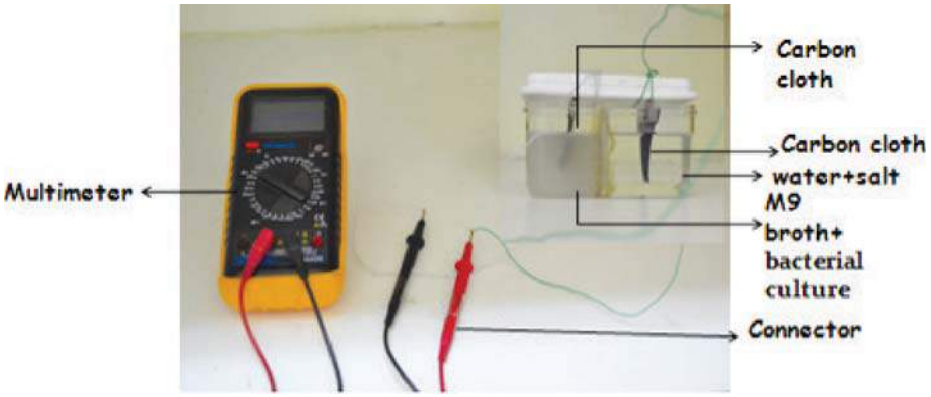
Nanotechnology, fuel cell, solar cell, seri-biotechnology, biochemistry, biodiversity, bioremediation of soil, water, plasma physics, polymer chemistry, mathematical and computational science, etc.

Major accomplishments:

- Linear and nonlinear dust acoustic waves, Hole Peregrine soliton in multicomponent 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, biosensors and nanostructured polymer nanomaterial as chemical sensor.
- Synthesis of co-polymer gels and hydrogels for efficient absorption of organic solvent and oil.
- A new notion of generalized difference for sequence spaces have been introduced and applied for the investigation of different classes of sequences. Fuzzy C-means for image processing of PAP smear image of cervical cancer.
- Different types of Bernoulli vacation models have been studied for different situations.
- Investigation of spectra of some matrix maps on sequence spaces and studies on b-open sets in bi-topological spaces.
- Study of structural, electronic and lattice dynamical properties of inorganic functional materials.
- Phyto-assisted bioremediation of oil contaminated soil for abatement of hydrocarbon pollution in soil.
- Creation of Metagenomic DNA Bank for long-term storage of genomes of microbes inhabiting diverse ecosystems of NE India.
- A fosmid library of 49×106 clones containing metagenomic DNA of compost samples has been constructed.
- The gut microflora of 225 representative volunteers from 15 tribal populations of north-east of India and Andhra Pradesh have been revealed.
- Aquatic biodiversity recorded and reported in high altitude watershed of Arunachal Pradesh and Exploration and study of faunal biodiversity in Assam.
- A skin ointment developed from medicinal plants against fungal infection and a base material for ointments from plants has been filed for patent and hypolipidaemic/antioxidant activities of some medicinal plants of this area have been established.



Androgen receptor with ligand interaction in binding site



A Microbial Fuel Cell (MFC) developed in IASST

Important highlights of major programmes:

(i) Metagenomic DNA Bank has been created for long term storage of genomes of microbes inhabitingdiverse ecosystems of NE India. In this library, highly efficient cellulose enzymes aredetected for conversion of lignoceliulytic to glucose to subsequently convert to bioethanol.

(ii) Production of (i) Low temperature and low density plasma, (ii) Positive ion-negative ion plasma. RF plasma polymerisation process on bell metal and Muga fibre, fabrics. Synthesis of organic-inorganic nanocomposite thin films by plasma based technique.

(iii) Fabrication of nanopatterns, Monolayer assembly. Investigation of metal coated polymer nanowire as chemical sensing material.

(iv) Development of nitroaromatic (explosive) sensors from biomaterial, preparation of carbon coated hydrogels beads with improved stability and drug delivery applications.

(v) Using pattern recognition and machine learning methods related to cancer data, software has been developed to provide decision support to doctors in confirmation of cervical cancer.

(vi) Introduced a new type of mixed fuzzy topological space and its different properties have been investigated.

(vii) Development of smart material and shape memory alloy which shows higher magnetic transition temperatures and more ductile than other conventional shape memory alloys.

(viii) Hydrocarbon remediation related studies include use of efficient biosurfactant producing bacteria for recovery of hydrocarbon from sludge, oxidative degradation of contamination in soil.

(ix) An efficient hydrocarbon degrading phytoremediation technology has been developed for oil fields of Assam.

(x) It was found that juice of *Musa balbisiana* rhizomes (local banana) could reduce blood sugar in animal model.

(xi) Plant extract and synthesis of DDL02 molecule from *Murraya koenigii* for the treatment of prostate cancer.

Major and unique national facilities created:

Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM), X-Ray Diffraction (XRD), LC-MS-MS, GC-MS-MS, DNA Sequencer, Fluorescence Microscope, FTIR, High-performance computation laboratory.

Important collaborations (national and global) established:

National: BARC, Mumbai; ISI Kolkata; IISc, Banglore; SINP, Kolkata; TERI, New Delhi; IIT (Kharagpur, Bombay, Guwahati, Roorkee); National Institute of Nutrition, Hyderabad; AIIMS, New Delhi, CAT, Indore; IMTECH, Chandigarh; Asian Institute of Gastroenterology, Hyderabad; IICT, Hyderabad; Annamalai University, Tamilnadu; Assam Agriculture University, Jorhat.

Global: Yokohama University, Institute of Space, High Energy Accelerator Research Organization and Astronautical Science, Japan; University of Ulster, School of Biomedical Sciences, Northern Ireland, Padova University, Italy; Stazionespermente la seta, Milano, Italy; University of Maryland, USA; Museum national d'Histoirenaturelle, Deakin University, Australia; Firat University and Adiyaman University, Turkey; Mother Teresa Institute, Kosovo; Dalhousie University, Canada; University of Missouri-Kansas City, USA; Michigan Tech. University and Chicago University, USA; University of Greece.

Important Output Indicators for 2014-15

S.No.	Parameters	Output
1	Papers in refereed journals	79
2	Chapters in books	04
3	Papers in conferences	63
4	Number of PhDs produced	10
5	Indian patent granted	01
6	Indian patents filed	04
7	Number of technologies/designs and other intellectual products commercialised	01
8	Research manpower trained (other than PhDs)	42
9	Technical manpower trained	01
10	B.Tech/ UG projects guided	07
11	M.Tech/M.Sc./M.Phil projects guided	04
12	Scientist with H-index 25	01

Indian Institute of Astrophysics, Bengaluru

Areas of focus:

- Astronomy, astrophysics, solar system studies and related research.
- Design and development of instruments and techniques for astronomical research.
- Establish, operate and maintain experimental and observational facilities for research in astronomy and astrophysics.
- Student training.

Major accomplishments during 2014-15:

Several important research findings and discoveries have been brought out through observations using the data obtained from the telescopes at Vainu Bappu Observatory, Kavalur, Indian Astronomical Observatory at Hanle, and the observatories at Kodaikanal and Gauribidanur. Several theoretical analyses of observational findings as well as numerical simulation were executed.

Important highlights of four major programmes (during 2014)

(a) Sun and the Solar System

The installation of a WARM full-disk imaging telescope was completed and the images of the Sun in two wavelengths have being obtained for synoptic studies. Extensive Kodaikanal Observatory data is used to understand the dynamics of the sunspots and duration of the flares.

(b) Stellar and galactic astronomy

Observational research has been carried out with the 2-M HCT in optical (HFOSC) and Near-infrared region (TIRSPEC) in the field galactic open clusters, star formation and processes along embedded hHII regions and bright-rimmed clouds (BRCs), post outburst photometric (Optical/ NIR) and spectroscopic study of rare low-mass eruptive variables and spectroscopic survey of Algol systems during totality. For the first time, relatively hydrogen-poor giants in the Galactic Globular Cluster omega Centauri have been identified. Photometric and spectroscopic observations of the nearby supernova SN 2014J were made using the HFOSC and TIRSPEC instruments. The analysis confirmed the supernova to be a normal type Ia.

(c) Extragalactic astronomy and cosmology

Analysis of data from the Fermi gamma-ray satellite has led to the discovery of GeV emission from five Narrow line Seyfert 1 galaxies. Using multi-wavelength data from radio to high energy gamma-rays which also involves HCT, we have established that these sources are the low black hole mass counterparts to flat spectrum radio loud quasars.

(d) Theoretical physics

For the first time, the importance of observing the centre-to-limb variation of the linearly polarised line profiles through extensive observations and modelling was demonstrated. An upper limit on the ratio between the Extreme Ultraviolet and Bolometric luminosities has been derived which constrains the habitability of rocky extra-solar planets in the habitable zone of the parent stars.

Major and unique national facilities created/continuing:

(a) Hanle Echelle Spectrograph: Hanle Echelle Spectrograph (http://www.iiap.res.in/hesp/) is a 2nd generation instrument for the 2-m Himalayan Chandra Telescope at Hanle. It has been developed in collaboration with Callahan Innovation, New Zealand. The full system integration tests are completed successfully and expected to be shipped in April 2015.

(b) Ultraviolet Imaging Telescope (UVIT): The Ultraviolet Imaging Telescope (UVIT) will provide ultraviolet and visible eyes of ASTROSAT -- an Indian satellite devoted to multi-wavelength astronomy. This payload, after all the tests and calibrations, has been delivered to ISRO for integration with the satellite which is to be launched in later part of this year (2015).

(c) J. C. Bhattacharyya Telescope: A 1.3-m telescope was inaugurated and named as the "J.C. Bhattacharyya Telescope" on 19 April 2014 at the Vainu Bappu Observatory.

Important collaborations (national and global established/continuing):

(a) Thirty Metre Telescope (TMT): India formally joined an international consortium of organizations in USA, China, Canada, Japan to build and operate the next generation mega optical and infrared ground based telescope known as the Thirty Meter Telescope (TMT) International Observatory (TIO). TIO will come atop a dormant volcanic mountain called Mauna Kea, Hawaii, USA which is one of the best astronomical sites in the world.

(b) H-Alpha Telescope at Kodaikanal Observatory: A state-of-the art 20-cm H-alpha telescope was successfully commissioned at the Kodaikanal Observatory in September 2014.

(c) National Large Telescope (NLST): Indo-German collaboration in solar astronomy, particularly towards the development of a spectro-polarimeter, and Indo-China collaboration on Fabry-Perot-based narrow band imager for the proposed National Large Solar Telescope (NLST) have been initiated.

(d) Several collaborative research programmes are underway through DST bilateral exchange schemes.

Important Output Indicators for 2014-15

S.No.	Parameters	Output
1	Papers in refereed journals	114
2	Books	1
3	Chapters in books	1
4	Papers in conferences	33
5	Number of PhDs produced	13
6	Research manpower trained (other than PhDs)	69
7	B.Tech/ UG projects guided	21
8	M.Tech/M.Sc./M.Phil projects guided	52
9	Other products/ indicators: Scientists of the Institute continued to receive academic honors/recognitions/awards; these include election to the National Academies, visiting professorships in international universities, important positions in Editorial Boards of professional national and international journals and coveted positions in International Astronomical Union.	

Indian Institute of Geomagnetism, Mumbai

Areas of focus: Geomagnetism and allied fields.

Major accomplishments:

Through the analysis and interpretation of ground magnetic data collected over Chikotra basin in the periphery of Deccan Volcanic Province (DVP), the presence of Proterozoic Kaladgi sediments below the Deccan lava flows has been delineated, thus proving that magnetic data can be used for sub-basalt imaging, than previously thought.

Important highlights of major programmes:

(i) Two GNSS receivers with East-West zonal separation of ~400 meters were installed at Equatorial Geophysical Research Laboratory, Tirunelveli with the objective of estimating the zonal velocity of the equatorial spread-F irregularities that cause the L-band scintillation.

(ii) Equinoctial asymmetry in the ionospheric scintillations was investigated for the years 2007-2013 using Pre-reversal Enhancement (PRE). It was found that the equinoctial asymmetry varies as per the variation of PRE from one equinox to the other

(iii) Satellite observations of middle atmospheric temperature fields have been used to delineate the seasonal, annual and inter-annual variability of migrating and various non-migrating tides.

(iv) All-sky imaging observations of 630.0 nm airglow have been yielding good insights of the plasma bubble phenomenon. They have also been revealing large-scale gravity wave features at upper thermospheric heights (~240 km).

(v) A new technique was developed at IIG for the measurement of Azimuth angle using GPS, which was verified at Alibag, Pondicherry and Hyderabad (against measurement done by Survey of India).

(vi) A comprehensive theoretical model for Quarter Wave (QW) oscillations of geomagnetic field lines has been successfully developed.

(vii) Theoretical analysis of ion and electron acoustic solitary waves in fluid plasma using Sagdeev pseudopotential technique and their applications to satellite observations was carried out. It has been found that the presence of a minority component of cooler electrons plays a deterministic role in the evolution of solitary waves, double layers and the newly discovered structures called 'supersolitons'.

(viii) Analysis along with 2D and 3D modelling of satellite derived free air gravity data and ship-borne magnetic data over the Laxmi Ridge was done to show its continental nature.

(ix) A two-dimensional resistivity survey of Chikotra basin, southern part of Kolhapur district in the Deccan Volcanic Province (DVP) of Maharashtra was conducted to help determine the aquifer zones using electrical resistivity imaging technique (ERI).

(x) Near and far-field response following the Chile M_w 8.1 Pisagua Earthquake on 1 April 2014 and the Indian Ocean doublet earthquake on 11 April 2012, were studied.

(xi) Anisotropy of magnetic susceptibility (AMS) of deformed and undeformed unconsolidated clay samples of Deccan Trap terrain from the ~2000-year-old paleoearthquake site of Ther village, Maharashtra, India, was studied.

(xii) Palaeomagnetic and rock magnetic investigations were carried out on 60 oriented block samples belonging to 9 dolerite dikes situated at Haludpukar and Onlajorito regions (south of Jamshedpur town), Singhbhum Craton. The field studies reveal that these dolerite rocks have been affected by hydrothermal alteration under lower green schist facies metamorphism.

(xiii) The MT and LMT data were collected across Cambay basin along three profiles of length 200 km each in east-west direction. The data were analysed and geoelectric model prepared for one profile and analysis of other profiles are in progress.

(xiv) Two workshops were conducted by IIG.

(xv) One scientist participated in the Indian Arctic Expedition and carried out the 2nd GPS Campaign at Vestre Brogerbreen Glacier, Svalbard from 8 September to 13 October 2014.

Important collaborations (national and global) established:

An India-Taiwan science and technology cooperation project "Investigations on pre- and post-seismic signatures in the ionosphere using novel GPS radio occultation technique" established with National Central University, Taiwan. Research collaborations on upper atmospheric studies established with Physical Research Laboratory and Space Application Center, Ahmedabad, and Space Physics Laboratory, Trivandrum, India. Two MoUs were signed, between IIG and (i) Andhra University, Visakhapatnam for five years, and (ii) Data Analysis Center for Geomagnetism and Space Magnetism (DACGSM) Kyoto University, Japan for three years. Collaboration has also been established with Department of Applied Geophysics, Indian School of Mines, Dhanbad, Jharkhand: School of Environmental and Earth Sciences, North Maharashtra University, Jalgaon; and Department of Environmental Sciences, Shivaji University, Kolhapur, Maharashtra.

Important Output Indicators for 2014-2015

S.No.	Parameters	Output
1	Papers in refereed journals	64
2	Chapters in books	0
3	Papers in conferences	29
4	Number of PhDs produced	03
5	Research manpower trained (other than PhDs)	01
6	Technical manpower trained	02
7	B.Tech/ UG projects guided	0
8	M.Tech/M.Sc./M.Phil projects guided	18
9	Other products/indicators	
a.	Workshop conducted	01
b.	Survey conducted for other organisations	0

Institute of Nano Science and Technology, Mohali

Area of focus:

Research and academic activities in all areas of nano science and technology with special emphasis on materials and devices for energy storage and harvesting, water purification and carbon dioxide sequestration, microfluidics based devices, device and thin film-superstructure, bio-sensors, online diagnostics, nano medicine and therapeutics, nanotechnology in agriculture and rural development and nano-toxicology, and understanding phenomena at the nano scale.

Major accomplishment :

- Started PhD program with IISER, Mohali.
- Started INST post-doctoral program.
- Delivered 75 lectures under the INST Outreach Programme for encouraging school students in remote and rural areas of Punjab, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Haryana, Karnataka.
- Ten projects approved for INST by funding agencies in 2014.

Important highlights of major programmes :

- Established laboratory facilities at 1) INST transit campus; 2) INST's Nano Materials and Bio-Nanomaterials at IISER, Mohali; 3) DIHAR laboratory at Chandigarh.
- Training of PhD, post-doctoral and short-term intern students.
- Introduction of advanced level courses in Nano Science and Technology for PhD students.
- Initiation of Nano Science club with Chandigarh Region Innovation and Knowledge Cluster (CRIKC) institutes/universities.
- Initiation of INST special and expert lecture series by authorities in the field.

Major and unique national Facilities created:

Established state-of-the-art dedicated laboratory facilities for research work in the field of nanoscience and nanotechnology.

Important collaborations (national and global) established:

- Collaboration between IISER and INST in the areas of material science, spectroscopy and bio nanotechnology.
- Collaboration between IIT, Delhi and INST in the area of nanotoxicology.
- Collaboration between Punjab University and INST in the area of Material Science.

Important Output Indicators for 2014-15

S.No.	Parameters	Output
1	Papers in refereed journals	27
2	Books	1
3	Papers in conferences	12
4	Research manpower trained (other than Ph.Ds.)	3
5	B.Tech/ UG projects guided	3
6	M.Tech/ M.Sc./ M.Phil projects guided	3
7	Number of PhD students registered	25
8	Invited talks/lectures	25
9	Outreach lectures	51
10	Sponsored research project sanctioned	10
11	Other products/indicators	
a)	International conferences organized	02
b)	National Conference organised	01
c)	Awards/Honours	02
d)	Workshop organised	01

Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

Areas of focus: Chemistry and physics of materials, Education technology, Engineering mechanics, Evolutionary and organismal biology, New chemistry, Molecular biology and genetics, Neuroscience, Theoretical sciences, Geodynamics

Major accomplishments:

The publication matrix of 25 years of JNCASR shows a significant number of over 4,500 papers crossing around one lakh citations with an annual average of more than 4,000 citations. Among numerous patent applications filed, we have been granted 22 Foreign and 6 Indian patents.

The year witnessed several key discoveries which include breaking bacteria's resistance to antibiotics; a new drug discovery tool using Surface-enhanced Raman Spectroscopy (SERS) and Molecular Dynamics (MD) simulation; and many others. The Thematic Unit of Excellence on Computational Materials Science at JNCASR, supported by the Nano Mission Council has established an advanced computer data centre in the campus.

Intellectual Property: During the current year, 23 patent applications (Indian Provisional Application: 7, International Patent Application under PCT: 3; International Patent Applications: 13 (USA: 5, China: 1, Japan:1, S. Korea: 1, Europe: 2, Australia:1, Canada:1 and Korea: 1) were filed and 10 patents (US:6, Europe:1, Japan:2, China:1) were obtained.

Important highlights of 5 major programmes:

A total of 46 students joined during the year. The current student strength is 290. **Science Popularisation Programme:** A series of programmes were organised by Education Technology Unit (ETU) and Hall of Science toward the promotion of science education. Teacher-student programs/workshops were conducted under the auspices of the Science Outreach Program for this year on 30 June 2014. The Science Teacher's Award Function cum lecture program was organized. The CNR Rao Education Foundation sponsored Outstanding Science Teachers Prize for 2013 was awarded to Shri. Narayan Vitthalrao Babanagar and Dr. Shripal Rathi. 'Program in Physics for Students' was organised on 17 July 2014 attended by 200 students and teachers.

On 22 August 2014, a Program in Biology for students was attended by 195 teachers and students of class XI & XII. A program jointly organised by NCU and ETU in September 2014 in which 200 students and teachers of XI and XII classes involved a tribute to Michael Faraday on his 223rd birthday. A video on the Innovative Chemistry Experiments conducted by NCU students and Faculty members was screened.

Major and unique national facilities created:

Several new facilities were created. They included ATAN Multiscan 794, DV Elite Imaging system, Air jacketed $C0_2$ incubator, etc, Maskless Lithography system, UV VIS NIR TRIR and LS55 spectrofluorimeter, Innova 4r and Innova 42R refrigerated incubator shaker, Multi-electrode amplifier with data acquisition hardware and software Multiclamp700B, PG welder premium, parallel gap welding system, Leica VT 1200S microscope, Anti vibration table for slicescope system, and many others.

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 collaborative agreements like European Commission Grant Agreement, Consortium Agreement "Nano2Fun" under Indo European Project, and Shell Agreement with Shell India Pvt. Ltd. were signed. A few MoUs were also signed between IKST (Indo-Korea) and Ecole Normale Superieure de Lyon, France, and JNCASR during the year.

Important Output Indicators for 2014-15

S.No.	Parameters	Output
1	Papers in refereed journals	228
2	Books	02
3	Chapters in books	14
4	Papers in conferences	10
5	**Total publications**	**254**
6	**Average Impact Factor**	**3.49**

S.No.	Parameters	Output
7	Number of PhDs produced/awarded	20
8	Other degrees awarded – M.S (Engg.), Biological Sciences, Chemical Sciences, and Material Science	41
9	Foreign patents filed	16
	Foreign patents obtained	10
10	Indian patents filed	07
	Indian patents granted	-
11	Research manpower trained (other than PhDs)	-
12	Summer Research Fellowships availed	61
13	Project-oriented Chemical Education - Diploma awarded	10
14	Project-oriented Biological Education - Diploma awarded	09
15	Visiting Fellowship Programme - offers made	11
16	JNCASR-CICS Programme - offers made	07

National Accreditation Board for Testing & Calibration Laboratories, Gurgaon

Important Highlights of Major Programs

Accreditation of laboratories:

During the period from 1 April 2014 to 31 January 2015, NABL has granted accreditation to 460 new laboratories in 580 disciplines. This includes 307 laboratories in testing, 63 in calibration, 85 in medical and 5 in PT Providers.

As on 31 January 2015, a total of 2,286 laboratories in 3,157 disciplines are accredited by NABL. This includes 1,240 laboratories in testing, 457 in calibration, 582 in Medical and 7 in PT providers.

New programs:

a. Proficiency Testing Provider Accreditation

i. 5 PTP got accreditation as per international standard ISO/IEC 17043:2010.

ii. NABL organized 4-day training program on "Quality System as per requirements of ISO/ IEC 17043:2010" during 22–25 April 2014 to enhance knowledge on preparation for accreditation of Proficiency Testing Providers.

iii. 2 Lead Assessor Training Program as per ISO/ IEC 17043:2010 conducted from 27 September – 01 October 2014 at Thane and 24-28 December 2014 at Delhi.

b. Reference Material Producer Accreditation

i. NABL took a step forward by launching its accreditation services to "Reference Material

Producers'' as per International Standard ISO Guide 34:2009. The program was launched on the occasion of World Accreditation Day on 9 June 2014.

ii. Three Awareness Programs on Reference Material Producer Accreditation conducted by NABL each one at Delhi, Mumbai & Chennai.

iii. Under EU Capacity Building Initiative for Trade Development (CITD) project, 2 nos. of 3-day training on Reference Material Producers Program as per international standard ISO Guide 34 conducted during 20–22 November 2014 at Mumbai, 24-26 November 2014 at Delhi.

iv. A "RMP Assessor Training Program as per ISO Guide 34" conducted during 01-05 December 2014 at Delhi with the support of PTB, Germany under CEMI Project.

v. One Application for accreditation of Reference Material Producer Accreditation received in NABL.

Memorandum of Understanding (MoU) with Russia

During the visit of Russian President Vladimir Putin's to India in December 2014, a Tripartite Memorandum of Understanding (MoU) was signed between the Federal Accreditation Service (Russian Federation) under the Ministry of Economic Development, Government of Russia and National Accreditation Board for Testing and Calibration Laboratories (NABL) under the Department of Science & Technology, Govt. of India and National Accreditation Board For Certification Bodies (NABCB) under Quality Council of India (QCI).

Training of Assessors/Staff and Conclaves:

- NABL in collaboration with CII organised the Third National Conclave for Laboratories on the theme 'Challenges in Managing Laboratories: Delivering Competent Services' in Pune on 28-29 October, 2014.
- 5 Lead Assessor training course as per ISO/IEC 17025:2005 including one in Nepal, 2 as per ISO 15189:2012, 1 as per ISO Guide 34:2009 and 2 in accordance with ISO/IEC 17043:2010 conducted during the period.
- NABL Officials trained internationally in various workshops / trainings like APLAC Evaluator training course, APLAC Workshop on Medical laboratory Accreditation, EURACHEM Workshop on Proficiency Testing, APLAC Training Course on Statistical Methods for Proficiency Testing, Best Practice of Implementing ISO17011:2004 and WADA ISL Assessors Training.

Others

- During the period April 2014 to 31 January 2015, Compactors have been installed for creating better storage facilities for records in NABL building.

- NABL accreditation system complies with ISO/IEC 17011: 2004 and Asia Pacific Laboratory Accreditation Cooperation (APLAC), MR 001. NABL is also a signatory member of Mutual Recognition Arrangement (MRA) of Asia Pacific Laboratory Accreditation Cooperation (APLAC) and International Laboratory Accreditation cooperation (ILAC). As a result of this MRA, test reports of NABL accredited laboratories are accepted by 88 Accreditation Bodies in 73 countries as equivalent to test reports of laboratories accredited by them. APLAC re-evaluation of NABL is due in early 2016; for which APLAC MRA Council has already appointed the Team Leader from Japan.

National Innovation Foundation – India, Ahmedabad

Areas of focus

Contemporary technological grassroots ideas, innovations and traditional knowledge

Major accomplishments :

a) NIF coordinated the Innovation Scholar in Residence program of the Rashtrapati Bhavan in 2014 and 2015.

b) NIF entered into understanding with Gogalgai Toys for non-exclusive marketing rights for twenty-three Etikopakka products of innovator CV Raju across India; with Aviva Equipment Pvt. Ltd. for non-exclusive marketing rights for Milking Machines of innovator Raghav Gowda; with grassroots innovators Pareshbhai Panchal and Gopalbhai Suratia for value addition, product development and marketing of the innovation, 'Cow Dung Pot Making Machine'; with Pareshbhai Panchal and Dip Technologies for exclusive marketing rights of the innovation, 'Cow Dung Pot Making Machine'; with Mansukhbhai Jagani and Shri Navkar Metals Ltd for exclusive manufacturing and marketing rights of 'Seed Cum Fertilizer Dibbler'; with Kaviraa Solutions for non-exclusive manufacturing and marketing rights of 'Walker with adjustable legs', an innovation by Shalini Kumari.

c) Recognition to innovators: NIF's National awardee Arunachalam Muruganantham, innovator of sanitary napkin making machine named in the list of *Time* magazine's list of 100 most influential people in the world; IGNITE Awardee Masira bi Hanif Patel awarded with the National Child Award of exceptional achievement 2014 in the field of Innovation; Shalini Kumari, won the IMC Inclusive Innovation Award 2014 for her walker with adjustable legs; IGNITE Awardee Tenith Adithya wins gold medal at International Sustainable World (Energy, Engineering & Environment) Project Olympiad (I-SWEEEP) 2014, USA for his banana leaf preservation technology; NIF's national award winners Gurmail Singh Dhonsi (rapid compost making machine and tree pruner), Dharamveer Kamboj (multi-purpose processing machine) and Tenith Adithyaa (adjustable electricity extension board and banana leaf technology) selected as Innovation Scholars under the Innovation Scholars-in residence scheme of Rashtrapati Bhavan; NIF awardee Biju Varghese received The Cavinkare Ability Mastery Award 2014, for his hand operated attachment for cars to enable lower limb disabled.

Important highlights of major programmes:

a. NIF was able to scout over 20,000 ideas, innovations and traditional knowledge practices from different parts of the country.

b. Over 110 grassroots technologies taken up for validation of innovators' claim at different research/technological institutions.

c. 29 applications for Intellectual Property protection filed nationally. In addition 8 applications under PPV&FR Act 2001 were also filed.

d. Two more community fabrication workshops set up at innovators' places in rural areas to provide fabrication facilities to grassroots innovators of their region. In total 34 such community workshops have been set up in 18 states of the country.

e. DST conveyed the approval of Technology Business Incubator (TBI) at NIF with support for five years.

Important collaborations (national and global) established:

- With Council of Scientific and Industrial Research (CSIR) for validation of and value addition in grassroots technologies MoU renewed.
- With Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS), makers of Jaipur foot, to promote grassroots innovations.
- With Bharat Vikas Group (BVG) India Ltd to form a New Joint Venture Company for Nutraceuticals and Healthy foods based on the outstanding traditional knowledge.
- With University of Mumbai (UoM) to collaborate efforts to further studies and research in inclusive innovation.
- With the Royal University of Bhutan to establish a basis of co-operation and collaboration.
- NIF was member of Indian Government's Science and Technology delegation to Peru in April 2014.
- NIF was part of the delegation of the Hon'ble President of India to Bhutan in November 2014.

Important Output Indicators for 2014-15

S. No.	Parameters	Output
1	Papers in refereed journals	4
	Books	1
2	Chapters in books	1
3	Papers in conferences	16
4	Indian patents filed	29
	Indian patents granted	-

S. No.	Parameters	Output
5	New applications filed under PPV&FRA	8
	Registration granted under PPV&FRA	1
6	Number of technologies/designs and other intellectual products commercialized	13
7	Number of technology leads awaiting transfer	16
8	M. Tech./M.Sc./M. Phil./ M Des/PGDM projects guided	15
9	Improved prototypes developed of various ideas/ innovations	11
10	Grassroots technologies validated / trials cum demonstration conducted	112
11	Projects supported under Micro Venture Innovation Fund (MVIF)	3

North East Centre For Technology Application and Reach (NECTAR)

The North East Centre For Technology Application and Reach (NECTAR) has been identifying and developing relevant technologies for supporting development in the North East. Projects taken-up by NECTAR in various states of North-East are briefly described below:-

(I) Software Defined Radios (SDR)

NECTAR has pioneered the indigenous development of the Software Defined Radios (SDRs), a closed technology which has not been shared by countries which have developed it because of the advantage it seeks to provide. NECTAR has taken the initiative to establish state of the art communication networks which have the capacity for voice and flawless data communication and a dedicated e-mail system.

Arunachal Pradesh

NECTAR is working with the Government of Arunachal Pradesh to install a fail-safe communication network for the State Police Department. Arunachal is beset with harsh terrain conditions, varying from dense jungles to high mountains ranges. Seventy two static SDRs are to be installed in Police Stations in a static mode, in order to link these with the head quarters. This network will allow voice and data transfer with the HQ as well as between police stations. A State wide network of e-mail has been established to enable data transfer. Twelve radios will be installed on vehicles in order to provide end-to-end communication from location to the police stations.

SDR's for Nagaland Disaster Management Authority

On the request of the Government of Nagaland, reliable High Frequency radio communication system network has been designed to connect the Dy. Commissioners with the Disaster Management Authority. In all 11 SDR equipments were installed and the necessary aerial to meet the requirement of the Terrain were installed and connectivity was also established between the locations.

SDRs for Government of Sikkim

The experience during disasters has been that all communication systems tend to become non-functional. On the request of the Government of Sikkim, the first stage of the SDR network has been established linking the disaster management authority in Gangtok with the Deputy Commissioners. After sufficient expeience has been gained, connectivity will be established between these five stations and all sub-divisional Magistrates.

SDR Network for the Government Of Meghalaya

The first SDR network was established for Meghalaya Police in the South Garo Hills. On the request of the Government Of Meghalaya, this is to be extended linking forty two police stations, eleven Superintendents of Police and eleven Deputy Commissioners.

SDRs for the State of Assam

On the request of Govt of Assam, a trial network of SDRs has been established.

(II) Meshnet for CCTV Surveillance

Guwahat

Based on the request from Assam, mesh networks were established as a de at a number of locations with fixed lens cameras as well as point, tilt and zoom cameras. The average through put in the system is 150- 180 mbps, providing sufficient band width to have streaming data with a clear picture. In the control room, streaming data is now being over seen by a team trained by NECTAR with a capacity to point, tilt or zoom the cameras according to their requirements. Ample data storage has been provided for control room for revisiting the footage for analysis.

Meghalaya

- Meshnet connecting Primary Health Centers with district hospitals in the **Tura district**
- A Mesh Network for video/CCTV based real time surveillance system is currently being implemented in **Shillong** for the Meghalaya Police. Meshnet for developmental use has also been set up in Tura District in Meghalaya.

TELEMEDICINE SYSTEM FOR NAGALAND:

The success of the Software Defined Radios (SDRs) and other high technology applications spurred the NECTAR to use this technology for wider societal applications. TELEMEDICINE system was decided to try out at nodes for telemedicine in Nagaland. Towers and specialized aerials were designed so that the communication speed could be between 150 to 180 Mbps. These nodes between the district hospital and Primary Health Centres (PHC) were operationalized. During the trial phase of this technology, doctors from the hospital were able to guide surgery in the connected PHC.

With the support of the Nagaland GIS and Remote Sensing Centre of the Govt. of Nagaland, NECTAR established a mesh network connecting 18 PHCs with the district hospital. On both sides high definition cameras were installed in order to provide the best quality picture for diagnosis between the PHC and the district hospital.

TELEMEDICINE SYSTEM FOR TRIPURA

Similar to Nagaland, a mesh network connecting Primary Health Centres is proposed to be established for Tripura.

(III) Technology Partnership Meets

In order to pursue its mandate to deliver technology products and tools for the social and economic development of the NE region, NECTAR has held Technology Partnership Meets of all the stakeholders viz. relevant state government departments, technology institutions in the state at Guwahati (Assam), Shillong (Meghalaya), Gangtok (Sikkim) and Agartala (Tripura).

Barracks for Meghalaya

NECTAR has supported installation of six bamboo based quick erect shelters and nine barracks for surrendered militants on the request of the Meghalaya Government.

Barracks for Arunachal Pradesh Police

On the request of Arunachal Pradesh Police, sixteen barracks are to be implemented for CRPF.

Brahmaputra Embankment mapping

Assam Government has entrusted NECTAR to study 4500 kms of protection embankments alongside Brahmaputra banks. Pilot study has already been taken up for fine resolution mapping of Brahmaputra Embankment.

(IV) precision agriculture initiative by NECTAR

Soil moisture sensors are normally imported, the cost of the same to farmer is unaffordable. Therefore, NECTAR developed these low cost soil moisture sensors which are now undergoing testing with **Punjab Agriculture University, Ludhiana.** These are hand-held, water/soil sensors for farmers in order to help them regulate water usage for rice, wheat, sugarcane. This should help in conserving 30 to 40% ground water and saving on electricity.

(V) MBDA-NECTAR partnership for developing GIS platform for Meghalaya.

The Meghalaya Basin Development Authority (MBDA) and the North East Centre for Technology Application and Reach (NECTAR) is working on developing a model for understanding the water flows in the Meghalaya Rivers. The GIS platform developed by NECTAR has been used to identify the water sheds of **26** rivers which flow either into the Brahmaputra or into Bangladesh.

(VI) Engineered bamboo pre-fabricated structure for kitchen cum store under Sarva Shiksha Abhiyaan in Manipur:

NECTAR has partnered with the Education dept. of Govt. of Manipur to implement the project of setting up 937 kitchen cum stores for the schools in various locations. The total cost of the project is Rs.8.5 crores. The size of the kitchen facility is 10ft.by 10ft. and is in accordance with the norms that have been set up for this purpose. This utility project is presently under implementation and nearly 450 structures have been completed.

(VII) Market Linkages Activity –

(a) Bamboo Mat Board:

NECTAR (through the erstwhile NMBA) has supported nine bamboo board manufacturing units in the North eastern states. These units are not able to penetrate in the market due to absence of marketing & high cost of advertisement (compared to plywood etc.). NECTAR has taken following initiative to support the units in terms of marketing their various products in major markets in India to start with in Delhi NCR, Uttar Pradesh, Andhra Pradesh & Telangana:

- To create the ready availability of mats on reasonable price, tying up various bamboo mat suppliers for supplying mats to mat board units. This is being done to eliminate the middleman and higher returns to the actual mat weaver.
- The total number of employment generated in a span of 11 months is 3.3 lakh man days, which is in addition to the employment generated through the normal structural/construction activity.

(b) Marketing of North east based agri products

NECTAR is working on exploring the speciality horticulture produce of North east and bringing them to major markets to benefit the farmers and local people. NECTAR aims at bridging the gap between producer groups and consumer.

NECTAR has identified around 30-40 local farmers and 2-3 SHGs in Meghalaya actively involved in producing, processing of Cherrapunji honey, black pepper and turmeric. Lakadong turmeric is one of the renowned varieties of Meghalaya with highest curcumin content. The high curcumin content increases the medicinal benefits of turmeric.

The black pepper has been procured from the West Garo hills of Meghalaya, the product is rich in spice and flavour.

For procurement of Nagaland Honey, NECTAR has directly collaborated with Nagaland Beekeeping and Honey Mission (NBHM). Honey is collected from honey growers located at various villages. Collected honey is processed and packaged in hygienic conditions to provide product of optimum quality.

Bay leaves were directly procured in dry form from Assam.

This initiative of NECTAR encourages the Agriculture practices in the region. The farmers are happy with the price realisation for the produce which is better then what they were receiving from the open market.

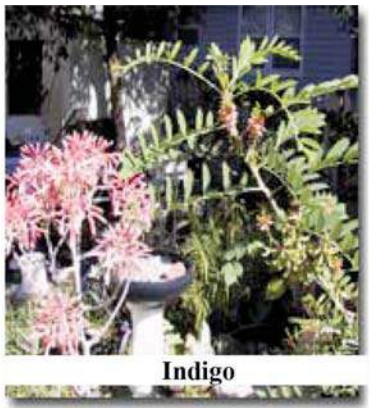
NECTAR'S ongoing initiatives to strengthen the Agri supply chain provide continued support to the farmers of NE and to develop a linkage to establish marketing chain for authentic quality supplies particularly in the metros and cities.

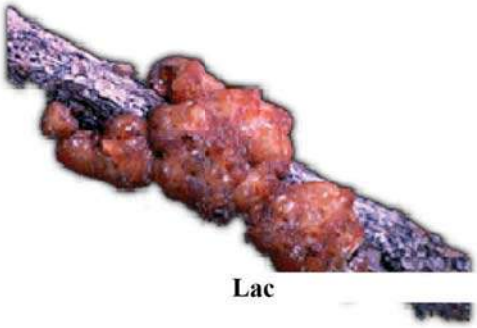
(c) Natural Dyes project in Meghalaya:

NECTAR has done baseline study on Natural dye yielding plant varieties in North East and as per the study of 4-5 months, some of the most viable plant varieties are identified and selected which has huge export potential. NECTAR has also generated a protocol to provide a regular livelihood and regular source of earning to farmers and artisans who are involved in weaving & dying. NECTAR is working towards providing better scientific techniques, which ensure higher returns to farmers.

NECTAR is implementing this project in Ri Bhoi district of Meghalaya for providing quality assured plant material and scientific techniques to increase the economic scenario of the North East.


Madder plant


Indigo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(d) Agarbatti Marketing Linkage

NECTAR as part of its activities has focused on establishing a linkage between the stick manufacturer of North East especially rural women and the market. NECTAR has provided training for manufacturing masala Agarbatti from hand rolling and pedal type machines in North East. The skill up-gradation programme is designed to: (a) Ensure strengthening the skills and knowledge of rural women/artisans engaged in production of masala stick through pedal type machines (b) Enhance skill of artisans in production of Machine rolled non-scented Agarbatti stick (c) Help the artisans to prepare Agarbatti masala (d) Link the activity of Agarbatti rolling to fragrancing , packaging and marketing.

NECTAR has provided training in Tripura, Meghalaya, Assam, Manipur, Bodoland and other places. The purpose is to link the activity of stick making to Agarbatti rolling to fragrancing, packaging and marketing by NECTAR identified agency. The agency picks up all the raw Agarbatti, gets it incensed and sold in market. NECTAR has provided technology support to such agencies.

Raman Research Institute, Bangalore

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 activities include (a) experiments for the study of ultra-cold ion atom interactions; (b) the Murchison Wide-field Array (MWA) which has now moved from building and commissioning phase to scientific research,; (c) development of an X-ray polarimeter and participation in the Large Area X-ray proportional counter for the ASTROSAT, both in collaboration with the Indian Space Research Organisation; (d) commissioning of a new Nano-biophysics lab that will investigate the biophysics behind the role of chromatin in packaging DNA inside a eukaryotic cell nucleus through sensitive nanopore based measurements; and (e) developing precision radio astronomy spectral radiometers for detecting the cosmological Epochs of Reionisation and Recombination.

Important highlights of major programmes:

(i) The Institute's participation in the Murchison Wide-Field Array, a radio telescope precursor array to the Square Kilometre Array and an international project between Institutions in the US, Australia, New Zealand and Raman Research Institute. This radio telescope is now scientifically productive and being used by the collaboration for research in selected key areas of astrophysics.

(ii) New Antennas, space beam splitters, receivers and high-speed digital signal processors have been designed and configured to make new improved measurements of the spectrum of the cosmic radio background at long wavelengths. This is aimed at detecting signals from cosmological epochs of recombination and reionisation.

(iii) The five quantum optics laboratories are being utilised for scientific experiments. To put special emphasis on a particular lab, our Quantum Interactions (QuaInt) lab has worked extensively on the creation of ultra-cold molecules and molecular ions in an ion-atom-molecule and photon trap experiment during the last year. Ultracold molecular ions have been created, and the hard job of detection of these molecular ions has been achieved, though these ions live only momentarily. The mechanisms of interaction between light and molecular ions are now being understood. Theoretical and experimental work on switching light with light has been completed.

(iv) One of the significant research works that was done in the past year was to derive a fundamental quantum limit on the measurement of time in a gravitational field. The research work done by members of the TP group at RRI showed that gravity and quantum mechanics set a fundamental limit on the fractional frequency uncertainty of clocks. This limit comes from a combination of the uncertainty relation, the gravitational redshift and the relativistic time dilation effect.

(v) The SCM group at RRI performed a study on the fragility and the dynamic slowing down process in soft colloidal glasses that showed striking similarities with super-cooled liquids. In particular the experiment showed a mapping between the aging time of colloidal glasses and the inverse of thermodynamic temperature in super-cooled liquids.

Important collaborations (national and global) established:

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

Major honours and awards received:

Dr. Sadiqali Rangwala was conferred the Shanti Swarup Bhatnagar award for the year 2014 in Physical Sciences, “for his outstanding contribution on collisionally cooled ions with trapped atoms leading to new ultracold ion-atom physics.”

Important Output Indicators for 2014-15

S. No.	Parameters	Output
1.	Papers in refereed journals	122 (26 in press)
2.	Papers in conferences	19 (7 in press)
3.	Number of PhDs. produced (awarded and submitted)	16
4.	Foreign patents under process	7
	Foreign patents granted (total)	Nil
5.	Indian patents filed – under process	9
6.	Research manpower trained (other than PhDs)	Nil
7.	Visiting students (includes M.Tech/M.Sc./M.Phil projects)	176

Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram

Areas of focus: Providing high-quality patient care in specialties and sub-specialties of cardiovascular and neurological diseases; Research in biomaterials, stem cells & tissue engineering and device development activities; To provide the much in demand testing services to medical device industry; research and training in various public health projects in the areas of non-communicable diseases, gender and health, health policy and management ; and various academic programme including PhD, DM, M Ch, PDCC, MPH, M Tech (Clinical Engg.), MPhil and other diploma courses.

Major accomplishments:

The Institute initiated the setting up of a Technology Business Incubator (TBI) for medical devices and biomaterials by means of a not-for-profit society.

The hormone releasing intrauterine device "Emily" which was developed jointly with industry partner HLL Lifecare Ltd and launched in the market in 2013, received good market acceptance and sales during the year.

Central Drugs Standard Control Organisation (CDSCO), Govt. of India approved issuance of license for BioGraft HA New Ortho to M/s IFGL Refractories, Kolkata. The technology for this hydroxyapatite based bone graft material was developed and transferred to industry by the Institute.

Faculty of Institute Dr. Roy Joseph and Mr. C.V. Muraleedharan won the 4th National Award for Technology Innovation in Petrochemical and Downstream Plastics Processing Industry under the category of 'Polymers in Public Health Care' for their work on developing "Fluoropolymer Coated and Hydrogel Sealed Vascular Graft Implant".

Important highlights of major programmes:

(i) The bone tissue engineering project aimed at seeding of mesenchymal stem cells on bioactive ceramic scaffold received approval from ICMR, facilitating the initiation of human clinical trials at CMC, Vellore. Many other projects that made progress in preclinical evaluation stage include fluoropolymer coated and hydrogel sealed large diameter vascular graft, cartilage tissue engineering, haemostatic scaffold using biodegradable polymer and biomimetic extracellular matrix components for healing of chronic dermal wounds.

(ii) Industry-supported projects like fluoropassivated and hydrogel sealed vascular graft, development of paediatric and neonatal membrane oxygenators and arterial filters made progress.

(iii) Biomaterial research continued on calcium sulphate bone cement, iron oxide nanoparticle probes for organ-specific molecular MR imaging, quantum dot conjugated single-walled carbon nanotubes for imaging and therapy, and many other areas. The ISO 17025 accreditation from NABL for the calibration services was extended for two years and for testing services from COFRAC, France continued with successful COFRAC surveillance audit.

Major and unique national facilities created:

Laboratories in the new engineering block at BMT wing were occupied and setting up of the facility for a Technology Business Incubator for medical devices was initiated. A 3 Tesla MRI was procured at Hospital wing.

Important collaborations (national and global) established:

An MOU was signed with National Health Systems Resource Centre (NHSRC), New Delhi for cooperation and collaboration in areas of mutual interest in healthcare technology.

Important Output Indicators for 2014-15

S.No.	Parameters	Output
1	Papers in refereed journals	75 (partial list)
2	Papers in conferences	18
3	Number of PhDs produced	6
4	Foreign patents filed	2
5	Indian patents filed	12
6	Number of technology leads awaiting transfer	4
7	Research manpower trained (other than PhDs)	12
8	Technical manpower trained	28

S. N. Bose National Centre for Basic Sciences, Kolkata

Areas of 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 sciences; New materials development including nanomaterials, nanodevices and related condensed matter sciences; Selected areas of astrophysics and cosmology like investigations on black holes, dark matters and observational astronomy; Networked research programmes through the visitor and associateship programme.

Important highlights of major programmes:

A wide range of research activities in basic sciences were taken up in the Department of Astrophysics & Cosmology (Study of deuterated species in interstellar medium; Reproduction of ionospheric responses by VLF of solar flare perturbations and time lag using GEANT4 simulations;

Effects of back reaction due to inhomogeneities on evolution of universe; Study of teleportation through two-qubit noisy channels, and others); Department of Chemical, Biological & Macro-Molecular Sciences (Non-equilibrium thermodynamics of enzyme catalysis; Quantum transport through conjugated polymer aggregates; Mass spectrometric study of breath to detect Helicobacter pylori infection; Laser-spectroscopy assisted breath-analysis for diabetes detection; Terahertz study of carbon nanotube-polymer composites; Ultrafast (femtosecond) studies of biological and biomimetic systems, and others); Department of Condensed Matter Physics and Material Sciences (Study of effect of adatom on bilayer graphene. It was observed that it was possible to switch magnetism of these atoms by external magnetic fields; First time demonstration of magnetic vortex based transistor operations in three isolated nanodots. It was found to be possible to exert control by core polarity and chirality of vortices; Photoresponse of colossal size was observed in single strand of complex oxide nanowire. This huge amount of enhancement makes the system applicable to device manufacturing and others); and Department of Theoretical Sciences ((The origin and significance of topological excitations in quantum spin models in low dimensions (vortices and anti-vortices) were studied in depth highlighting possible experimental consequences and signatures. A bridge was established between field theoretical formalism and well-known statistical mechanical treatment of Berezinskii-Kosterlitz-Thouless transition involving these topological excitations; A new differential geometric structure was developed for principal fibre bundles on path spaces using the tools of category theory, and others), which produced valuable results.

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 art materials characterization facilities; time and space resolved Kerr Effect measurements.

Important collaborations (national and global) established:

Collaborations were established during the year with DST, Swedish Research Council, DST-SERB, DST-UKIERI, DST-SERC, CSIR, DST-DAAD, MoES, Biotech Consortium India Ltd. (DBT), DRDO, and BRNS-DAE relating to 32 projects.

Important Output Indicators for 2014-15

Sl. No.	Parameters	Output
1	Papers in refereed journals	173
2	Books	1
3	Papers in conferences	3
4	Number of PhDs produced	24
5	Indian patents filed	2
	Indian patents granted	0
6	Technical manpower trained	7
7	M.Tech/M.Sc./M.Phil projects guided	1
8	Other products/ indicators (M.Sc. Degree under Integrated Ph.D. Programme):	9

Technology Information, Forecasting and Assessment Council (TIFAC), New Delhi

Areas of focus: Technology foresight, nurturing innovation, supporting MSMEs, capacity building, collaborative linkages

Important highlights of major programmes:

Technology Vision 2035: The vision document has been finalized and is due for release now. This document identifies 12 prerogatives that every Indian must be assured of at both individual and societal level. The vision would be presented as a document dove-tailed with 12 technology roadmaps which are underway.

Thematic Foresight: Regular foresight exercises are undertaken on the technology areas of social and economic importance to the country. During the year TIFAC has prepared an Interim Report for the R&D Plan under the National Mission on Electric Mobility (NMEM) and submitted it to the Department of Heavy Industry. It provides broad level R&D targets and infrastructure requirements for R&D. The draft report on Solar Photovoltaics study was prepared during the year.

Patent Facilitating Centre (PFC): PFC functions with four-fold objectives of creating awareness and deeper understanding of patents and IPR amongst Indian scientific community, supporting technically and financially in obtaining patents and other IP rights on their innovative and creative work. PFC took up filing of 35 patents, including patent applications relating to INSPIRE program of DST.

TIFAC-SIDBI Revolving Fund for Technology Innovation Programme (SRIJAN): The programme is aimed at identification and assessment of technology innovations for scaling up by industries particularly MSMEs to bring innovations from lab to market. Two innovations were successfully commercialized during the year. In addition, four new technology innovation based projects were sanctioned for scaling up during the period

MSME Internship Scheme: The Scheme has been designed to enhance and establish long term linkages of academia with the MSMEs through greater involvement of students and faculties thus making use of the vast pool of academic human resource for the benefit of industries and vice versa. To begin with, five (5) technical institutes have been empanelled for implementing the scheme namely, IIT, BHU, Varanasi, PSG College of Technology, Coimbatore, M S Ramaiah University of Applied Sciences, Bangalore, Pimpri Chinchwad College of Engineering, Pune, and Vellore Institute of Technology, Vellore.

MSME Support

TIFAC - MSME Cluster program: TIFAC's MSME Program aims to provide R&D and technical support to MSMEs by leveraging Academia Industry interaction. So far, the Program had covered 29 MSME clusters while completing 22 technology gap analysis studies and establishing 2 R&D Centres. During the year, seven (7) new MSME clusters have been taken up carrying out studies.

MSME Exports Program: Government of India during 2012-13, constituted an Inter-Ministerial Group (IMG) for addressing comprehensively the challenges of export oriented MSME Sectors including falling exports. The study '*GUAR: Status, Potential, Prospects, Challenges and R&D Road Map – Towards Boosting Exports*' has been completed. The report prioritizes dissemination of best practices and requisite R&D and presents an action plan towards boosting exports. The final report titled, had been submitted to Ministry of Commerce.

TIFAC Internship: Internships to students of M.Sc./ B.Tech./ M.Tech, etc., are given to do projects in TIFAC, as part of their coursework. A total of 23 students underwent the internship during the year.

Training to Women Scientists in IPR (KIRAN-IPR): Knowledge Involvement in Research Advancement through Nurturing (KIRAN-IPR) scheme (erstwhile WOS-C) prepares women towards self-employment by providing on- job training in the area of IPR. During the year printing and binding of 82 technology scan cum patent analysis reports prepared by 7th batch of Women Scientist trainee have been completed.

International Linkages: Some of the active collaborations include International Institute for Applied System Analysis (IISA), Austria, UK Foresight Group, UK, and Global Foresight Network, UK.

Important collaborations (national and global) established:

India-IIASA Programme is an international collaborative effort being purse by TIFAC.

Important Output Indicators for the calendar year 2014-15

S. No.	Parameters	Output
1	Papers in refereed journals	
2	Chapters in books	1
3	Papers in conferences	1
4	Number of technologies/designs and other intellectual products commercialized	2
5	Number of technology leads awaiting transfer	--
6	B.Tech/ UG projects guided	12
7	M.Tech/M.Sc./M.Phil projects guided	11
8	Other products (Technology Gap Studies, Foresight reports, etc)	1

Vigyan Prasar, Noida

Area of focus: Science and technology communication/popularisation

Major accomplishments

Vigyan Prasar developed knowledge products that highlight the method of science as part

of a framework of science and technology communication. This is to popularise the spirit and versatility of science to enable rational and value-based thinking. To this end, three major theme-specific accomplishments related to:

(i) The spread and depth of contents for end-users and facilitators aligned with local and national level developmental aspirations;

(ii) Institutional mechanisms to ensure timely delivery of services, and

(iii) Visioning for immediate, medium and long term communication interventions.

These approaches helped deliver (1) Communication modules and build capacities on tools and techniques to reduce drudgery experienced by women farmers in farming; food safety and nutrition for children in particular; Environment, health and empowerment for the benefit of communities in tribal belts through the radio and Spices of India and IT developments using video and recent developments in science and concepts on methods and communication on of science and technology through the newsletters and satellite-based modules for all stakeholder groups and school clubs / children in particular. (2) Institutional support/facilitation to highlight innovative film-based communication of concepts, developments and calls for citizen engagement; (3) Outlines of inferences based on reality checks on training needs of science communicators and capacity building needs of teachers, educators and other facilitators as part of the science clubs network; and (4) Special technical assistance to teachers and other enthusiasts to develop telescopes to consolidate astronomy as a window of opportunity to comprehend the methods of science.

Important highlights of major programmes:

VP has carried out extensive in-house research to conceptualise messages, materials and strategies for communication in response to locally felt needs including,

1) Popularisation and sensitisation workshops on hands-on science for teachers/ science communicators/agencies for science popularisation in the tribal districts of the country. Four workshops to orient science clubs in addition to modules through the Edusat.

2) Development of special resource material and outreach programmes on Technology Awareness for women, Safe Health and Hygiene for School Children and Quality Food and Food Safety for Street Vendors.

3) Newsletters: Dream-2047, a bi-lingual science magazine reaching out to nearly fifty thousand receivers including about 8,000 E-version subscribers and the VIPNET Newsletter for school clubs across India.

4) Mass media based content enhancement, mainly in audio-visual format, especially through All India Radio and Doordarshan, through a series of new programmes in several major Indian languages.

5) Fifth National Science Film Festival & Competition and workshop on science film making to encourage new and young film makers, access to materials through the Vigyan Prasar

Information Systems as a repository available online on www.vigyanprasar.gov.in and several knowledge products on biotechnology related aspects through e-media and exhibitions.

Major and unique national facilities created:

1) A country-wide network of Science Clubs, and Edu-Sat.
2) Publication of *Dream-2047* every month. MoU on Science broadcast through DD, AIR, LSTV
3) Vigyan Prasar Digital Library, Discussion Forum.
4) Online availability of S &T communication content (publication, audio, video programmes) developed by VP.
5) Workshop and training programmes throughout the country to train and motivate science teachers carry out innovative activities during classroom teaching to make science interesting to the students & Network of resource persons.

Important collaborations (national and global) established: (from/through the calendar year 2014 to 2015):

- DBT, Government of India, NCSTC (DST), NCSM of the Ministry of Culture, Ministry of Earth Sciences, NCERT, National Institute of Open Schooling and CIAE of the ICAR.

Important Output Indicators for 2014-15

S. No.	Parameters	Output
1.	Papers in refereed journals	12
2.	Books	23
3.	Chapters in books	6
4.	Papers in conferences	39
5.	Number of technologies/designs and other intellectual products commercialised (Activity Kits, Poster, Exhibitions) (Films, TV and Radio Serials)	193
6	Technical manpower trained (S&T Communication)	8,200
7.	B. Tech/UG projects guided	10
8.	M. Tech/M.Sc./M. Phil projects guided	3
9.	Other products (Popular science articles in different/Magazines/ Newspapers/Radio/TV Talks	230
10.	Teaching undergraduate course	1
11.	Guidance for PhD	2

Wadia Institute of Himalayan Geology, DehraDun

Areas of focus:

Geological and geophysical investigations of the Himalayas with emphasis on study of Himalayan river systems, glaciers, earthquake precursors and landslides.

Major accomplishments:

- DST flagship programme to Map the Neighbourhood of Uttarakhand (MANU) for the Yamuna and the Bhagirathi valleys was completed and many hot spots were identified to help the sustainable development of the region.
- A new tillodont mammal, *Anthraconyx hypsomylus*, and an assemblage of four frogs found from the Early Eocene Cambay Shale Formation at Vastan Lignite Mine, western India suggest possible origins of these on the Indian subcontinent.

Important highlights of major programmes:

(i) Factor and cluster analyses of the 53 highest-ranked benthic foraminiferal species suggest five biofacies, indicating the varied nature of deep-sea environments during the late Quaternary, with a major shift roughly 300 Kyr ago, across Marine Isotope Stage 9 and 8 (MIS 9/8), recorded as mid-Brunhes transition at Hole 716A.

(ii) Along the mountain front in the Kumaun Himalaya, geomorphic indices study on a fan deposit truncated by the Himalayan Frontal Thrust (HFT) exposing a fault scarp suggest that the HFT is tectonically active.

(iii) Integrated field and petrological studies of the Higher Himalayan Leucogranites (HHLG) intruded into the high grade rocks of the Higher Himalayan Crystallines (HHC) in Arunachal Himalaya suggest their affinity to peraluminous S-type granite generated by the partial melting of crustal material. Geothermobarometric estimations and mineral assemblages of the HHC metapelites confirm that the HHLG were generated in the middle crust (~20 km) and the produced melts intruded the HHC in the form of sills/dykes.

(iv) Assessment of suspended sediment concentration (SSC), suspended sediment load (SSL) and yield data for the Dunagiri Glacier, Garhwal Himalaya suggest that the cumulative proportion of SSC precedes the discharge throughout the melt season. Release of SSL in terms of total load is less in the early part of melt season than in the later stage as compared to that of discharge.

(v) Palaeoseismological study carried out at Nalagarh in the Pinjaur Dun has revealed Late Pleistocene earthquakes along the Nalagarh Thrust (NT) that separates the Palaeogene rocks from the Neogene Siwaliks. It is reported that at least two large magnitude earthquakes rocked the region.

(vi) Study of the Durbuk Pluton in the eastern Ladakh region suggests that Durbuk Pluton is syn-tectonic with deformation along Karakoram Fault Zone (KFZ), pervasive migration of

leucogranitic melt through the existing tectonic structures of the gneiss, also inferring that the KFZ initiated at least ~23 Ma ago.

(vii) Colonisation delay of Rhizocarpon geographicum species of lichen in the Gangotri glacier environment has been interpreted to be about 78 years for granite and between 50 and 78 years for the gneisses. This will help to establish the absolute ages of the various terminal moraines of the Gangotri glacier, which in turn will help to ascertain its recession history.

Important collaborations (national and global) established:

- With IIRS to augment studies using space data for better comprehension of the crustal deformation in the current tectonic regime.
- With ICAR-Indian Institute of soil and Water Conservation, Dehra Dun to study new challenging research problems in the Himalayan region

Important Output Indicators for 2014-15

S.No.	Parameters	Output
1	Papers in refereed journals	62
2	Chapters in books	4
3	Papers in conferences	4
4	Number of PhDs produced (6 awarded and 4 submitted)	10
5	Research manpower trained (other than PhDs)	72
6	B.Tech/ UG projects guided	15
7	M.Tech/M.Sc./M.Phil projects guided	8
8	Other products/ indicators (to be specified by adding rows to this Table) • A training program on the fundamentals of geology and engineering geology was organised for the senior officers of the Rail Vikas Nigam Ltd. • Institute jointly with Central University of Himachal Pradesh (CUHP) organized "National conference on implication of Climate change on Himalayan environment" at CUHP, Dharamshala • A meeting of the Indo- Norwegian Joint Working Group Committee (INJWGC) on Science & Technology was held at WIHG, Dehra Dun.	3

Indian National Academy of Engineering (INAE), New Delhi

Report on Activities during 2014-15

(a) Seminars/Workshops/Conferences. The following seminars/workshops/ conferences were organized during 2014-15.

(i) A Seminar on "Building process excellence in manufacturing" was jointly organized by INAE and Indian Institute of Technology Kharagpur in association with Bengal Chamber of Commerce and Industry (BCCI) on 17-18 Jan. 2014 in Kolkata.

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

(iii) A joint symposium on "Advanced Manufacturing, Logistics and Urban Development: New Perspectives for International Development Cooperation?" with acatech, Germany was held on 3-4 Sept. 2014 in New Delhi.

(iv) The 8th National Frontiers of Engineering Symposium organized by INAE and Indian Institute of Technology Gandhinagar was held on 5-6 Sep. 2014 at IIT Gandhinagar.

(v) A joint conference on "Technology: Corporate and Social Dimensions" with the Forum for Global Knowledge Sharing was held on 27-29 Oct. 2014 at National Institute of Advanced Studies (NIAS), Bangalore.

(vi) The second Engineers Conclave (EC - 2014), was jointly organized by INAE and Indian Space Research Organisation (ISRO) from 30 Oct. to 1 Nov. 2014 at Indian Institute of Science, Bangalore. The two themes for Engineers Conclave-2014 were "Emerging Space Applications" and "Technologies for Hill Regions".

(vii) A discussion meeting on "Indian Metallic Heritage: Perspectives and Issues on Characterisation and Conservation of Ancient Metallic Objects" was jointly organised by INAE, *Archaeological Survey of India* (ASI), Department of Culture, Indian Institute of Metals, ASM International, USA & ASM International India Chapter, at New Delhi, on 03 Dec. 2014. The objective of the meeting was to celebrate the Historical Landmark Recognition Award given to Delhi Iron Pillar by ASM International, USA.

(b) National competition on "Innovation on Manufacturing Practices - 2014" (IMP-2014)

INAE in association with Indian Institute of Technology Kanpur organised a National Competition on "Innovation on Manufacturing Practices - 2014" (IMP-2014), which was held at IIT Kanpur on 5 March 2014.

(c) Promoting excellence in the field of engineering

(i) Life Time Contribution Award in Engineering 2014: Prof. S. Ranganathan, NASI Senior Scientist Platinum Jubilee Fellow, Indian Institute of Science, Bangalore and Mr. S. Ramadorai, Vice-Chairman, Tata Consultancy Services, Mumbai were conferred Life Time Contribution Awards in Engineering 2014.

(ii) **Prof. Jai Krishna and Prof. S.N. Mitra Memorial Award 2014:** Dr. Avinash Chander, Scientific Advisor to Raksha Mantri (SA to RM), Secretary, Defence Research & Development and Director General, DRDO, Ministry of Defence, New Delhi and Prof. RK Shyamasundar, Senior Professor and J.C. Bose National Fellow, Tata Institute of Fundamental Research, Mumbai were conferred the Prof. Jai Krishna Memorial Award 2014 and Prof. S.N. Mitra Memorial Award 2014 respectively.

(iii) **INAE Outstanding Teachers Award:** Prof. Pradip Dutta of Indian Institute of Science, Bangalore and Prof. Bhargab B. Bhattacharyya of Indian Statistical Institute, Kolkata were conferred the INAE Outstanding Teachers Award 2014.

(iv) **INAE Young Engineer Award 2014:** Ten candidates were selected for the Award.

(v) **Innovative Student Projects Award 2014:** Five theses at Doctoral level, five at Master's level and five projects at Bachelor level were selected for conferment of Innovative Students Project Award 2014.

(d) Fellowships

Twenty six Indian Fellows and five Foreign Fellows were elected during the year.

Important Output Indicators for 2014-15

The following important publications have been brought out during the year 2013-14.

a) *Annals of INAE* containing the text of the lectures delivered by Life Time Contribution Awardees; Professor Jai Krishna and Prof. SN Mitra Memorial Awardees, newly elected Fellows of the Academy and INAE Young Engineer Awardees.

b) The *INAE Vision 2037* document was prepared as a follow up activity of a coffee table book entitled "Glimpses of Indian Engineering Achievements". *INAE Vision 2037* envisions the state of Indian Engineering during the coming years to enable the Academy to chalk out priorities for its activities.

Indian Academy of Sciences, Bengaluru

Areas of focus: Publication of scientific journals; election of Fellows and Associates; organising mid-year and annual scientific meetings; Fellows Repository; women in science; Endowment Chair; science education programmes.

Major accomplishments: For Jan-Dec 2014: 1,364 peer-reviewed articles published in 10 thematic journals and made available in open access platform. Over 22,500 individuals/ universities/other institutions received print versions of these journals. Worldwide visibility to Academy journals increased with more submission of articles. Journal citations have enhanced over years**.** Under Summer Research Fellowship Programme**,** over 1,572 students and teachers underwent two-month Fellowships and worked with Fellows and other mentors spread across 219 research institutions.

Important highlights of five major programmes:

(i) Publication of scientific journals: The journal-wise account (January-December 2014) of total number of articles, issues, number of pages published and circulation figures are presented below:

Name of the Journal	Number of Articles received	Number of published articles	No. of issues published	No of pages published	Circulation figures
Pramana	818	215	12	2,190	2,253
Journal of Astrophysics and Astronomy	212	107	3	593	1,322
Proceedings Mathematical Sciences	407	52	4	624	1,924
Journal of Chemical Sciences	1,118	199	6	1,988	2,017
Bulletin of Materials Science	908	232	7	1,782	1,879
Sadhana-Proceedings in Engineering Sciences	888	90	6	1,621	1,745
Journal of Biosciences	1,180	93	5	965	2,152
Journal of Genetics	796	146	3	957	1,770
Journal of Earth System Science	453	140	8	1,958	1,379
Resonance- Journal of Science Education	152	90	12	1,208	6,037

(ii) Election of Fellows and Associates: 475 nominations for the Fellowship and 74 nominations for the Associateship were considered for 2014. 31 Fellowships and 11 Associateships have been conferred to accomplished and promising young scientists of the country.

(iii) Organising scientific meetings: The mid-year meeting was organised during 4-5 July 2014 at Indian Institute of Science, Bengaluru. The annual meeting was organised at IITM-Chennai during 7-9 November 2014. Symposia, public lectures and scientific talks by Fellows/ Associates were held at these meetings.

(iv) Fellows' Repository: Through this initiative, 92,299 metadata of important researches in all branches of science carried out by Fellows of the Academy are freely made available online. The number of full text made available as of now is 20,751.

(v) Science education programmes: A total of 1,416 students and 156 teachers have availed of Summer Research Fellowship and were provided with an opportunity of furtherance of studies and research in science and engineering. Till December 2014, 23 refresher courses in Physics, Life sciences, Engineering and Earth & Planetary Science have been conducted for university science teachers in different parts of the country. 767 students and faculty benefitted from these courses. 96 lecture workshops were held in Physics, Life Sciences, Engineering, Earth & Planetary Science, Mathematics and Chemistry in different parts of the country and over 12,000 students and faculty were the beneficiaries.

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 has been established with Springer.

The National Academy of Sciences- India, Allahabad

Areas of focus : Promotion & popularisation of science and technology; to aid and advise in policy making

Major accomplishments:

(i) Publications

The Academy published the *History of Science in India* in several volumes.

Apart from regular publications (Proceedings of NASI & Science Letters), in collaboration with the Springer, the Academy published a book on Nanoscience & Technology for mankind; and another on Marine Biology.

(ii) Science communication activities

Children Science Meet, Summer and Winter Schools, Vocational Training Programmes, Workshops, Vigyan, Jal & Health Chaupals, Seminars, National Technology Day, National Science Day and World Environment Day, and several other activities were organized during the year. NASI-HQ and its 17 Chapters organised hundreds of science communication activities, in and around their region throughout the year. A series of workshops on Scientific Paper Writing was organised by the Academy to train the young researchers.

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 to provide opportunities to bright under-and post-graduate students and teachers to usefully spend their summer/winter vacations.

(iii) Singhania Library

Library services were enriched through digitization of the library, subscribing more books and by providing facilities of storage, reading room and citation etc. Internet facility for educational

purpose is also being provided to the students free-of-cost. The library has been connected to National Knowledge Network (NKN).

(iv) River galleries

After the establishment of Ganga-gallery at Allahabad, the Academy established another river-gallery on Brahmaputra river at Assam. The work on third gallery (on river Cauvery) is to be started soon at Mysore, Karnataka.

(v) Sensitization Programmes for Women Researchers/Scientists and Conducting DISHA Programme

The Academy organised five workshops on Technological Empowerment of Women at different centres of the country; also organised meetings of DISHA (DST Scheme) for selecting the women scientists/researchers, for SoRF Scheme. About 2,000 women scientists/researchers were sensitised under this programme.

Important highlights of major programmes:

a) ***Science communication activities:*** The highlights of activities were Children Science Meet, Summer & Winter Schools, Vocational Training Programmes, Workshops, Vigyan & Health Chaupals, Seminars, National Technology Day, National Science Day and World Environment Day etc. A series of workshops on Scientific/Research Paper Writing was also organised. The Academy also started a unique programme of scientific awareness amongst the Army personnel.

b) ***Annual Session/Symposia/Seminars & Scientific Discussions:***

About 600 researchers/students/teachers/scientists attended the symposium on "Desert Science- Opportunities and Challenges" held at Jai Narayan Vyas University, Jodhpur, Rajasthan, on December 4-6, 2014, during the 84th Annual Session of NASI. Several other symposia/sessions were also organized as Brainstorming Session on Safe Water & Sanitation, several Sensitization programmes on Nutrition & Health; Environment, Pollution & Conservation issues, etc.

Major and unique national facilities created:

The Ganga-gallery and the Brahmaputra gallery have been dedicated to the nation. The library of the Academy is also serving nation for last more than eighty years.

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 & SCOPUS for recognizing the talent in scientific research.

c) It has also established an association with the Springer for publishing its journals.

d) Also organized many science communication activities in collaboration with the Indian Universities/Institutes/CSIR Laboratories/ NCSM and other prestigious institutions.

Indian National Science Academy, New Delhi

Areas of focus: Science promotion and recognition of scientists

Major accomplishments:

Election to Fellowship of eminent Indian, foreign and pravasi scientists, INSA Young Scientist Awardees, INSA Teachers Awardees, INSA Young Historian of Science Awardee, 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 major programmes:

(i) Professor Nicole Le Douarin, Secrétaireperpétuelhonoraire, French Academy of Sciences, delivered the Fifth Etienne Wolff-Ramanujan Lecture on 21 April 2014.

(ii) 3rd Summit of South Asian Academies and AASSA General Assembly was held during 14-17 October 2014. A meeting of the Special Committee on Women in Science and Engineering (WISE) was also held along with the AASSA General Assembly.

(iii) Academy hosted the International Conference on Data Sharing and Integration for Global Sustainability (SciDataCon-2014) during 2-5 November 2014 at Jawaharlal Nehru University.

(iv) A three-day INDO-US Workshop on Challenges of Emerging Infections and Global Health Safety was organised jointly by Indian National Science Academy (INSA) and US National Academy of Sciences (US NAS) during18-20 November, 2014.

(v) To celebrate the International year of Crystallography (IYCr 2014), an International Symposium cum Workshop on Frontiers of Structural Biology: New Advances in X-ray Diffraction and Cryo-electron Microscopy was organised by the Academy jointly with Regional Centre for Biotechnology at INSA during 15-17 December 2014.

(vi) A symposium on Human Evolution towards language was organized organised jointly by IISER, Pune during 15-16 January 2015.

(vii) The Academy awarded INSA Medal for Young Scientists to 31 young researchers including INSA Young Historian of Science Award and INSA Teachers Award to 10 outstanding teachers.

(viii) The Inspire Faculty Award Scheme for the year 2014 has been successfully completed.

Major and unique national facilities created:

a) e-Granthalaya Library software has been installed with the help of NIC. Data migration from older system to e-Granthalaya is in progress.

b) All the three journals i.e. *Proceedings, IJHS, IJPAM made* available on INSA website for open access.

Important collaborations (national and global):

The Academy has established linkages with Science Academies/ Organisations in 49 countries in Europe, Asia, North America, South America and Latin America. During the year 2014-2015, to establish scientific bilateral cooperation, Academy has signed two new Agreements with Far Eastern Branch of Russian Academy of Sciences (Russian Federation) and Monogolian Academy of Sciences (Monogolia).

Important Output Indicators for 2014-2015

INSA is continuing its research support through its various programmes/schemes.

1. Under the ***Science Promotion Programme***

a) Support to three Research Professorships was released. (b) 43 scientists were working under this program during 2014-2015 under Senior Scientist Fellowship programme. (c) 45 scientists were supported under Honorary Scientist scheme during 2014-15. (d) Out of 34 INSA Visiting Fellowships selected for 2014-2015 support to 14 Visiting Fellowships was released during the period. (e) The Academy supported 57 Seminar/ Symposia during the year 2014-2015. (f) Under the Young Scientist Research Programme,:31 research projects of Young Scientist Medal awardees were supported.

2. **Research in history of science**

During the year the Commission recommended 10 new projects and renewed 22 on-going projects covering various topics like history of cannons, metals and metallurgy, mathematics and astronomy, ecology and forestry, art and architecture, etc.

3. **International Council of Science (ICSU) and other important scientfic meetings**

As an adhering organisation in India and on behalf of the nation, Academy discharges its responsibilities of adherence to ICSU. The Academy facilitated participation of Indian scientists at various Congresses/General Assemblies held abroad and supported about 70 scientists for such ICSU programme and about 85 Scientists for other important scientific meetings under non-ICSU programmes.

4. **Inter-Academy Bilateral Exchange Programme**

During the period April 2014 to March 2014, forty-one Indian scientists visited abroad and 20 overseas scientists visited India under the various exchange/International programmes.

5. Publications

Pursuant to its objective the Academy brings out Proceedings, Journals, Memoirs and other scientific publications. Following publications were brought out during April 2014 to January 2015.

a) Proceedings of Indian National Science Academy - 5 issues
b) Indian Journal of Pure and Applied Mathematics (IJPAM) - 5 issues
c) Indian Journal of History of Science (IJHS) - 3 issues
d) Annual Report
e) Statement of The Third Summit of The South Asian Science Academies and AASSA General Assembly,14-17 October 2014

Digital Optical Identifier (DOI) Numbers: DOI numbers for *Proceedings of the Indian National Science Academy* were procured.

OJS Software for Journal: Software for online submission and peer reviewing has been procured by the Academy and is customised for our use.

Digitization of Biographical Memoirs: The process of digitization of all the 40 volumes of *Biographical Memoirs* has been initiated. It is likely to be completed soon with uploading on INSA website.

6. Science & Society

(a) Eleven lectures were organised under the "100 Lecture Series" in remote and rural areas.

(b) The Academy approved the proposal regarding commissioning of well-considered reports by INSA fellows on issues of societal /national importance.

(**c) Public lectures:** During the period, the Academy organised 11 Public Lectures at INSA.

7. Informatics

Redevelopment of Journal website (www.insa.nic.in) is complete. We have also obtained necessary certificates of NIC and CERT-IN. Data migration work is in progress.

8. Local Chapters

Academy has 16 local chapters charged with the responsibility of deliberating on various issues concerning their region. Local chapters also deliberate on various issues related to science policy, science planning, etc., in addition to organising lectures, workshops which has a direct bearing on the capacity building in science and technology and also to inculcate scientific temper in the minds of young students through various popularizations of science programmes.

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 center functions under the auspices of the Indian National Science Academy (INSA) with grant obtained from the Department of Science & Technology, Government of India. The activities pursued during the period ranged from providing support to scientists from developing countries to work in research institution in India, partial travel fellowship to Indian scientists to attend international conferences abroad, organised series of lectures, etc.

The Indian Science Congress Association, Kolkata

Areas of focus

The Indian Science Congress Association was established in 1914 with the following objects:

(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 including the rights of disposing of, or selling all or any portion of the properties of the Association;

(e) To do perform any or all other acts, matters and things as are conducive to, or incidental to, or necessary for, the above objects.

Major Accomplishments (2014-15) :

01. Holding of 102nd Indian Science Congress Session at University of Mumbai, Mumbai.
02. Publications including ISCA bi-monthly journal Everyman's Science.
03. Augmentation of ISCA Chapter Activities.
04. Subscription of Journal for ISCA Library
05. Organising Seminars, Symposia, Discussions, Workshop etc.
06. Young Scientists' Programme
07. Best Poster Presentation Award Programme
08. Science Awareness Programme for Popularisation of Science
09. Advancement and Promotion of Science and Technology through National/International Symposia, Follow-up of Recommendation(s) Involving Young Scientists
10. International Collaboration on Exchange Programme
11. Microfilming of ISCA Old Publications

Important highlights of major programmes (2014-2015)

The 102nd Indian Science Congress was held at University of Mumbai, under the guidance of the General President of ISCA, who is an eminent scientist. Recommendations on focal theme of 101st Science Congress "Innovations in Science and Technology for inclusive development" were published also printed in *Everyman's' Science* and hosted in ISCA Web site.

A two-day National Seminar in Hindi on the Focal Theme of 102nd Science Congress "*Manav Vikash Ke Liye Vigyan aur Prodyogiki*" was organised at ISCA Headquarters in Kolkata on 6th and 7th February 2015.

The Indian Science Congress Association (ISCA) has instituted several new awards to honour and encourage scientists in India – mainly through special endowments received from individuals and groups and also from its own funds.

The Association envisaged constructive work for the popularisation and advancement of science by organising seminars, symposia, discussions, popular lectures, quiz contests, etc., throughout the year under twenty-eight ISCA Chapters. The Association through its Chapters observed the Science Day, Environment Day, Doctor's Day, Engineer's Day, Technology Day, and also organised joint collaborative programmes with other organisations.

The Journal of the Association *Everyman's Science*, which is circulated to all members free of cost, has been published regularly.

CAPACITY BUILDING OF R&D INSTITUTIONS

Fund for Improvement of S & T Infrastructure in Universities and Higher Educational Institutions (FIST) Program was the Millennium year initiative by the Government and formally launched in FY 2000-01 to facilitate 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.

The Program is currently operated in competitive mode of support at three levels i.e. Level 0, Level 1 and Level II covering six subject areas (Life Sciences, Physical Sciences, Chemical Sciences, Engineering Sciences, Earth & Atmospheric Sciences, Mathematical Sciences) and PG Colleges. While support under Level 0 is provided to all PG Science & Applied Science departments as a composite project in "Colleges as a whole " mode, supports under Level I/ Level II are meant for Science/ Applied Science departments of universities / 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 2014-15: For 14th round of operation, fresh proposals were invited in March 2014 through advertisements from eligible S&T related departments and PG colleges for considering support under this program. In this year about 383 new proposals in all levels (L0-119, Level I- 173 and Level II – 91) were received and finally167 proposals (L0-55, Level I-93 and Level II-19) were identified to consider financial support for varying quantum (from Rs.22 lakh to Rs.790 Lakh) at a total budget of about Rs.231.31 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. So far, nearly 2150 S&T departments and PG colleges (Level 0-244, Level I-1706 and Level II-197) have been supported with a total investment of Rs1900 crores.

Outcome: The Program has provided sustainable funding over a period of thirteen 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: Micro CT, Micro-scale thermophoresis, Reflection High Energy Electron Diffraction, Femto-second Ultrafast Spectrometer, Scanning Near Field Optical Microscopy, Electron Probe Micro Analyzer, High Resolution Transmission Electron Microscopy, FIB Based Scanning Electron Microscope, 600 MHz NMR, Thermo-Mechanical Stimulator, Hyper-spectral Imaging System and X-ray photoelectron spectroscopy (XPS) etc.

Many prestigious Medical institutions in the country like All India Institute of Medical Sciences, New Delhi, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Postgraduate Institute of Medical Education and Research, Chandigarh, Maulana 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. are beneficiary of the FIST Projects at both the levels.

FIST Program has significantly contributed to the enhancement of teaching and research in Agricultural Sciences. Several departments at Agricultural Universities such as University of Agricultural Science, Dharwad, Assam Agricultural University, Johrat, 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. have been recipients of the FIST Projects both at level I and II.

Apart for acquiring facilities for capacity building of teaching and research, the Departments supported under the Program have also established a Computational facility 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 benefited Communication technology based infrastructures such as Grid Computing, Networks and Communications systems, Cloud Computing infrastructure in many engineering departments.

In the last thirteen 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.

The Department of Science and Technology has also evolved state and region specific special packages under the FIST Program. North East 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.

Chemical sciences related research infrastructure provided at the Department of Chemistry, Vidya Sagar University, Midnapore.

Major facility provided at the Department of Inorganic and Physical Chemistry, IISc Bangalore.

Promotion of University Research and Scientific Excellence (PURSE)

As a mark of recognition of the research performance adjudged in terms of the h index based on research publications, the Department of Science & Technology (DST), New Delhi has proactively initiated a scheme "**Promotion of University Research and Scientific Excellence (PURSE)"** during 2009. The scheme was initiated with the purpose of building the research capacity of Indian Universities. The objective of the scheme is to create, nurture and strengthen the research ecosystem in performing university. Using a transparent criteria forty four (44) 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 three study periods 1996-2006, 1998-2008 and 2000-2010..

Table- 1: Criteria for Support in PURSE Program

h-Index	Research Grant for 3 years
More than 50	**Category A** (Rs 30.0 cr.)
40-49	**Category B** (Rs 15.0 cr.)
30-39	**Category C** (Rs 9.0 Cr.)
26-29	**Category D** (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 grant released in the scheme is for augmentation of research infrastructure at the University level. The Universities supported under the PURSE scheme are provided immense flexibilities with respect to choice of budget projection and selection of equipments required for conducting research etc. Under the PURSE initiative support is provide to acquire research equipments, research man-power cost, augmentation of 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:

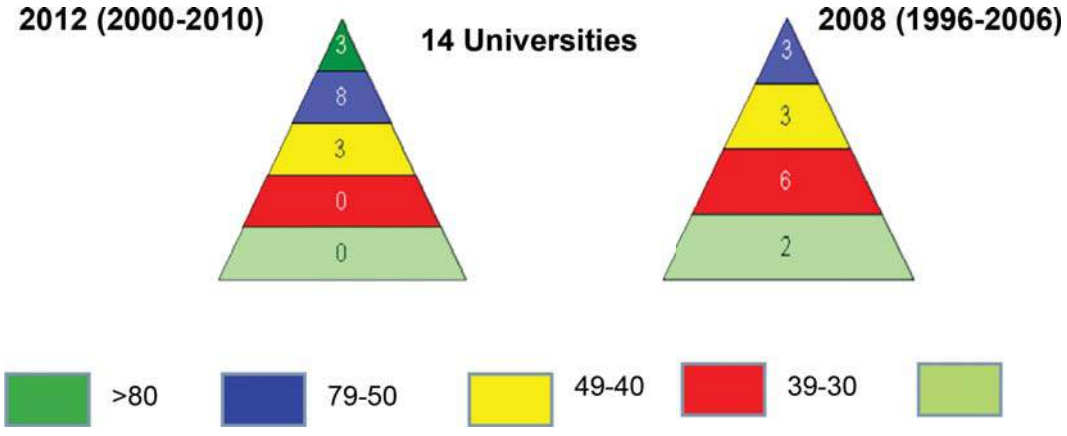
- The support provided to each university has been classified under '**Flexible**' and '**Fixed**' Components.
- The expenditure heads in '**Flexible Components (85%)** are totally flexible among the expenditure heads like support for acquiring Hardware (Equipment, Infrastructure Facilities and Networking & Computational Facilities) and Consumables.
- The support areas in **'Fixed Components (15%)** covers expenditure heads like Manpower Cost (10%), Travel (1%), {Contingences, Seminar/Workshop to organize or to attend abroad and Maintenance - 4 %).

- 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.

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 1st set of 14 Universities has been completed now, Universities (30) supported in the 2nd set are ongoing and releases have been made in the current year.

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 1st 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 outstanding performance of the 1st 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. PURSE Phase 2 awards to many universities have been released in current financial year. Since its initiation in 2009, Rs 400 Crores has been made available to performing universities supported under the PURSE Program

Table1. List of 14 Universities under PURSE Program

Sl. No.	Name of the University	Sl. 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

DST has duly constituted a Programme Management Board to review the progress in PURSE Project at performing universities and regular reviews are carried out under the scheme.

Centre for Interdisciplinary Research in Science & Technology (CISST) established under DST PURSE at Sardar Patel University Gujarat

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. The details of collaborative research and development programs initiated jointly with the Department of Science & Technology (DST), New Delhi and Research Council (RC), UK are given below:

Name of the Program	***Starting Date and Committed Investment***	***Number of projects supported***	***Total Indian Side Project Cost (Rs in lakh)***
Science Bridges Awards	2008 & 4 M GBP by each country	**Three** multi-partners projects between India and UK Universities/ Academic Institutes	Rs 1270 lakh, supported on September 2009 for 3.5 to 4 years
Indo-UK Advanced Centre of Excellence in Next Generation Systems and Services	2008 & 5 M GBP for 5 years by each country in two phases @ 2.5M GBP for each phase of 2.5 years.	**One** multi-partners project between India and UK Universities/ Academic Institutes	For Phase 1, Rs 15 crores was supported during October 2009. The Phase 2 started on July 2012 at an estimated budget of Rs 20 crores.
Research Initiatives on Solar Energy	2009 & 5 M GBP by each country	**Two** multi-partners consortium projects between India and UK Universities/ Academic Institutes	Supported 2 projects costing Rs 2342 lakh in December 2010.
Research Initiative on Fuel Cell	2010 & 3M GBP by each country	**Four** multi-partners projects between India and UK Universities/ Academic Institutes.	Supported 4 projects costing Rs 866 lakh in the later part of 2011.
Research Initiatives on Bridging the Urban and Rural Divide (BURD)	2011 & 5M GBP by each country	**Four** multi-partners projects between India and UK Universities/ Academic Institutes.	Supported 4 projects costing Rs 1932 lakh in the year 2012.

Name of the Program	*Starting Date and Committed Investment*	*Number of projects supported*	*Total Indian Side Project Cost (Rs in lakh)*
Research Initiative on Advanced Manufacturing	2012-2013, 3M GBP by each country	**Seven** multi-partners multi-Institutes projects between Indian and UK Universities/ Academic Institutions	Recommendations finalized in September 2013. Estimated investment on Indian portion of Seven projects is about Rs 20 crores. Expected to start from January 2014.
Research Initiatives on Smart Grid and Energy Storage	2012-2013, 5M GBP by each country	**Five** multi-partners multi-Institutes projects between Indian and UK Universities/ Academic Institutions	Recommendations finalized in September 2013. Estimated investment on Indian portion of five projects is about Rs 39 crores. Expected to start from January 2014.
Research Initiatives on Applied Mathematics	2012-2013, 0.25M GBP by each country	**14 Workshops (7 each)** have been planned in next 18 months duration between two countries	Indian side Coordinator: Professor Dinesh Singh, Vice-Chancellor, University of Delhi is steering the Indian activities. Estimated invest-ment is about Rs 2 crores. Expected to start from April 2014

In all these areas, the specific theme areas of collaboration having common interest from both countries were identified by organizing the joint Workshops between the Academicians/ Scientists/ Industry partners from both countries. Subsequently on the basis of Joint Call announcement on these theme areas, projects were identified and recommended through the Joint Expert Panel specific to each area and financial supports are being considered and provided subsequently by the respective country to their part of activities. These programs are currently being coordinated by FIST & INSPIRE Division and financial supports are provided through R&D support budget.

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

This is a major research & technology transfer initiative for the ICT Sector. The main objective of the project is to place infrastructure to facilitate, develop & enable the Digital/ Information

economy of both countries. It is expected to develop novel solutions for research, innovation in Next Generation Communication Technology & wealth creation opportunities between UK & India.

DST, 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 project has achieved commendable progress in various cross layer work packages in all three Groups in the Indian Side activities of the consortium. Platform for Agricultural advisory system and Course Pack Learning Platform are ready to scale up in the project. Emergency response system, Interactive Health Monitoring and Advisory system is likely to be commercialized shortly.

2. DST-RC UK Research Initiative on Solar Energy

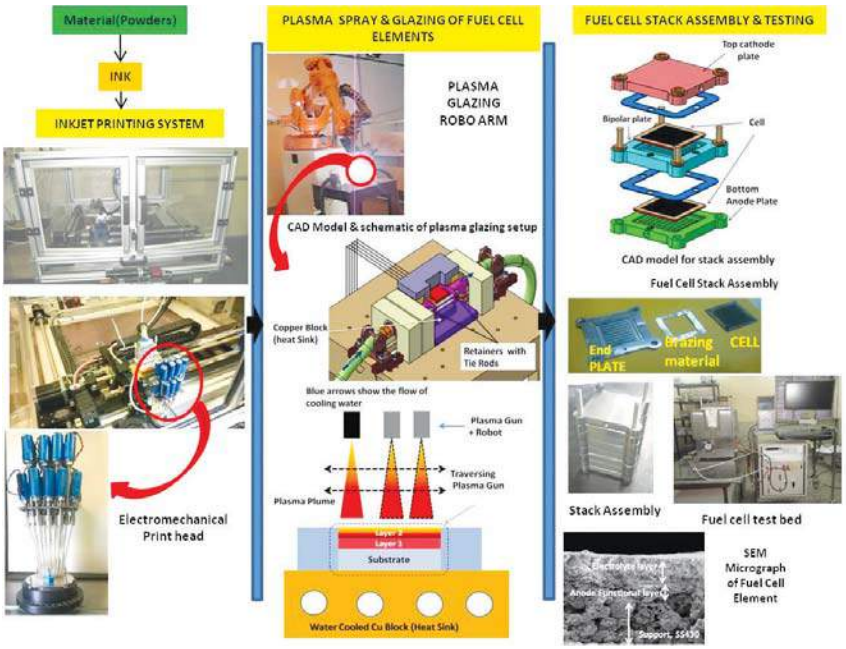
Solar Energy has been identified by both the India and UK a crucial area of significance in providing solutions to the problem of meeting future energy needs and developing energy security. A cooperation agreement was signed in 2009 between the two countries has provided the framework for fruitful collaboration. 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 "Advancing the Efficiency and Production Potential of Excitonic Solar Cells" (APEX) and "*Stability and Performance of Solar Photovoltaics (STAPP)*" have been supported by DST and RCUK, Digital Energy Program under the Research Initiative on Solar Energy. Review of these projects was held in financial year 14-15 and commendable progress is noted in all theme areas of the project. Based on the remarkable progress in APEX Project, DST has in principally agreed to support Phase 2 of the project starting from January, 2015.

Inert glove box based organic solar cell device fabrication facility created under INDO-UK Solar Energy Initiative DST funded project "Advancing the Efficiency & Production Potential of Excitonic Solar Cells" (APEX) at CSIR-NPL.

3. Research Initiative on Fuel Cells

The Research Initiative on Fuel Cell was initiated at an investment of 3M UK Pound each for collaborative research activities. Four projects - Mind the Gap jumping the hurdles limiting polymer Fuel Cell performance and commercialization, Performance Optimization of IT-SOFC by Inkjet Printing on Porous Metal Substrates (JETCELL), Advancing Biogas Utilization through Fuel Flexible SOFC and Modelling Accelerated Ageing and Degradation of Solid Oxide Fuel Cells were supported under this program at the total cost of Rs 866 lakhs. The review of these activities was carried out in August 2014 and review panel has noted remarkable progress in these projects.



Schematic of project JETCELL supported under DST-RCUK Research Initiative on Fuel Cells.

4. 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 have started their activities by July 2014.

5. 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. These projects have started their activities by July 2014.

6. 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.

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 purse 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.

400 MHZ Solid State FT-NMR Spectrometer at the SAIF, Bangalore

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.

NEW SAIFs IN LESS ENDOWED REGIONS OF THE COUNTRY

During the year focus of the programme remained on less endowed regions in the country where required instrument facilities are not available to enable the research community from these regions to have access to the required instruments in their close proximity. Seven new SAIFs are being set up 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. During the year, these SAIFs initiated the process of procuring and setting up the instrument facilities. The SAIFs at M.G. University, Kottayam and IIT, Patna are likely to become operational during the year.

INSTRUMENT FACILITIES STRENGTHENED

Instrument facilities were strengthened during the year in the areas of Electron Microscopy and NMR Spectroscopy at the existing SAIFs to meet the current and emerging needs of research community. Some of the major instrument facilities installed at the SAIFs during the year are 300 KeV Transmission Electron Microscope at the SAIF, Mumbai, 200 KeV Transmission Electron Microscope at the SAIF, Kochi, FEG Scanning, Electron Microscopes at the SAIF Chandigarh and SICART, Vallabh Vidyanagar and 400 MHZ Solid State FT-NMR Spectrometer at the SAIF, Bangalore. Accessories including Ultramicrotomes and Dimple Grinder were added to the existing Electron Microscopes at the SAIFs, New Delhi and Kochi to make them more useful to the users. 500 MHZ FT-NMR Spectrometers, ICP-AES, CHNSO Elemental Analyser (2400°C) and STGA/DTA are being added to the SAIFs at Mumbai, Bangalore, Shillong, Chennai and SICART, Vallabh Vidyanagar respectively to further strengthen them.

200 KeV Transmission Electron Microscope at the SAIF, Kochi

ANALYSIS PROVIDED/OTHER ACTIVITIES UNDERTAKEN

Analysis provided/Usage of the facilities

- A wide range of analysis/techniques are being provided by the SAIFs to the research workers to meet their analytical needs for chemical/materials characterization including qualitative/ quantitative elemental, molecular/compound analysis, structure determination, microstructure analysis and surface topographic studies etc.
- Services like solution to analytical problems including development of analytical methods for specific needs, spectrum analysis and interpretation of results etc. were offered 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 are likely to 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 are likely to help about 1000 Ph.D. students in their research work.
- About 16,000 research workers from all over the country are likely to utilize and benefit from the facilities provided by the SAIFs during the year. These include research workers from almost all the universities in the country. About 87% of the users are likely from the academic sector.
- About 1,30,000 samples are likely to be analyzed at the facilities during the year.

Workshops/Training programmes/Short term courses organized

About a dozen workshops and training programmes are likely to be 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. Some of the workshops/training programme/short term courses organized/planned to be organized during the year are as follows:

- A workshop on "High Resolution Electron Microscopy and its Applications" by SAIF, Chennai.
- Training programmes on "Electron Microscopy" for scientific investigators and technical personnel by SAIF, New Delhi.
- A workshop on "Electro Microscopy and its Applications" by SAIF, Shillong.
- A workshop on "Electron Microscopy" by SICART, Vallabh Vidyanagar.
- A workshop on "Applications of Mass and NMR techniques" by SAIF, Lucknow.
- A workshop on "NMR Spectroscopy" by SAIF, Bangalore.
- A workshop on "NMR Spectroscopy and its application" by SAIF, Shillong.
- A workshop on "Mass Spectrometry- Applications in Proteomics" by SAIF, Chandigarh.
- A workshop on "Single Crystal X-ray Diffractometry" by SAIF, Guwahati.
- Workshops on "Chromatography Techniques" and "LC-Mass Spectrometry" 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 science 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:

- A new assignment technique for ^{13}C NMR spectra in the solid state by correlation to dipolar coupled proton-pairs has been developed at the SAIF, Bangalore.

  A method for rapid characterizations of molecular diffusion by NMR spectroscopy has been developed at the SAIF, Bangalore.

- Development of pure-shift NMR methodology and novel resolution enhancement techniques have been developed at the SAIF, Bangalore.
- A fast NMR method for resonance assignments in NMR metabolomics has been developed at the SAIF, Bangalore.
- Algorithms and method for reconstruction of two dimensional NMR spectra from one dimension projections has been developed at the SAIF, Bangalore.
- A method for sensitivity enhancement through polorisation sharing with NMR has been developed at the SAIF, Bangalore.
- In a study conducted at Dr. H.S. Gaur University, Sagar, it has been found that aceclofenac loaded chondroitin sulfate (CS) conjugated solid lipid nanoparticles (CS-SLN) could be potentially effective vector for the treatment or management of Osteoarthritis. Characterization of SLNs for this study was facilitated by SAIF, New Delhi.
- In a research work facilitated at SAIF, Kochi pyroelectric nano-composites comprising of pyroelectric ceramics prepared in nano form embedded in electro-active polymers have been developed. These composites were found to have comparatively high figures of merit and could be used as flexible IR/thermal detectors.
- A method has been developed at the SAIF, Kochi to measure the dry rubber content (DRC) in natural rubber latex by determining the change in enthalpy of unit mass of sample in a definite temperature range.
- In a research work facilitated at SAIF, Lucknow, a set of indole based molecules have been designed and a library of indole derivatives has been synthesized, which showed potent growth inhibitory activity against some cancer cell lines. It was concluded that molecule IT-14 can be a good lead candidate to treat prostate hyperplasia.

PROVIDING MEGA FACILITIES FOR BASIC RESEARCH

This programme was launched in the XI Plan 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 technical complexities and requirement of huge funds and other resources, such projects/programmes

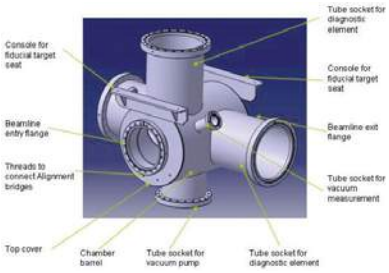
are manifestly multi-agency, multi-institutional and, most often, international in character. The Department of Science & Technology (DST) and the Department of Atomic Energy (DAE) have been jointly promoting most of such projects. Both DST and DAE have a long-standing MOU on joint funding, implementation 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. The implementation of FAIR project gained momentum during the year. Civil construction advanced with deep drilling of pillars on which the building housing the accelerator would rest. The first beam is expected in 2021. Important technical deliberations on in-kind items to be contributed by India were made during the year. Significant progress was reported on some of the in-kind items as given below :

Power converter: In May 2014, the first tri-partite contract was signed between FAIR, Bose Institute, Kolkata (BI) and Electronics Corporation of India Limited, Hyderabad (ECIL) for 78 Power Converters to be used in High Energy Branch Beam Line. The design report for building the prototype was also completed during the year.

Beam stopper: Collaborative work between BI, GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany (GSI) and Central Mechanical Engineering Research Institute, Durgapur (CMERI) to design the Beam Stopper initiated during the year. A team from CMERI visited FAIR to finalize the specifications in consultation with the GSI team.

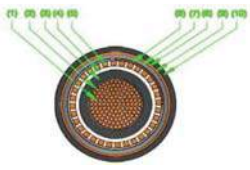


Constituents of the FAIR beam diagnostic vacuum chamber.

Vacuum chamber: The process of selection of a vendor to supply vacuum chambers as per FAIR specifications was initiated during the year.

Superconducting magnets for Low Energy Branch of FAIR Super-Fragment Separator: During the year, the physics design of the dipoles was completed in India and specifications of the multipole magnets were under finalization by the FAIR team.

A new in-kind item – Power cable: Efforts were made to find additional in-kind items. Co-axial power cable was identified as one such item. These cables will carry up to 500 A current from the power supply to the FAIR magnets. Efforts were made during the year to identify Indian industry which will develop such cables as per FAIR specifications.



Cross-section of Power Cable

Sample cable of 50 mm^{2}area and 33.80 mm dia

Co-axial power cable

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

The new phases of CMS, ALICE and GRID projects got sanctioned during the year. Indian researchers vigorously continued their initiated research work on these projects.

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 top 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 near Madurai. The project got financial sanction at a total cost of Rs. 1583.05 crore during the year. This project is also being jointly funded by DST and DAE. DAE is the Lead Agency for this project. DST continued its support to the 13 university groups for INO-related R& D work.

Indian Participation in Neutrino Experiments at Fermi National Accelerator Laboratory, USA (Fermilab)

The project by Indian physicists to collaborate in Neutrino Projects at Fermilab (USA) made good progress during the year. Indian faculty members and 14 Indian Ph.D. students from 9 institutions continued research work on different experiments like MIPP, MINOS/MINOS+, NOVA, LBNE at Fermilab, USA during the year. 5 Indian Ph.D. students took courses in the country during the year. Work on setting up hardware labs at Panjab University, Benaras Hindu University and Delhi University gained momentum during the year. 14 research publications and 25 Conference Papers/Seminar Papers/Posters/Invited Talks resulted from this project during the year.

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. During the year, the Cabinet approved this project at a total cost of Rs. 1299.80 crores from the year 2014-15 to 2022-23. The project is jointly funded by DST and DAE and DST is the Lead Agency for this project. This will be a major international scientific collaboration for Indian institutions. India signed the Master Agreement, Company Agreement and the Contribution Agreement as the "Financial Authority" during the year.

With this, India has become a full 'Member' in the project. The process for financial sanction of the project was also completed during the year.

Signing of TMT Agreements by India as Financial Authority on December 2, 2014

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. The construction phase of the project was completed during the year. The beam lines were put under trials during the year. The technical personnel employed under the project undertook extensive on-the-job-training at site.

Constructed Beam Line with Indian Scientists at ELLETRA

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. India has now joined this project. National Centre for Radio Astrophysics (NCRA) of the Tata Institute of Fundamental Research (TIFR), Pune and Raman Research Institute, Bangaluru (RRI) are the Lead Institutions. NCRA is being funded by DAE and RRI by DST through its institutional support. DAE is the Lead agency for this project.

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. One School on Accelerator Science & Technology was organized at IUAC in May 2014.

STRENGTHENING SURVEY AND MAPPING CAPABILITY

SURVEY OF INDIA

Survey of India (SoI) is one of the subordinate offices under the Department of Science & Technology. It is one of the oldest Departments of the Govt. of India, which was set up in 1767. SoI is headed by Surveyor General of India and its headquarter is located at Dehra Dun.. It is a pan-India organisation which has 7 Zones, 21 Geo-spatial Data Centres, 1 Printing Zone and Indian Institute of Surveying and Mapping (IIS&M), located at Hyderabad, a training Institute in the field of surveying and cartography, which imparts training in Surveying and Mapping techniques. There are also six Military Survey Units under Additional Director General, Military Survey, MoD, to cater to the survey and mapping needs of the Defence Ministry.

Major Activities completed by Survey of India in 2014-15 :

(i) Marine Geodesy (Tidal Observation):

Survey of India has been monitoring the sea level change since more than 150 years by continuous tidal observations at various ports. Survey of India taken up the initiative for Modernization and expansion of Indian Tide Gauge network with special reference to storm Surge Modeling and Tsunami Warning System and equipped 30 nos. of Tide gauge stations with digital tide gauges co-located with GPS receiver to monitor sea level variation and crustal movement. Real time data communication facilities have been established at National Tidal Data Centre, Dehra Dun as well as at several remote locations along Indian coastline and Islands. Prediction of tides at 44 ports including 14 Foreign ports and publication of Tide Table one year in advance to support navigational activities. Work of Maintenance/ inspection of Tidal Observatory are continuous process and it is being carried out. Indian Tide Table - 2015 and Hugli River Tide Table – 2015 have been published and supplied to indentor and Kolkata Port trust respectively. 32 days tidal observations have been completed at 5 ports.

(ii) 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 upto the maximum width of 7 km from shore line on the landward side under the "Integrated Coastal Zone Management" (ICZM) project. Control work consisting of GPS and levelling of the entire coastal area, Aerial photography of the project area, QA/QC of Aerial photography and 32 days tidal observations for densification of secondary ports which required for delineations of Hazard Line as per recommendation of World Bank has already been completed by Survey of India.

Status of the mapping work is as under:

Total area of the project:	75930 Sq.Km.
Control work	completed
Aerial photography of the project area	completed
Aerial Triangulation under progress:	9751 Sq. Km
Field work under progress:	7431 Sq. Km.
Mapping Completed:	2937 Sq. Km.

(iii)Coal Mine Project

To generate Updated Topographical Maps of Major Indian Coal fields on 1:5000 scale with 2 Metre contour interval in Plains (in case of hilly terrain contour interval may be 3-5 Metre as practical) in GIS digital format based on Digital Photogrammetric Techniques using high resolution aerial photographs and adequate ground verification is continued during the year. Updated Topographical Maps of 10 Major Indian Coal fields of 1st Phase are in the final stage and some of the maps have already been supplied to the Indentor. Aerial photography of 17 Indian coal fields has been completed and field work for secondary control is under progress.

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

Indian Institute of Surveying & Mapping (IISM), impart 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 conduct M. Tech (Geomatics) and M.Sc. (Geospatial Science) Academic two years Post Graduate Programme in collaboration with Jawaharlal Nehru Technological University, Hyderabad. 20 departmental Officers, 222 extra-departmental and 30 others have been trained during the year.

(v) Densification of Level Network under Redefined Vertical Datum Project:

Survey of India (SOI) is pioneer National Mapping Organization with a responsibility to provide the framework of horizontal and vertical control for variety of users involved in surveying, mapping and research activities in the country. To fulfill the requirement of horizontal control GCPs have been provided throughout the country by GPS under Plan scheme GCP Library and for Vertical Control, leveling network has been planned to be completed in two phases i.e Phase-I, to create basic skeleton net work and in Phase- II, densification of level net based on skeleton network and further connecting these level lines to GCPs provided by GPS under Plan scheme GCP Library. Thus the GCPs with very accurate ITRF coordinates and geopotential number with Helmert orthometric height can be used by state governments and other agencies for irrigation, cadastral, National Urban Information System, developmental projects like Hydro-electric Projects, National Highway Projects etc and other utility mapping and engineering projects requiring precise Horizontal and Vertical control.

In First Phase about 45,000 lin km back and fore leveling has been completed under the Project titled 'Redefinition of Indian Vertical Datum (RIVD)' under Plan scheme GCP Library. Computation and Adjustment have also been completed by Survey of India. Based on the main frame of vertical control, further densification of the vertical control of about 1,00,000 linear km. in both direction in second phase is involved for the Project. Planning of the leveling line State wise has been completed by Geodetic and Research Branch of Survey of India and it has been provided to GDCs for carrying out HP leveling. Some GDCs have started recee work for selection of sites for construction of BM.

Gravity observation near Ahmedabad Airport

(vi) National Topographic Database (NTDB):

Initiative: In addition to topographic map data, SOI produces and maintains several other data sets, e.g. gravity, tidal measurements, geodetic framework, Administrative Boundaries, Toponomy (place names) and various types of geographical maps & Aeronautical Charts.

Survey of India now has the complete topographical data of the entire country in analogue and digital modes on the 1:2,50,000 scale, 1: 50,000 scale and in part on the 1:25,000 scale. The updation of the data sets is continuous process and the following data sets are updated during the year:

- Field verification for New edition of on 1:50K OSM = 200 Sheets
- Hill shading of DSM on 1:50K = 309 sheets
- Compilation of DSM on 250K from 1:50K DSM component = 137 sheets.
- Gravity Observation = 110 stations.
- Geomagnetic observation on repeat stations = 55 stations.
- Correct Spelling of Names in Roman & Devanagari of 18 railway Stations and 07 Villages are recommended by Survey of India during the year.
- Preparation of New edition of State map of Assam, Nagaland, Bihar, Chhattisgarh, Arunachal Pradesh, Tripura, Mizoram,and West Bengal has been completed.
- Preparation of New edition of Guide map of Patna, Ara, Bhagalpur, Ranchi, Shillong, Chandigarh, Ambala, Lucknow, Allahabad and Varanasi have been completed.
- New Edition of Hyderabad Guide Map was released during XXXIV Annual Congress of INCA on 16th December 2014 at Hyderabad.
- Digitisation of 570 sheets on 1:25,000 Scale during the year and 9350 Sheets up to of the year.
- QC of digital data for 790 sheets.

(vii) Preparing data for Web Map Service and Web Feature Service:

Survey of India is providing Web Map service (WMS) based on 1:50K OSMs through SoI portal "surveykshan.gov.in". Access to feature data through Web Feature Service (WFS) is pre-requisite to data processing and application in GIS. In this connection, it is decided that 1:50,000 scale topographic sheets should be cleaned for the creation of feature data for use in GIS. The work for cleaning of existing vector data files (.dgn) for provision of SOI WFS is taken up during the year. Survey of India has completed Quality Check of 3595 OSM of 1:50K and 2600 OSM has been uploaded on Web Portal. Survey of India has prepared 2500 topographic sheets data for WFS during 2014-15.

(viii) Map the Neighbourhood in Uttarakhand (MANU) Project:

To prepare DEM (Digital Elevation Model) and map on 1:10K scale for disaster affected area of Uttarakhand for macro and micro level planning and post disaster scientific application by other agencies involved in MANU project Under the project Survey of India take up the Mapping of Disaster affected Areas of **"Char Dham and Pindar Velley area"** covering around 8000 Sq. Km. in Uttarakhand by Using Modern Techniques of Air- Borne LiDAR and Aerial Photogrammetric Survey**.** Data Acquisition work in part of the area by using Modern Techniques of Air-Borne LiDAR and digital Aerial Photography of Disaster affected Areas of " **Char Dham and Pindar Velly**" has been completed and Quality Control and further processing to generate deliverables is under progress.

(ix) International boundary Surveys:

Survey of India has the responsibility for Demarcation of the External Boundaries of the Republic of India, their depiction on maps published in the country and also advise on the demarcation of inter-state boundaries For demarcation of External Boundaries joint Survey team of both countries should agree. For Indo-Nepal Boundary demarcation the first meeting of Nepal-India Boundary Working Group (BWG) was held in Kathmandu on 17 to 19 September, 2014. The Indian delegation was led by Dr. Swarna Subha Rao, Surveyor General of India and the Nepalese delegation was led by Mr. Nagendra Jha, Director General of Survey Department of the Government of Nepal.

Both sides recalled the decision of the 30th meeting of the JTC to recommend the respective governments to set up a permanent mechanism headed by the Director General of the Survey Department of Nepal and the Surveyor General of India which will consist of the representatives of the Ministry of Foreign Affairs/External Affairs of both sides and other related agencies as per functional needs of the activities at hand.

The first meeting of Nepal-India Boundary Survey Officials Committee (SOC) was held in Dehra Dun, India, on December 30-31, 2014 to finalise work programme of field survey team, Composition, Location of Camp offices, GPS observation and technical specification for field work.

Field Programme for Joint Inspection of boundary pillars/Boundary demarcation Survey between Indo-Pak, Indo- Bhutan, Indo-Myanmar and Indo-Bangladesh are finalised in current field season.

(x) Special Survey for Indian Air Force:

Survey of India has completed the following maps and Data for IAF during the Year:

(i) IAF(OGM) -20 Sheets, IAF- (PGM) – 31 Sheets, IAF-OLM(New Edition)-01 Sheet & Land Approach Chart (LAC) 8 Parts.

(ii) Verification of 17 Landing charts on 1:50k Scale including Obstruction Survey for 30 NM from ARP for IAF

(iii) Supply of AMSL Height, Co-ordinate and Distance of Project 3 sites.

(xi) Geodetic Control Survey for Punatsangchhu HE Project in Bhutan:

The task for providing Geodetic Planimetric and Vertical control for layout of various Engineering Structure of Punatsangchhu Hydro Electric Project in Bhutan has been awarded/ allotted to Survey of India. Geodetic and Research Branch of Survey of India has provided Geodetic Plan & height control for layout of Head Race Tunnel, adits, surge shaft, Dam for Power House Complex and other salient Structures of Punatsang Chhu Hydro Electric Project.

NATIONAL ATLAS & THEMATIC MAPPING ORGANISATION

National Atlas and Thematic Mapping Organisation functions under the administrative control of the Union Ministry of Science & Technology (Department of Science & Technology), Government of India. The Organization is at Kolkatta. A large number of qualified professionals including geographers, geologists, statistician, mathematician, software applicants prepare maps and atlases in this organization.

NATMO also provides training in remote sensing, GIS application, digital cartography, GPS reading & use and allied issues. A large number of professionals, technocrats, professors/ associate professors, research scholars, teachers have been benefited from these training programmes. 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.

Main functions:

a) Compilation of National Atlas of India in English and in Hindi

b) Preparation of National Atlas maps in regional languages

c) Preparation of thematic maps based on socio-economic, physical, cultural, environmental, demographic and other issues.

d) Automated mapping and GIS application for increasing efficiency in mapping technique.

e) GIS, digital cartographic research and training

f) Golden Map Service covering whole of India, especially, towns and cities.

g) Development of digital cartographic data base for large scale mapping and service providing.

h) Web-based map/atlas making and updating.

i) Preparation of maps/atlases for visually handicapped persons.

j) Preparation of maps/atlases for low vision persons.

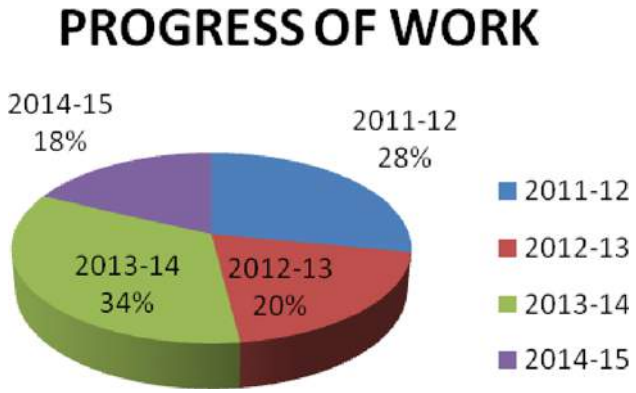
k) Any other work as entrusted to NATMO by the Department of Science &Technology, Ministry of Science and Technology, Government of India.

1. TECHNOLOGY DEVELOPMENT PROGRAMMES

A) Golden Map Service (GMS)

Selection for GCP for adjustment of GPS data covering whole of the country has been marked

up. State/Region wise field survey has been going on. During the year 2014-15, GMS-Calangute and Candolim, GMS-Mohali, GMS- Sultanpur, GMS- Raebereli, have been published. Conversion and patterning of the digital format is going on. Year-wise progress of the project is shown below;



Golden Map Service

B) District Planning Map Series (DPMS)

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.

C) National Atlas Of India

In the year 1956, the then Prime Minister of India, Pundit Jawaharlal Nehru approved the formation of National Atlas & Thematic Mapping Organisation (then it was National Atlas Organisation) and granted the 'National Atlas Project' to NATMO. 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.

D) Large-Scale Mappiing:

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.

E) Atlas For Visually Impaired (Braille Map)

'Atlas for Visually Impaired' has been published depicting physical and political features of every continent along with special focus on physical, political features of India has been published both in English and Hindi Braille Script. Atlas of West Bengal in Bengali Braille Script, Atlas of Tamil Nadu in Telugu Braille Script has been published. Braille Atlas for other states of the country in concerned regional Braille Script, has been taken up as well.

F) Training And Development For S&T Advancement of The Country

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. During the year 2014-15, 450 persons were trained in NATMO.

G) Number of people getting benefited from the projects/schemes:

Hundreds of scholars, technocrats, teachers, engineers take training in digital cartography, remote sensing, GIS, GPS technology application from NATMO. During the year 2014-15,

H) Ongoing Map/Atlas Projects ready for printing:

- Thematic Atlases: Cultural Heritage Atlas, second edition; National School Atlas, 5th edition, Students' Reference Atlas, 2nd edition; Historical Atlas, second edition, Socio-Economic Atlas (in Urdu), and many more.
- DPMS: Thiruvannamalai, Pauri-Garhwal, Pithoragarh, Bageshwar, Angul, Jajpur.
- Golden Map Service: Jaisalmer,
- Tourist Map of West Bengal and Sikkim.

I) Ongoing projects ready for printing, subject to vetting clearance from Ministry of Defence.

- Golden Map Service – Burdwan, Gangtok
- DPMS: Darjiling

J) Research Development &Training:

Regular activities on research, development and high tech training jobs are carried out throughout the year. Digital Mapping and GIS training, GPS technology training, Remote Sensing and GIS training were imparted to post graduate students, researchers and professionals from various institutes of eastern, northern and western India. Refresher course is conducted on digital cartography and map reproduction for departmental candidates as well as candidates from other cartographic institutes. During the year 2014-15, about five hundred trainees were trained from this Division.

K) International Science and Technology Cooperation

AS per the MOU signed between Geoinformatics and Space Technology Development Agency, Govt. of Thailand and National Atlas and Thematic Mapping Organisation, Govt. of India, for cooperation in the field of Mapping and Geospatial Technology Applications, project on publication of an Archaeological Atlas, jointly by NATMO

and GISTDA with thematic plates using high-resolution satellite data and geospatial technologies, to highlight the spread of Buddhism from India to South East Asia. The project will include India and participating ASEAN countries is going on. The activities of the project on the India have been completed by NATMO. GISTDA has to provide the translated data so that the Atlas will be completed in time.

L) 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.

M) Revenue generated during financial year of 2014-2015 (April to January 2015)

The Organisation generated revenue about rupees 5 lakh by selling maps, atlases and monographs from the sales counters of Kolkata Headquarters, Delhi Sales Counter, Exhibition stalls and SOI outlets. NATMO has also earned about rupees as Course fee for providing training on different courses.

BUILDING GEOINFORMATION CAPACITY

Natural Resources Data Management System (NRDMS) and National Spatial Data Infrastructure (NSDI)

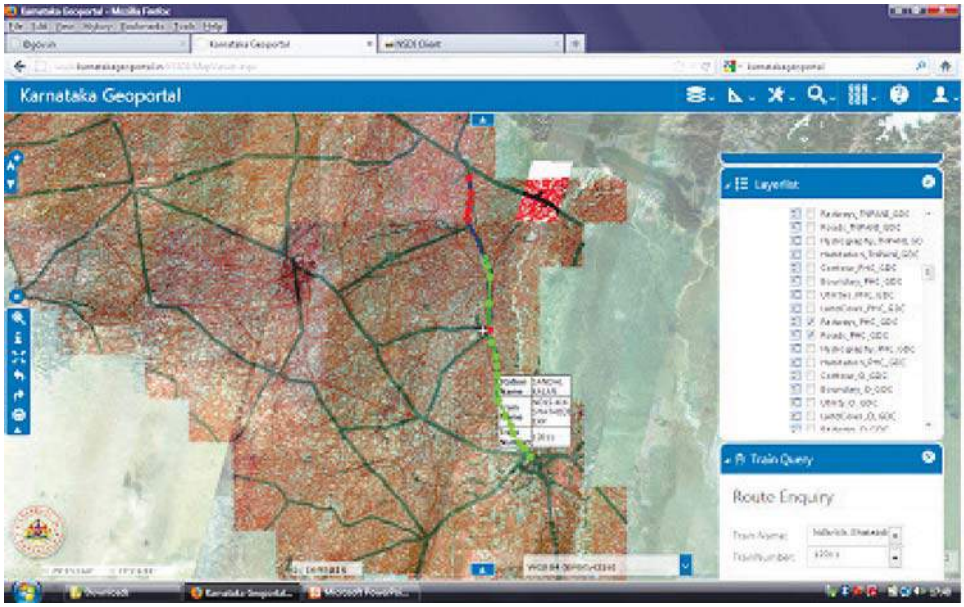
Natural Resources Data Management System (NRDMS) Programme aims at promoting R&D in emerging areas of Geospatial technologies and applications for providing relevant inputs to solve area specific problems. Over the years, NRDMS has developed capability for handling resource management at State, District and Panchayat levels. Efforts have also 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.

National Spatial Data Infrastructure (NSDI) aimed to develop spatial information infrastructure with Collection of Technologies, Policies and Institutional arrangements. During the current year, the focus has been on suitably re-orienting NSDI towards developing and implementing GIS applications by providing processed information to its stakeholders for decision support. Several activities have been undertaken towards achieving the goals set under NSDI Aspiration Document. Linkages have been established with Central Government Ministries/ Departments like Railways, Telecom, Oil & Natural Gas, Environment & Forests and Climate Change and the State Governments for demonstrating the utility of the NSDI Data Services from the India Geo-portal. Existing geo-spatial data sets of the NSDI Partnering Agencies have been re-engineered for creation and provision of GIS Data Assets useful for automated processing and in developing applications/ products for decision support.

A prototype application service has been developed and implemented using the Web Map Services and Web Feature Services from Surveykshan Geo-portal of Survey of India, Bhuvan Geo-portal of National Remote Sensing Centre, and the Indian Railways data services from the India

Geo-portal. The application - 'Spot your train' - for the running trains of the Northern Railway has been hosted on the web (from Karnataka Geo-portal) and is useful in providing the passengers with actual departure and arrival information of the running trains of the Northern Railway. Standardised data services from multiple data sources could be used in improving the management of various railway assets like land, equipment, tracks and other resources at the stations (Figure).

A prototype of the National Data Registry (NDR) has been developed and tested for correct interpretation and analysis of spatial data sets acquired by various NSDI Partnering Agencies. Designed to improve governance of spatial data sets in the country, the NDR is expected to contain web-based registers on feature concept dictionaries, feature catalogues, application schemas, and the codes lists for reference by all the stakeholders for harmonization and automated processing of spatial data sets for developing applications and products.



Prototype of 'Spot your Train' application using standardised data services from Survey of India, National Remote Sensing Centre and Indian Railways

National Data Sharing and Accessibility Policy (NDSAP) – notified in March, 2012 is being implemented jointly by DST (NRDMS) and DeitY (NIC). A national portal i.e. data.gov.in was developed to proactively share the government shareable data to the general public. At present more than 12000 data sets contributed by 86 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 an open data sharable policy. The home page of the open data portal is given as under:(Homepage of data.gov.in Portal)

State Spatial Data Infrastructure (State SDIs)

In order to enhance the application of Geospatial Technologies in implementing developmental schemes in the country, it is felt essential to provide S&T support to develop State Spatial Data

Infrastructure (SDIs) . To achieve this, a Detailed Project Report (DPR) has been prepared. At present, technical support to develop State Geo Portal prototypes are being set up in West Bengal, Haryana, Jammu & Kashmir, and Uttarakhand States. Karnataka State has been taken up for demonstrating utility of the State Geo-portal in developing GIS applications in two selected sectors e.g. Watershed and Health..

New Initiatives - Sub Programmes : Based on the review of NRDMS programme, the following new sub programmes were initiated.

(i) **Village Information System** : As per the initiatives of the Government, the focus of the planning process is being given at village level to develop uniform infrastructure facilities at lowest level i.e. village. This has been emphasized with the adoption of villages by the Member of Parliaments and other important dignitaries. To provide the framework for planning using geospatial technologies, a Village Information System would be developed on temporal and spatial domains that will host critical information for an effective operation of a Decision Support Information System (DSIS). It could lead to an optimum and comparable development of all regions including utility of local resources. Builds up self-confidence and national belongingness and career inspiration among the young students and community. Thematic maps on various data elements like demography, natural resources, infrastructure, communication network etc. will form the base line data for attempting spatial and micro level planning to address the local issues.

(ii) **Large Scale Mapping of the critical areas in Uttarakhand** : After the Kedarnath tragedy occurred in June, 2013, it was felt that the large scale mapping along the corridor from Rishikesh to Kedarnath, which will be very vital for undertaking developmental schemes in the State may be undertaken. Thus, based on the consultative process, details of the activities and the institutions which will participate in the programme have been finalized. Programme will be launched in the Current Financial Year. The major output of this programme would be availability of seamless large scale geological maps along the corridor from Rishikesh to Kedarnath. This would provide the information for further relocation and reconstruction of the infrastructure facilities to develop the State.

(iii) **Geospatial Public Health Data Management**: Establishment of geospatial public health management system is the need of hour considering new technologies / information available. Under NRDMS programme, efforts are being made to develop a comprehensive geospatial public health data management system sub programme which will basically address to the method of diseases and risk mapping, spatial pattern of diseases, health care emergency management and location based hazards vulnerability assessment. The details of this sub programme have also been finalized.

(iv) **Revival of Village Ponds** : This programme would focus to demonstrate the efficacy of revival of village ponds to meet the ground water level and increase the usage of pond water. The programme will focus to demonstrate site specific studies in different States to meet the

storage of water and help in recharging the ground water and its utility. The programme is being finalized in the consultative mode with the participation of various relevant institutions and universities.

Mapping the Neighbourhood in Uttarakhand (MANU)

In order to develop a concrete scientific action plan for reconstruction and relocation of infrastructure facilities in Uttarakhand, a multi-institutional initiative "Map the Neighbourhood in Uttarakhand (MANU)" has been launched by DST during Sept, 2013. Based on the studies supported, a final report has been prepared highlighting the assessment of damaged objects and proposing reconstruction and relocation actionable development plan for the Uttarakhand State.

Landslide Hazard Mitigation

It is a multi-institutional and multi disciplinary coordinated programme focusing on development of methods and models for landslide mitigation. It also includes the techniques for slope stability analysis with the field inputs related to slope material i.e. soil, rocks and mix boulders. To prove the efficacy of the technology, several projects have been supported to the R&D institutions to undertake research and develop the design for mitigation of landslides by suggesting suitable site specific remedial measures. As part of the programme, following two important sites were investigated on the request of the stakeholders**.**

(i) Biamah landslide near Kargil

Based on the request from Army, a team of experts from DST visited the landslide area in May, 2014. Based on the primary survey, a project to undertake detailed geological and geotechnical mapping for developing a model for slope stability analysis has been supported to IIT Mumbai. The final outcome of this project would be to help the Army to minimize the impact of the slide and also develop suitable preventive measures to control the slide. The project will be completed in the next six month.

(ii) Malin Village Landslide (District Pune)

It was occurred in July, 2014 where 153 people buried under the debris and about 55 houses broken. It was a major disaster of its kind. In order to understand the causes of the slide and also provide technological inputs to handle such disasters, DST sent a team of experts in Nov, 2014. Based on the field data collected by the team, it was found that the landslide occurred in the weak

Mud flow during Malin landslide

geological strata which comprises of weathered basalt / soil. With the combination of heavy rain and increasing pore water pressure, which is basically acting as agent for decreasing the shear strength of the slope material, is responsible for such massive slide. Now, further efforts are being made to analyze the geotechnical parameters of slope material and develop a model to simulate various factors to draw a design for preventive measures.

National Geotechnical Facility

In Himalayan region number of infrastructure facilities / projects are being operational by Govt. as well as Public Sector Undertakings to develop hydro power, tunnels, underground constructions etc. All these major projects required detailed geological and geotechnical testing facilities to understand the behavior of the materials. To provide the strength in this direction, DST has set up a National Geotechnical Facility in Dehradun with the technical support from Wadia Institute of Himalayan Geology, Dehradun. It is being considered as the state of the art facility to attract various stakeholders for providing technical inputs and training to strengthen their programmes. The major stakeholders are : State Govt. of Uttarakhand, Railway, Tehri Hydro Power Corpn, etc. This facility is well equipped with the equipment like Ground Penetrating Radar and Rock and Soil Testing facilities to act as technical hub in this region. The technical capability of NGF is being further strengthened with the technical support from Norwegian Geotechnical Institute, Oslo.

Capacity Building on Geospatial Technologies

Under NRDMS programme, number of R&D projects and sub programmes are being supported to develop tools and methodologies for promoting geospatial technologies. In the process, good amount data bases have been developed to address area specific problems. To disseminate such outputs to the larger scientific community for adoption and replication, efforts are being made to support training programmes on short terms (3 days) and long term (21 days) on the subject. This will have a major impact to develop a trained manpower and build up a pool of experts. To facilitate this, a portal has been developed by Bhartiya Vidhyapeeth, Pune. In addition to this six Chairs have also been set up in different universities to promote the geospatial technologies.

PROMOTING GOOD LABORATORY PRACTICES

The National Good Laboratory Practice (GLP) Compliance Monitoring Authority (NGCMA) was set up in August, 2002. 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.

The NGCMA provides **GLP certification** to the test facilities, which are involved in conducting safety studies on such chemicals in accordance with Organization for Economic Co-operation and Development (OECD) Principles of GLP. India is a full 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 countries.

Some of the major achievements of the Indian GLP programme during the financial year 2014-15 are given below:

- **Six new test facilities were granted the GLP-compliance status**. These include:
  a) Toxicity Testing: GLP Test Facility, CSIR- Indian Institute of Toxicology Research, Lucknow
  b) Vivo Bio Tech Ltd., Pregnapur, Medak Dist (Telangana)
  c) Centre for Toxicology and Developmental Research, Chennai
  d) Laila Nutraceuticals Research & Development Centre, Vijayawada
  e) Drug Safety Assessment, Novel Drug Discovery and Development, Lupin Limited, Pune
  f) Lambda Therapeutic Research Limited, Ahmedabad
- Five test facilities were **re-certified**. These include:
  a) Sa-Ford, Taloja, District, Raigad (Maharashtra)
  b) Orchid Research Laboratories Limited, Chennai
  c) PI Industries Limited, Udaipur (Rajasthan)
  d) Bioneeds India Private Limited, Bengaluru
  e) Advinus Therapeutics Limited, Bengaluru
- Annual Surveillance inspection of following test facilities was done and their GLP-compliance status was continued for a period of another one year :
  a) Himalaya Drug Company, Makali, Bengaluru
  b) NIPER, Mohali
  c) Indofil Industries Limited, Thane
  d) Laboratory Animal Research Services, Reliance Life Sciences Private Limited, Navi Mumbai
- The following training programmes/Consultative meetings were organized:
  a) One Day "Consultative Meet on Good Laboratory Practice" in Hyderabad on May 30, 2014.
  b) Three Day "Training Course for Quality Assurance Professionals of GLP Test Facilities" in New Delhi on August 4-6, 2014.
  c) Two Day "Sensitization Workshop on GLP" in New Delhi on September 11&12, 2014.
  d) Two Day "Refresher Course for GLP Inspectors" in Hyderabad on October 31 & November 1, 2014.
  e) One Day "Training Course for Archivists of GLP Test Facilities" in New Delhi on January 30, 2015.

Senior Scientist, CSIR-Indian Institute of Toxicology Research, Lucknow as a faculty during NGCMA's Sensitization Workshop on GLP

Assistant Drug Controller General (India) as a faculty during NGCMA's Refresher Training Course for GLP Inspectors

- India has been selected to organize the 12th OECD Training Course for GLP inspectors, to be conducted in Hyderabad during October 12-15, 2015. NGCMA, India has been elected as Chairman of the Steering Group for GLP Training.
- India has been elected as a member for conducting the Mutual Joint Visit (MJV) of Thailand for evaluating Thailand's GLP Compliance monitoring procedures and its adherence to MAD status.
- The website of National GLP Programme **"www.indiaglp.gov.in"** has been re-designed and is continuously being updated.

CHAPTER 3

TECHNOLOGY CAPACITY STRENGTHENING

TECHNOLOGY DEVELOPMENT

CLEAN ENERGY RESEARCH INITIATIVE

Clean Energy Research Initiative (CERI) is aimed at promoting research in the area of Clean Energy with focus on hitherto Solar energy. The programme 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 Clean Energy. The programme is positioned upstream with thrust on enabling knowledge based R&D activities for entire gamut of solar technologies including balance of systems. Solar energy utilization for power as well as non-power applications to develop convergent technology solutions under real-life conditions is one of the allied objectives of initiative. The research facilities are being strengthened to develop technological competence within the country to achieve international bench-marks.

Based on stakeholders' consultation, focussed research calls were formulated and proposals were invited for Solar Oriented Fundamental Research (SOFR) and Development of Devices, Sub-systems and Systems (DSS). These calls received enthusiastic response from research community and associated stakeholder'. Out of 271 proposals received, 33 proposals were recommended for support following transparent criteria. The salient achievements in current year emanating from efforts mounted earlier, are highlighted below:

1.1 **Development and Demonstration of Modular Light Weight Solar Aluminium Tubular Air Heater (SATAH)** (Indian Institute of Technology Bombay)

A light weight solar aluminium air heater coupling DC fan with PV panel with heating capacity of 30˚C - 75˚C having efficiency in the range of 65 -80% for delivering hot air was developed and demonstrated by IIT Bombay. The estimated mass production costs for the developed system, having wide spectrum of potential uses (for drying agro produce, herbs and spices, household products, room heating) in cold regions are likely to be of the order of Rs 5000 / m^2.

Solar Aluminium Tubular Air Heater developed by IIT Bombay

1.2 **Solar Cooling and production of potable water with two stage silica gel-water adsorption system** (IISc, Bangalore and IIT Madras)

Indian Institute of Science (IISc) and Indian Institute of Technology- Madras (IITM) have

jointly developed the lab scale system of 2 kW cooling, which has bagged award for its design. The interrelationship between thermal energy input and quantity & quality of refrigeration and potable water output has been established. The options are being explored for commercial exploitation of the lab scale system.

Adsorption system based solar cooling-cum-potable water production developed by IISc, Banglore.

1.3 **Design and Development of Solar Dryer with Phase Change Material Thermal Storage for Herbal and Spices Crop Drying** (CAZRI, Jodhpur)

Design and fabrication of data logged solar crop dryer comprising of reflector, phase change material thermal storage system, drying chamber and natural ventilation system for the optimum treatment of herbal and spices was completed. .

Solar crop dryer developed by CAZRI, Jodhpur

Community Scale PV powered desalination unit developed by CSMCRI, Bhavnagar

1.4 **Energy Efficient Community scale PV powered Reverse Osmosis (RO) Desalination Unit** (CSMCRI, Bhavnagar, Gujarat)

The developed system uses V-trough concentrated photovoltaic system having multiple photovoltaic modules, arranged in long rows in order to boost the electrical energy output over a day using North-South reflectors without recourse to any tracking, and only through seasonal adjustments of the reflector angles following computational methods. The system uses direct contact heat exchanger fitted on the underside of the PV modules for active cooling and use of RO feed water as heat exchange medium. It also enhances permeate flux from RO unit through the rise in feed water temperature. In order to conserve energy, it uses a turbo-turbine for conversion of hydraulic energy in RO reject water into mechanical energy to operate the booster pump utilized in the RO unit and thus save expensive PV power.

1.5 **Development of large area, high efficiency silicon solar cells using shallow emitter technology** (BHEL- ASSCP, Gurgaon)

BHEL was able to develop the high efficiency solar cells (>18%) using lightly doped emitter (shallow emitter 50-70 ohms /sq) by optimizing various process steps using new front metal contact pastes and adopting standard manufacturing steps without introducing any additional process steps. The best cell efficiency of 18.4% has been achieved and typical efficiency distribution of a batch of 125 cells was also demonstrated.

1.6 **Development of Diamond Like Nanocomposite (DLN-PS) double layer anti reflector coating for large area Crystalline-Silicon Solar cells** (Meghnad Saha Institute of Technology, Kolkata)

The deposition and characterization of diamond-like Nanocomposite coatings and the challenges associated with prefabricated PS layer solar cell were established. These structures were deposited on 40 cells and 2.48% absolute efficiency enhancement on silicon nitride coated cell has been obtained.

1.7 **Fabrication of Nano Structured Surfaces by Soft Lithographic and Non Lithographic Techniques** (Indian Institute of Technology -Kharagpur)

Several low cost routes were identified for fabricating meso and nano patterned substrates on which both amorphous and crystalline silicone solar cells can be developed. Patterned substrate for developing solar cells has been transferred to BESU (now IIEST) for PECVD based deposition. Initial result show marked improvement in efficiency and density. Good research facilities such as dip coating facility, imaging ellipsometer, vacuum evaporation unit, rapid thermal processing tube furnace were set up to accelerate solar research.

1.8 **Efficiency enhancement of 1 to 2 % in a-Si:H/c-Si Heterojunction Solar Cells by enhanced absorption process due to surface plasmons induced by metallic nanostructures** (Indian Institute of Technology -Delhi)

Development of plasmonic textured silicon solar cell having the efficiency (~2%) more than the conventional textured silicon solar cell accomplished. This was due to the further light trapping using silver nanoparticles surfaced plasmon resonances, which led to the additional power generating electrons and improved photovoltaic parameters, which contributed the enhancement in photocurrent/ efficiency.

1.9 **Enhancement of Functional Property of N3-based Dye-Sensitized Solar Cell (DSSC) by use of Conducting Polymers and Surface Plasmon Resonance of Metal Nano-particles** (IIEST, Howarah)

Differing amount of PAN conducting polymer and plasmonic effect enhanced the performance of DSSC. However, the results are being validated through proper calibration and controlled experiments.

1.10 **Development of CZTS (Cu_2ZnSnS_4) based solar cell using Magnetron Sputtering** (FCIPT, Institute of Petroleum Research, Gandhinagar)

Plasma based deposition system has been developed and optimization of process parameter are in progress. Facilities such as plasma based deposition system, solar simulator and spectro photo meter have been set up.

1.11 **Nano-Patterned Conductive Adhesive for Metal-Polymer Inter-Connectors in Solar Cell** (Inidan Institute of Technology- Kanpur)

Development of soft conductive material and studies on focusing effects of the lenses as a function of liquid surface tension has been completed and 2 patents have been filed based on the work done under the project. The approach to integrate the lens with specific type of solar cells is being examined.

1.12 **Improved Efficiency c-Si cells -fabrication and characterization with industry collaboration** (Indian Institute of Technology- Bombay)

The focus of study was to analyze the cells at various stages of manufacturing process and develop alternate processes for possible integration in the manufacturing line. Base line solar cell optimization process was undertaken as part of the project. The facilities set up under the project viz. 3D imaging and meteorology system and Zeta 20 -3D microscope were quite useful for pursuing the activities of National Centre for Photovoltaic Research (NCPR).

1.13 **Re-synchronizable Autonomous grid** (PAN-IIT Project)

The design of inverter controls has been completed and experimentally verified. Regarding inverter paralleling, algorithm using droop based method was being tested. The power stack enclosure design is near completion. The control algorithms of a suitable topology with reduced number of components to handle unbalanced and reactive power in the system have been tested. An experimental proto-type filter of 10 kVA rating has been developed in the laboratory. The overall controls have been designed to take care of both Maximum Power Point Tracking (MPPT) as well as grid synchronization along with reactive power control as a function of overall power rating of PV system in field.

1.14 **Bhaskara Advance Solar Energy (BASE) Fellowship** supports capacity building activities in the area of Solar Energy and provides an opportunity to research scholars and young scientists to gain exposure and access to world class research facilities in leading U.S. institutions. It also encourage and motivates outstanding students to take up research as a career path, and pave the way for interaction between India and US thus helping to build long-term R&D collaborations. During 2014-15, 9 fellows and 12 interns visited US labs and gained knowledge to accelerate the solar research in country. For year 2015-16, 10 fellowship & 12 internship awardees have been selected for final support.

1.15 **US-India Joint Clean Energy Research and Development Centre (JCERDC)**: Solar Energy and Building Energy Efficiency initiative of JCERDC are progressing well. The Solar

Energy Research Institute for India and the United States (SERIIUS) is co-led by the Indian Institute of Science (IISc)-Bangalore and the National Renewable Energy Laboratory (NREL) in which 27 partners from industry and academics of India and US are putting their joint efforts in Sustainable PV, Multi-scale Concentrated Solar Power, and Solar Energy Integration Research. 75 numbers of accepted or published papers and conference proceedings has been reported from solar energy research institute.

I. Solar Energy Research Institute for India and US (SERIIUS)

SERIIUS is the large Indo-US consortium with more than 165 researchers from around 30 public and private organisations.

In line with its focus on fundamental and applied R&D on low cost materials and processes, the consortium has developed low cost roll to roll processing technologies for CIGS and CZTS solar cells, which has attracted new industrial partner. Also, the materials developed under the project have been successfully used to produce DSSC by the industrial partner.

SERIIUS has also focused on low cost distributed energy system utilizing concentrated solar power. Technical design of supercritical CO_2 test loop and steps to bring down cost of Organic Rankine Cycle through use of innovative expander and absorber coatings have been successfully achieved. The third pillar on Solar Energy Integration has focused work on storage requirements for bringing down storage costs as well as seamless integration with grid and DC networks. Several high impact publications (40) and patents (1) have been filed. 8 SERIIUS Fellows currently working in US.

Some specific achievements of SERIIUS are as under

Photovoltaics

- Low cost process for CIGS and CZTS solar cells developed on corning willow glass
- Solar cells based on new polymers developed produced by industrial partners.
- Modelling & characterization techniques for HIT solar cells developed.

Concentrated Solar Photovoltaic

- Complete technical design of supercritical CO_2 Brayton cycle loop.
- New tubular serpentine receiver of higher efficiency.
- New absorber coating and expander for low cost organic rankine cycle
- Novel hemispherical highly reflective inter metallic mirror.

II. Centre for Building Engineering Research & Development (CBERD)

CBERD had focus on development of Life Cycle Performance Analysis Framework (LPAF) for commercial multi storey buildings. The important component included decision support systems, hardware for improved functioning and enabling buildings to become grid responsive.

CEPT CBERD Window Testing

MNIT CBERD Field work

Key Achievements

- Novel heat and mass exchanger patented
- Patents filed for building integrated PV, overhangs, dynamic shading devices, advance power strip and thermal comfort reader
- Software developed and customized for window optimization, cool roof calculator, thermal comfort analysis, life cycle cost benefit analysis

1.16 In order to identify thematic areas for conducting India-centric R&D and develop R&D roadmap, DST organised a Brainstorming on "Building Energy Efficiency" on 15th December, 2014, a national workshop on "Photovoltaics" during 20-21 January, 2015 and a national workshop on "Advanced Solar Thermal Technologies" during 16-17 February, 2015.

WATER TECHNOLOGY INITIATIVE

Water Technology Initiative (WTI) aims to develop and provide low cost convergent technology solutions for domestic application to ensure safe drinking water 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: WAR for Water to cope up with appropriate research based solutions to address various challenges related to water availability, water purification and water reuse and recycling.

During the year 2014-15, convergent solution for augmentation of water resources in Koraput region of Odisha, Chirawa block in Rajasthan and Sabarkantha district in Gujarat were successfully provided. Convergent solutions in three clusters viz. Mamsapuram, Thirupattur and Buja Buja for drinking water purification and waste water treatment were successfully demonstrated incorporating a unique self sustainability model and were handed over to the local authorities in Tamil Nadu and Andhra Pradesh. Rain water harvesting systems in the states of Mizoram, Nagaland and Tripura were established with active participation and contribution of local community for addressing water scarcity issues across villages located in hilly terrain. Initiation of in-situ water purification technology in Haryana, and River Bank Filtration technology in Uttar Pradesh on banks of Yamuna, showed efficacy of technology for addressing water scarcity and quality issues across various states. Another multi-institutional collaborative field intensive project was successfully implemented in Srikakulum district, Andhra Pradesh, to understand the co-relation of Water Quality with certain clinical conditions and to relate and evaluate them with geogenic and anthropogenic causative source. 26 R&D projects in the area of water research were also initiated. The Mission activities specifically focused on providing technological solutions to disadvantaged sections of society including tribals inhabited in remote and difficult terrain.

1. Development and proving of Convergent Technology Solutions:

1.1 Addressing Multiple Water Challenges

Three systems have been successfully commissioned in Mamsapuram, Thirupattur and Buja Buja demonstrating an innovative self sustainability model and have been handed over to the authorities for further operation and maintenance.

Water Treatment System at Buja Buja, Nellore District, Andhra Pradesh

1.1.1 An innovative, holistic and sustainable technological solution in Buja Buja (Andhra Pradesh) addressing low per capita water availability covering a population of 12170 (due to hydro geological formation of clay up to 100 m) and poor quality of surface water (due to multiple contaminants, hardness and salinity due to seawater intrusion) has been provided.

Water Treatment Facility and Waste Water Treatment Plant at Thirupattur, Vellore District, Tamil Nadu

1.1.2 Technology solution for ground water contaminated with alkalinity, total dissolved solids, fluoride as well as low per capita availability in Thirupattur (Tamil Nadu), covering 25540 populations has been provided in holistic manner using surface water during monsoon season and ground water in summer period for production of drinking water. The reject waste generated from the process is conveyed to the waste water treatment plant for further treatment and disposal. The waste water is treated and reused for irrigation and also for improving the ground water table.

Water Treatment Facility at Mamsapuram, Virudhunagar District, Tamil Nadu

1.1.3 A unique integrated and sustainable technological solution in Mamsapuram (Tamil Nadu) covering a population of 17999 to address low per capita water availability has been implemented to address domestic as well as irrigation water requirements using broad spectrum membrane technology adopted for water purification. Each household pays an amount of Rs 60-90 per month for use of drinking water and a card system is put in place for keeping a check on the quantity of water delivered. The unique approach for the low per capita water availability and water quality problem can be easily replicated where similar problem exists.

1.2 Enhancing water availability

1.2.1 Ground Water Recharge and Community Water management network in Sabarkantha District of Gujarat*:* 4 clusters in Sabarkantha District (Gujarat), namely Mudshi, Halodar, Mota Kantharia & Limbda covering a population of 12285 people faces severe water challenges such as scanty and erratic rainfall, mismatched rate withdrawal and charging capacity leading to depletion of ground water tables and surface run-off. An integrated solution focusing on water conservation, ground water recharge and scientific rain water harvesting is underway to meet primarily drinking water requirements.

Check Dams and Catchment areas for Ground Water Recharge in Sabarkantha District, Gujarat

Overhead Community Reservoir in Sabarkantha District, Gujarat

1.2.2 Ground water recharge and safe drinking water to tribal households in Koraput district, Odisha- Safe drinking water supply was ensured for 634 tribal households (of six tribal groups namely Bhatra, Bhumia, Durua, Kandha, Paroja and Penthia) covering a total population of 3118 in 10 villages under Boipariguda and Kundura blocks of Koraput district, Odisha. 10 deep bore wells were made and 3-6 stand posts were erected for supply of drinking water from the overhead tank. Recharge filters of different sizes were constructed near to the bore well for recharging the ground water. Four community ponds of different sizes 600 Sq. M to 2400 m^2 were dug to conserve and use of water in three villages. Leveling and bunding of slope up lands were taken up in 30 acres of land belonging to 47 households covering 7 villages for conservation of rain water. Water harvesting structures were created to conserve the surface run off of water.

Water Collection and Distribution points in villages, Khurda District, Odisha

Check dams for ground water recharge

1.2.3 Water conservation techniques to recharge groundwater and tapping of rainwater in Chirawa, 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 & 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.

Rain Water Harvesting with household and Community Tankas in Chirawa, Jhunjhunu District, Rajasthan

1.3 Augmenting Water Quality

1.3.1 Development of Low cost Laterite base Arsenic Filter

The Laterite based Arsenic filter developed by IIT Kharagpur uses raw naturally abundant laterite modified using suitable chemical treatment. The Arsenic removal capacity of the filter is 32.5 mg/g, which is maximum among other adsorbent materials as compared to expensive activated alumina, iron oxide coated sand, iron based commercial adsorbent etc. It requires no power for functioning. The adsorbent is cost effective and adsorbs both As (III) and As (V). IIT Kharagpur has transferred this technology to Industry, Vas Bros. Enterprises Private Limited, successfully. The technology was also presented at Indovation - an Innovation workshop organized by Ministry of Water and Sanitation at New Delhi on 23rd and 24th January 2015.

Low cost Laterite Arsenic Filter (Left) and Arsenic filter at Chouduar Primary School in Malda District, West Bengal

1.3.2 Development of water treatment technology for Arsenic Removal based on Zero Valent Iron (ZVI)

The cost effective locally available non electrical Zero-Valent Iron (ZVI) based low sludge generating process capable of consistently removing Arsenic as per drinking water standards and each unit provides 60-80 litres per hour of drinking water sufficient to cater to 300 families. The process achieves oxidation of As(III) to As(V) and subsequent arsenic removal by hydrous ferric (Fe) oxide, which is formed from oxidation of leached Fe^{2+}, without the addition of any chemicals, thus bringing down the arsenic content to desired levels.

Arsenic Removal Plant based on Zero-Valent Iron

This affordable and energy saving decentralized technology solution for addressing geological contamination through arsenic integrated with appropriate reject management systems covering 1870 families spread over 4 clusters in 56 sites in parts of **West Bengal, eastern UP** and **Bihar** has been implemented fully.

1.3.3 In-situ Treatment of Saline Groundwater, Village Dighal, Dist Jhajjar, Haryana

In-situ Purification System in operation at Dighal, Jhajjhar District, Haryana

Like many other villages in Haryana, Dighal village in Jhajjar District was facing high salinity of groundwater. To address this scarcity In-situ Purification system (ISP), was installed to treat saline groundwater in the tube well. The system manages the reject water within the aquifer. The ISP system delivers the quality water reducing TDS and the reject water is dissipated in the deep aquifer zones having almost the same or higher salinity. The high quality water will serve the population of 300-500 people per day.

1.3.4 **Impact of Water quality in endemic kidney disease in coastal Srikakulam (Andhra Pradesh)-** Four Mandals of Srikakulam, Andhra Pradesh is under study, covering 11 villages to assess and classify the renal and related diseases prevalent in the region. Initial studies indicate

the presence of higher traces of Silica and other trace elements in the various water sources. Also a thorough observation of the trace element analysis data of the shallow aquifers, deep aquifers, surface waters and soil samples collected from the study area indicates higher concentrations of Gallium, Rubidium, Lithium, Strontium and Cobalt. The water containing high concentration of these elements like Cobalt and radioactive elements like Gallium, Strontium, Lithium and Rubidium etc in addition to Silica may lead to kidney and related diseases. The study is to provide critical information on possible sources causing this disease. Further it will provide scope to follow up the same and arrive at remedial measures to eradicate the same which helps to design and develop a water treatment technology if the causative sources happen to be water.

2.0 Referencing of Technologies

2.1 Scientific Evaluation of Water Purification Systems in Sikkim

Water filtration system in Singtam Sr. Sec School, East Sikkim, Sikkim

The performance of different types of water purification technology to provide safe drinking water in schools/ institutions across Sikkim has been assessed through this project. The filter has a three staged filtration process consisting of pre filtration, Ultra-filtration and (UF) and ultraviolet (UV) filtration unit. The total output of this filtration system is 500 litres per hour per unit. At present the installation of these three stage filtration system along with water tanks and drinking platform in 20 different institutions has been successfully completed in Sikkim.

The direct beneficiaries of the project include students and staff of twenty schools across the state of Sikkim. The project is providing safe drinking water to an average of 1000 persons per school in different districts of the state which sums up to 20,000 beneficiaries and hence, children in twenty different areas of the state are safe and secure from common water borne diseases. Various physical, chemical and biological parameters are also being evaluated to ascertain the work performance of these filters.

3.0 Capacity Building

A capacity building exercise of scheduled castes youths for water resource development and management through appropriate scientific technologies and tools in rural parts of Kozhikode, Kerala was supported. This training and skill development exercise has led to capacity building and empowerment of the community on Water Resources Management (WRM) for their betterment and livelihood.

A Water Quality Testing laboratory has been set up with NABL accreditations in the NE state of Nagaland. The major deliverables of this project is to produce trained manpower equipped with analytical techniques and its usage to test the water sources and water bodies in all the 1376 settlements of Nagaland, and monitor Water quality in specific problem areas, particularly where water is contaminated with heavy metals and toxic chemicals in the region.

4.0 International Cooperation

Under New Indigo India and select EU countries collaborative arrangements, 9 projects were supported with focus on Waste water management including applications in industry & agriculture and green chemistry applied to water purification including drinking water purification. These projects have resulted in good scientific publications and collaborative research.

The first Dutch India Water alliance and leadership initiative (DIWALI) has been approved for setting up a pilot 5 MLD Sewage treatment facility under New Urban Sanitation System with Dutch technology for Vadodara urban development authority (VUDA) in Vadodara.

5.0 R&D Projects

Some R&D Projects on water research initiated during the current year are:

- More crop and income per drop of water-a scientific approach for its effective realization.
- Pilot Scale Demonstration of Novel Water Defluoridation Unit for Rural Areas.
- Field Trials of Low Cost Fluoride Filter: Domestic and Community Scale.
- Development of a novel hybrid process for the economic removal of ammonia from wastewaters.
- Control and Operation of urban distribution networks.
- Hydroxyapatite based ceramic adsorbent for strontium removal from drinking water.
- Catalytic Oxidation of Nitrogenous Aromatic compounds bearing wastewater.
- Removal of Arsenic from Drinking Water using Liquid Membrane based Separation Technique.
- Surface Plasmon resonance (SPR) based colorimetric sensing of Mercury and Chromium species in the contaminated waters.
- Development of River Filtration system on the banks of river Yamuna in Dayalbagh, Agra.
- Characterization & testing of Nanocellulose class of nano materials in model & real waters.

- Quantification & Characterization of Disinfection by products in drinking water from various places of T.N.
- Defluoridation of water by Graphene metal ferrite composite.
- Small Community Level low cost process from local Biomass for Iron & fluoride removal from bore well water of Assam.
- Assessment of the quality of drinking water sources in the western part of Godavari Western Delta, West Godavari Dist, A.P.
- Studies on the effect of ingression of seawater in selected 56 villages of the Sunderbans of W.B.
- Innovative Aquaculture technology for conservation of water & safe discharge of effluents.
- Policies for sustainable water resources: A study of Vizag urban area.
- Development of optodefor fluoride by Digital color Analysis.
- Automation of Hygienic drinking water supply system using wireless sensor networks.

TECHNOLOGY SYSTEMS DEVELOPMENT PROGRAMME (TSDP)

Technology Systems Development Programme (TSDP) 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/ process or techniques/technology aimed at specific end use. The programme stresses on clearly identifying the needs for technology development.

The mandate of TSDP is limited to converting proof-of-concepts for development of pre-competitive/commercial technologies/ techniques/ processes. The commercialization of these technologies needs further assessment/incubation, which does not fall within the scope of the programmes. Transfer of technology developed under the project to the industry will be the onus of the host institutions. The projects related to only hard core technologies are considered. Proposals of incremental R&D over the existing technologies are also considered for support under this programme. Theme based concept proposals for proof of feasibility are not considered under TSDP-DST. Only full fledged complete proposals for development of technology/process/product are considered under TSDP. Projects related to design and development of software/IT, as required for products and processes, as a part of technology development project are considered. Pure software development does not fall in the scope of the programme. Technology upgradations of industry clusters in select areas are also taken up under TSDP.

The programme supports the projects for design & development of prototype and product. The programme also supports technology demonstration projects to prove technical viability prior to commercialization/societal dissemination. The programme also creates technology innovation centers to strengthen the linkages between academia and industry with a focus at university level.

23 new projects were supported during the year under TSDP during the year.

Major achievements: Technologies developed and under-going trials

1. **Indian Institute of Science (IISc), Bangalore has developed and demonstrated Hybrid Ultra Capacitor (HUC) lighted solar/mechanical/grid chargeable lanterns with mobile charger. HUC technology is protected by the Institute and its know-how is transferred to M/s Mesha Inc., US.**

A photograph of the HUC along with some lantern units with their technical specifications is given below.

Hybrid Ultra Capacitor (HUC)

The technical features of the lanterns are as under.

- 2W cool white LED light.
- 4-5 hours lighting from fully charged condition.
- Full charging time about 2 hrs.
- Charging possibilities through grid, solar and mechanically driven dynamo.
- Mobile charging via USB.
- 5 year product warranty.
- Meets MNRE specifications.

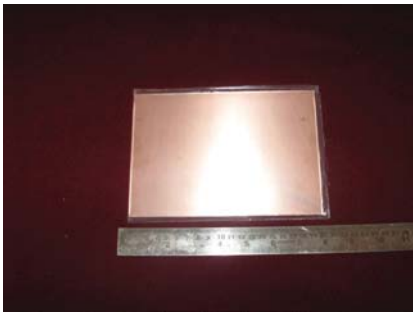
2. **Plasma treatment of brass valves to improve bonding with rubber by by** Facilitation Centre for Industrial Plasma Technologies **(FCIPT), Institute for Plasma Research (IPR), Gandhinagar, Gujarat.**

The objective of this proposal was to scale up eco-friendly plasma etching process for treatment of brass valves to improve rubber to brass bonding by designing and development of an industrial scale (5000 valves per batch) system along with Industrial Partner.

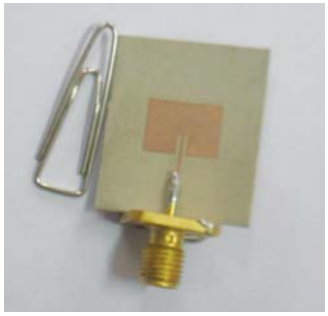
FCIPT has successfully commissioned and demonstrated the plasma treatment on 5000 valves per batch with total valves treated were more than 7.0 lakhs at M/s Triton Valves, Mysore. Plasma. Further, this rubber-brass bond is very durable and has high resistance to dynamic and thermal aging (during service, the inside of the tire can reach a temperature of about 120°C).

3. **Flexible microwave substrates for wireless communication applications by Centre for Materials for Electronics Technology (C-MET), Thrissur.**

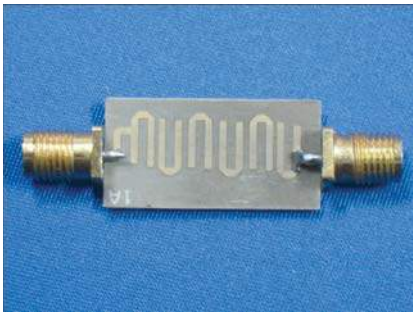
Flexible microwave substrates are extensively used for variety of high end microwave circuit applications such as high power solid state amplifiers, patch antennas, missile guidance, mobile base stations etc. More than 70% of the cost of any microwave device accounts for the base microwave circuit board and the availability of such circuit boards in the country are going to make phenomenal changes in the overall performance of microwave PCB industries.



8"x8" size Cu-cladded microwave substrates developed at C-MET through DST funding



Miniaturized patch antenna fabricated using high dielectric MW substrates



Band pass filter fabricated using indigenously developed MW substrates

4. **Setting up of an industrial scale atmospheric pressure plasma system at Himalayan Institute For Environment, Ecology & Development (HIFEED, Ranichauri and Kullu Region to improve angora wool processing by Facilitation Centre for Industrial Plasma Technologies (FCIPT), Institute for Plasma Research (IPR), Gandhinagar.**

In Angora wool, the smooth surface and low bonding force among the fibers leads to shedding and thus weaving is difficult. Plasma surface interaction enhances surface roughness and form oxygen containing functional groups thus improve cohesion among Angora wool fibres. It is a cost effective eco-friendly process as the plasma treatment

Atmospheric pressure plasma system for angora wool treatment

cost is $ 0.8 per kilogram of Angora wool which is much less if it is compared with the cost of Angora fibers that is $ 32 per kg. The developed systems are installed at Himalayan Institute for Environment, Ecology & Development (HIFEED), Ranichauri, Uttarakhand and Kullu Handloom & H/C Weavers Cooperative Society, Kullu, Himachal Pradesh. One meter wide Angora web at the processing speed of 3-4 m/min can be treated by using this system.

5. **Development of cost effective process for enhanced dye production from selected micro fungi *curvularia, phoma, pestalotiopsis* sp., large scale testing and formulation as industrial textile dyes by Shri AMM Murugappa Chettiar Research Centre (MCRC), Taramani, Chennai, and Dept For Advanced Studies In Botany, University of Madras, Chennai.**

Total 88 colored cultures were isolated from the sampling trips and maintained in malt extract medium. Molecular identification was carried out at Centre for Advanced Studies in Botany. Continuous production of extracellular and intracellular dyes was carried out up to10 L capacity per month from *Phoma foveata* (13 g/ 3L), *Curvularia lunata* (12 g/10L) in MCDB and PDB for *Pestalotiopsis* sp. The extracted dyes were tested for their dyeability on different cotton fabrics (50 meters wide cotton fabric) and developed variety of shades using different dyeing techniques and its efficacy such as repeated wash fastness and rubbing fastness was tested at M/s Vaibhav Processing Mills, Erode.

An offshoot of this project, brown and orange dyes from selected mushroom such as *Ganoderma* and *Pycnoporus* respectively was done along with these selected micro fungi for formulation of additional shades. In combination of mushroom dyes with micro fungal dyes, different shades were developed. "A novel process for the treatment of raw textile dyeing effluents" was also designed and tested at laboratory scale.

Extraction of brown dyes for industrial dyeing

Dyeing of cotton fabric using brown dyes in industrial jigger machine

Dyeing of cotton fbric using pink dyes using industrial jigger machine

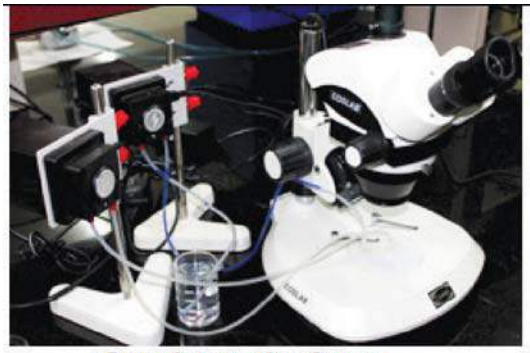
Dyed fabric

6. **Ferro Fluids: S&T & Applications: Up-scaling of tailor made magnetic fluids & its characterization for different applications: Coolant, Damper, Seal, etc. by Charotar University of Science and Technology (CHARUSAT), Changa, Gujarat.**

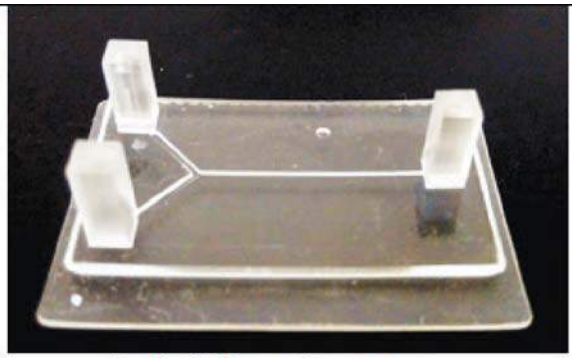
The adoption of magnetic fluid for various applications like damper, coolant, etc. have not been optimized due to the variable performance of magnetic nanoparticles systems especially during large scale production. The aim is to tune a reproducible and potentially scalable magnetic fluid for damper and coolant applications.

7. **Micro-fluidic Lab-On-a-Chip sensor to detect and monitor viscosities for a variety of biochemical applications by University of Petroleum & Energy Studies (UPES), Dehradun and CSIR-Central Electronics Engineering Research Institute (CEERI), Pilani.**

The project envisages the platform technology development for a Microfluidic based Micro-viscometer, able to detect and monitor in a variety of biochemical applications where viscosity being the sensing parameter. Simulation and experimentation methods are being developed, followed by characterization and optimization by optical and electrical sensing mechanisms. Initially, such devices are being tested for fuel adulteration and biofuel blending on lab-scale with a goal to optimize it for industrial setting.



Complete testing Setup

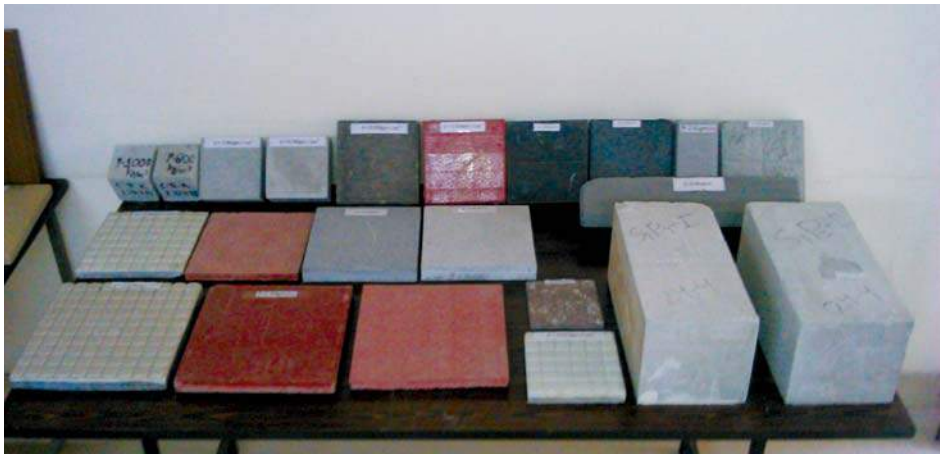


Optical Micro-viscometer

8. **Development of value added products utilizing kota stone waste by Central Building Research Institute (CBRI), Roorkee.**

Kota and Jhalawar districts of Rajasthan have been subsisted with about 100 million tonnes of splitable type of decorative grade flooring limestone, known as Kota stone. The year wise production of Kota stone is almost continuously increasing giving a way to secondary industries for recycling and using such solid wastes in construction materials.

The work has been done to produce lightweight foamed concrete with a given design targeted density of 800 and 1000 kg/m^3 as per IS code that can be classified for non-structural applications. The decreased density reduces the self-weight, foundation size and construction costs. Non-structural lightweight foamed concrete generally used to reduce dead weight of structure as well as to reduce the risk of earthquake damages to a structure.



Different value added products made by Kota stone waste

9. **Development and implementation of a model telepsychiatry application for delivering mental healthcare in remote areas (Using a medical knowledge-based decision support system) by Dept of Psychiatry, Postgraduate Institute of Medical Education and Research (PGIMER), Chadigarh.**

The PGIMER was the nodal centre for this project with three peripheral centers at Srinagar, J &K, Srinagar, Uttrakhand, and Bilaspur in Himachal Pradesh. The PGIMER telepsychiatric project has followed a novel model of training and enabling non-specialists (i.e., general physicians and para-professionals) at remote sites to diagnose and treat mental illnesses on their own, with minimal supervision from the nodal centre. The major achievement of this project has been the development of a net-based computerized application for diagnosis and treatment of common psychiatric disorders in adults and children. It replaces the need for a psychiatrist and serves as a "virtual psychiatrist" instead. The Application has two interlinked parts, one for diagnosis and the other for treatment and follow-up of psychiatric disorders. The team at the PGIMER is currently working on refining this application further, as well as extending the project to additional centres in other states.

10. **Intelligent Remote Health Monitoring for Bridge Systems (IRHMS) by Structural Health Monitoring Laboratory, CSIR-Structural Engineering Research Centre, Taramani, Chennai**

Structural Health monitoring is gaining importance, to assess the structural health and to ascertain the safety and integrity of major civil infrastructure. The project aims at the development of state-of-the-art technology in structural health monitoring application, involving multidisciplinary approach, and reaps the advantages of rapid developments in electronics, sensors, communication and information technology for efficient bridge health monitoring and decision support systems. IRHM scheme provides self-diagnosis and self-calibration capabilities with optimum bandwidth and power requirements. Developed methodologies with use of indigenous sensing techniques and wireless technologies, reduces the cost of monitoring and improves the efficiency.

Proposed IRHM scheme

11. **Low cost dye sensitized solar cell technology : An alternative of Silicone Based Solar Cell by Department of Chemistry, Sardar Patel University, Vallabh Vidyanagar, Gujarat**

Dye Sensitized Solar Cell (DSSC), a third generation photovoltaic technology has emerged as a subtle alternative for the contemporary Silicon based technology in terms of production and costing. Under the first phase of the project, PI has developed low cost purely organic dye molecules as a light harvesting material in dye solar cell. These dyes are easy to synthesize in laboratory as well in bulk without using precious metals either as catalyst or in dye itself.

The DSSC devices were fabricated using this dye molecule and achieved more than 7% solar to electricity conversion efficiency under the illumination of sunlight. The fabrication of first indigenous dye solar cell based portable battery charger, a device with 5 cm^2 area, is under progress. This technology has potential for industrial absorption.

12. **Development of technology for use of fly ash as an alternate material in pavement construction through accelerated pavement testing by Central Road Research Institute (CRRI), Delhi.**

The project focuses on following aspects:

Basics	:	Assessing the basic engineering properties and behavior of the selected fly ash based sub- base/base course materials
Evaluation	:	To know the field performance under real life like traffic loads and drawing inferences on the utility of the fly ash based on analysis of observations and documenting
Application	:	Drawing Inferences on the utility of these materials based on analysis of observations and documenting

Material for laboratory evaluation of aggregate base has been procured and basic tests initiated. Required fly ash sample is availed and basic evaluation is in progress. Evaluation tests on cement have been initiated.

13. **Development of new designs and new products based on the indigenous material, skills and infrastructure available at Purdilnagar bead & bangle making cluster by Ceramic and Glass Discipline, NID, Ahmedabad.**

The Purdilnagar cluster witnessed steep rise in demand of its beads from late nineties until the end of year 2007 and a fall afterwards. Preliminary study of the work space, existing infrastructure, technology and the range of products helped PI to identify some of the gaps, while working through the project later helped to probe further into reality and understand the dynamics amongst the stakeholders located in the region, much clearly.

New Developments

- Product diversification considering the existing set of skills and infrastructure. Development of new range of accessories for the identified markets, where bead is used as a raw material,
- Skill development workshops to execute & mobilise the above developments.
- Workshops across metro cities to popularize the bead making craft amongst other stakeholders who would ideally want to collaborate and work with the cluster in future.
- Up-gradation of the existing infrastructure; to provide better working conditions for the craftsperson, such as; tools, equipments and work space. This will help to consider health and safety aspects and overall well-being of the artisan community.
- Building Market connects, through craft bazaars, across Ahmedabad, Vadodara and Delhi, and intends to take this activity further.

INSTRUMENTATION DEVELOPMENT PROGRAMME (IDP)

The Instrumentation Development Programme (IDP) of Department of Science & Technology (DST), Government of India was initiated in 1975 and is a programme through which the Department of Science and Technology (DST) promotes R&D programmes for indigenous development of instrumentation. The thrust areas include Medical and Healthcare, Analytical, Industrial and

Sensors & Allied Instrumentation. The aims and objectives of the programme are as follows:

- Promotion of indigenous development and production of instruments
- Supporting up-gradation of instruments developed earlier
- Establishment of strong base in Research, Design and Development (RD&D) and production techniques
- Capacity building in the area of Instrumentation

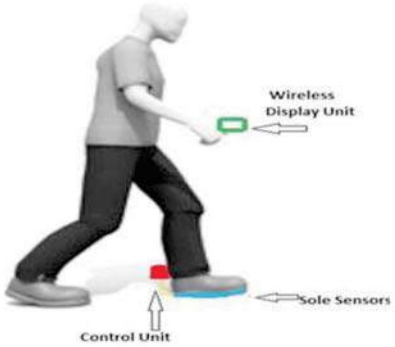
New Projects supported

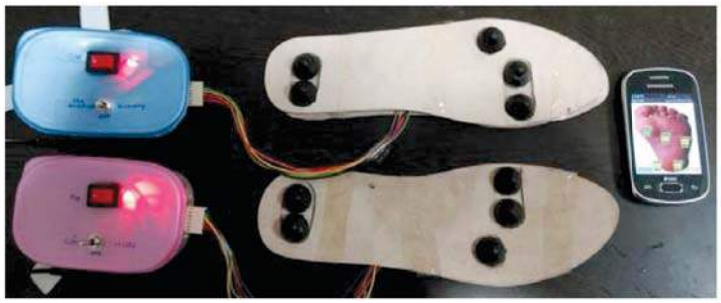
Fifteen new projects in the area of textile, quality control, agriculture, food processing, medical and healthcare, veterinary and sensor based instrumentation have been supported with industry collaboration at various National institutes/ Universities/ Engineering and Medical colleges.

Major achievements: Technologies Developed, Transferred & Commercialized under IDP

1. Design and Development of a sensor sole for stroke patients by D/o Phsiotheraphy, Manipal College of Allied Health Sciences (MCOAHS), Manipal University, Manipal

The device collects real time data from feet of stroke patients in standing position and provides feedback of their weight distribution through the mobile device wirelessly.





Sensor sole for stroke patients

2. Development of Smart Prognostic System for Early Indication of Cardiac Problem of a Patient by Bengal Engineering and Science University, Shibpur, Howrah

Smart Prognostic System

A small, low cost, portable, battery operated device to record electrocardiogram (ECG) and phonocardiogram (PCG*)* signals and keyboard based entry of patients questionnaire to record various parameters viz. age, Non-invasive blood pressure (NI-BP), diabetes etc has been developed. Once all the data are collected, processed and analyzed, the patients cardiac risk can be estimated. This risk factor has to be produced to a Cardiac expert to facilitate both diagnosis and prognosis of the patient's disease.

3. Design and Development of cost effective in-situ induction motor efficiency monitoring system using the latest art of instrumentation by Central Scientific Instruments Organisation, Chennai Centre.

The prototypes of induction motors efficiency monitoring system (iMEMS) were developed and tested in the lab for their performance with the help of loading arrangements fitted with induction motor. The results obtained were compared with the conventional method of efficiency measurement and found satisfactory.

View of the Power Interfacing Unit fabricated & installed at Site

4. Development of low cost device for non-invasive management of feacal incontinence and urinary stress incontinence by Department of Gastro-intestinal (GI) surgery, All India Institute of Medical Sciences (AIIMS), New Delhi

The new device can be used by patients who can sense the urge but cannot withhold the leak. This will limit the amount of urine leaked as they will get time in hand to go to the washroom and relieve themselves.

Leak Sensor embedded in a Diaper

5. Somatic Cell Count Flow-through based Reader for detection of mastitis in bovine by Department of Animal Biotechnology, Madras Veterinary College, Chennai

A liquid based assay (ABT-SCC Quick count kit) to determine the somatic cell count from bovine milk by targeting the cell bound enzymes has been developed. The result appears in less than 30 min and test can be performed at the farmer's premises. The colour produced in a sample is directly proportional to somatic cell count which can be determined by comparing with the colour card. The kit is a portable, user-friendly, cost effective (Rs. 2.00 per milk sample).

Somatic Cell Count-Quick count kit

6. Development of Mechanized System for Effective Sett/Bud Treatment of Sugarcane by Central Institute of Agricultural Engineering (CIAE), Coimbatore and Sugarcane Breeding Institute (SBI), Coimbatore

A low pressure plant protection chemical treatment has been developed to address the issue of Red rot and smut disease management in the sugarcane setts / buds before planting. By using this equipment, the soaking time is reduced significantly by almost 90 per cent and achieved more effective penetration of the chemical in to the Sugarcane setts / buds. Since the same chemical

can be reused, the saving in chemical used for pretreatment was 80-85 percent, thus making the system environmentally friendly, addressing the issue of optimized chemical use in Agriculture. The scaled up model (about 20,000 sugarcane buds chips and 2000 double set buds) was developed could be hitched to the tractor and transported to the sugarcane field, making it very convenient to use.

Mechanized sugarcane sett/bud treatment-prototype model

7. Development of network and online metering of drying parameters of Biomass Hot Air Generation System integrated with Solar Tunnel Dryer for agro products drying applications by Department of Bioenergy, Agricultural Engineering College & Research Institute, Tamil Nadu Agricultural University, Coimbatore

The solar tunnel dryer integrated with biomass hot air generation system is developed with control instrumentation for relative humidity and temperature controls for continuous drying for agro products. The integrated drying system is consist of solar tunnel dryer for hot air generation during sunshine hours and biomass hot air generation system for off sun shine hours of drying. The utility of the instrumentation and control system facilitates to attain uniform temperature and relative humidity inside the drying chamber, thereby; it promotes uniform drying condition at all tray levels throughout the length of the tunnel for large scale drying of coconuts (2000 kg of coconuts per batch) throughout the drying period. The integrated drying system with instrumentation is applicable for drying of chilli, medicinal plants and food products like vadam.

Solar tunnel dryer integrated with biomass hot air generation system

8. Design and Development of Vacuum Frying System (VFS) for the Production of Healthy Snacks Products by Department of Lipid Science and Traditional Foods, Central Food Technological Research Institute (CFTRI), Mysore

Vacuum Frying System (VFS)

The machine (VFS) can be used for production of healthy fried snack foods for health conscious consumers, who prefer low fat snacks with high health benefits such as, reduced-fat potato chips with low acrylamide, reduced-fat bitter gourd chips with high charantin content, reduced-fat beetroot chips with higher retention of betalain content and reduced-fat *kabuli chana.*

Vacuum frying is carried out below atmospheric pressure; this lowers the frying point of oil (90- 120°C) and boiling point of water. Instead of pump, nitrogen gas is introduced to flush out the oil from storage tank to frying chamber and vice versa by maintaining vacuum/ pressure. Operation precisely controlled by computer.

9. Development and Evaluation of Drying Systems for Important Spices of North Eastern States by Department of Agricultural Engineering, College of Agriculture, Central Agricultural University, Iroisemba, Imphal

The equipment operates on the principle of space heating, consists of a separate biomass combustion chamber/furnace and a drying chamber (temperature 60±5°C). The wood charcoal/ biomass briquette burns completely in smokeless environment and supply clean hot flue gas to the rectangular ducts with the help of baffles. The capacity of the equipment is about 95-100 kg fresh sample per batch and drying takes about 8-10 hours to reduce the moisture content below 6-7% (w.b.) saving the drying time upto about 64% compared to traditional Bhatti dryer and fuel saving of 57.6%. Benefit-cost of operation of equipment for drying of ginger/turmeric worked out to be in range of 2.6. One sensitization workshop cum demonstration of operation with the collaborative NGOs and progressive farmers was conducted at the Institution trial field.


Demonstration to the NGOs, farmers

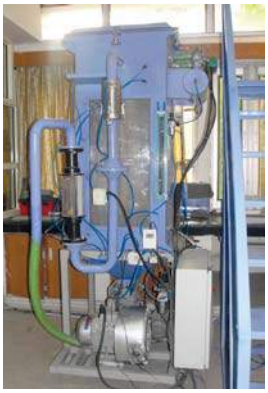

Drying operation of Turmeric slices

10. Design of Pulse-jet Filtration Apparatus by Department of Textile Technology, National Institute of Technology, Jalandhar, Punjab

Two test rigs, viz. a viz. pulse-jet filtration test rig and industrial filtration rig have been developed. Pulse-jet Filtration Instrument can be used for the assessment of filtration performance of filter media (in flat form) challenged with aerosol; whereas Standardized Industrial test rig can be used for the assessment of filtration performance of filter media in tubular form similar to industrial set up maintaining clean air requirement. Technology transfer event and one day workshop on the filter media characterization was organized at NIT Jalandhar on December 15, 2014. NIT Jalandhar has transferred the right of manufacturing of test rigs (for characterizing filter media used for pollution control in industries) to Kanwal Enterprises, Gurgaon, Hr.).

The development will help textile and environmental technologists, researchers, practicing engineers and technologists, industry personnel, and filter unit manufacturers and consultants involved in pollution control activities.

Pulse-jet filtration test rig



Industrial filtration test rig

11. Design and Development of Portable Pain Relieving Instrument by D/o Phsiotheraphy, Manipal College of Allied Health Sciences (MCOAHS), Manipal University, Manipal

Musculoskeletal pain is one of the most common reasons for patients to contact health care professionals. At present, there is no single device with Low & Medium Frequency currents in a single unit. It is a safe and easy to use medium frequency device to be used at community level. All these features are not available in other devices which are used in electrotherapy and the novelty has been patented.

Portable Pain Relieving Instrument

Post operative pain relieving

INTER SECTORAL SCIENCE & TECHNOLOGY PROGRAMME

Inter Sectoral Science and Technology Advisory Committees created with the initiative of the department continued to function in the ministries of Steel, Coal, Mines and Shipping and Transport. The salient features of business transacted in these STACs is given below:

Ministry of Mines

The fourth meeting of Geoscience Advisory Council (GAC) was held under the Chairmanship of Shri Narendra Singh Tomar, Hon'ble Minister of Steel & Mines, in the presence of Shri Vishnu Dev Sai, Hon'ble Minister of State, Steel & Mines, at Vigyan Bhawan Annexe, New Delhi on 12th November 2014. Dr. Anup K. Pujari, Secretary (Mines) as Vice-Chairman of the council was also present. The Hon'ble Minister, Steel and Mines invited the views and suggestions of the GAC members for enhancement of the performance of GSI. Members gave their suggestions which will be implemented by the Geological Survey of India.

The ministry has constituted Standing Scientific Advisory Group (SSAG) t**o** recommend, evaluate and monitor the projects relevant to the ministry under the chairmanship of Secretary Min. of Mines

29th meeting of Research Advisory Committee was held on 1st November at Jawahar Lal Nehru Aluminium Research Development and Design Centre, Nagpur. In this meeting four completed projects were reviewed. Status of six on-going projects funded to various organisations related to development of portable analytical kit for field analysis of bauxite, upgradation and utilisation of laterite of east and west coast deposit was noticed. It was also noted that six projects have been sponsored by the industries including GMDC, Gujarat and NALCO. Five new project proposals have been submitted to Standing Scientific Advisory Group of Ministry of Mines. The Research papers have been published by the officers in intenational journals with impact factor of 4.2. Various administrative and financial issues concerning existing manpower and staff crunch were also deliberated in the meeting and appropriate decisions taken for their implementation.

15th project Monitoring Committee was held at Jawahar Lal Nehru Aluminium Research Development and Design Centre, Nagpur under the chairmanship of Prof. S.Subramanium. Progress of 11 on-going projects, 6 from Ministry of Mines and 5 from NALCO were reviewed.

Ministry of Steel :

The ministry has two level structure -Empowered Committee (EC) and Evaluation Group (EG). Empowered Committee is constituted to recommend, evaluate and monitor the projects relevant to the ministry under the chairmanship of Secretary, Steel. Empowered Committee is serviced by the Evaluation Group with the department as one of its member. In various meetings of the Group new projects received from the ministry from the universities, IIT's, research laboratories and industries were evaluated and sent to experts for their comments. The consolidated view of the experts along with the department was shared during various meetings of the Group to facilitate

decision making. Evaluation Group met four times during the year and considered new proposals.

Ministry of Coal

Eleventh meeting of the Technical Sub Committee of STANDING SCIENTIFIC RESEARCH COMMITTEE (SSRC) under the chairmanship of Chairman Cum Managing Director, Central Mine Planning and Design Institute Limited was held on 28th July, and 12th meeting was held on 26th November, 2014 in New Delhi. New projects received were evaluated, status of the on going projects was monitored. The whole issue of Intellectual Property Rights was discussed as IIT Bombay, ISM, Dhanbad and CIMFR, Dhanbad approached the organisation for filling the patent. The request received in the department from Ministry of Coal was carefully studied and comments were forwarded with contact details of in charge of Patent Facilitating Cell in TIFAC for further clarifications.

Indian Academy of Engineering in close co-operation with Canadian Academy of Engineering are organising Joint Conference on Cean Coal Technology in Toronto, Canada in July 9-10, 2015. Representatives from Government, Industries and Academia discussed the various pertinent issues facing coal industry in India under the Chairmanship of Dr KV Raghavn, Vice-President, Indian Academy of Engineering on 6th February in New Delhi.

NATIONAL PROGRAM ON CARBON SEQUESTRATION RESEARCH (NPCSR)

The programme which was initiated in 2007 continued during the year. As DST has sanctioned an appreciable number of projects in the area of Agro Forestry sequestration in the past, therefore AICP is being contemplated so as to replicate these in a consolidated manner all over the country. In addition AICP is also in line with the recommendations of the 12th Five Year Plan. The C-sequestration in agriculture, forest and other land use (AFOLU) sector is considered important in view of the degree of short term low cost opportunity cushion available with very high potential for C-sequestration. IPCC report of 2014, also states that the AFOLU sector has the portential for Carbon Sequestration in soil and stock Twelfth plan period recommended that an All India Co-ordinated Project on C-Sequestration in Agro-forestry and other Land Use Sector (AFOLU) will be formulated. Efforts were made to launch the said AICP with first phase in all the seven states of North Eastern Region of India. Eminent experts belonging to Indian Institute of Science, Bangalore, Universities, Research Institutions were involved in formulation of this project. Common guidelines including objectives, methodology, work plan were formulated to assess the organic carbon in subsoil, stock and litter. The title of all the projects is listed at the end.

During the year, more than 40 proposals were mobilized, evaluated and peer reviewed by the experts. Programme Advisory and Monitoring Committee recommended seven new projects received from various universities, national laboratories etc. The programme has expended in 23 States across the country. During the year five Programme advisory and Monitoring Committee Meetings were held. Total 22 new proposals were evaluated and reviewed the progress of 28 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.

Achievements of the project/programme during the current year

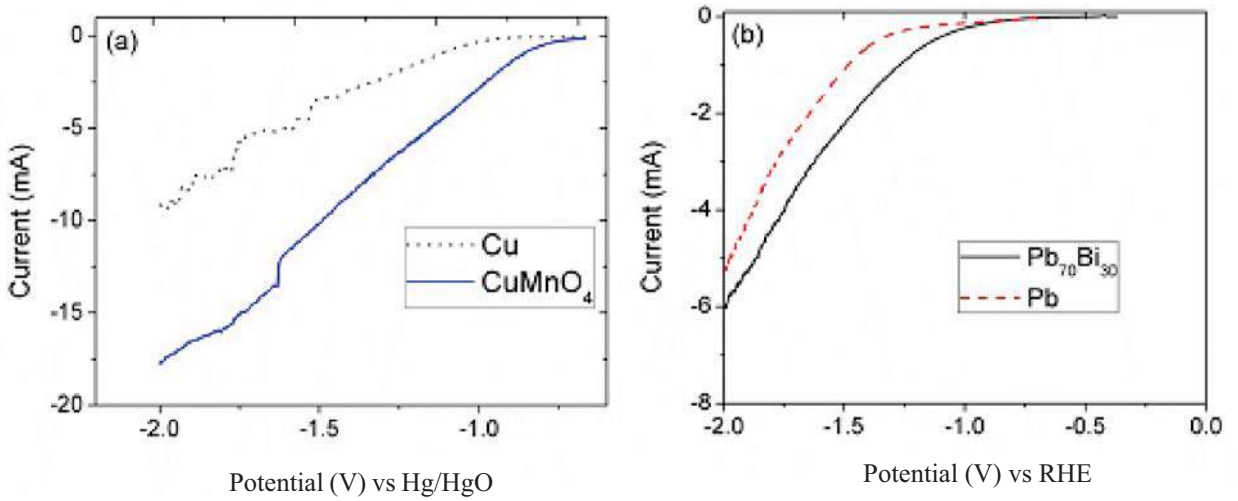
At National Facility for Marine Cyanobacteria **(NFMC)**, a marine cyanobacterial strain was selected among twenty strains which could grow at 15% continuous CO_2 and in simulated flue gas conditions. The various experiments carried out substantially prove, that cyanobacteria can be grown in effluent at outdoor condition with flue gas at point source.

Industrial setup for carbon sequestration by marine cyanobacteria at point source at Pioneer Jellice Industries Cuddalore. (NFMC, Bharathidasan University)

Many species of microalgae were grown in simulated and actual flue gases from cement plants, thermal power plants, coal firing plants etc. Microlagae like *Chlorella* sp, is by far the most widely used organism for algal sequestration from flue gas. The organism was cultured in outdoor thin layer and cylindrical photobioreactors .The merit of CO_2 bio-mitigation is primarily in the fact that biomass produced in the process of CO_2 fixation can be converted efficiently into biofuels for energy production.

Under the project "Development **of electro catalysts for electrochemical reduction of carbon dioxide to formic acid and syn-gas" implemented by** Indian Institute of Technology Bombay, The project primarily seeks to develop electrocatalysts for efficient reduction of carbon dioxide to valuable chemicals. The chemicals that are being targeted are formic acid and syn gas. Following are the highlights of the work:

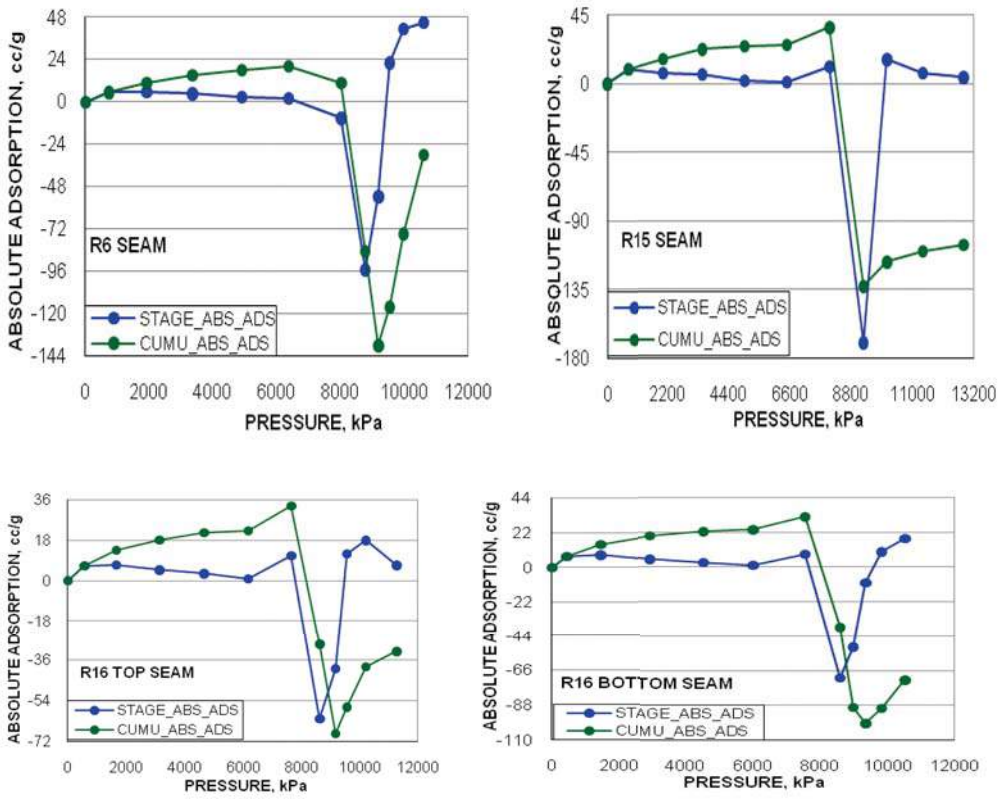
- It has been demonstrated that $CuMoO_4$ has much higher activity compared to well known metallic copper for electrochemical reduction of carbon dioxide.
- A lead bismuth alloy shows 2 times higher activity for electrochemical reduction of carbon dioxide compared to lead.



Polarization data (current-voltage) showing electrochemical reduction of carbon dioxide on (a) copper and copper molybdate and (b) lead and a lead bismuth alloy. The electrolyte was Carbon dioxide purged 1.0 M potassium bicarbonate solution. The area of the electrode was 0.196 cm^2.

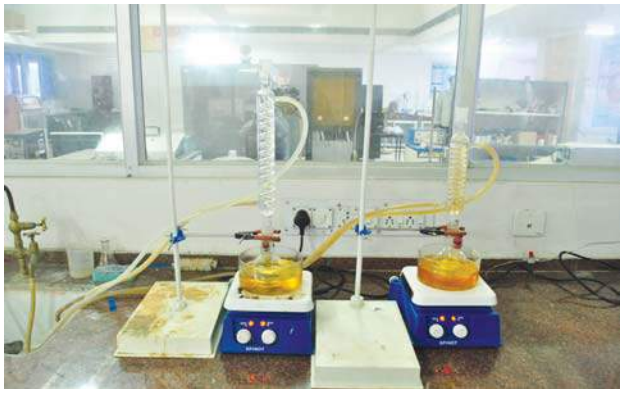
Study was undertaken to understand the behavior of coal when exposed to supercritical carbon dioxide, which is the most likely fate of injected carbon dioxide to unmineable coal seams under the project "Effect of supercritical carbon dioxide on pore structure, sorption properties, and permeability of coals". Till date, adsorption isotherm tests have been performed on five coal samples. Two of these samples are non-coking coals from Raniganj coalfields while the other three are coking coals from Jharia coalfield. Isotherms were established with carbon dioxide for all five samples, after moisture equilibration, at 40 ^{o} C and up to ~ 12 MPa. Additionally, one sample was tested after oven drying to compare the nature of isotherm curves, if nay, between the dry and moisture-equilibrated samples. Then to evaluate the effect of temperature on the isotherm behaviour, two samples were tested at 60 ^{o} C. Adsorption isotherm of all the five coals were then established for methane to compare the difference in nature between the isotherm plots with carbon dioxide and methane. This would also help in evaluating the potential for enhanced coalbed methane for all the five coals. The characterization of pore structure of coal is in progress. Additionally, a new triaxial core-holder has been fabricated to test the permeability of coal samples. The experiments on permeability will commence soon.

This is the first time such work on supercritical carbon dioxide adsorption on coal has been attempted in the country.



Isotherm adsorption characteristics of supercritical CO_2 on moist coal at 40°C

Under the projects "CO_2 Capture by CO_2 Selective Thin Film Composite Polymeric Membrane containing amine carrier" Membranes are being used to separate gas mixtures to various extents by the selective permeation of their components. Membrane based separation offers a number of advantages in terms of energy cost and capital investment. In this research work, CO_2-selective facilitated transport polymer membrane was synthesized. The effects of process conditions on the membrane performance were examined. It was found that facilitation is more significant at lower CO_2 partial pressure differential across the membrane. At higher partial pressure differentials, the facilitation effect of the membrane is marginal due to the saturation of the reactive part of the membrane. Under such conditions the permeance values and selectivity obtained were simply due to the solubility and diffusivity of the CO_2 and N_2 in the membrane matrix. The results showed that the synthesized CO_2-selectve polymeric membranes have a very good potential for flue gas CO_2 separation which is published in Journal of Membrane Science 2014 Impact Factor: 4.908.



Polymerization Reaction Set-up

Membrane Casting Unit

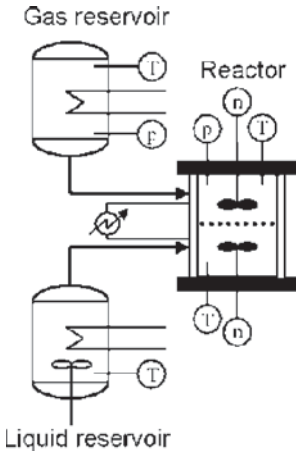
Gas Permeation Measurement Set-up

Thickness Measuring Device

Discovery of novel absorbents for enhanced CO_2 capture

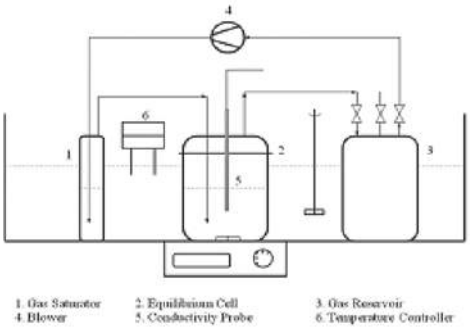
In the last decades, significant effort has been made towards optimization of CO_2-capturing technologies. One of the key issues is to find well suited solvents, preferably, more efficient and easily regenerable. In the present work, the performance of two new candidate solvents (viz. amine blends) was investigated.

From the absorption rate measurements at 35°C in a stirred cell reactor in the 5-25 kPa CO_2 partial pressure range, reaction kinetics was studied. To facilitate a comprehensive insight into the reactivity of the proposed solvents, plausible reaction pathways were investigated. Solution density and viscosity were measured and the CO_2 diffusivity in solution was estimated.



To accomplish the design of gas-liquid contactors for CO_2 capture, knowledge on the vapour-liquid equilibrium (VLE) is essential. Commonly, the dependence of equilibrium partial pressure of CO_2 on the loading capacity of the absorbent is determined. In this work, the equilibrium solubility of CO_2 was measured in a setup comprising an equilibrium

cell, gas reservoir, saturator and gas recirculator/ blower. Vapour-liquid equilibrium (VLE) data for the proposed solvents were obtained at T=30°C and P=1 atm.



Formation of toxic degradation products due to amine decomposition is a major operational problem of the gas purification industry. Tests are being performed to study the resistance of the proposed solvents to degradation.

A study of the efficacy of the proposed solvents in a lab-scale closed-loop absorption-desorption setup is underway. A flow sheet for the proposed process was developed and material balance was calculated. The results of this study will be able to facilitate the design and operation of gas treating plants with the proposed solvents as the CO_2 capturing component.

The **potential for carbon sequestration by land use sectors of Eastern Ghats and Carbon dynamics associated with land use changes was studied** based on global/regional models, for 2020 and 2030's in Andhra University VISAKHAPATNAM.

The total C stock in all the pools were estimated for different crown density classes (Very Dense, Moderately Dense and Open forests) and in the scrub forests of the selected three villages (Devudivalasa; Koranjiguda and Suvva) in the zone. Of the total C stock, SOC accounted for 60 to 90%. The total carbon forests in these forests have ranged from 42.9 t/ha to 83 t/ha. Cover class of the forest showed relatively greater influence on the Biomass carbon, than on the soil carbon.

Significant projects supported under NPCS during the year 2014-15 are listed below

(1) CO_2 Sequestration in Marine Hydrate Sediments with Simultaneous CH4 Recovery

(2) Carbon- Silica composite material from rice husk for CO_2 capture

(3) Sequestration of carbon dioxide by biochar and chemolithotrophic bacteria Serratia sp. in sequential bioreactor for production of biodiesel

(4) Catalytic Methods for Conversion of CO_2 to Acrylic Acid, Formic Acid and Methanol

(5) Phycoremediation of Cyanide from Coke-oven Wastewater and CO_2 Sequestration from Waste gas using a Mixed Consortium of Green Algae and Cyanobacteria : An integrated approach

(6) Sequestration of Carbon in Bamboo Forests of Aizawl District, Mizoram"

(7) Development of a VSA Technology for simultaneous Production of High Purity CO_2 and H_2 from the H2PSA tail gas of a Petroleum Refinery

(8) Assessment of Carbon Sequestration Potential by land use sectors of North Eastern Region and Carbon Dynamics Associated with Land use Change

(9) Assessment of carbon sequestration potential of major land-user of Barak Valley, Assam

(10) All India Coordinated Project on Carbon Sequestration in major land cover of Arunachal Pradesh

(11) Title: Evaluation of carbon sequestration potentiality in dominant cropping sequences of Assam : Role of management practices on carbon stocks and functional diversity of sequestration promoting microbes.

(12) Assessment of carbon stock and Flux from Various landuse systems of a hilly district Churachandpur, Manipur

(13) Mapping and estimation of above ground biomass and soil organic Carbon in Nagaland, India

(14) Soil Carbon sequestration and CO_2 flux from soil in a forest and agro-forestry ecosystem of Sikkim Himalayas.

(15) Carbon sequestration potential of biomass under different land use systems in Tripura, Northeast, India

FLY ASH UTILIZATION AND MANAGEMENT

Fly Ash is generated when Coal is burnt in a Thermal Power Station (TPS) to produce electricity. To meet the demand for electricity, considered one of the main drivers of economy, coal fired TPS presently contribute about 70% of its total production and in the wake produce over 200 million tonnes of Fly Ash. To meet the ever increasing demand for electricity, expected to quadruple by 2013, at least 600GW is expected to be contributed by coal fired TPS. As most of our plants use poor quality locally available coal with very high ash content, Fly Ash generation too will increase manifolds. Thus its utilization and management would require more innovative and out-of-box ideas and solutions.

FAU is an outcome of Fly Ash Mission that was launched in 1994 as a joint activity of DST and Ministries of Power and Environment & Forests primarily to support R&D in its utilization and management. Though term of the Mission got over in 2002, DST converted it into a Fly Ash Utilization Programme which subsequently assumed its present form. DST thus continued to support new challenges for R&D in this nascent field that were identified by S&T agencies, academic institutes and industry who were brought together on a single platform. They examine & analyze the existing practices in the light of regulations through baseline surveys and technology forecasts besides endeavoring to develop cost effective processes, technologies and strategies. Such initiatives coupled with concerted efforts of all stakeholders have resulted in gainful utilization of Fly Ash to the extent of about 100 million tones per annum resulting in substantial reduction in annual CO_2 generation.

Fly Ash is now being increasingly utilized in production of various types of cements, concrete, bricks, boards, pavement blocks, and so on and it also used extensively in structural fills, road embankments, pavements, filling & reclamation of mines besides being tried as a comparatively

less polluting source of micro-nutrients in agriculture. Scientific studies and projects have also been commissioned by FAU to belie several myths treating Fly Ash as environmentally hazardous product only in addition to its introduction in academic curriculum to generate awareness about its multifarious aspects. About 80 projects have been commissioned since inception of the Mission in academic institutes, R&D labs and S&T organizations, among others, who have joined hands with industry to address challenges in utilization and safe management of Fly Ash besides in generating awareness among stakeholders through workshops and conferences. These initiatives could enable stakeholders to apprise themselves of state-of-the-art of technology, existing practices & expertise in this challenging realm, future trends, etc.

SECURITY TECHNOLOGY INITIATIVE

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 Centre for Strategic Initiative at Indian Institute of Science, Bangalore is also coordinating bilateral Indo-German Research project under DST's Security Technology Initiative. The three specific areas have been identified for the research -

1. Vulnerability of Transportation Structures, Warning and Evacuation in case of Major Inland Flooding
2. Vulnerabilities and Volunteerism
3. Sensor based Security and Emergence Management System for underground Metro

Scientist from both the countries are engaged in chalking out programmes under these categories and the proposals for the same are under processing with the Department.

SYNERGY PROJECTS

Synergy programme encourages R&D projects in `advanced high quality basic research', and `directed basic research', as also 'pre-competitive applied research'. These projects are in consonance with national S&T priorities, as perceived from time to time. Currently the following areas are being pursued: National Knowledge Network; Cyber Security; Advanced Ultra Supercritical Technology; Integrated Photonics Initiative; Green Chemistry; Technology Delivery in Rural Areas (RuTAG); Additive Manufacturing; Energy Storage Devices; Rural Centric Food Processing; Gifted Children; and Electronic Hardware.

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.

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 32 (Thirty Two) 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 2014-15, TDB provided financial assistance of Rs. 650.83 lakhs to the industrial concerns. 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.

Exhibition/Seminars

To create awareness in the industry, entrepreneurs and R&D institutions about the available financial support from TDB, various activities were undertaken such as interactive meetings/ participation in exhibitions in collaboration with other organizations.

During the year 2014-15, TDB created awareness about its scheme by participating in 4th National Level Exhibition and Project Competition under Innovation in Science Pursuit for Inspired Research (INSPIRE) during 6th to 8th October, 2014 and India-US Technology Summit & Knowledge Expo 2014 during 18th -21st November, 2014.

DRUGS AND PHARMACEUTICALS RESEARCH PROGRAMME

The Drugs and Pharmaceuticals Research Programme (DPRP) was initiated in 1994-95 for promoting Industry – Institutional 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. The specific objectives of this scheme are:

- To synergize the strengths of publicly funded R&D institutions and Indian Pharmaceutical Industry in developing drugs in areas of national relevance;
- To create an enabling infrastructure, mechanisms and linkages to facilitate new drug development; and
- To stimulate skill development of human resources in R&D for drugs and pharmaceuticals.

Major Achievements

Seven Conferences and Workshops in the area of Drug and Pharmaceuticals were supported during 2014-15. The supported institutes include Delhi Institute of Pharmaceutical Science and Research (DIPSAR), New Delhi, Institute of Genomics and Integrative Biology (IGIB), Delhi, Jadavpur University, Anna University Chennai, BIT Campus, Tiruchirappalli, Central Drug Research Institute (CDRI), Lucknow, B.V. Patel Pharmaceutical Education & Research Development (PERD) Centre, Ahmedabad.

The Tamil Nadu Veterinary and Animal Sciences (TANUVAS) and M/s. Neospark Drugs and Chemicals Pvt. Ltd., Hyderabad working on project "Development of Novel Mycotoxin binders for the management for mycotoxicosis in animal and human" has the objectives of developing a successful commercial mycotoxin to reduce the harmful effects of mycotoxins in animal nutrition. At present mapping of Aflatoxin in feed and stuff completed, *in-vitro* binding efficacy of Toxin binder assessed at various PH 4, 7, 9 and microbial quality of binders evaluated.

The DPRP supported project on "Product Development of Phyllanthus niruri and Glycine max (L.) Merr. formulation for the management of Diabetes and associated complications, its validation, standardization, Preclinical Toxicology and Pharmacological evaluation" between Sri Ramachandra University, Chennai, Visva Bharati University, Santiniketan and East India Pharmaceutical Works Ltd., Kolkata aims to develop a plant based drug for diabetics and its complications has been scientifically validated for efficacy, safety and reproducibility. At present the product is in the stage of efficacy validation in animal model.

The ongoing project at IIT, Chennai on "National facility on community based cancer tissue bio bank for drug targets" aims to develop several novel approaches in tackling cancer, provides a highly innovative concepts with great potential to result in new technologies. It provides opportunities to researchers and industries make use of those diverse tissues for research and drug targeting.

Super Resolution Microscopy at IIT, Chennai for the cancer tissue bio-bank project supported under DPRP. This system can be used for (a) measuring single molecules in or near the plasma membrane like lipid rafts, receptor clustering or cell-substrate or cell-cell adhesion sites, actin-cytoskeleton remodelling during cell migration and (b) combined with 3D reconstruction precisely localize molecules within cells.

Cell Sorter at IIT, Chennai for the cancer tissue bio-bank project supported under DPRP. It is used to isolate cells from cancer tissue based on cell surface markers for further genomics and proteomics analysis.

CHAPTER 4

S&T COMPETITIVENESS THROUGH ALLIANCES, PARTNERSHIPS AND R&D MISSIONS

ENHANCING S&T COMPETITIVENESS THROUGH INTERNATIONAL COOPERATION

INTERNATIONAL BILATERAL S&T 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 and academic institutions, sister scientific government departments & 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) Leverage international alliances which can value-add to national programs and missions;

(ii) Gaining global competitiveness through bilateral collaboration;

(iii) Accelerate institutional and human capacity building through international exposure and linkages;

(iv) Connect Indian research with global efforts in frontier areas and in addressing global challenges;

(v) Participation and access to mega-science projects and international advanced research facilities;

(vi) Promote eco-system of innovation and techno-entrepreneurship through collaboration with countries high on innovative index;

(vii) Adoption of new paradigms of innovative practices by developed and emerging economies in the Indian ecosystem;

(viii) Enable applied and industrial R&D through industry-academia connect program aimed at creating new IP, process, pro-types or products;

(ix) Connect Indian innovation model to gain access to markets in developing countries;

(x) Use soft prowess of S&T to build and develop bilateral relationship and people-to- people contacts through capacity building and fellowship programs.

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 and symposiums; (iii) Joint research projects; (iv) Virtual multi-institutional R&D projects; (v) Training programs; (vi) Access to advanced research facilities abroad; (vii) Participation in international mega-science projects; (viii) Continue support to Bi-national S&T bodies; (ix) Fellowships and Visitation programs for both Indian and foreign researchers; (x) Promoting academia-industry partnerships for industrial R&D on bilateral level; (xi) Contributions to international non-governmental scientific bodies; and (xii) Technology summits, industrial fairs, S&T exhibitions.

SALIENT ACTIVITIES DURING THE YEAR

Joint S&T Committee/Council meetings were held with Bangladesh, Belarus, Bulgaria, Egypt, Finland, Germany, Japan, Mexico, Norway, Peru, Russia, Sweden, South Korea, Slovenia, Taiwan, United Kingdom and United States. Governing Body meeting of the Indo-U.S. Science & Technology Centre (IUSSTF), Indo-U.S. Endowment Board for Innovation and Indo-German Science & Technology Centre (IGSTC) were held during this year.

New/ Renewal of Inter-Governmental S&T Cooperation Agreements/MoU/ Programs of Cooperation (POC) were concluded with Bangladesh, Bulgaria, Canada, Egypt, Finland, Mexico, Peru, Slovenia, Republic of Korea, United Kingdom, and USA.

About 300 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:

Australia: Launch of new Phase of Australia-India Strategic Research Fund (AISRF) to address grand societal challenges through S&T interventions;

Canada: R&D Networked Centre (IC-IMPACTS) on Integrated Water Management and Sustainable Infrastructure;

Egypt: S&T cooperation was revived with Egypt through the signing of a new POC with focus on two thematic areas of cooperation on solar energy and agricultural biotechnology;

Japan: Linkage between INSPIRE and SAKURA for exchange of outstanding science students

at school level; commitment to support the Phase II of the Indian Beam-line at Photon factory in KEK, Tsukuba;

South Korea: Industrial R&D Program to support industry-academia projects of applied nature;

India Science & Research Fellowship: for scientists from **neighbouring** countries including Afghanistan, Bangladesh, Bhutan, Maldives, Myanmar, Nepal, and Sri Lanka to undertake R&D work in Indian institutions;

Peru: In a new initiative with Peru, joint studies on the 'El Nino effects and monsoon phenomenon' would be undertaken on priority basis. A new Protocol of Cooperation in Science & Technology between DST and CONCYTEC, Peru was finalised.

Russia: With Russian Ministry of Education and Sciences (RMES) a program to support joint research projects in the areas of Applied Sciences was agreed and launched.

UK: Newton-Bhabha Program to support basic & translation research to address grand challenges on energy-food-water-health nexus, public health, advanced manufacturing, sustainable cities and big data analytics;

USA: India has joined the Thirty Meter Telescope project at Hawaii as a consortia member country. Through SERB of DST India has partnered in new collaborative research and innovation programs with U.S. NSF and NIH.

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: Following the 3rd meeting of India-Argentina Joint Committee on S&T held in October 2013 at Buenos Aires, a total of 23 joint research projects were considered for evaluation, out of which 11 in the areas of Agriculture and Food Technology, Medical Sciences and Health, Renewable Energy Sources have been identified for implementation with joint support over a 3 years period. Besides, 15 on-going projects in the areas of structural chemistry, bio-pesticide, health and food continued to be supported.

Australian Prime Minister along with the Minister for Science and Technology interacting with doctors at AIIMS, New Delhi where an Indo-Australian Grand Challenge project on Trauma Care is being supported

Australia: Under the Phase I of the Australia-India Strategic Research Fund (AISRF), seven new joint competitive grant projects under the Round 8 call was agreed for support. Under the ongoing activity of AISRF-Phase I, thirty seven joint research projects were supported in the areas of agricultural research, astronomy & astrophysics, microelectronic devices & materials, nanotechnology, renewable energy and marine sciences. 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. Two workshops were organized in the areas of smart materials and information & communication technology.

It has been agreed by both sides to launch the Phase II of the Australia-India Strategic Research Fund with committed funding of Aus $ 20m over four years by each country. The modalities and contours of Phase II of the AISRF are under finalization.

Austria: Support to 12 joint research projects under DST-BMWF and DST-FWF schemes was continued. A call for proposals under the DST and Austrian Research Fund (FWF) was launched.

Brazil: under a MoU between DST and Brazilian CNPQ, fourteen mutually agreed projects continued to be supported in the areas covering earth and ocean sciences, biotechnology, medical sciences, physics and materials research.

Belarus: In addition to 3 ongoing joint R&D projects with Belarus, 8 new joint R&D projects have been identified for support as agreed in the meeting of the India Belarus Joint Science & Technology Committee held in New Delhi in October 2014. These projects are in the areas of

cooperation of Material Sciences, Metallurgy, Physics, and Chemical Sciences. In addition, 5 fellowships for Belarusian scientists to undertake R&D work in Indian institutions have been agreed.

Bulgaria: The 8th India-Bulgaria S&T Joint Committee met in January 2015 in New Delhi. The joint committee focused on developing new partnerships to optimize technological innovation in life sciences, water and in new & advanced materials. A Programme of Cooperation for the period 2015-2017 was concluded. The POC will facilitate cooperation through joint R&D projects, exchange of researchers and joint workshops on agreed areas of solar energy, water, material research etc. A new fellowship for Bulgaria scientists to undertake research work in Indian R&D institutions was also agreed to.

Canada: A new MoU was concluded between DST and NSERC, Canada to partner in the IC-IMPACTS program to support joint R&D projects involving multi-institutional participation in the areas of Safe and Sustainable Infrastructure and Integrated Water Management. Currently, projects received under the maiden call are under review. In addition, support to industrial R&D projects implemented through GITA platform is continuing.

China: Following decisions taken in the last joint S&T committee meeting held in 2013, brain storming meetings in the areas of (i) Traditional Medicine & Indigenous Knowledge was held in Kunming, China in July 2014 and (ii) Astronomy & Astrophysics was organized in Bangalore in December 2014. These scientific meetings have helped in formulating joint R&D projects and outline of the modalities of joint research in mutually identified areas of interest.

Finland: Third Joint S&T Committee and Innovation Working Group meeting was held at New Delhi during December 2014. Support was continued to 11 Joint projects in the areas of green chemistry and nano-materials. A joint workshop on Inclusive Innovation was held at IIT Delhi in conjunction with the JCM. A new joint call for proposals with Academy of Finland in the area of Energy Research was launched in 2014. Three projects were jointly selected for implementation under the program.

France: Targeted programs 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 targeted program in Information and Communication Science & Technology; (iii) DST-ANR joint call in the areas of Neuroscience and Engineering Sciences was launched. 6 joint projects against the first DST-Inria joint call and 2 projects against the DST-ANR joint call were agreed for support during this period. The Indo-French Centre for Applied Mathematics (IFCAM) is proactively facilitating cross-disciplinary interactions between mathematicians, engineers and other scientists of the two countries. Against the first two joint calls for proposals, 18 joint projects have been selected and are under implementation. An active short-term visitors program and exchange of post-doctoral fellows/research students are form important components of this Centre's activities. Under the Centre a summer school in applied mathematics was conducted jointly in July 2014 to train the next generation of mathematicians.

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.

DST-AvH Program: The 5th and 6th ediitons of Indo-German (DST-AvH) Frontiers of Engineering symposium was held in Potsdam Germany in May 2014 and in Agra in February 2015. These symposiums were attended by 35 young engineers and technologists from each side to deliberate upon the cutting edge research across engineering disciplines with the aim to develop new collaborations in promising areas of engineering sciences.

DST-MPG Partner group program: Seven new partner groups and five 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 and gravity, mass black holes in gravitational wave window, human genetic diversity, health sciences and evolutionary biology and structure-function relationship in protein machinery.

Hungary: Following 8th meeting of the Indo-Hungarian Joint Science & Technology Committee, held at New Delhi in October 2013, joint call for proposals was were invited in 2014. Four R&D projects were mutually agreed for support in the areas of Mathematical Sciences; Life Sciences; and Chemical Sciences.

Israel: Against the joint call announced earlier in 2014, seven projects in the areas covering Engineering Materials for Energy have been mutually selected for support. A new program to support pre-commercial and applied R&D with dedicated funding is under discussion for which joint meetings were held in Israel and India.

Italy: Support continued to 17 ongoing joint projects under Indo-Italian bilateral S&T agreement. Under the India-Trento Program for Advanced Research (ITPAR), support continued to 4 ongoing projects in the areas of nano-photonics, computer sciences, telecommunication and cognitive science. ITPAR Joint Scientific Committee meeting held at Trento, Italy during October 2014 reviewed the ongoing activities under these projects. In addition, about 25 Indian scientists visited Trieste to perform experiments on Elettra Synchrotron Beam-line. Two joint workshops in the areas of Computer Science and MEMS were organized.

Japan: Under cooperative program with JSPS, the India-Japan Academic Council approved twenty two new projects, four workshops and twenty exploratory visits for support in the areas of fundamental sciences. Support continued to 41 on-going joint projects. A 'Mizushima-Raman Lecture' was delivered by eminent Indian scientist in Japan under this program. India participated in the Asia Heads of Research Council meeting organized by JSPS in Thailand. A DST-JSPS Asian Academic Seminar on "Spectroscopy and Chemistry of Materials " was held in India during March, 2014. Support continued to three ongoing projects the area of bio-medical technology under DST-JST S&T Cooperation Program.

Mexico: The 5th meeting of the Indo-Mexican S&T Joint Committee on S&T was held at New Delhi in October, 2014. It was agreed to organise two joint workshops in areas of Earthquake Hazards and Solar Energy before announcing the next joint call for project proposals in 2015. Joint Committee agreed that next joint call should focus on four broad areas of mutual interest including (i) Water; (ii) Biotechnology and Human Health; (iii) Seismology; and iv) Solar Energy (new generation photovoltaic, & grid integration).

Netherlands: Besides the ongoing projects in the area of bio-medical devices, three new projects on functional materials and smart grids have awarded for bilateral implementation. A bilateral program called Dutch India Water Led Initiative (DIWALI) also provides interaction between with Indian and Dutch water scientists and industry. A project on municipal waste water treatment has been launched in Gujarat.

New Zealand: Following the first meeting of the India New Zealand Joint Science & Technology Committee held in Wellington in 2013, two projects were approved for implementation in the maiden call made in the area of food technology. Natural hazards and resilient structures and food-processing technologies were identified as future areas of cooperation for which scoping workshops have been supported.

Norway: Support to 2 new collaborative projects in the area of Changes in Mass Balance of Glaciers and Rivers were continued. A call for proposal was launched in the area of renewable energy. The joint projects received are under evaluation. The new Program of Cooperation was concluded for the period 2015-17. The thrust areas of cooperation agreed were on bio-economy and ICT.

Peru: In a new initiative to enhance our cooperation in Americas, the India-Peru Joint Committee on Science and Technology met in Lima in April 2014. Both sides agreed to cooperate in the research for the development of vaccines for infectious diseases common in the two countries, water management and dissemination of basic agricultural technologies to end users. It was decided that Joint studies and workshops on the El Nino effects and monsoons phenomenon would be undertaken on priority basis and efforts will be made to share information and experiences for studies on climate change. A new Protocol of Cooperation in Science & Technology for 2014-16 between DST and CONCYTEC, Peru was finalised during the meeting.

Portugal: Seventeen projects in areas of nano-materials, smart textiles, microelectronics, mechanical engineering, health and biotechnology rated high on both sides and adopted in the protocol during the 4th Indo-Portuguese Joint Committee on S&T held in New Delhi in 2013, were taken for support by both sides.

Russia: Cooperative activities continued under basic science research program with RFBR. Fresh call for proposals was made and 127 proposals were received which are under assessment. These are in addition to 38 ongoing projects being implemented in the areas of Physics & Astrophysics, Chemistry, and Biological Sciences. The 8th meeting of the Indo-Russian Working Group on Science & Technology was held at New Delhi in September 2014. A new program between DST and the Russian Ministry of Education & Science was launched with a focus on

applied areas of research with support of six new projects on Environmental Sciences and Materials Sciences.

Singapore: Five joint projects in the area of Materials and Energy were supported against the maiden joint call for proposals with A-STAR, Singapore. Second joint call for proposal in the areas of Advances in Chemistry; Biology & Technology for Medicine was also launched. The joint proposals received are currently under review.

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. In addition, 12 new joint projects in the areas of health science & biotechnology, indigenous knowledge systems, astronomy and green chemistry were approved for implementation. Two joint workshops on Agricultural Biotechnology and HIV/TB biopharmaceutical were held in India and South Africa respectively. A brain storming session on astronomy was also organized in India to develop joint R&D projects as a part of the mega SKA project on radio astronomy in S. Africa.

South Korea: Support continued to the 21 on-going joint research projects in the areas of Nanotechnology; New Materials; Robotics & Engineering Sciences; Information and Telecommunication Technology; Water Resources & Environment; Chemical & Biochemical Technologies; Biotechnology including Health & Medical Sciences and Renewable Energy. Visit of eleven Indian PhD students and five Korean PhD students have been jointly supported to pursue Internship in each other country during 2014-15. A new program on applied R&D in the areas of Robotics & Automation, ICT and Cleantech has been launched.

Slovenia: The fourth meeting of the India-Slovenia Joint Working Group on Scientific and Technological Cooperation was held in New Delhi in November 2014. Besides reviewing progress of the 13 ongoing joint R&D projects, the JWG considered the 33 project proposals received against the joint call launched in both countries in March 2014. The JWG agreed to approve 13 projects for award in areas of areas of health & biomedical sciences; metallurgy & new materials; polymer chemistry; mathematics; electronics; and alternate energy sources for the period of three years starting 2015.

Spain: Support continued to 10 ongoing joint research projects on industrial R&D 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.

Sweden: Against the maiden joint call for proposals under DST- Swedish Research Council (VR) cooperation launched last year, seven joint projects were approved for support. New strand of cooperation on industrial R&D between DST and Vinnova are under discussion for finalisation.

Switzerland: Support to ten projects was continued. In addition, ten new joint projects in areas of Renewable energy and Translational Medicine were jointly awarded for implementation.

Thailand: Under the Indo-Thai Program of Cooperation, support continued to 11 ongoing joint projects.

Tunisia: Support continued to 12 ongoing projects. Two joint workshops in the areas of Nanomaterials and Geospatial Technologies were held in India and Tunisia.

Signing of the MoU on Indo-UK Newton-Bhabha Program by Minister for Science & Technology and ES with UK Minister for Universities & Sciences.

UK: The 4th meeting of the Indo-UK Science and Innovation Council was held at New Delhi, co-chaired by Dr. Harsh Vardhan, Minister for Science & Technology and Rt. Hon. Greg Clark, British Minister for Universities & Science. It was agreed to launch a new program for STI cooperation named as the Newton-Bhabha Program. It aims to co-invest £ 50 million over a period of five years to support three strands of cooperation involving People, Research and Translation. Initial focus areas would be on Food-Water-Energy nexus; Public Health & Well Being; Manufacturing Sciences; Big Data Analytics; and Sustainable Cities.

The program on India UK Science Networking between DST and Royal Society was renewed for supporting joint scientific seminars and meetings including the Frontiers of Science symposium. Under this program, 19 bilateral workshops were held including the first Indo-UK Frontiers of Science Symposium held in India. This provided the opportunity to 70 young scientists, 35 from each country, who are future leaders across the different disciplines of science to meet, interact and develop new contacts.

Under DST-UKIERI program, 33 new projects were selected for support in the areas recommended by the Science & Innovation Council. 70 exchange visits of scientists from both sides have taken place under these projects. The next phase of DST-UKIERI program is being negotiated.

In partnership with Innovate UK (erstwhile Technology Strategy Board), a new program on Industrial R&D was launched through GITA platform. Four projects have been approved for award in affordable healthcare and clean technologies. These projects are led by industry partners from both sides.

USA: The 3rd Indo-U.S. Joint Commission Meeting on Science and Technology was held on November 14 & 17, 2014 in New Delhi. The JCM reviewed the progress of the ongoing activities and provided future directions of cooperation in the areas of (i) Basic and Applied Sciences; (ii) Atmospheric, Environment, and Earth Sciences; (iii) Health and Medical Sciences; and (iv) Emerging Materials and Manufacturing Sciences. The JCM also reviewed activities of other bilateral programs including the Indo-US S&T Forum (IUSSTF) US-India Endowment Board for Innovation, and Joint Clean Energy Research & Development Center (JCERDC). The Joint Committee agreed for the STI Action Plan to be implemented during 2015-16.

The U.S.-India Endowment Fund for Innovation which supports joint projects with potential for commercialization approved five new projects in the areas of Healthy Individual and Empowering Citizens. These participants in these projects which are aimed to have social impact are from industries, start-up companies and academia from India and USA.

Third Indo-U.S. S&T Joint Committee Meeting held in New Delhi Co-Chaired by Sh. Y.S. Chowdary, MOS for S&T and ES

The 20th **DST- CII Technology Summit with USA as partner country** was organized in Greater Noida on November 18-19, 2014. The Summit was inaugurated by Dr. Harsh Vardhan, Union Minister for Science & Technology and Earth Sciences. On the U.S. side the delegation was led by Dr. John Holdren, Director, OSTP and Science Advisor to the U.S. President. The two day Summit saw unprecedented participation with over 1700 delegates including 300 American participants. B2B meetings were held for exploring Techno-business partnerships between the two countries. During the summit 35 technical sessions took place on 5 thematic areas including, Manufacturing; Information Technology; Clean & Renewable Energy; Life Sciences; and Sustainable Cities. An exhibition with over 75 Indian and American technology exhibitors from diverse sectors was also showcased in the Summit.

Dr. Harsh Vardhan, Minister for S&T and ES innaugurating the Technology Expo at the Indo-U.S.Technology Summit 2014

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. A major project on remediation technology for leather processing and tannery waste was approved for implementation.

Bilateral Workshops

Nearly 75 joint S&T workshops/ symposia and training programs were supported in India and abroad in partnership with Australia, Brazil, Bulgaria, Chile, Canada, Finland, Germany, Italy, Japan, Mexico, Myanmar, New Zealand, Russia, Singapore, 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 with tangible outcome through creation of new IP, processes, prototype and products bilateral industrial R&D program on Applied R&D have been pursued with chosen partner countries like Israel, Canada, Finland, France, Germany, South Korea, Spain, UK and USA. These programs are based on a PPP model of funding and are being implemented through the Global Innovation Technology Alliance (GITA) platform, except those with France, Germany and USA. Most of these projects directly feed to some of the new national initiatives on Clean & Green India, Digital India, Make in India and Smart Cities.

Joint R&D Centers

Twenty virtual R&D centers with networking between Indian and institutions abroad were continued to be supported. These Centers have been built on leveraging 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 meant for facilitating focused and integrated interaction and collaboration through networking of capabilities and infra-structure between Indian and institutions in partner countries like Australia, France, Germany, S. Africa, UK, and USA.

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 64rd Meeting of Nobel Laureates and students at Lindau, Germany. Twenty undergraduate science students from across the country along with three supervisors participated in the 8th Asian Science Camp with Nobel Laureates held at Singapore in August 2014.

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. Eleven Indian Ph. D students were selected to visit South Korea under the India-Korea Research Internship Program. Seventeen Indian PhD students have been selected to visit France under the Raman-Charpak Scholarship. Thirty INSPIRE PhD students will visit UK institutions as a part of DST-Royal Society exchange program under Newton-Bhabha scheme.

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 42 countries across Africa covering the broad areas of science, technology and medical research. Against the 5th call launched in 2014 more than 1000 applications were received from 42 African nations. The applications are currently under review for final selection of awardees.

Under other bilateral schemes, 10 Swiss PhD students were awarded fellowships to work in Indian research institutions; 5 Korean students were selected under India-Korea Research Internship Program; and 4 French PhD students have been awarded the Raman-Charpak Fellowship to work in Indian laboratories and R&D Institutes.

A new India Science and Research Fellowship for providing opportunity for young researchers from neighboring countries to undertake R&D work in India has been approved. Six fellowship slots each for seven neighboring countries (Afghanistan, Bangladesh, Bhutan, Nepal, Maldives, Myanmar, and Sri Lanka) will be covered under this new fellowship scheme. The first call for applications was launched and the applications are under review.

Bi-national Centres

Bi-national R&D Centres are independent bi-national entities established under inter-governmental bilateral agreements between India and the partner country. The activities undertaken by these Centres are as follows:

Indo-French Centre for Promotion of Advanced Research (CEFIPRA):

During the year 2014-15, under the collaborative scientific research program, 22 new projects were supported in the areas of Computer Science; Life and Health Science; Pure and Applied Physics; Material Sciences and Earth Sciences while support was continued for the 72 ongoing scientific projects. Knowledge-Product pathway had been catalysed through 7 ongoing projects in the areas of Material Science; Health Science; Information Technology; Green Technology; Chemistry and Genomics under the Industrial Research Program with newly recommended project for Intelligent transport system. Nine Indo-French bilateral seminars/workshops/training schools were supported to promote knowledge dissemination and networking.

The Centre has continued to offer a platform to facilitate 'Targeted Programs' for the national funding agencies to come together and support collaborative scientific research in focused areas of mutual interest. These include (i) DST-ANR program, under which two proposals were recommended for award during the year in the domains of Neuroscience and Material Science; (ii) DST-INRIA-CNRS program, two proposals were supported in the domains of Big Data and Reliable & scalable computation; and (iii) DST-INRA a project on "Adaptation of irrigated agriculture to climate change' is being implemented.

In order to strengthen human resource development, under the existing Raman-Charpak Fellowship, 17 Indian and 4 French students were supported to work in each other's laboratories. Eight Indian doctoral students were trained under European School on Nano-Sciences and Nanotechnologies (ESONN) program through CEFIPRA-ESONN fellowship. A MoU with Association Nationale de la Recherche Technique (ANRT), was signed for creating opportunities for Indian doctoral students to be placed in French companies as interns.

To promote Innovation through a PPP model of funding, four projects were initiated under the Saint Gobain Research India (SGRI)-CEFIPRA program in the area of "Sustainable habitat for hot and humid climates". As a facilitator, under the DBT's Biotechnology Industrial Research Assistance Council-French Embassy program, two proposals were supported in the areas of molecular diagnostics for prediction of cardiac disorder.

Indo US Science & Technology Forum (IUSSTF): established under an agreement between DST and the US State Department has a 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 supported over 16 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 Engineering Symposium was organized. Special training schools for women scientists were organized under

Women in Science cooperation program. Support was continued to the 15 ongoing Indo-US Joint Centers of Research. Four new R&D Knowledge Networked Centers were awarded towards promoting collaborative research activities.

Visitation programs enabled through Fellowships and Internships included :

Over 110 Indian and US student exchanges took place through various internships namely SN Bose Fellowships, Khorana Scholar Program, Vitterbi-India program, Research Internship in Science and Engineering, Bhaskara Advance Solar Energy Research Fellowships, Graduate Research Opportunities World Wide (GROW) – India which are supported by Science and Engineering Research Board (SERB), Department of Science and Technology (DST) and Department of Biotechnology (DBT). Thirteen Indian and US faculty and students exchange took place under IUSSTF funded visitation programs with the American Physical Society (APS) and American Society for Microbiology (ASM).

In the space of Innovation and Technology Entrepreneurship under the DST- Lockheed Martin 'India Innovation Growth Program', 50 Indian innovators were trained under the boot camp organized by Stanford Graduate School of Business. Visit of a team of 20 innovators, incubator managers and innovation/entrepreneurship promotion agency officials to the Silicon Valley and Washington DC was organized during September 2014. Under the Stanford-India Biodesign Program for biomedical innovation in partnership with DBT, four fellowships were awarded.

IUSSTF is also implementing the US-India Science & Technology Endowment Fund for Innovation supported by DST and the US State Department. Support continued for eleven ongoing projects on affordable biomedical devices, diagnostics, clean water, sanitation, clean energy, cold chain, financial inclusion, and prosthetics. Four new projects on technology-based innovative product development were approved against the 4th call. The Fifth Call for Proposals is currently under processing.

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. Support was continued to the three consortia on Solar Energy, Second Generation Biofuels and Energy Efficiency of Buildings The JCERDC is based on a public-private partnership model with equal funding from government and participating industries and academic institutions from both countries. 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 for rapid deployment of technologies.

Support continued for 3 ongoing projects on India-U.S. Grand Challenge on Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in India and the US. This program is supported by the SERB of DST and US NIH.

Indo-German Science & Technology Centre (IGSTC): established between DST and BMBF, Germany, has been successful in establishing an ecosystem and support structure for bilateral

research partnerships of industrial relevance by connecting academia and industry on a PPP model. The Centre is currently supporting fifteen 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, three new 2+2 projects were selected for support in the area of bio-medical devises.

IGSTC is also entrusted the responsibility for implementing the DST-Max Planck program 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 through a networked model of cooperation. The scheme so far has established 15 Partner Groups at newly established IISERs, IITs and Central Universities. In the current year five more new Partner groups have been agreed to be supported. With this, the largest number of Max Planck Partner Groups is now established with India.

INTERNATIONAL MULTILATERAL & REGIONAL S&T 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.

Brief account on some of the significant India's multilateral and regional STI cooperation program's framework, key achievements and way forward 2014 onwards is given below:

India European Union Cooperation

To expand scale, scope, impact of research and innovation to resolve key common societal challenges

India-EU S&T cooperation is currently focusing its priority on S&T based solutions on resolving societal challenges. In this regard, India is engaged in plurilateral funding opportunities with EU Member States (MS).

EUROPE-INDIA Research and Innovation Brokerage/Twinning Event on Water: On 1st and 2nd April 2014 the brokerage/twinning event was held in Delhi, India. The objective of the meeting was to define a roadmap/list of activities for the coming 3 years and beyond. About twenty European experts and 50 Indian experts were present to jointly draft a roadmap/list of activities in 3 separate workshops and some plenaries. The meeting recommended short term and long term joint activities for India –EU/MS collaboration. The short term activities includes (i) Technologies for drinking water purification including removal of emerging toxic pollutants and Online/remote water quality monitoring techniques (ii)Technologies for wastewater treatment for reuse and recycle and reject management in urban and agricultural sectors and (iii)Technology Incubation and Demonstration Park(s). The Long term priority activities includes Climate change (data collection/availability/quality, modelling, prediction and impact assessment, climate services), building on, e.g., the High Noon project, with focus on moving up the reliability curve and creating a direct interface between climate solution providers and decision makers. This has the potential to be an iconic project. Similarly, strong collaboration on reliable assessment of groundwater dynamics, Flood routing and forecasting can be from climate change perspective supplemented by human intervention of the natural hydrological systems can be one of the major components of this theme.

India-EU/MS GSO Thematic Group on Energy Meeting on 11 April, 2014: Pursuant to decision GSO Meeting, the 1st Meeting of India-EU/MS GSO Thematic Group on Energy (GSO TG-E) was organized by European Commission DG Research and Innovation coordinated by French Ministry of Higher Education and Research on 11 April 2014 at Paris for further discussions on Energy Baseline Document with emphasis on defining scope of India-EU/MS Research and Innovation flagship projects; exploring potential co-investors for Joint Call in variable geometry approach; and also to develop an action plan for its implementation with stakeholders: The joint thematic group suggested following topics of common interest for India-EU/MS collaboration in new and renewable energy:

Solar energy: Distributed solar and hybrid energy systems for rural/smart communities; Use of solar energy for cooling and heating households and businesses; Development of various energy storage systems for both thermal and electrical energy; Advanced materials for solar components and systems ; Conservation for improved efficiency including building integration

Smart cities/grids: Smart meter identification, loss reduction; Grid integration of renewable energy (solar and wind); ICT for security and monitoring, control and protection of grids; DC and AC micro-grids; Energy grid links; Energy storage; Utilization of waste heat from industries into useful energy can be a major gain and cut down carbon emission

Bioenergy: Converting waste biomass including agro-waste and municipal solid waste into source of energy; Developing efficient processes to transform biomass particularly urban waste into energy for power generation, by thermochemical technology or biological process (biogas, biofuel , H2); Energy from agricultural or lingo-cellulosic residues and waste, to replace or complement fossil fuels both in the transport sector and in power generation; developing engines to use efficiently biofuels: research on formulations, combustion, modelling, new engine technologies, etc.

Funding of Indo-European projects in the areas of energy under India-EU/MS New Indigo Framework: The Expert Committee Meeting on May 16, 2014**,** for grant linked negotiation of Indo-European Projects under New Indigo Framework, recommended implementation of 7 new projects aimed at development of new energy material and smart grid technologies for power sectors with funding support of 100,000-150,000 USD per project. Total 7 New projects in the areas of New Energy Material and Smart Grids (7) funded by DST from Indian side and 7 European funding agency from Europe side.

India-EU Joint Commission Meeting: DST participated in the 23rd India-EU Joint Commission Meeting held on 26th June at New Delhi co-chaired by Mr. Rajeev Kher, Commerce Secretary from Indian side & Mr. D.O Sullivan Chief Operating Officer, European External Assistance & Services (EEAS), European Commission (EC). The India-EU S&T cooperation is moving in the right direction based on deliberations at 1st India-EU/MS GSO Meeting, 9th Meeting of India-EU Joint S&T Steering Committee and India-EU/MS GSO Thematic Groups Meeting (2013-14).The JCM noted the multiple opportunity for furtherance of parity driven and co-investment based cooperation instruments within the framework of India-EU S&T Agreement. The JCM welcomed the New India-EU/MS GSO on Research and Innovation Cooperation that represents the new governance system (functional from 2013 onwards) adopting variable geometry approach for co-investment to resolve societal challenges. JCM looks forward to early initiation of India-EU/MS collaborative R&D projects in Water; Affordable healthcare–Diabetes; Energy(Smart cities/grids, renewable energy) traceable to India-EU/MS GSO Strategic Research and Innovation Agenda Thematic Documents.

India-EU/MS Inno Indigo Platform for S&T Funders Meeting was held during 2-4 September, 2014 at Berlin, Germany. The meeting was attended by 13 EU Member States with a focus on next Indo-European joint Call for Proposal in 2015 in the area of Affordable Health with focus on diabetes, and identified to work on the following two sub themes: i) Research and Innovation within Diagnostics and ii) Interventions Biomedical Technologies/ Systems. It was also agreed that EU/MS would support 150,000 Euro per Project for three years with matching funds from DST.

The review meeting of two India-EU solar projects ESCORT and LARGECELLS having co-investment to the tune of 5 million Euro from each side (DST & European Commission Research Technology Development (ECRTD)) was held on 19th July 2014 at Indian Institute of Chemical Technology, Hyderabad. Under the ESCORT project, dye sensitized solar cell material were developed which had shown solar conversion efficiency up to 6.5 % at test cell level(IICT), while under LARGECELL project fabrication of new generation transparent conducting electrode made by Jawaharlal Nehru Centre for Advanced Scientific Research **(JNCASR),** Bangalore were the significant achievements.

India-ASEAN Cooperation

Shared Vision and pathways through STI cooperation framework for better collaborative index around inclusive development

4th GC of AISTDF (ASEAN-India S&T Development Fund) meeting was held in Singapore on April 25, 2014. This meeting approved release of funds for FY 2014-15 for the two ongoing ASEAN-India S&T collaborative projects. The meeting approved the merit of funding new ASEAN-India Collaboration collaborative projects around Malaria R&D and Marine Biotechnology.

Development of ASEAN–India Collaborative Research Projects in Food Science and Technology: DST Stakeholders Meeting for development of research projects under ASEAN–India Collaboration in Food Science and Technology was held at Mysore on 5-6 Aug. 2014. DST has entrusted CFTRI, Mysore to review the 8 R&D proposals received from ASEAN in

context of regional relevance, scientific merit, deliverables to be achieved, value addition through collaboration in terms of technology development/improvement, product development, knowledge gain, capacity building etc. In this regard, a stakeholders meeting was organized by DST at CFTRI Mysore on 5-6 Aug. 2014 under the overall leadership of Director CFTRI to build concrete ASEAN _India Proposals in the above area. The scientists/experts from different scientific organizations such CSIR (CFTRI Mysore), DBT(NABI, CABI, Mohali), MoFI (IICPT Thanjavur, NIFTEM Kundli), ICAR(CIPHET, Ludhiana), ICMR (NIN Hyderabad) Anand Agricultural University, along with DST Officials participated in this stakeholders meeting. The three broad proposals for India-ASEAN Collaboration in Food science and technology finalized in this meeting were i) Application of tropical fruits and cereals in functional foods; ii)Post- harvest technologies for shelf life enhancement; iii)Technology evaluation, demonstration and transfer. These proposals have been presented in ASEAN S&T Week by Indian side and awaiting response from ASEAN member States.

Brazil, Russia, India, China, South Africa (BRICS) Cooperation

Harnessing STI for effective use of natural resources and Co-develop new knowledge/technology that offers added coherence of technology and trade

The BRICS STI cooperation made its beginning in 2011 and progressed with an endorsement to the draft text of BRICS STI Cooperation MOU in the 3rd BRICS STI Senior Official Meeting hosted by India in 2013. The final text of this MOU was approved by the 1st Meeting of the BRICS STI Ministers held in February,2014. This Ministerial Meeting also adopted the Cape Town Declaration wherein inter-alia five thematic areas and leadership among the BRICS countries was approved with . 'Natural Disaster prevention, mitigation' led by **Brazil;** 'Water resources' led by **Russia;** 'Geospatial Technologies and application' led by **India;** 'New, renewable and efficient energy' led by **China** and 'Astronomy' led by **South Africa**.

DST participated in the **1st BRICS Workshop on Climate Change,** Prevention and Mitigation of Natural Disasters during May 7-8, 2014, organised by Brazil. The workshop statement recommended : Online platform to share key national documents in the area; An Inventory of scientific infrastructure and program; Scholarship for mobility of students and researchers; Programmes on (i) impact of climate change in the sustainability of urban territories and mega cities, (ii) monitoring of oceans, (iii) data sharing and data availability of the imagery, (iv) Modelling of ocean, atmosphere and coastal phenomenon etc.

Representatives from DST (IMRCD) along with Bureau of Energy Efficiency (BEE), Bureau of Indian Standards (BIS) and Dept of Electronics and IT(DeitY), participated in the 1st **Meeting of the 'BRICS Solid State Lighting Working Group' (SL-WG)** hosted by China. in Goungzhou during 7-9 November 2014. The meeting shared the SSL scenario in the respective BRICS countries

and finalized the terms of reference (TOR) of the SSL Working Group. India showed interest to be part of the SSL project especially a joint venture if it results in establishing manufacturing base, service stations in India for increased domestic value addition, Technology transfer- especially in chip manufacturing; sharing of testing methodologies etc.

India, Brazil, South Africa (IBSA) Cooperation

Strengthening collective research competencies for key societal challenges and build research capacity in emerging S&T fields

The IBSA S&T activities are guided at the Ministerial level through annual meetings of the S&T Ministers and implemented through IBSA S&T Working Group. Till date 4 meetings of IBSA S&T Ministers have taken place. The IBSA S&T Working Group has met 9 times. The last meeting was held at in New Delhi, on 31 May, 2013. The next meeting is to be held in Brazil. A **MoU** on trilateral cooperation in Science, Technology and Innovation was signed during the IBSA trilateral commission meeting held at Brasilia in April **2010**.

One project in the area of Biotechnology (***Evaluation and Optimization of Biodiesel Production from Micro Algae*** involving Indian Project Coordinator Dr. Yogesh C. Sharma, IIT BHU, Project Cost – 52 Lakh for 3 years) has been supported in 2014.

India's engagements UN and its Specialized Bodies/Agencies

DST continued to contribute on science and technology aspects of UN and its specialized bodies and agencies during the year , These included the following:

Participation in 17th Session of UNCSTD Meeting at Geneva, Switzerland

DST is the designated national focal point on behalf of Govt. of India on United Nation's Commission on Science and Technology for Development (UNCSTD).

The 17th annual session of the UNCSTD took place in Geneva, Switzerland from 12-16, May 2014 with two priority themes namely a) Science, technology and innovation for the post-2015 development agenda; and b) Information and communications technologies for inclusive social and economic development**.** Representatives from DST and DeitY provided India's perspective on the themes. The Indian perspectives on the challenges with respect to post 2015 Development Agenda, that UNCSTD can suitably incorporate in their resolutions, were stated that inter-alia included : (i) Mainstreaming STI in post 2015 Development Agenda (ii) Upholding the principle of common but differentiated responsibilities with regard to environmental security;(iii) Need for pragmatic indicators to measure Sustainable Development Goals (SDGs) that are not abstract and which do not suffer from lack of data to substantiate;(iv) Need to enlist deployable technologies beneficial to large populations; affordable, usable and accessible especially with regard to healthcare, water & sanitation;(v) Contemplate STI space in upcoming global trajectories/trends.

Collaboration with TWAS

Strengthen S&T cooperation through gaining by giving, Augmenting India's leadership/ scientific footprint in Africa-Latin America-Asia, Partnerships for Inspiring & Empowering Next Generation Scientific Talent.

Secretary DST stood in for Hon'ble Minister for S,T& Es and made an intervention by India in the Ministerial Session of 25th General Meeting of TWAS on Oct 26,2014 on the theme "Building Future: Cultivating and Promoting Young Scientific Talent- Indian Experience & Outlook". On the sidelines, **DST-TWAS Program of Cooperation(POC) in S&T for 2015-19** was also concluded with a budgetary provision of USD One Million. This POC symbolizes partnerships for Inspiring & Empowering Next Generation Scientific Talent. This partnership envisages building human capacity and resource material in science diplomacy; facilitation for ~100 India Destination Pan-African Doctoral Research Fellowship; and placement of 200 Indian INSPIRE fellows (PG, Ph.D and Post Docs) with world class research institutions across developing countries for international experience.

TWAS Executive Director Dr. Romain Murenzi (left), and Secretary Department of Science and Technology, Prof. Krishnaswamy VijayRaghavan(right) sign an Memorandum of Understanding at TWAS's 25th General Meeting in Muscat, Oman on Sunday, 26 October, 2014.

India's association with ICTP Ramanujan Prize

India's investment for recognizing talent across developing countries in scientific fields that is traceable to Indian civilizational legacy

Govt. of India (DST) has agreed to fund the ICTP Ramanujan Prize, named after the illustrious Indian mathematician, for a period of five years from 2014 onwards. The award carries an amount of US $ 15,000 for the work done by a mathematician in a developing county. A Memorandum of Understanding (MoU) with ICTP and IMU has been signed to this effect and award money has been sanctioned. The first recipient for the year 2014 has been chosen.

Indian National Commission for Cooperation with UNESCO -Natural Sciences Sub Commission

India has been a member of the United Nations' Educational, Scientific and Cultural Organization (UNESCO) since 1946. Ministry of Human Resource Development (MHRD) is the nodal ministry from GoI to coordinate engagements with UNESCO. This is facilitated through framework of Indian National Commission for Cooperation with UNESCO (INCCU) presided and chaired by Minister of MHRD and one of its constituent, the Natural Sciences Sub Commission chaired by Secretary, Department of Science and Technology(DST) The term of the INCCU and its Sub Commissions' expired in April 2014 and therefore new members of the Natural Sciences Sub-Commission under the two categories; Institutional and Individual has been reconstituted comprising 10 institutional and 10 expert members respectively and were forwarded by DST to MHRD, GoI.

Collaboration with NAM S&T Centre

Strengthen India's leadership, prestige, impact, global outreach for S-S cooperation through science diplomacy in partnership with international organizations

The Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre) is an inter-governmental organisation with 47 member countries. India is a founder member of the Centre and also the host country. This Centre has the mandate of strengthening cooperation among non-aligned and developing countries in the fields of S&T. DST as the designated Focal Point for the Centre has been paying the annual membership contribution on behalf of India and also nominating Indian researchers and experts to participate in various scientific activities of the Centre. Over the years it has contributed significantly in strengthening human capacity building in socially relevant sectors such as food, energy, water and science literacy.

The 1st Bureau meeting of the 13th Governing Council (GC) of the NAM S&T Centre was held at Harare, Zimbabwe during 8-9 September 2014 with South Africa as Chair and Malaysia and India as Vice-President of the Bureau. Secretary DST, as Vice-President of NAM S&T Centre was represented by Head IMRC (DST). The meeting approved minor amendments to the 4th Feb 1985 Statutes of the NAM S&T Centre to delete inter-alia, outdated provisions in the context of changing time and strength the provisions with regard to governance and functioning of the Centre

Recognizing the role of Science and Technology Diplomacy in facilitating bilateral, regional and multilateral cooperation, DST sponsored International Workshop on Perspectives on Science

& Technology Diplomacy for Sustainable Development in NAM and other Developing Countries organised at Manesar, Haryana during 27-30th May 2014 through NAM S&T Centre. The workshop was attended by 36 experts/Govt. officials from 22 countries including i.e., Afghanistan, Cambodia, Colombia, Egypt, Germany, India, Indonesia, Iran, Malaysia, Mauritius, Myanmar, Nepal, Nigeria, Pakistan, Sri Lanka, South Africa, Switzerland, Syria, Turkey, Venezuela, Zambia and Zimbabwe.The workshop adopted a '**Manesar Declaration'** including recommendations such as (i) Promoting Science and Technology Diplomacy as a distinct discipline (ii) creating science diplomacy platforms for networking of institutions-science academies-experts; (iii) Establishing appropriate fora to include science communication activities and heritage/indigenous knowledge relevant to S&T in S&T Diplomacy; (iv) Strengthening the practice of Science and Technology Diplomacy through inter alia Science and Technology Attachés/Counsellors in their foreign missions and establish a Centre for Science and Technology Diplomacy in a developing country.

The NAM S&T Centre is implementing the Research Training Fellowship for Developing Countries Scientists (RTF-DCS) scheme from the year 2012 onwards for five years (2012-2017), which is fully funded by the Department of Science and Technology (DST), Government of India. The scheme is aimed at empowering the scientists of the developing countries and human capacity building in S&T by giving opportunities of affiliation to young scientists and researchers from non-aligned and other developing countries with premier academic and research institutions in India for the duration of 6 months for carrying out research work in any field of science and technology. The Scheme was successfully implemented in the last two years (2012-13 and 2013-14) with 20 Fellows each in each of these financial years having completed their research work in the respective host institutions in India. 20 scientists from 19 countries in the fields of earth system sciences, agricultural sciences, bio-medical sciences and chemical Sciences were chosen for fellowship award for the year 2014-2015.

A mid-term review of the RTF-DCS scheme was conducted by an Inter-Ministerial Committee in a meeting held at the NAM S&T Centre on 11th November 2014. Taking cognizance of increasing response (215 applications from 24 countries in 2014-15) to this opportunity by over 50 countries from Africa and Asia and with a view of enlarging India's global scientific foot print, the committee recommended enhancing the scale of this fellowship program to 100 slots per year to be supported by DST and executed by NAM S&T Centre. The landmark achievements of the phase II RTF-DCS fellowship program highlights the translational benefit to the developing counties, by way of drought resistant crops of Botswana, toxicity evaluation of medicinal plants of Cameroon, development of GIS for disaster relief and wildlife tracking in Myanmar etc., Besides the program also helped in Internationalization of Indian Institutions and also seeded global regional and multilateral research collaborations. Besides, co-publications in high impact journals such as Nature, as an in-tangible gain the leadership of India gets firmer credibility with our neighboring counties, extended neighbors and African countries.

DST- Research Information System for Developing Countries (RIS) partnerships

RIS is a registered society with core funding from MEA and serves as a think tank on fostering policy dialogue and capacity building among developing countries on international economic

and development cooperation. It also offers advice to the GoI on multilateral forums-issues-collaborative arrangements. Secretary DST is an ex-officio member of the RIS Governing Council (GC). DST participated in the 43rd RIS GC meeting on June 25, 2014 chaired by Mr. Shyam Saran, Former Foreign Secretary, Ministry of External Affairs and included discussion on ASEAN-India Centre functioning under the aegis of RIS. Meeting suggested linking of RIS ASEAN-India website (aic.ris.org.in) with 2 existing ASEAN-India Portals created under ASEAN-India Science & Technology Development Fund (AISTDF) framework viz., i) ASEAN-India Virtual centre on Intellectual Property Rights (VIIP) [www.aseanindiaip.org]; ii) ASEAN-India Technology Information & Commercialization Centre (TICC) [www.asean-india-tic.org]. In future, DST-RIS linkages will help augmenting strategic ASEAN-India cooperation at large.

India's participation in the 'Carnegie Group' Meetings,Other Multilateral Fora

Build tacit insights and approaches of major countries for better leveraging of international alliances for domestic STI program and honing India's global research leadership/footprints.

India will be hosting the 43rd Carnegie Group Meeting of Science Minister's & Advisors to the Heads of the State and Government in 2015. The Carnegie Group is an international forum comprising of the Science Ministers, Science Advisors to the Presidents and Primes Ministers of the (G8 Nations-SA +EC–European Commission +Emerging economies (O 5) -Brazil, China, India, Mexico and South Africa) and is meeting annually/ semiannually since 1991 at various location in the participating nations. The Carnegie Group meetings provide a platform for high level policy debates on the S&T issues of global significance as well as offer opportunity to participating nations to provide their interventions and perspectives on the various thematic issues resulting in tangible and intangible spin off. Of the emerging economies that joined the Group in 2007, India is the second nation after South Africa to host this meeting.

Participation in the Group of Senior Officials on Global Research infrastructures (GSO-GRI) Meetings

Representing India, DST(IMRC) official and the representative of the India based Neutrino Observatory (INO) participated in the 5th Meeting of the Group of Senior Officials (GSO-GRI) constituted by the Carnegie Group of Science Ministers of the G8+EC+ O5 (emerging economies), to collaborate on world wide development of global research infrastructure. The meeting hosted by Italy, in Rome, during December 15-16, 2014 deliberated on various dimensions of development of Research Infrastructures(RIs) of global interest, such as access to RIs; access to data; evaluation criteria; life cycle issues and legal framework for global RIs. The meeting also discussed the opportunities of global participation in about 40 research infrastructures so far proposed by the member countries. India also reiterated its offer of global participation in (i) construction of 50 kiloton magnetized Iron Calorimeter detector (ICAL) to be set in the India Neutrino Observatory(INO); its operation; data analysis; and dark matter research, (ii) R&D activities for the next generation detectors and other related technologies around LIGO-India.

Engagements with Science and Technology in Society Forum (STS) Japan

India has been engaged with the 'Science and Technology in Society' *Forum* (STS *Forum)* Japan, which provides a framework for global leaders to reflect on strengthening lights and

controlling shadows of science and technology for future of mankind and provides a platform to share common experience, S&T policy measures and success stories. STS Forum has dwelt on S&T for global health, energy, climate change, environment and natural disasters, ICT for human welfare, food security, university education, international S&T collaboration (science diplomacy, joint research, natural disaster EWS-Rescue). India has been participating in STS Forum from 2008 onwards in various capacities and have contributed in 'STS S&T Ministerial Round Table and key STS Plenary Thematic Sessions' related talks such as on the theme: 'Brain Circulation and Mobility of Human Resource in Science and Technology' during the tenth Anniversary of STS Forum (2013) .

Mr. Koji Omi, Chairman Science & Technology in Society Forum Japan & Member Japan's House of Representative met India's Minister(s) for S,T,Es Dr. Harsh Vardhan, Cabinet Minister and Mr. Y.S Chowdhary, Minister of State on Nov.21 and Nov.19,2014 respectively. He gave a brief overview and outcome of the 11th STS Forum Meeting held during Oct.5-7, 2014 and also invited our Hon'ble Ministers for the upcoming 12th STS Forum Meeting to be held in Kyoto Japan during Oct.4-6, 2015.

Mr. Koji Omi, Chairman STS Forum, Japan with Dr Harsh Vardhan, Hon'ble Cabinet Minister for Science, Technology and Earth Sciences, India (at New Delhi, November 21, 2014)

STRENGTHENING S&T IN STATES/UTs

State Science & Technology Programme (SSTP) initiative was started in the year 1971 to encourage and promote science and technology activities in the States and Union Territories (UTs). The main objective of the initiative is to assist all the States/UTs to set up State Councils on Science and Technology which in turn could act as focal point for formulation, planning, coordination and promotion of S&T activities within their respective States. The state S&T councils are also expected to help in preparing State S&T plans, compilation and dissemination of S&T information

and popularization of Science. The Department extends core support annually to State Science & Technology Councils for their effective functioning.

In order to give focused attention for identification of location specific research and technology development and demonstration, projects are supported to a number of institutions apart from the councils. To evaluate the proposals received from such institutions as well as the councils, the Department has set up a core group and during 2014-15, the core group considered 34 new projects in diverse areas. The group also monitored 35 ongoing projects. 25 new projects have been supported by the Department on location specific research and technology development domain during 2014-15.

Some of the important achievements during the year under various activity heads of the programme are enumerated below:

1. Core Support to S&T Councils

- A new mechanism for assessment of the progress of State S&T Councils has been created.
- Based on the assessment, core support was continued to the State S&T Councils of 27 States/Union Territories. The support was oriented to S&T man power to strengthen S&T capabilities of the State S&T Councils to undertake Location Specific Research & Technology Demonstration Programme. An amount of Rs. Rs. 15.35 Crore was provided under this during the year.
- A new State S&T Council has been created in the newly constituted State of Telangana.

2. Location Specific Research and Technology Development Demonstration (LSR&TDD)

Under this programme, some of the location specific issues were identified by the concerned State Council were addressed through Science & Technology Interventions as well as the local institutions were encouraged for carrying out field trials, demonstration and replication of successful technologies. Some of the major issues were addressed through S&T projects during the year are mentioned below:

Study on Wild Edible Plants and Documentation of Ethno-botanical Knowledge of Utilization Practices associated with different Tribes of Arunachal Pradesh, at Arunachal Pradesh State Council for Science and Technology, Itanagar, Arunachal Pradesh

The wild edible plants draw much attention, as many of these plants are non-conventional and less known. The current project deals with an investigation made on the wild edible plants that have been used as food, vegetables by the tribes of Arunachal Pradesh, and the indigenous knowledge associated with different tribes concerning the use of these wild plants. The utilization of wild plants is strongly linked to their strong traditional and cultural system and is necessary part of the strategies adopted by the local people for sustenance.

Ethno-botanical surveys were carried out in Lower Subansiri, Papum Pare, Kurung Kumey and West Siang districts. Local guides and informants were used to locate and collect the wild edible vegetable plants. Information on plants species used for edible purposes, methods of utilization,

cultivation and other ethnic uses were gathered. About 25 wild plant species have been recorded from the above four districts.

Identified and preferred two Wild Edible plants

Zanthoxylum Rhetsa DC.

Spilanthes paniculata Wall.

Identification, Modification, Evaluation and Knowledge transfer of novel rodent traps and other eco friendly rodent control methods in Tamilnadu at Arul Anandar College (Autonomous), Karumathur, Madurai

This project has identified around 25 different traditional or native control methods in Tamil Nadu, South India. Currently the northern districts of Tamil Nadu is chosen for the last phase of identification of new traps. Many of these rodent control methods have hitherto not known elsewhere. Based on these designs, traps have been improvised and modified in order to make them simple, easy to construct, operate with enhanced efficiency and suitable for mass production. Farmer friendly 'Prototypes' of **10 traps** have been designed with simple metal and plastic materials and function. They are currently under evaluation in the field .This year, farmers and rural youth have been chosen from around the college and six batches of 120 farmers and 150 rural youth have been trained to use to trap Rodents and volunteers have been given the prototypes for evaluation. Training to rural youth is given as an entrepreneurial skill to take up pest management operations during the cultivation season.

Tanjore Bow trap

Wonder Trap

Modern Agricultural Implements, Science and Technology Transfer To Tribal Community For Sustainable Livelihood Along The Western Ghats, Coimbatore District, Tamil Nadu" at Multipurpose Social Service Centre, Coimbatore District, Tamil Nadu

This project has lead to introduction of modern equipments and training in modern agricultural practices, there has been a rise in the socio economic status of the tribals. Introduction of high yielding varieties of seeds and saplings has increased the produce, which in turn contributes to the rise in economic status of the tribes. Their nutritional intake has increased due to the introduction of kitchen garden and high yielding varieties of seeds. Better storage facility has been developed to store the produce. Drip irrigation system and spring irrigation system, without the use of electricity has been transferred to the tribal population. Because of this, they will not depend on electricity. A sense of awareness about the nature and its protection has been imparted. They have also been made known about the various government schemes and now they are more aware about their rights and duties. Medicinal plant cultivation in waste lands has been set up.

Introduction of modern equipments

Training of modern agricultural practices

Farmers Participatory Demonstration and evaluation of drip fertigation technique in Kerala, at Centre for water Resources Development and Management (CWRDM), Water Management (Agriculture) Division, Kunnamangalam, Kerala, Kozhikode

The project involves demonstration of drip fertigation in farmers' plots for motivating farmers to adopt it. The drip fertigation was installed in seven plots in Thiruvananthapuram, Alappuzha, Thrissur, Palakkad, Kozhikode and Kasaragod districts for coconut, arecanut and banana in the first year , and during the second year, in fifteen plots for arecanut, banana, vegetables and cardamom in Thiruvanthapuram, Alappuzha, Ernakulam, Idukki, Thrissur, Palakkad, Malappuram, Kozhikode, Wynad and Kasaragod districts. Green house experiment/demonstration on drip fertigation was established for Bhendi in CWRDM campus. Seminars and field visits for farmers were organized in ten demonstration plots. After observing drip fertigation in the demonstration plots, 76 to 95% of farmers expressed positive opinion about the technique, while 72 to 89% expressed interest in adopting it using subsidy provided by Agriculture Department. Media coverage of the project was done in various newspapers, based on which, farmers contacted CWRDM to know more about the technique.


Drip fertigation green house experiment and field visit of farmers

Farmers' Participatory Action Research through Geomatics based Research: Agricultural Intensification and Diversification for Sustainable Agriculture in West Bengal" at Centre for Environmental Management and Participatory Development, Water Resource Management Department, Kolkata

- The project was implemented in six districts covering all the agro-climatic zones of West Bengal.
- The project trained a large no of farmers with scientific technology of cultivation and scientific use of fertilizers.
- Crop intensification and diversification increased as earlier farmers cultivated mainly paddy during kharif season and rabi season remained as fallow period. Farmers were also not interested in summer cultivation due to water scarcity. But mixed cultivation of Moong and Sesamum facilitate them to cultivate with low water supply in summer. In rabi season also farmers cultivated crops like Lentil, Lathairas and Mustered resulting increase in crop production.
- Mixed cultivation in rabi and summer season increased their income from crop with optimum utilization of land.
- Thus crop production in all three season increased.
- Farmer's registration list generated with details of the farmers.
- Local farmers were satisfied with the proposed cultivation model and they will adopt this practice in the ensuing years.


Second time fertilizer in mustard field through relay process with rice / Research team giving seeds to a farmer in South 24 Parganas

MASTEC-ICAR joint venture project on pisciulture and its allied activities for socio-economic development in Manipur, at Manipur Science & Technology Council (MASTEC), Imphal

A joint collaborative project between Manipur, at Manipur Science & Technology Council (MASTEC) and Regional Research Centre of ICAR was supported by this Department for rearing and production of spawn, fish brooders of Indian major carps – *Catla catla, Labeo rohita, Cirrhinus mrigala,* and other exotic carps such as Grass carp (*Ctenopharyngodon idella)*, Silver carp (*Hypothalmitric molistrix*), Common carp (*Cyprinus carpio*) Breeding of the above fishes were carried out during the month of June 2014 adopting Induced breeding technique using Wova FH at the rate of 0.5 ml per body weight. Breeding was successful and the fry were reared in the nursery pond till they attain fingerling size.11 demonstration farms for food fish and 4 for ornamental fish had been selected after inspection of the farms sites by the project team. Out of the 11 food fish farms, 8 are in valley districts and 3 are in hill districts.

To impart basic knowledge about scientific farming of food and ornamental fish, a two day training programme on Pisciculture was organized during June 19-20, 2014 at Manipur Science Aquarium, Imphal. Altogether 30 participants including all the 11 beneficiaries for food fish and 4 beneficiaries for ornamental fish attended the training programme. 5 local Resource persons gave in-depth training to the participants.

In addition, the breeding of fan tail Gold fish (*Arassius auratus)* was tried with the available facilities at Manipur Science Aquarium. Survival rate of the fry was 50%.

Distribution of critical inputs to beneficiaries

Gold fish fertilised egg

Socio-Economic empowerment of SC self-help group (SHG) women in STAND adopted villages through compost, bio-fertilizer, and biogas production in Tirunelveli district in Tamil Nadu, at St. Xavier's College, Department of Botany, Palayamkottai, Tamilnadu

Under the project for upliftment of the living status of the women farmers a total of 600 women were selected and they were given awareness on the importance of socio-economic empowerment, sustainable environment, solid waste management, production of compost, bio-fertilizers, biogas, tissue Culture and Ornamental Fish Culture, marketing the products etc.

After the awareness programmes 564 selected participants were invited to the college on every Saturday and given training on production of Vermicompost and Azolla through presentation, video shows. In addition hands on training provided on the production of Vermicompost and Azolla to 444 women. Azolla and Vermicompost are produced in large quantities and used in the dairy forms and in the agricultural farms in the college and also given to people for use. Efforts are being made to market these products. Demonstration and training is being given to the women on Biogas production and Ornamental fish production.

Socio-Economic Upliftment of Farmers Through Mithun Based Farming System, National Research Centre on Mithun (ICAR), Krishi Vigyan Kendra, Phek, Jharnapani, Medziphema Dimapur, Nagaland

Mithun based farming is the foremost traditional livelihood method in some of the North Eastern States. This project was supported for the collection of basic and household information from Mithun owners and farmers like predominant forest plants, major horticulture crops and other livestock in the project range. Therefore the GPS mapping of the Project area 236.32 hectares along the traditional boundary is carried out and the area was declared a biodiversity conserved site by the village community. Three days training on use of GPS was held at Nagaland Science Technology Environment Council , Kohima The Mithun present in the project area were identified by putting Ear tag and Microchips and their scientific management and health care are being carried out regularly. The Villagers were trained on the scientific method of farming and Mithun rearing

Training of Farmers at NRC on Mithun

Vaccination programme of Mithun

Technologies Developed / Demonstrated :

Test bed for integrated production of 3 TPD FCO grade SOP (Sulphate of Potash) and caustic calcined magnesia (MgO) from sea bittern-based mixed salt through CSMCRI's internationally patented process.

The SOP Pilot plant is based on CSMCRI's patented technology for the production of SOP from sea bittern. Sea bittern at 29°Be concentration contains about 2.0 - 2.5% (w/v) of KCl. This bittern is further concentrated to crystallize mixed salt.

A test bed facility for the production of SOP will serve the purpose of demonstration and collection of data on such scaled up unit for the validation of technology and economic feasibility.

SOP test bed will be utilized to validate, optimize and demonstrate the process and collect data on such scaled up unit for validating technical and economical feasibility.

Sulphate of Potash Plant view

Development of Tricycle Rickshaw Operated Paddy Thresher at Manipur Science & Technology Council, Imphal

This project relates to the improvement in the threshing machine and has a reference to a machine particularly adapted for the purposes of threshing paddy and like crops although it is by no means limited to these specific use and may accordingly be used for threshing any other crops. The first and foremost objective of the present Thresher is to overcome at least some of the drawbacks of the prior art. In the present Thresher a cheap and portable arrangement of thresher is provided which operates without fuel or electricity. This new prototype Thresher is to provide a drum type threshing mounted on tricycle rickshaw assembly. It is also used to rotate the threshing drum with spikes which will require a minimum manpower and reduced cost for threshing. The machine can be transported easily by driving the Tricycle rickshaw assembly where it is required All the 12 (twelve) Tricycle Threshers have been fabricated and field trials have also been carried out at different sites/ locations in the last paddy harvesting season.

A view of the Tricycle Rickshaw Operated Paddy Thresher

Setting up of 2 *100 KW Micro hydel plant at Thangu, North Sikkim

A **2* 100 kw MHP** has been commissioned at height of 13000 feet in Thangu North Sikkim based on Cross flow turbine technology

Setting up of demonstration plants for pineapple leaf fibre and banana fibre using anaerobic extraction at National Institute for Interdisciplinary Science and Tech. (NIIST) Thiruvananthapuram

Demonstration plant for the extraction of banana fibres

The banana fibre and pineapple leaf fibre are usually extracted by physical methods which do not yield pure fibres in full structure. Biological extraction of these fibres through anaerobic process was developed for producing pure fibres and is demonstrated in the field through this work. Accordingly a demonstration plant was designed, fabricated and installed in Maneed Panchayat, Ernakulam District, Kerala for extracting *pineapple fiber* from a batch of 300 kg leaves. The plant was put in operation and is run by "Kudumbashree", the collaborating agency under the Kerala state government. This operation enables production of quality pineapple fibres from the waste pineapple leaves. Another demonstration plant for the extraction of banana fibres was designed, fabricated and installed in Kulathoor Panchayat, Thiruvananthapuram District, Kerala. The plant is under testing for commissioning and operation. This anaerobic extraction plant can produce pure fibres from banana pseudostem.

Training cum production centre in leather goods and garments with strong market orientation" at Indian Institute of Integrative Medicine, Srinagar

1. During the first two batches a total of 30 unemployed educated girls of different districts of Kashmir valley were imparted training in manufacturing of leather goods and garments. These included hands on experience in making of Jackets (ladies and Gents), Coats, Bags, ladies purses etc. These trainees were given training of six months in two batches. The third batch of 18 trainees in under process.
2. The selected batches of trainees were given lectures and power point presentations on different

selected topics from the already formulated syllabus following the advice and pattern of CLRI Madras. These trainees were taught about the potential of leather industry in India and particularly the leather goods and garment industry potential in Kashmir. Other theoretical lectures were given about the overall know how and making of leather goods and garments.

3. Leather goods and garments manufacturing was done with the help of one instructor and 04 skilled workers from finished leather purchased from the market. Strict quality control was observed at every process beginning from assorting to packing. Trainees were taken to different selected private leather goods manufacturing units of valley for exposure to leather manufacturing processes and discussions regarding hands on experience in making different leather products. 08 trainees got absorbed in private leather industries of J& K.
4. The leather items manufactured during the training course were sold through a committee of IIIM to different visitors and locals time to time. Leather products were also displayed during seminars, conferences and Kissan Melas etc.


Trainees working at Leather centre, IIIM Srinagar)

BUILDING NANO S&T CAPACITY

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 2014-15, Nano Mission actively continued its activities which are summarized in brief below.

Basic Research Promotion

34 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 dealth with: physics of nanosystems probed by ultrafast time-resolved spectroscopy and Raman scattering; spectroscopy and imaging down to subnanometer length scales on novel electronic systems and their nanostructured devices; nanoscale modelling of energy-storage materials; oxides nanostructures: processing, properties and some specific applications towards healthcare; fabrication and application of functionlized magnetic carbon quantum dots (MCQD) in tumor therapy: a new light on nanotheranostics; development of si-RNA loaded nanomedicines and their

evaluations in pre-clinical cellular and computational models; polymeric graphitic-carbon-nitride semiconductor nanomaterials for next-generation lithium-ion rechargeable batteries; development of dendrimeric sunscreens containing polyphenols; nano-bead based approach to identify suitable vaccine candidated for latent mycobacterium tuberculosis.

The ongoing individual scientist-centric R&D projects, Units, Thematic Units of Excellence and other programmes continued to receive support during the year. Some important achievements of these ongoing projects were:

- Layer-by-layer assembly (lbl) and template-based infiltration approaches have been used to prepare polymer/carbon capsules, amorphous carbon particles, and PDMS particles. These capsules have been used as nano/micro reactors to prepare variety of nanoparticles and their in vitro/in vivo biocompatibility have been evaluated (Figure 1). Mesoporous carbon and PDMS nanoparticles were loaded with anticancer drugs and their efficacy have been evaluated.

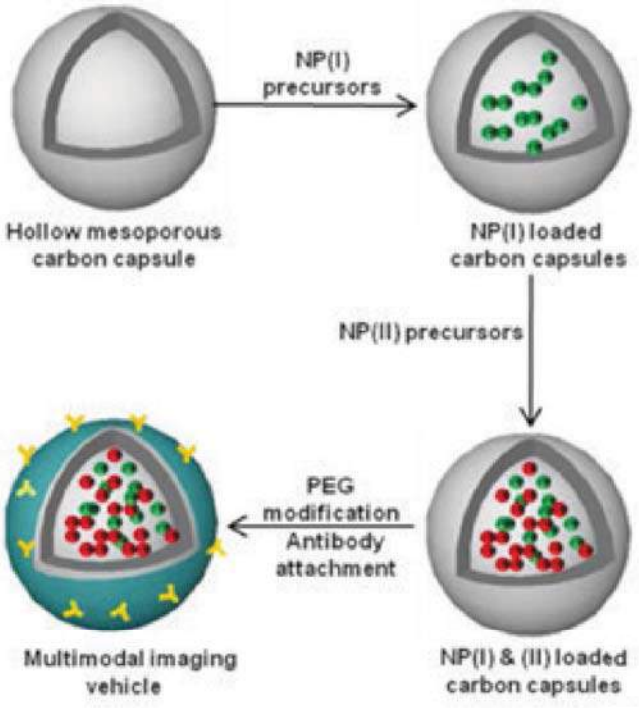


Fig.1. Synthesis of nanoparticle-loaded PEGylated capsules

- A bio-engineered tri-layered nanocomposite scaffold for periodontal regeneration was synthesized and characterized for periodontal regeneration. The bio-engineered tri-layered nanocomposite scaffold consists of chitin/poly(lactic-co-glycolic acid) (PLGA)/nano bioactive glass (nBGC) with platelet rich plasma (PRP) derived growth factor as the alveolar bone layer, chitin/PLGA with fibroblast growth factor (FGF-2) as the periodontal ligament layer whereas Chitin/PLGA/nBGC with cementum protein-1 (CEMP-1) as the cementum layer. Chitin/PLGA/nBGC/PRP derived growth factor layer facilitated the osteoblastic differentiation of

human dental follicle stem cells (DFCs) which was confirmed by RUNX-2 (5th day) (Fig. 2A). Chitin/PLGA/FGF-2 layer supported the fibroblastic differentiation which was confirmed by periodontal ligament associated protein (PLAP-1) and collagen type-1 (COL-1) expression (7th day) (Fig. 2A). Chitin/PLGA/nBGC/CEMP-1 layer supported the cementoblastic differentiation of DFCs which was confirmed by bone sialoprotein (BSP) expression (7th day) (Fig. 1A). Further to assess *in vivo* periodontal regeneration, a periodontal defect was created in the maxillary anterior region of New Zealand white rabbits and the tri-layered nanocomposite scaffold with and without growth factors were implanted into the defect (Fig. 2B). Commercial collagen guided tissue regeneration (GTR) membrane and empty defects served as the positive and negative controls. Micro-CT and radiographic analysis were performed.

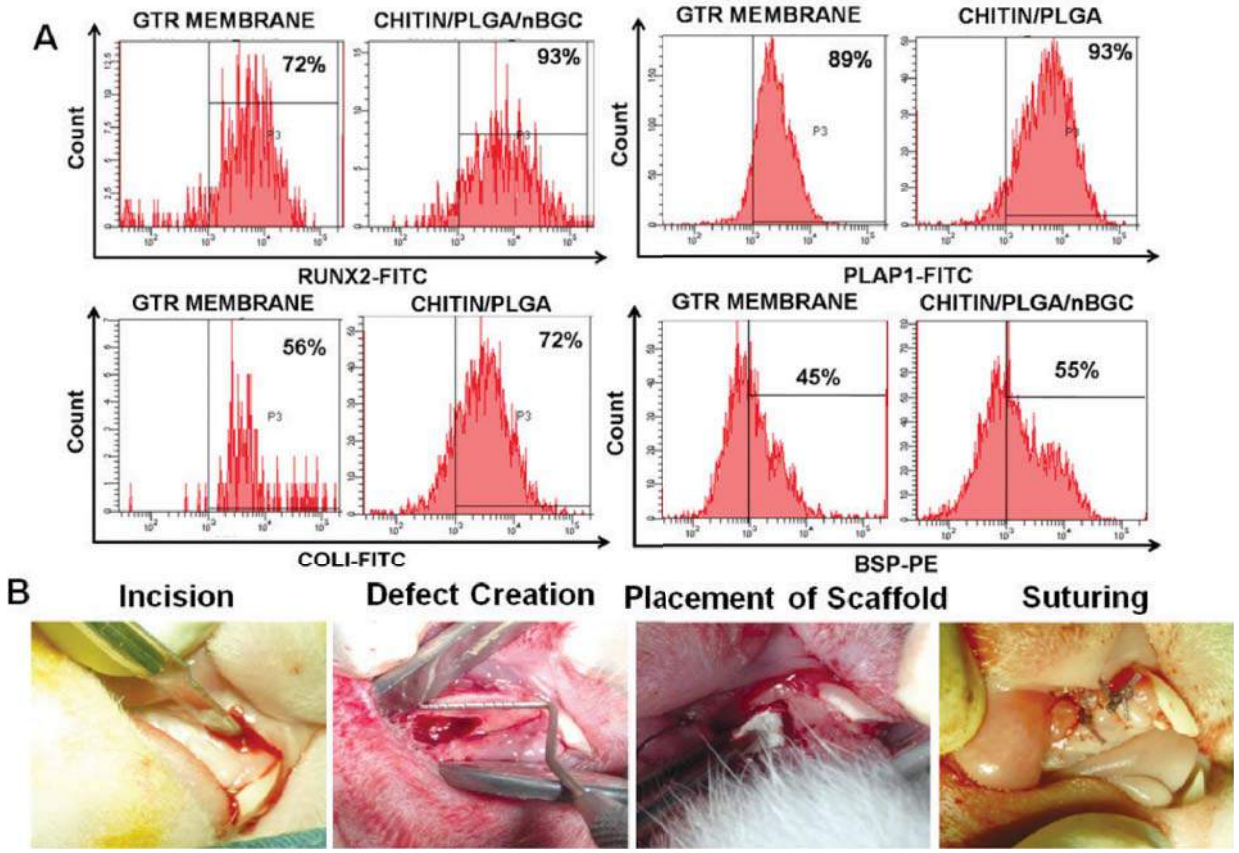


Figure 2: (A) RUNX-2 expression showing osteoblast differentiation on GTR control and Chitin/PLGA/nBGC, PLAP-1 and COL-1 expression showing fibroblast differentiation on GTR control and Chitin/PLGA, BSP expression showing cementoblast differentiation on GTR control and Chitin/PLGA/nBGC, (B) *In vivo* periodontal defect creation and material placement in New Zealand white rabbits.

- A live cell agarose based micro-matrix system (Fig.3) was developed with cell embedded alginate beads for prolonged hepatic functionality in dynamic cell culture conditions, which displayed both detoxicification and synthetic functions.

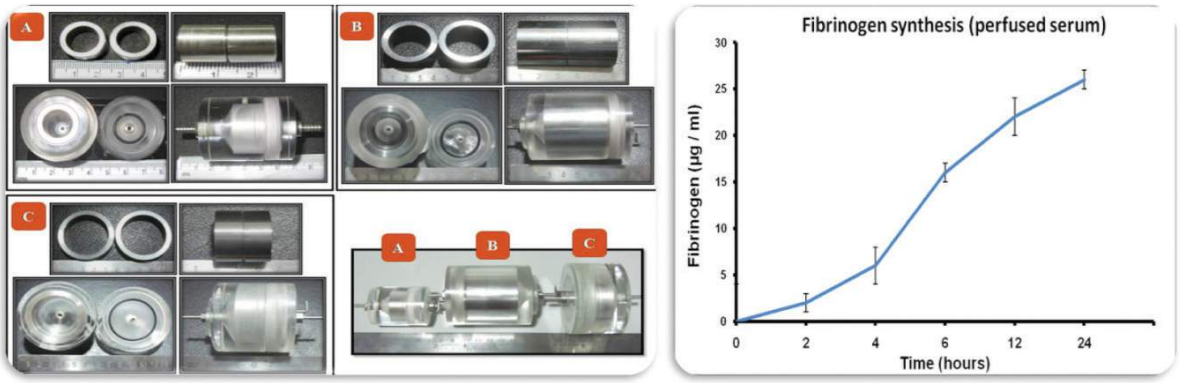


Figure 3 : Left panel shows the scaling-up of perfusion cassettes for enhanced hepatic biofunctionality and the right panel shows the Hepatocytes form *in vitro* functional spheroids capable of synthetic function expression on day-7, day-14 and day-28 respectively.

- Injectable fibrin based hydrogel was developed and tested *in vivo* in rabbit models which showed minimal inflammatory and immune response.
- A variety of electrospun and doped TiO_2 and ZnO hollow and porous nanofibers and their carbon composites were synthesized for photocatalysis and degradation of organic pollutants.
- A new-generation point-of-care (POC) medical diagnostic tool exploiting a residual gas analyzer (RGA) coupled with a high vacuum chamber for the non-invasive diagnosis of the *Helicobacter pylori (H. pylori)* infection in human stomach through ^{13}C-urea breath tests without endoscopy and biopsy tests has been developed.

Research Facilities

Support to the project entitled "National Facility on Ultra High Resolution Aberration-Corrected Transmission Electron Microscope" at the International Centre for Materials Science, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore continued during the year. Good progress was reported from this project. A large number of samples were tested using the facility. 31 research publications came out of the project during the year besides training of research students and technical manpower.

The project entitled "Clean Room Infrastructure for National Nanofabrication Centre at the Indian Institute of Science, Bangalore" was completed. A world class clean room infrastucture has been created which is utilized by many investigators and research students for their research work. 46 Ph.D, 4 M.Tech. and 22 UG students, 65 project staff and 24 other manpower utilized this facility during the year. Besides this, a large number of regular faculty members from different institutions of the country also utilized this facility.

Good progress was made for establishment of low-energy ion-beam facility at Kurukshetra University. A 200 kV Heavy Ion Accelerator system was installed and commissioned at Kurukshetra University during the year.

Construction of the building for housing the accelerator facility at University of Allahabad continued and procedural formalities for AERB clearance were completed during the year.

Human Resource Development

Support to ongoing Post-Graduate programmes (M.Tech/ M.Sc. in Nano Science & Technology) continued during the year. The progress of various PG programmes was reviewed. Projects supporting 8 M.Tech. and 1 M.Sc. programmes were completed during the year. About 200 M.Tech. students passed out from these PG programmes.

Post-doctoral fellowships to attract talented young researchers towards advanced research in Nano Science & Technology continued to be offered through the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. 5 students completed their research work under the PDF programme.

The Nano India Meet-2015, a flagship event of the Nano Mission, was organized at SASTRA University, Thanjavur during January 29-30, 2015. About 500 participants from India attended this event. Partial support to 4 other International /National Conferences was also provided. The National Research Award in Nano Science and Technology for the year 2015 was awarded to Prof. A.K Ganguli, Director, Institute of Nano Science and Technology (INST)-Mohali and the Young Career Awards in Nano Science and Technology for the year 2015 were awarded to Prof. P.S Anil Kumar, IISc, Bangalore and Prof. S. Swaminathan, SASTRA University, Thanjavur.

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.

The Indo-Canada collaborative programme was completed during the year.

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.

Support to the project for development of Standards for Nanotechnology implemented by National Physical Laboratory, New Delhi continued this year. 17th meeting of ISO/TC 229 & its 4 Working Groups was organized in India during the year. The progress of the project was also reviewed during the year.

Review of Ongoing/Completed Projects

A Group Monitoring Meeting to review the progress made in Thematic Units of Excellence, Units and other R&D projects funded by Nano Mission was organized at SASTRA University,

Thanjavur during January 31- February 01, 2015. In this meeting, progresses of 88 ongoing/ completed projects were reviewed.

DEVELOPING STRATEGIC KNOWLEDGE FOR CLIMATE CHANGE

CLIMATE CHANGE PROGRAMME aims to coordinate and implement two national missions on climate change launched under National Action Plan for Climate Change [NAPCC]. These are:.

(a) National Mission for Sustaining the Himalayan Ecosystem [NMSHE] and

(b) National Mission on Strategic Knowledge for Climate Change [NMSKCC]

HIGHLIGHTS OF ACTIVITIES OF THE SCHEME DURING 2014-15:

- Implementing a major climate change research programme on 'Building Human and Institutional Capacities under two missions i.e. NMSKCC and NMSHE
- 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.
- International bi-lateral, multi-lateral and Regional cooperation
- Setting up of Thematic Task forces under NMSHE
- Establishment of State climate change cells in the Himalayan and Non-Himalayan States

OUTPUTS/SERVICES PRODUCED

As part of deliverables of the two national missions, several major research programmes have been supported during the period 2014-15. A brief summary of these activities is given below:

(i) **Setting up of Thematic Task Forces under NMSHE**

One of the deliverables of NMSHE mission is to set up 6 Task Forces anchored around lead institutions working in the key areas of Himalayan ecosystem. Four such TFs have been established during 2014-15. Following is the summary of these Task Forces-

(1) Task Force on "Forest Resources and Plant Diversity" by G.B. Pant Institute of Himalayan Environment & Development, (GBPIHED), Almora.

The Himalaya is one of the biodiversity hotspots, and supports representative, natural, unique socio-economically important biodiversity components. Although, a vast range of scientific information is available on various aspects of forest resources and plant

diversity, yet an appropriate and effective monitoring system is not available for the same covering various bio-geographical zones/provinces. The programme, therefore, intends to develop approaches for actions for developing a strong and commonly acceptable and widely applicable monitoring system for Indian Himalaya. While considering the approach for developing such a programme, it is intended to develop the monitoring system in a way to help in conserving the wild native plant diversity in forests of IHR, maintaining and enhancing forest ecosystem health and productivity in the region, protecting and conserving Himalaya forest habitats, soil and water resources, monitoring Himalayan forest contributions to national and global ecological cycles, maintaining a continuous and predictable flow of goods and services (i.e., ecological, economic and social benefits)

(2) ***Task Force on "Fauna and Wild Life Habitats" by Wildlife Institute of India, (WII) Dehradun.***

This Task force programme is relevant to the sub themes of Ecology, Biodiversity and flora/fauna and climate change vulnerability and impact as it deals with (a) faunal biodiversity including macro fauna, micro flora and fauna (b) major focus on spatial ecology, habitat ecology and population ecology of faunal species / taxa in the Himalaya; (c) addresses the effects of climate change/variability along with other factors such as habitat and anthropogenic pressures on the distribution and abundance of faunal species/ taxa under various scenarios; (d) ecosystem services, impacts on wildlife habitats and ecosystems due to anthropogenic pressures and climate change; (e) prioritization and monitoring of selected species/taxa and areas in the IHR.

(3) ***Task Force on "Traditional Knowledge System" by Jawaharlal Nehru University, (JNU), Delhi.***

This task force programme is expected to work on objectives such as, (a) to document, validate and analyze the traditional knowledge on climate change in the Indian Himalayan Region, To create a digital library on TKS in the Himalaya.(b) To understand the linkages between traditional knowledge and modern science in order to identify promising TKS for improvement and adoption. (c) To capacitate the institutions in the Indian Himalayan region to focus on TKS for sustainable development of indigenous communities in the hills. (d) To formulate strategic framework for indigenous knowledge management in ecologically fragile mountain ecosystems.

(4) ***Task Force on "Himalayan Agriculture" by Indian Council of Agricultural Research (ICAR), New Delhi***

Agriculture is the mainstay of people in the Indian Himalayan Region (IHR). However, with climate variability and the growing capriciousness in precipitation and rising temperatures, the traditional farming systems and cropping patterns are increasingly under threat. The resource-poor rural farming communities are most vulnerable to the risks of climate change due to poor adaptation capacity. Furthermore, the physiographic

and environmental constraints associated with the wide variability in altitude, slope, and aspect limit the adoption of modern agricultural technologies in the IHR. The Task Force focuses on evolving a database on soil, water, crop genetic diversity and indigenous practices, promote climate resilient farming models and validate technologies for hill farmers covering aspects related to crops, livestock, agroforestry, farming systems, horticulture and fisheries. Further, it attempts to establish monitoring systems, validate climate models and capacity building. The focal geographical areas of this taskforce will be eastern (NEH region), central (Uttarakhand) and western Himalayas (Leh, Ladakh, HP and J and K).

(i) Glacial Lake Outburst Flood (GLOF) at South Lhonak Lake of Sikkim

This specialized survey programme has been formulated by Sikkim State Council for Science and Technology for the assessment of the present condition of the South Lhonak Lake in the Sikkim Himalaya with respect to GLOF in the region utilizing latest scientific technologies. This study is expected to undertake a detailed investigation and study for predicting and mitigating such disasters, associated with the GLOF on the downstream population.

(ii) Setting up of State Climate Change Cells

In order to implement NMSHE related deliverables/actions in the State Action Plan on Climate Change (SAPCC), it is proposed to set up a State CC Cell in each State in the Indian Himalayan Region (IHR). Such CC Cells have already been set up in 7 out of 12 IHR States. These include: J&K, Himachal Pradesh, Sikkim, Meghalaya, Tripura, Mizoram, and Manipur. The proposals from States are being received which will be processed. In the Non-Himalayan States, a State CC Cell has been set up in Punjab under NMSKCC.

(iii) Global Technology Watch Group (GTWG)

One of the major deliverables of the NMSKCC, is to set up Global Technology Watch Groups to help accomplish the task of technology mapping, selection and prioritization in the areas relevant to all other 7 National Missions such as Solar Energy, Enhanced Energy Efficiency, Water, Agriculture, Forest, Sustainable habitat and Himalayan ecosystem. In addition, manufacturing and Clean Coal technology were also identified as areas where GTWG will be relevant. During 2014-15, two GTWGs have been set up, one each on Renewable energy including Solar positioned at NIAS, Bangalore with IISc, Bangalore, IIT,Delhi and GERMI, Ahmadabad as partners; and on Advanced Clean Coal Technology positioned at IIT, Chennai with IIT, Delhi, IIT-Bombay, and IRADe, Delhi as partners.

GENERATION OF TECHNICAL REPORTS RELATED TO CLIMATE CHANGE

The CCP had undertaken a detailed review of all the ongoing projects/programmes (nearly 25) being implemented under the programme during 4-6 September 2014 at Jaipur by the Expert Committee (EC) of Climate Change Programme (CCP). Each of these programmes/projects brought out a detailed Technical report about the R&D work carried out by them.

Review of 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.

The CCP had launched two national knowledge networks, one each on CC & Human Health and Climate Modelling last year. A detailed review of the progress made by each of these networks was undertaken during 9-10 january,2015 at IIT, Delhi. Each partnering institutions/PIs have brought out detailed technical report and presented in the review meeting.

STUDY REPORTS PRODUCED/GENERATED AND THEIR BRIEF FINDINGS

Detailed technical reports were prepared and submitted by institutions/PIs in all the R&D programmes/projects supported by CCP. A Strategic Knowledge Report in Climate Change was brought out by the Division based on the major outcome from such projects/programmes. A gist of important findings/outcomes/achievements is given below.

(A) Long-term changes in extreme sea level and mean sea level along the Indian coast, by CSIR-National Institute of Oceanography, Goa

In the present study, altimeter data to determine sea-level-rise trends in the northern Indian Ocean, particularly, off the Indian coasts has been used. Satellite altimetry data from TOPEX/ Poseidon since 1992 and later from Jason-1 and Jason-2 satellites has helped in estimating spatial variations of sea-level-rise trends over most of the globe within ± 66^0 latitudes. These data have been extensively used to determine global sea-level-rise trends during the last two decades.

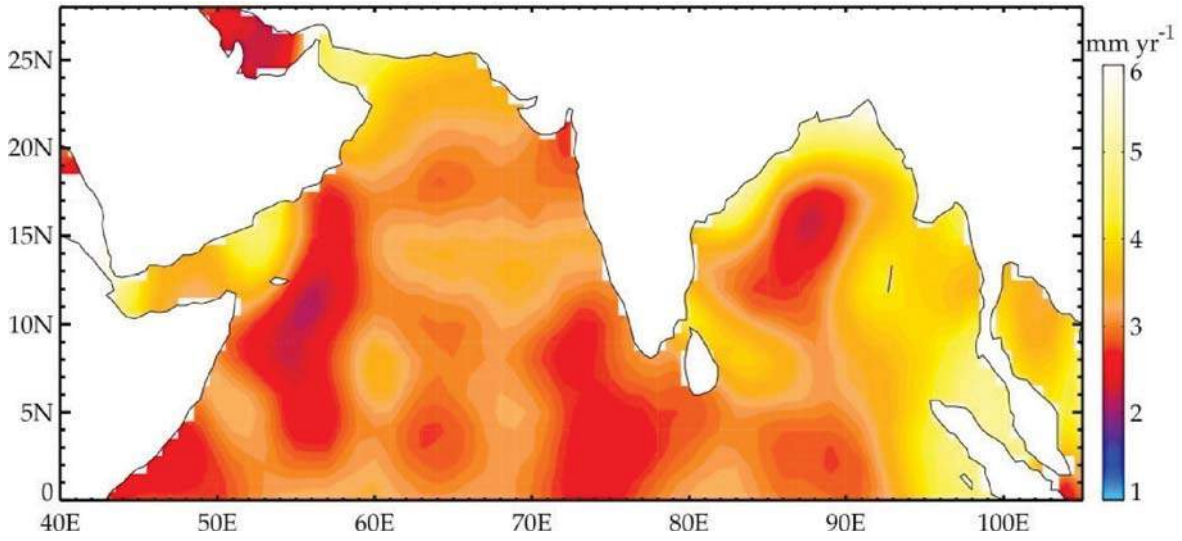


Figure-1: Spatial map of sea-level-rise trend (mm yr^{-1}) for the period 1993-2012, estimated from sea-level anomalies over the north Indian Ocean, obtained from satellite altimeter measurements.

The spatial pattern of sea-level-rise trends (Fig. 1) (1993-2012) shows that trends are about 3.0 mm yr^{-1} in the north Indian Ocean, with an average trend of 3.28 mm yr^{-1} for the entire region. In

the northeastern coast of India, head of the Bay of Bengal and east coast of the Bay, sea level rises slightly faster than other regions. The causes for large trends in the northern Bay of Bengal need to be further investigated for the effects caused by interannual and decadal variability. The present estimates show higher sea-level-rise trends in the north Indian Ocean during the last two decades, when compared to those made using past tide-gauge data, covering mostly 20th century. It may be noted that global averaged mean sea-level-rise trend (1993-2012) is about 3.12 mm/year (Master et al., 2012). The difference in trends between those estimated from the satellite altimeter data and past tide gauge data is mainly due to different period of analysis considered. During the last two decades, sea level rose faster than for the entire 20th century. It is true that a period of two decades is not long enough to resolve natural variability in the ocean, for instance, decadal variability. Based on the present understanding, it is not possible to say whether the increased sea-level rise during the recent period is an acceleration resulting from global warming or partly caused by natural variability.

(B) Strategic Knowledge for Climate Change on Agriculture and Forest Ecosystem in Indo-Gangetic plains (IGP) of UP by CSIR-National Botanical Research Institute, Lucknow

This programme has been supported to compile the plant diversity and ecological data of the long term ecological monitoring at permanent plots established in tropical dry deciduous forests at Sonbhadra district of Uttar Pradesh as well as to study the response elevated CO_2 on tropical tree species dominant to dry deciduous forest ecosystems of Uttar Pradesh under FACE (Free Air CO_2 Enrichment) facility at CSIR-NBRI**.**

Apart from the ecological studies, the general plant diversity assessment of the area has also carried out, therefore many herbaria of the country like LWG, BSA, BSD, CAL & DD were consulted to examine and record the previous collections made from the study site, if any, to explore total number of species of the area. The preliminary analysis based on the literature survey, herbarium consultation and our own collections about 414 specimens belonging to 272 genera and 87 families have been recorded till date (Fig.2).

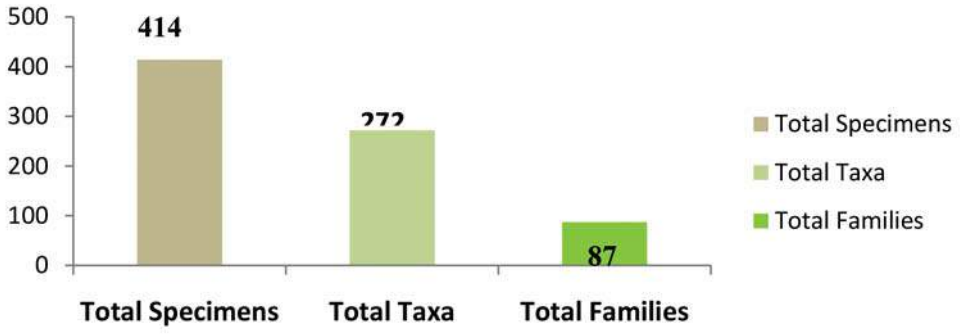


Figure-2. Plant Diversity of the study site

(C) Institute of Rural Management, Anand: Climate change adaptive behavior for sustainable rural livelihoods

Assessment of the dynamic vulnerability of rural livelihoods to climate variability and change

and disasters and to develop a range of storylines for climate resilient (rural) development and implications for policy was done through this study. Based on the results of semi-arid Central India and Western Himalayan region, government should mainstream climate-smart agriculture (CSA) along with better water management practices while empowering communities, groups and collectives to serve as climate stewards in enhancing resilience of primary production systems. CSA includes sustainably increasing agricultural productivity; adapting and enhancing resilience of agricultural systems for food security while reducing greenhouse gas emissions from agriculture and allied activities. CSA along with sustainable developments enables reconciling social, economic and ecological objectives and providing a better future for humanities.

(D) Centre of Excellence on Climate Change Research for Plant Protection (COE-CCRPP) ICRISAT, Patancheru, Telangana

The project investigated the impact of climate change on diseases and insect-pests of chickpea and pigeonpea, the two widely grown pulses in India. Both these pulses dominate with over 70% share of total pulses and are largely grown in rainfed environments, most vulnerable to climate change.

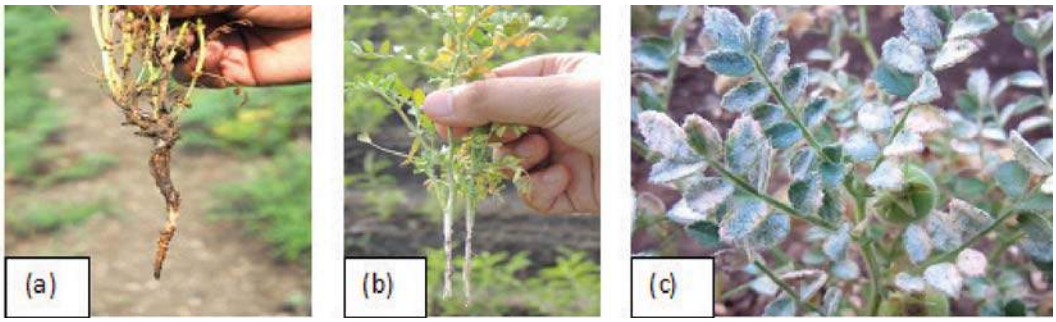


Fig 3:. Emerging diseases in chickpea (a) Dry root rot (b) collar rot (c) powdery mildew

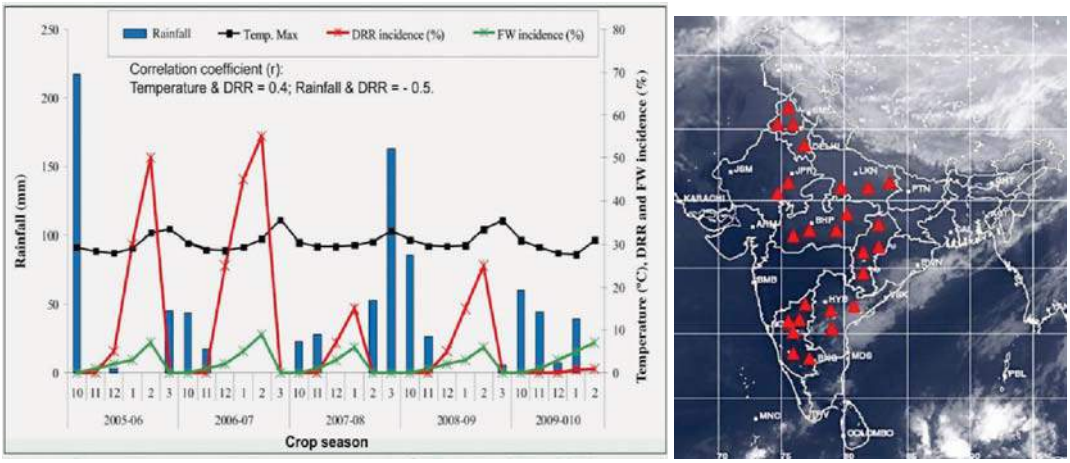


Fig.4: Weather data and dry root rot disease in chickpea and map showing current distribution of dry root rot in India

Attempts have been made to develop weather based forecasting model to help in prediction of diseases such as Phytophthora blight in pigeonpea and dry root rot in chickpea. The study concluded that the severity of diseases (Phytophthora blight and sterility mosaic in pigeonpea, and root rots in chickpea) and insect pests (*Maruca* and *Helicoverpa* in pigeonpea, and *Spodoptera exigua* in chickpea) will increase as a result of global warming and climate change. New diseases (Alternaria blight in pigeonpea & chickpea and sudden death and root rots in pigeonpea), and insect pests (leaf miner and mealy bugs, *Planococcus* and *Ceroplastodes* in pigeonpea, and white fly, *Bemisia tabaci* and mealy bug, *Planococcus* in chickpea) are likely to emerge as serious pests under elevated temperature and CO_2. This information can be used to develop strategies for pest management in these crops to mitigate the effects of climate change for sustainable production of grain legumes.

(E) Analysis of Climatic Changes during The Quaternary from Glacial Sites In India Based on Multi-Proxy Data, Birbal Sahni Institute of Palaeobotany (BSIP), Lucknow, UP

In the project analysis of the past vegetation and climatic changes were conducted on the basis of palynological studies. The impact of anthropogenic activities were traced through the pollen record in the sediments, from high-altitude regions of western Himalaya.

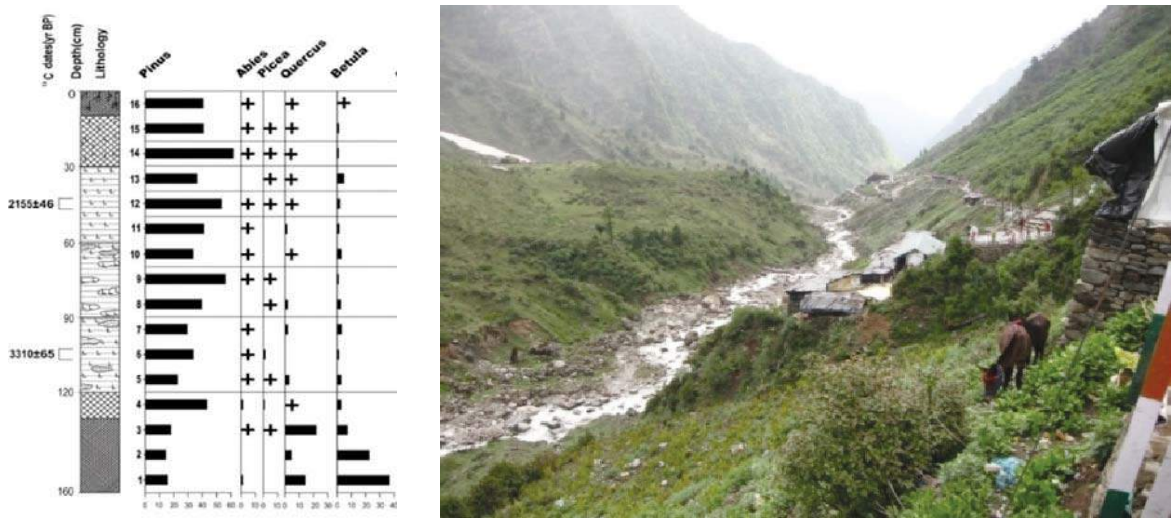


Fig.5. Diminishing frequencies of Betula and Quercus pollen since ~ 4500 years and degradation of tree-line around Kedarnath

The past climatic fluctuations are being studied from two important glaciers: Chaurabari Glacier (Kedarnath) and Hamtah Glacier (Lahaul-Spiti). In Chaurabari, the palynological results from the outwash plain of the glacier depict the vegetational and corresponding climatic changes since 4368 to recent. In **Hamtah Glacier (Lahaul-Spiti)** the palynological results depict the vegetational changes and concurrent climatic fluctuations since 4783 till recent. The subsurface profile in the study area of **Chhatru Glacier (Lahaul-Spiti) depicted** the vegetational changes and corresponding climatic fluctuations from 8,100 yrs BC to recent.

The pollen record has brought out the impact of anthropogenic activities in the form of grazing and degradation of tree line from Lahaul-Spiti and Kedarnath, respectively. Grazing destroys many species from the meadows and where the grazing is heavy the plants do not produce flowers and fail to regenerate. On the other hand, some species such as *Iris kemaonensis* (Iridaceae), *Anemone rivularis* (Ranunculaceae) and *Thermopsis barbata* (Fabaceae) thrive well under these conditions and display abundance on grazed ground which they do not achieve elsewhere.

(F) IITB-Centre of Excellence In Climate Studies: Indian Institute of Technology Bombay, Powai, Mumbai, Maharashtra

The research covers the three broad themes of 1) Regional Climate Change 2) Vulnerability Assessment and Adaptation and 3) Technology Assessment and Mitigation.

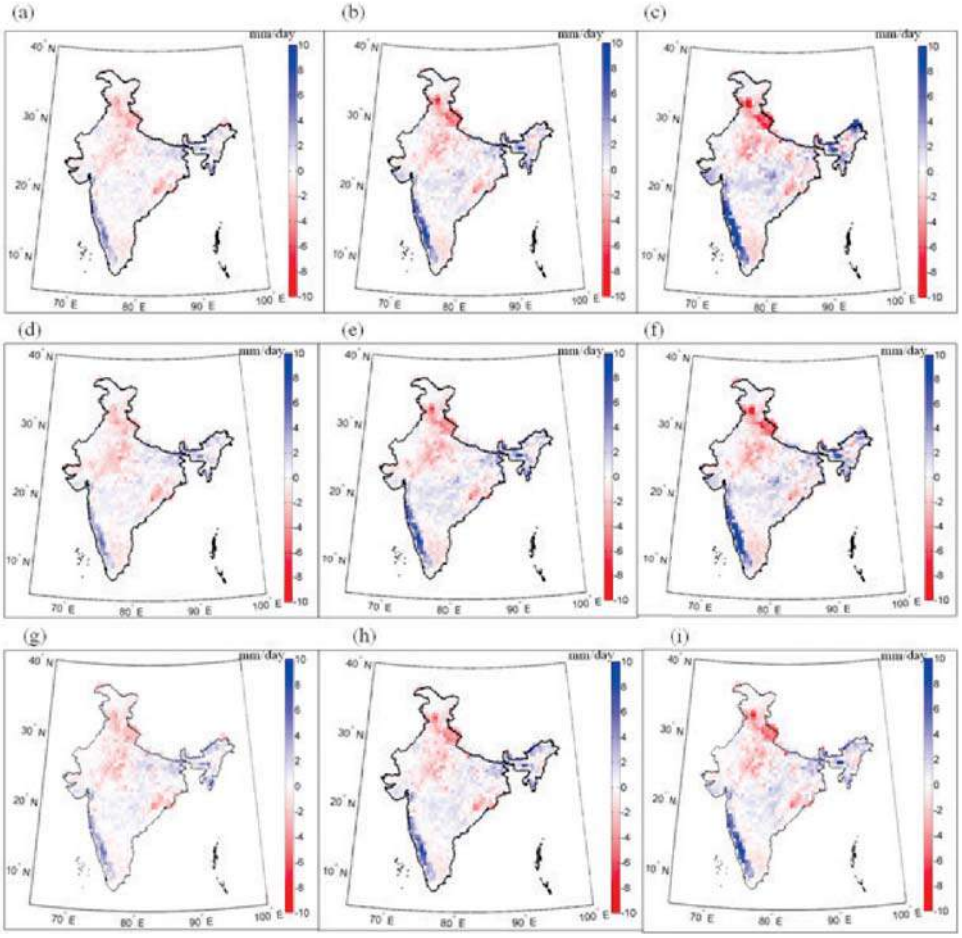


Fig.6. Rainfall projections for future for scenarios SRESA2, SRESA1B, and SRESB1.

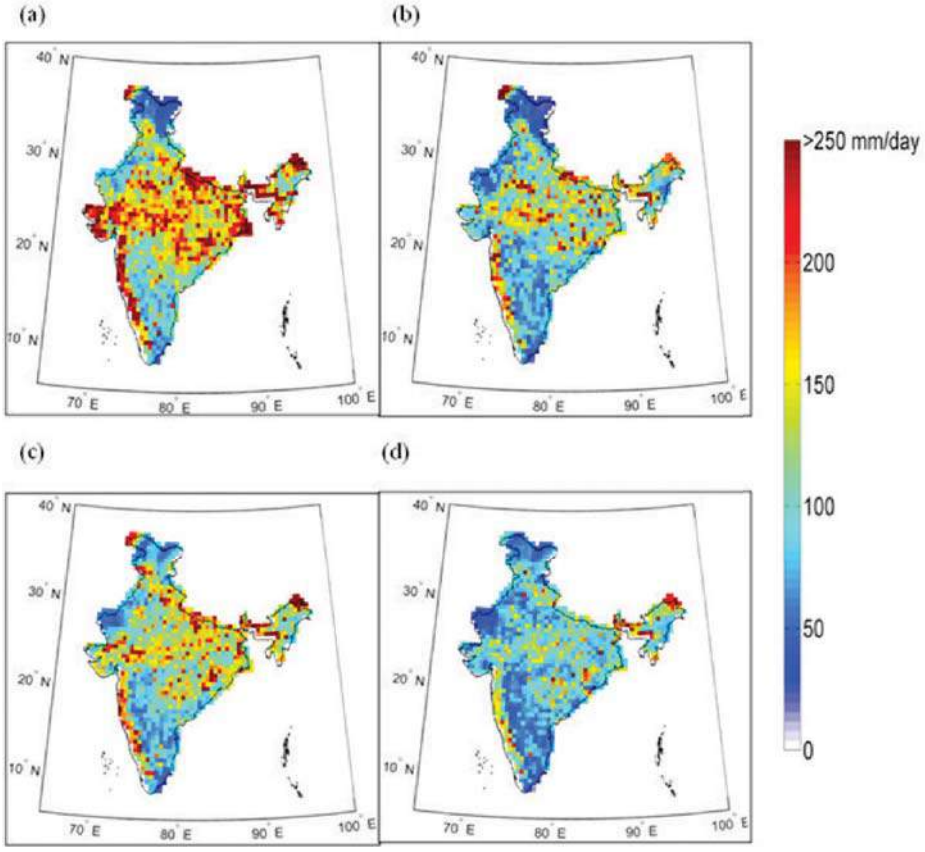


Fig.7. Thirty year return level rainfall (computed with Gumbel distribution) comparison between observed and projected rainfall at 0.5° resolution.

The study of High-resolution multisite daily rainfall projections in India with statistical downscaling for climate change impacts assessment shows climate change impacts assessment involves downscaling of coarse-resolution climate variables simulated by general circulation models (GCMs) using dynamic (physics-based) or statistical (data-driven) approaches.

The study on *Assessment of Socio-Economic Vulnerability to Climate Change:* *A City-Level Index based Approach* indicates that the cities of Jaisalmer and Jodhpur are the most vulnerable among all the cities studies. Pune is the least vulnerable among all followed by Mumbai, Delhi and Bangalore. Thus, metropolitan cities (except Chennai) seem to be on the lower end of vulnerability. The indices which are non-inclusive of any climate variables give an indication of the cities' capability to cope with a natural hazard in context of its infrastructural, technological, social, financial and space capability.

Technology assessment shows that LPG and biogas stoves, followed by biomass gasifiers, comprise the cleanest available cooking technologies. However, there is a tradeoff between mitigation of climate and health impacts.

(G) Strengthening an Existing Centre of Excellence In Climate Change: Divecha Centre For Climate Change, IISc, Bangalore

Estimate of Glacier Water Stored In the Indian Himalaya

The distribution of ice thickness for a Himalayan glacier was estimated using surface velocities, slope and the ice flow law. It was found that the thickness varies from ~ 540 m in the upper reaches to 50–60 m near the snout. The volume of the glacier is estimated to be 23.2±4.2 km^3. The technique can be used to estimate distribution of ice thickness of thousands of glaciers in the Himalaya, if systematic program is launched.

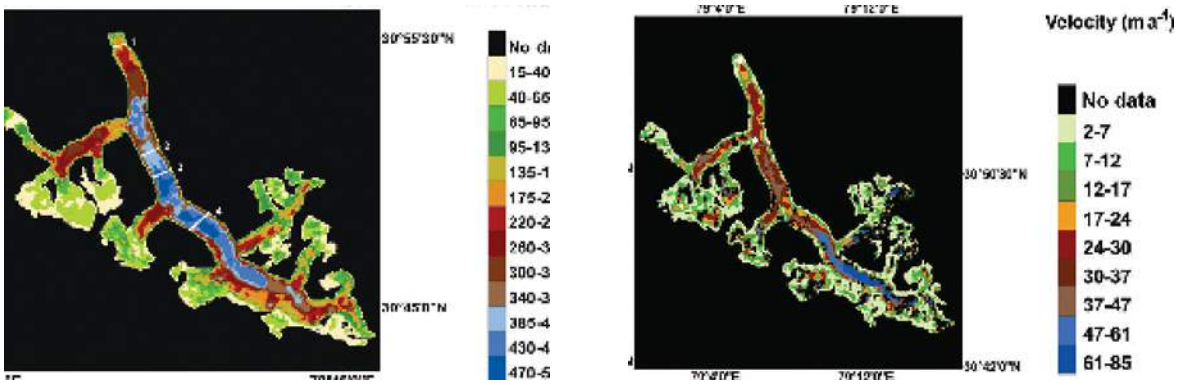


Fig.8. Surface velocity and depth of Gangotri glacier. The maximum velocity around 80 m/y and depth of 540 m was observed

GLACIAL RESPONSE TO CLIMATE CHANGE The study provided a 'broad order-of-magnitude' estimate of the glacial mass balance towards the end of the 21st century. The current (i.e., year 2000) glacial mass loss was estimated as -6.6±1Gt yr. The mass loss is projected to increase to --14.4±1 Gt yr-1 in 2030s, -35.5±2 Gt yr-1 in 2080s in the RCP 8.5 scenario. The analysis c suggests that a rapid mitigation of Green House Gas emissions (i.e. a shift from the RCP 8.5 pathway to RCP 2.6) could prevent more than 16% of the KH glaciated area from 'eventual disappearance' by the end of this century. Therefore, present pattern of stream runoff and availability of water resources could be largely maintained, if lower emissions pathways are followed in future. The study suggests that the reduction in Green House Gas emissions (i.e. a shift from the RCP 8.5 pathway to RCP 2.6) will help in conserving part of glaciers.

IMPACT OF DEBRIS COVER ON GLACIERS

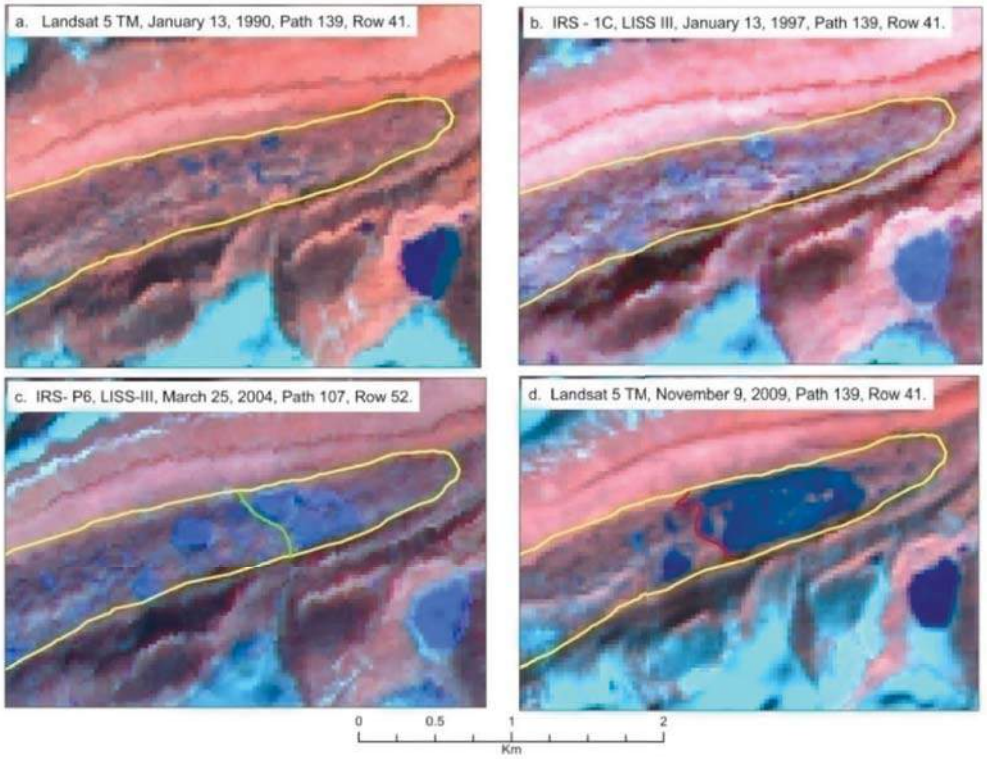


Fig.9. The evolution and coalescence of a supra glacial lake and the formation of a moraine dam.

The overall loss in glacier area in 20 years, from 1990 to 2010 was estimated. The rate of change was estimated as 0.16 ± 0.10 %, with an increasing rate after 1997. The glaciers with 'debris' appeared to lose area at a slower rate than 'debris-free' glaciers. However, debris covered glaciers can lose area at much higher rate after the formation of supra glacier lakes. Investigation has shown that rate of retreat is accelerated for at least 38 Glaciers in Sikkim Himalaya due to formation of supra glacier lakes. This is an important observation reported for the first time and it has major implications on distribution glaciers in future.

POLICY LEVEL INTERVENTIONS INTRODUCED

The action under "Governance for Sustaining the Himalayan Ecosystem (G-SHE)" is one of the components of the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) wherein DST and Ministry of Environment & Forests are required to work together with the State Governments of Himalayan States to introduce policy driven actions. G-SHE initiatives comprise of actions related to sustainable urbanization, water security, building environmental awareness, conservation through community involvement and infrastructure development. DST in partnership with MoEF & CC has already initiated some action on these aspects.

MEGA EVENTS ORGANIZED

(a) Indo Swiss Training Programme- "Capacity Building to train manpower in Himalayan Glaciology" Jawaharlal Nehru University, New Delhi during December 2014 – January 2015.

(b) Regional Consultation Second Workshop on State Action Plan of Climate Change [SAPCC] for Himalayan Region will be organized on 28 – 30 January 2015 in collaboration with SDC at TERI Campus, New Delhi

NUMBER OF PEOPLE BENEFITTING FROM THE SCHEME/PROJECT

Under the two national missions on climate change coordinated by SPLICE-CCP, several programmes have been initiated during past 3 years. Over 100 institutions and 300 scientists are participating in these programmes across the country. It is expected that the projects outcomes will provide required information in terms of adaptation strategies for various stakeholders that include State/Central Government agencies/departments, communities, policy makers and end-users etc. Academicians, practitioners and decision-makers will benefit from the results of presently supported proposals. These outputs will not only provide contributions to the scientific fraternity but also provide good practices that will aid decision making to cope with the current and future climate regimes. Strategic knowledge generated through these programmes may help formulating national policies for addressing the climate change issues and may also help developing strategies for international negotiations.

CHAPTER-5

SOCIETAL CONTRACT FOR S&T

SCIENCE FOR EQUITY, EMPOWERMENT & DEVELOPMENT

Concerted efforts are being made by the Department to take forward the activities related to S&T interventions for societal benefits. In this endeavor, Science for Equity, Empowerment and Development (SEED) Division has launched several initiatives having people centered approach to provide technological solutions at the grassroots level with special schemes for Rural Areas, Women, Scheduled Caste and Tribal populations. The primary objectives and functions of SEED Division inter alia are as follows:

- To support S&T based academic institutions and field based voluntary organizations (VOs) throughout the country to take up innovative projects at the grassroots level, targeted at different section of the society, to address location & occupation specific problems;
- Catalyze & support research, development of relevant and appropriate technologies and their adaptation for empowering as well as improving quality of life of Artisans, Landless labour, Women, SC/ST and other disadvantaged sections, particularly in rural areas;
- Evolve & demonstrate replicable models of S&T based development for the benefit of disadvantaged sections; and
- Establish linkages with various arms of the government, Developmental Agencies, Financial Institutions and others so as to promote integration of the models with wider developmental processes.

The continuous and intensive efforts made in the year under report, various schemes/ programmes have made a distinct and marked impact due to unconventional approach and involvement of S&T based VOs having strong linkages at grassroots level. Major initiatives/ achievements made during the year are listed below:

1. **Long Term Core Support-Technological Advancement for Rural Areas (TARA):** TARA is a unique scheme under societal programme of DST, providing long term core support to S&T based NGOs which are located across the country. During the year, 24 organizations were supported for development, field testing and delivery of appropriate technologies for rural application to address location-specific needs. These core supported groups (CSGs) have major focus on **technology innovations, incubation and delivery** in respective geographical coverage area to train and empower local community in field oriented technologies and packages like bio-fertilizer production & application; application of improved and sustainable agriculture practices with post harvest processing for value addition; utilizing renewable energy and IT technologies and linking these for micro-enterprise creation involving rural

youths, among others. For instance, Madhya Pradesh Vigyan Sabha (MPVS) based in Bhopal, is implementing core activities (Minor Forest Produce processing and value addition) in tribal dominated blocks of Chhindwara (Gaildubba and Kodia) and Karhal (Khohree and Meharbani) Districts in Madhya Pradesh. MPVS has developed technology package for making value- added products of Bael (Aegle marmelos) and Mahua (Madhuca longifolia) flowers and evolved a business model for alternate/ additional source of income. It has also focused on mechanization of post harvest procedures and developed energy efficient and drudgery reducing threshing-cum-de-husking machine for millets like Kondo (Paspalum scrobiculatum) & Kutki (Panicum sumatranse) in collaboration with CIAE, Bhopal.

Gandhigram Trust, Gandhigram, Tamilnadu, another CSG working in handicraft sector, has been able to develop solar powered 8 spindle Charkaha with better production efficiency, while, Sardar Patel Renewable Energy Research Institute, Gujarat is working on energy efficient technologies and has developed high efficacy biogas plant design with low water requirements, showing visible impact and adoption at the community level. Further, Society for Energy, Environment & Development (SEED), Hyderabad, working in the area of green energy applications, has been able to design & develop a high capacity cabinet solar dryer and standardize production protocols for value-addition and making marketable products through solar processing for fruits grown in Himalayan Region and for processing of organic fruits & vegetables, forest produce, spices, etc. with long shelf life.

Vivekananda Institute of Biotechnology (VIB) working in Sunderbans delta, dominated by rural people especially farmers and fishermen, has been able to engage them in good agricultural practices that could be replicated like soil test based INM and IPM package; organic methods for tea production in homestead tea gardens; water harvesting methods in the hilly regions with low water holding capacity besides introducing elite varieties of elephant foot yam with cultivation package; quality paddy seed production; and protected cultivation technology. For sustaining the

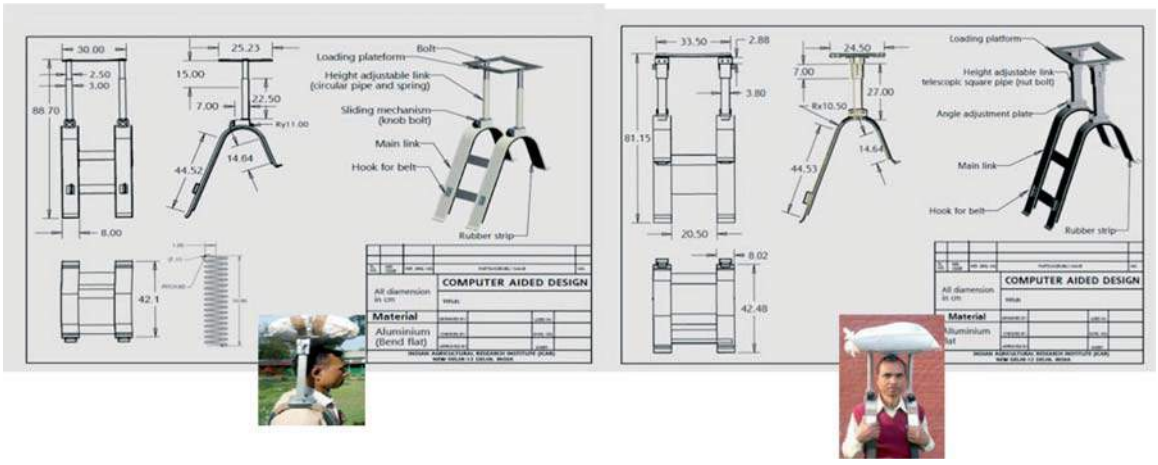
interventions, 6 Farmers' Clubs having 20 members each have been formed in the project area.

2. Technology Interventions for Addressing Societal Needs (TIASN): This scheme aims at developing & facilitating research and application of S&T based solutions to identified problems and societal needs. Some specific programmes/projects covered are as follows:

Network Programme Programme for Lower Shivalik Region: Two Workshop-cum-Seminars were organized with an aim to identify the niche areas in respect of enhancement of productivity, primary value-addition, organic farming, improvement and availability of seed varieties in lower Shivalik range of Punjab, Himachal, Haryana, Uttarakhand and Jammu & Kashmir. After extensive deliberations, critical areas of intervention for livelihood generation and value-addition were also identified in Kandi area of Punjab and Shivalik region. Accordingly, a need based program namely 'Sustainable Agriculture and Rural Transformation High Initiative' (SARTHI) for small and marginal farmers has been launched and 14 projects initiated.

Individual Projects:

- **Development of interventions for manual load carrying on Indian farms:** An assessment of load carrying capacity, mode and related detrimental health effect on Indian farms was undertaken by IARI, Pusa, Delhi in crop production and animal husbandry related activities in villages of Haryana, UP and Odisha. Based on field assessment and problem analysis, and to minimize the adverse impact of carrying load on head, user friendly ergonomic interventions are being developed to reduce stress on cervical spine without introducing element of eccentricity during load carrying on human body.



Head load and spring loaded adjustment for effective load distribution

- **Packaged drinking water from dew and rain:** Shortage of drinking water is a chronic, severe and widespread problem in Kutch, a hot semi-arid region in the north-west Gujarat. Groundwater is the main source, but, it is not suitable for human use in most of the places. Accordingly, a project was evolved by Kutch Centre of Technology for Sustainable Agriculture, Ahmedabad with an aim to design and implement a dew and rain harvest system at Kothara.

Plant is now ready as base for demonstration and training for dew water entrepreneurs who can establish more such plants along the coast.

- **Model project for 'Creation of sustainable livelihoods by enhancing economic viability of village level micro industries:** It is a project aimed at developing a model village at Kuthambakkam in Tamilnadu. People's participation was ensured in each phase of village industries development. Training was given to the villagers, particularly to youth and women. Technology packages with scaling of operation and optimizing the de-husking capacity of modern rice mill, Thorr Dhall processing mills and edible oil extraction units using low temperature pulverising utilizing stone wheels instead of metallic grinding wheels, filtration of oils using simple vacuum cad ridges, improving oil extraction efficiency using steam purging; optimising solar energy usage in baking process, for lighting and ventilation and biogas generation using oil cakes were developed and demonstrated under field conditions. Six micro enterprises of various capacities with business models were developed ensuring people's participation in such village development process involving Panchayat as well.

Programme on Technology Intervention for Disabled & Elderly (TIDE): This programme aims at providing individual autonomy and independence to elderly population and persons with disability through holistic development by creating enabling environment for their empowerment through application of S&T. Design and development of cost effective and affordable assistive devices for elderly and disabled, preventive technology packages for persons having disabilities, development of multi-disciplinary research materials/R&D programmes, field testing of newly developed technologies and modulation of existing technology specific for use of elderly and disabled to suit Indian conditions are a few aspects which have been take up for appropriate interventions.

Refreshable Braille devices comprise the main component in the lives of visually handicapped. To address the problem of poor acceptance at the user level due to high cost (of the existing refreshable Braille devices that use piezo-electric technology), an alternative cost effective device using novel refreshable Braille display technology is being developed by Indian Institute of Technology, Delhi based on shape memory alloy (SMA) actuation that significantly reduces the cost of existing displays and is of high relevance to countries like India.

Fig. a) below shows the various components of the actuation mechanism. An 'inverted U shape' configuration of the SMA wire allows the electrical terminals to be located on one single plane. Braille cell housing was further designed to employ six actuators corresponding to the six dots in a Braille character. Fig. b) illustrates one such Braille cell. The cost of the present display is expected to be one tenth of the presently available commercial devices. A refreshable Braille display capable of electronically generating a row of Braille characters on a refreshable surface has been developed. The device would operate in conjunction with a regular PC or laptop, and would be capable of generating Braille characters from any language. This would allow visually impaired individuals to use a computer independently. Extensive user trials of prototypes were conducted at National Association for Blind (NAB) for refinement of the prototypes.

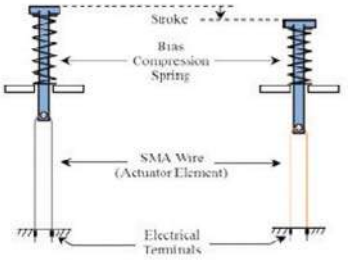


Fig. a) Actuation Mechanism

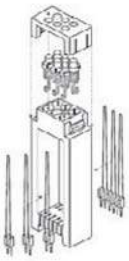


Fig. b) Braille Cell

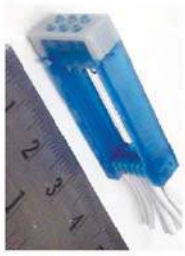


Fig. c) Braille Cell

Performance of Braille cells was tested by making 8 cell arrays at different design stages and to check the system level response of the array. Fig. c) shows the real life photo of one Braille cell which was fabricated using 3D printing method. Fig. d) further shows a Braille cell module comprising of 8-Braille cells. The associated driver circuitry (current amplification and module level control of pins) are also displayed. A new batch of cells were manufactured using injection moulding. DFM (design for manufacturing) and subsequently necessary changes were made in the cell. Fig. e) shows these changes which facilitate reliable manufacturing of the cell as per the target specifications.

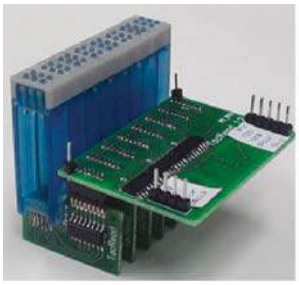


Fig. d) An assembled working prototype of an 8 cell Braille display

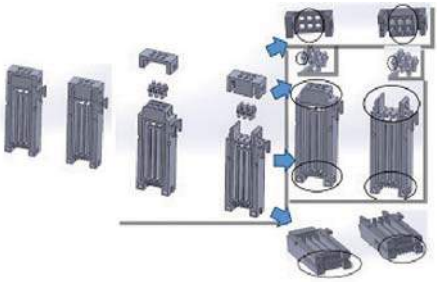


Fig. e) Series of images illustrating design-for-manufacturing changes in the design

The various components on an individual Braille cell (mechanical structure and SMA wire actuators) developed are shown in Fig. f) and an 8-cell refreshable Braille display module with individual cells through injection moulding processes is shown in Fig. g).

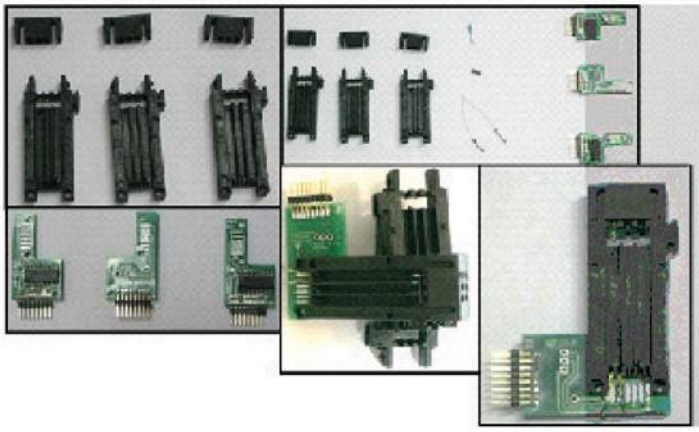


Fig. f) Various Components of an individual Braille Cell

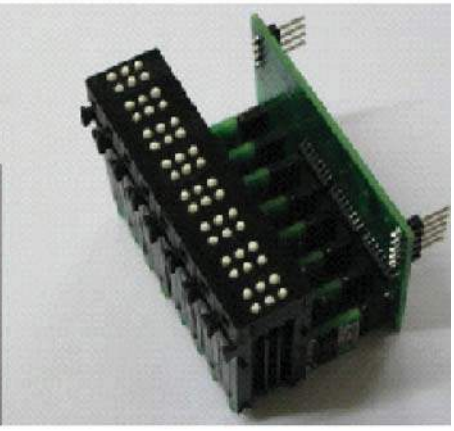


Fig. g) Refreshable Braille display (8 cell)

Design and Development of Heating/Cooling Pads, Foot-Warmer and Thermal Jackets Based on Phase Change Materials (PCMs) for Old Aged Persons : Arthritis and other joint pains occurring frequently in old aged persons, is widespread problem in our country, especially due to our climatic conditions and prevalent life style habits. Apart from other medications, one common treatment, which is used across the country, is the use of heating/cooling pads, mostly using water. The use of Phase Change Materials (PCM) based heating/cooling pads though more efficient, is yet not very common due to the high cost involved and also less awareness about the technology. Under this project implemented through Rajiv Gandhi Institute of Petroleum Technology (RGIPT) Rae Bareli, some novel PCMs using fatty acids were developed and studied for thermal cycles to see the variation in their thermo-physical properties. It is found that some of the fatty acids viz Capric Acid, Lauric Acid, Palmitic Acid, Stearic Acid and their eutectics like (code names - CAMA, CAPA, LAMA, etc) are best suited PCMs for heating and cooling pads. Some of the affordable products developed and tested under this project are back-support belt for back aches, elbow support, knee joint supports and collar support.

Assistive Device for Public Bus Access for the Visually Impaired: India has the largest population of visually impaired which is estimated to be around 12 million. Visually impaired individuals repeatedly mention reliable access to public transport buses as their most pressing day-to-day mobility need. However, to make it more effective, under the project, a **prototype navigation system** has been developed by Indian Institute of Technology, Delhi that will aid visually impaired persons to board buses without any sighted assistance. This system for the visually impaired is an entirely user-controlled radio-frequency based system that reduces the persistent anxiety of boarding the right bus. The system comprises of three units:

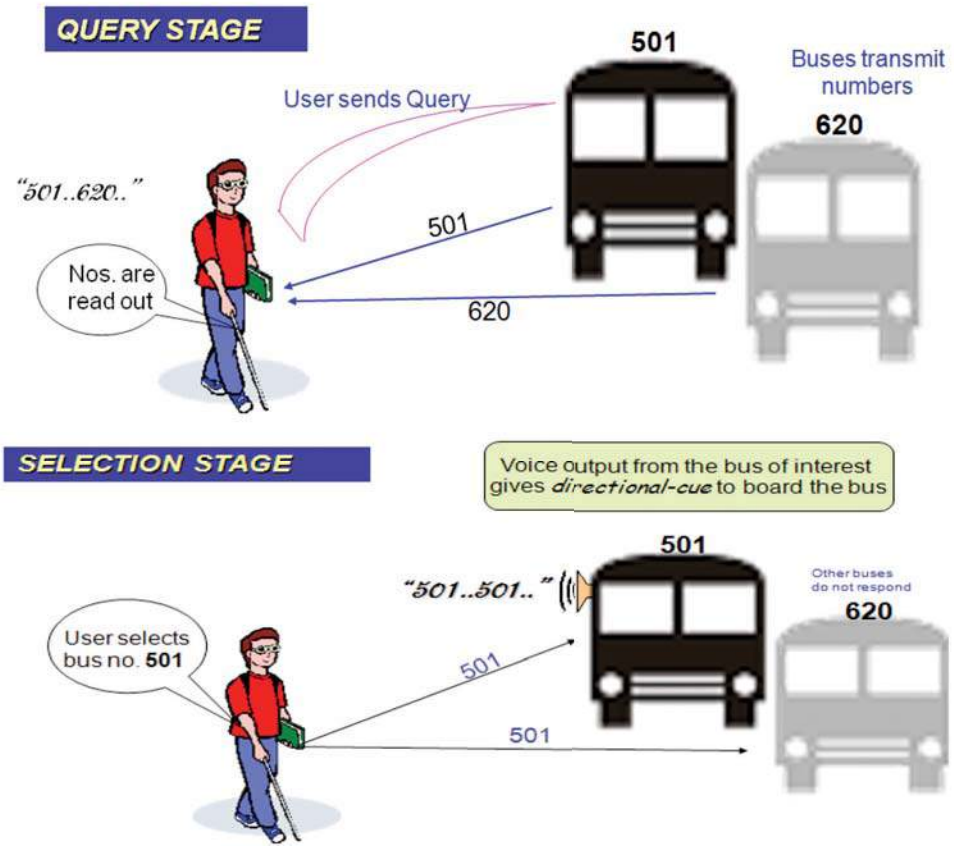
(i) User Module (works on rechargeable battery),

(ii) Bus Module with speaker, placed in each bus (power to this module will be supplied by the battery of the bus in final installation)

(iii) Number Feeding Unit, to be potentially used by bus depot personnel to modify the route number of a said bus module.

System operation:

1. Query stage: Once the user hears a bus approaching the bus stop, s/he presses the Query Button on the User Module, transmitting a RF signal to all buses in the vicinity (in the range of 15-20m). Each bus responds by transmitting its route number. All bus numbers of nearby buses are received and sequentially spoken out by the user module



2. Bus selection stage and boarding: The user selects the desired route number by pressing the Selection Button when the desired bus number is spoken out. e.g. if the buses in the vicinity say '501' and '620' and the user has to board bus number '501', s/he must press the selection button just after the module speaks '501'. This triggers a voice output (from a pre-mounted speaker on the bus) at the entry of the selected bus. The sound of the speaker saying the bus number acts as an auditory cue to guide the user towards the gate of the bus. The system allows flexibility to customize operation according to user-specific bus usage patterns, saving time and effort.

   Supervised trials have been completed and a thorough functionality testing & user interface

verification of the on-board system has also been done. Extensive field trials of the prototype are being carried out on DIMTS buses in Delhi and BEST buses in Mumbai.

3. **Scheme for Young Scientist & Technologists (SYST):** This Scheme is operational with an aim to encourage young scientists to provide technology based solution of societal problems. Specific achievements are as under:

   - The model for open toilet systems to suit the rural mindset has been designed by National Community Welfare Organization, Wardha, Maharashtra. 20 such systems were demonstrated in the Akoli village of Vidarbha region. These 20 toilet points were connected to common PVC pipe, thus, allowing the night soil flow upto the inlet of biogas plant. A special filtration system was fitted at the opening point of PVC pipe before the inlet of biogas plant. From this, excess water was filtered and diverted to 8 septic tanks attached with each other alternately to provide maximum space for the settlement of night soil and the water of the septic tank was connected to the closed drainage system. Some amount of night soil with water is passed into the biogas plant for biogas generation; generated gas is being used by one family of 4-5 members. These open toilets are well accepted and being utilized by 300 people daily. After production of biogas, the remaining slurry is used as liquid organic manure in agriculture field. A field trial of compost was also conducted on vegetables and wheat crop. Vegetative growth and grain/fruit yield of biogas slurry treated plot was almost equal to chemical fertilizer treated plot.

Toilet cum Biogas System

   - Under the project "Documentation of traditional Ethno-veterinary practices and its formulation in Sikkim Himalaya", implemented by Sikkim S&T Council in 250 villages of four districts, scores of folk healers (medicinal plant practitioners), livestock herders (farmers), senior citizens and other amateur traditional ethno-veterinary plant practitioner of the state were consulted. Significantly, 45 new, hitherto unreported traditional formulations have been recorded in the treatment of livestock in Sikkim. The majority of ethno-veterinary formulations documented under the project have a strong basis to claim for Geographical Indicator (GI) Registration under the Intellectual Property Right of the farmers. Pangolakha Wildlife sanctuary, Barsay Rhododendron Sanctuary and Kanchendzonga National Park have been successfully explored for the habitat identification of plants species being used for ethno-veterinary purposes. The sample specimens of

more than 185 plants species were collected, processed and deposited at Botanical Survey of India. More than 350 persons have been successfully sensitized about conservation of traditional knowledge, medicinal plants and their sustainable usages within the State. The project has also generated awareness among line departments, research institutions, NGOs to take up further exploration on ethno-veterinary practices for alternative treatment of livestock. Another achievement is the creation of traditional knowledge digital library for the protection of ethno-veterinary practices and its formulations.

In order to reenergize the scheme and to encourage young professional throughout the country to come up with new ideas of social relevance, Concept Ideas were invited from across the country. Out of 726 concept notes received in diversified areas, about 100 were invited after screening for submission of full proposals which have been evaluated by experts.

4. **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 in traditional skills as well as new vocations. During the year, 15 projects were sanctioned in different technology areas linking with capacity building and entrepreneurial skill development with better production efficiencies and income. Outcome of some of the projects which have shown visible impact are:

   - **Multi-site Network Programme on Livelihood Generation for Tribal around National Parks and Sanctuaries/Parks-** Second Phase of this innovative programme has been launched covering 17 Protected Areas/sanctuaries to further evolve technology-based alternative livelihoods generation model(s) for tribals through S&T based activities for value addition of Minor Forest Produce, nursery raising, etc. Programme in network approach aims to demonstrate innovative approaches and mechanisms based on appropriate technological inputs that address not only conservation issues but also enhance livelihoods opportunities of people living around Protected Area (PA). The programme has been designed involving WWF-India and 16 grassroots level VOs to work on scalable technological solutions by identifying technologies developed at S&T Institutions and apply these in the local context (customize) utilizing local resources (materials, skills).
   - **Local Area Network Programme addressing Migrating and Malnutrition in Tribal Population of Maharashtra State and over come through Innovative Programme and Appropriate Technologies:** The focus of this network programme initiated in 2014 is on sourcing/customization of need-based technologies/innovative systems to bring changes in the life of tribal people in project coverage area (40 villages in 7 tribal districts of Maharashtra) with cluster approach to address livelihood and malnutrition problems. Programme covers energy, animal husbandry, forestry and agriculture sector and has a focus on following:
     - ❖ Awareness of migration and malnutrition
     - ❖ Capacity building on improved technologies
     - ❖ Entrepreneurship Development

- ❖ Marketing of the produce/products
- ❖ Marketing linkages
- ❖ Financial Support from local banks and SHGs federations.

Individual Projects:

- **Enabling tribal farmers of U.P. through hands-on training and demonstration in conservation and cultivation of economically important medicinal and aromatic plants:** Under the project implemented by CIMAP, Lucknow, Tharu tribal community has been trained in scientific cultivation and processing of ornamental plants in two villages namely Dhuskiya, Chandan Chowki range and Chediya Pashchim, Bankati range of Dudhwa National Park, Palai Block of Distrcit Lakhimpur Kheri, Uttar Pradesh. The technology of Mentha oil distillation has been adopted by 32 farmers. The farmers have produced good quality oil of menthol mint and Artemisia dry herb.

Demonstration of distillation unit

A view of the Mint field

- **Organizing rock bee honey collectors in Sundarban with S&T intervention for better productivity:** During the project implementation, 210 honey collectors were organized in 31 groups (Joint Liability Group) in the target area Kultali, Patharpatima, Namkhana, Mathurapur-I & Sagar blocks in Sundarbans and trained in the scientific collection of honey from rock bee hives, its storage, testing, collective marketing, etc. As a result, honey collectors collect quality honey and colonies are not destroyed and they get honey more than once from one hive. A honey processing unit has also been installed in the project area which is being used by them as the Common Facility Centre for scientific processing of the product, under the brand name "Sundarban Honey" with 3 fold increase in income with a quality product.

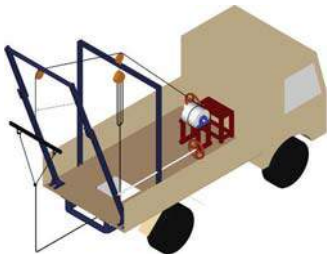
5. **Scheduled Caste Sub-Plan (SCSP):** Department has been implementing Scheduled Castes Sub-Plan (SCSP) for the Development of Scheduled Caste Population since 1992 with a view to empower SC population through the input of S&T. Over the years, the scheme has achieved significant breakthroughs in developing and demonstrating technology packages in several sectors with the association of S&T based field groups and institutions for improving the

quality of life of the economically weaker sections of SC communities in urban/rural areas. Specific achievements made during the year are as under:

- **Capacity building and Livelihood Generation Activities**

  A unique programme called 'Coordinated Programme on Resource Management and Development for the Empowerment of Scheduled Castes' has been implemented involving the SC communities in 93 villages located in Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Tamil Nadu, Uttarakhand and West Bengal where they are mostly engaged as unskilled seasonal labour. Programme with need based S&T interventions has enabled to address issues related to water, sanitation, health, education and adoption of technologies for livelihood and micro enterprise development using local resources. Community mobilization and building/strengthening the existing people's institutions or groups are an integral part of this programme. Construction of Water Purification Plant is one of the important components in the project for providing clean drinking water.

- **Supply Chain management for rural leather sector:** Under this project, being implemented by Central Leather Research Institute (CLRI), Chennai, a flaying device has been developed. The hides and skins from bovine and ovine animals are the basic raw material for the leather industry. Animals dying of natural death pose disposal problem and add to environmental pollution in view of the decomposition. Effective recovery of hides & skins from fallen animals is, therefore, of extreme importance. Un-scientific flaying and faulty transportation of fallen animals result in poor quality of hides and skins. These poor quality substrates when converted to leather do not match with the quality standards laid down for particular end usage of leather as products. Currently, the practice followed for recovery of hides and skins from fallen animals is to flay the animal and leave it on the outskirts of the village for carrion. Improper flaying of the animal results in damage to the hide/skin. The time taken to reach the dead animal and flay the animal for the hide sometimes takes too long by which time putrefaction sets in. CLRI has developed a COMBI device in which the dead animal is hoisted through a hydraulic system and the hide is ripped from the fallen animal. The COMBI device is mounted on a tractor thus enabling quick transportation at the site of flaying itself.



Combi device developed by CLRI, Chennai

- **Feed conservation and storage by making silage:** Forage cultivation is becoming difficult due to unfavorable climate and dwindling land area and particularly its availability during lean period. It is possible to preserve green fodder by anaerobic fermentation which is called silage. With this aspect in mind, a project has been undertaken to explore the viability of using different fodder grasses in three different methods to make silage and feed it to the cows in Hosur region. Farmers were trained to make silage using Drums of 200 litre capacity/plastic bags that can hold up to 50 Kg material and pits on the ground.

If not opened, it could be stored for nearly 8 months. Silage with maize or combinations involving maize seemed to be superior to other combinations as it is richer in starch. The process of making silage is being continued and cows are now being fed with prepared silage. Effects on milk yield and milk quality characteristics of cows fed with different silages are being studied.

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 intensive enterprises. The Board aims to integrate innovation and entrepreneurship in academia, through various initiatives with a view to translate knowledge to wealth.

The programmers of the Board and the related achievements during F.Y 2014-15 are summarized below.

1. Technology Business Incubator (TBI)

In the knowledge economy, mechanisms such as Technology Business Incubators (TBI) have assumed greater significance and relevance as they support and nurture knowledge driven start-ups into successful enterprises. Under one of the flagship programs, department has established number of Technology Business Incubators (TBI) and Science and Technology Entrepreneurs Parks (STEP) and several among them have matured and developed competence to become state-of-art Incubators. During the period 2014-15, nine new TBIs have been established. These are 'Nanotechnology Research, Innovation and Incubation Centre' at PSG College of Technology, Coimbatore; TBI at Indian Institute of Management, Calcutta; TBI at Narayana Hrudayalaya, Bangalore; Centre for Incubation and Business Acceleration (CIBA), North Goa; TBI at National Academy of Agricultural Research Management (NAARM), Hyderabad; Incubation Cell at IIT Madras; TBI at Kumaraguru College of Technology, Coimbatore; TBI at Thiagarajar College of Engineering, Madurai and TBI at Graphic Era University, Dehra Dun.

Technology Incubation under TBI program

The National Centre for Aerospace Innovation and Research (NCAIR) established at IIT Bombay under TBI program is working on developing vibrant aerospace manufacturing ecosystem in India. Outcome of one of the major activity on Machining of long slender parts for aero engines is shown below:

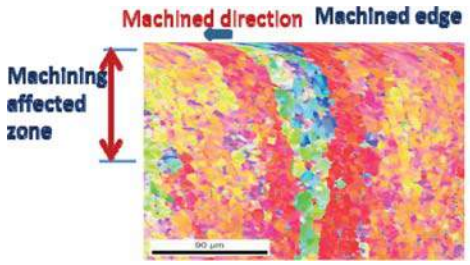


Figure1a: Depth profile of the machining affected zone based on plastic strain in alpha Ti grains (Inverse pole figure mapping)

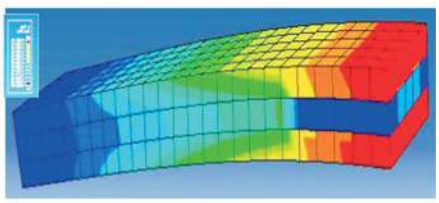


Figure1b: Bending and strain in a constant cross section slender blisk like profile

Several components of an aero engine have long slender geometries. This makes their manufacturing through machining a major challenge due to large deflections and poor surface finish. NCAIR has developed and filed patents for specific technologies which reduces these deflections and leads to improved surface finish. These technologies, although developed for aerospace sector, have far reaching applications to energy, environment and medical implant industries too.

2. Seed Fund to Incubators: The Seed Fund is provided to equip the Technology Business Incubator (TBI) with the much needed early stage financial assistance to be provided to deserving ideas/technologies of start-ups under incubation. The fund enables some of the innovative ideas/ technologies under incubation to graduate to a level where they can seek external investments from Angels, VCs and normal lending from Banks/Financial Institutions.

So far, 18 STEPs/TBIs have been supported with the seed support since its initiation in the year 2008 and through timely support, 70 start-up companies have taken their ventures to the next level by way of validating prototypes, securing market orders and raising external funding through angels/VCs. During 2014-15, Seed fund has been given to TBI at Kalinga Institute of Industrial Technology, Bhubaneswar.

3. 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. The IEDCs aim to promote innovation and entrepreneurship amongst the students of S&T. The students are encouraged to take up innovative projects as a part of their curriculum and are supported to develop a working prototype. 44 IEDCs have been supported so far across the country including 6 IEDCs established during the year.

A Borewell Rescue Machine developed by students under IEDC project at Amal Jyothi College, Kottayam. This machine can rescue children who accidently fall in borewell. It can supply oxygen to reduce chances of hypoxia, monitor the child through IR camera and means to establish two way communications between parents and child to reduce the trauma.

4. i-STED (Innovation, Science and Technology led Entrepreneurship Development)

The i-STED program initiated in FY 2013-14 aims at inculcating strong entrepreneurial orientation in people to translate already developed innovative /S&T solutions in the market. It provides demonstrable avenues to translate the identified innovative solutions by tapping the market opportunities and aligns them with appropriate business models. Four projects were sanctioned

in 2014-15 focusing on locally relevant technologies viz. Green construction in parts of M.P, U.P and Maharashtra; Cane/bamboo processing & value addition in Assam; Agricultural implements and solar based products for lighting and electrification in Jharkhand; Handicrafts, wood and clay technologies in Gujarat.

5. STED Programme

The programme on Science & Technology Entrepreneurship Development (STED) aims to promote micro-enterprises leading to local area development. STEDs tap the locally available material, human resources and opportunities at the project location and transform these into sustainable and efficient micro enterprises through the interventions of Science & Technology. The STED programme, during its tenure of 4 years, aims towards achieving a target of promoting 200 micro-enterprises.

During the year 2014-15, 31 ongoing STED projects have been provided support for continuation of STED activities across the country at various locations. New STED projects have been sanctioned in the F.Y. 2014-15 at Nashik, Maharashtra; Fazilka, Punjab; Alappuzha, Kerala; Krishnagiri, Tamil Nadu; Chamarajnagar, Karnataka and Dimapur, Nagaland.

6. 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 programmers across the country. These modules are Entrepreneurship Development Programme (EDP), Women Entrepreneurship Development Programme (WEDP), Technology based Entrepreneurship Development Programme (TEDP), Faculty Development Programme (FDP) and Entrepreneurship Awareness Camp (EAC). During the year 2014-15, a total of 1278 training programmers have been supported to train 77635 participants under these modules.

7. DST-Lockheed Martin India Innovation Growth Programme (IIGP) 2014

The IIGP focuses on "Mind to Market" strategy by providing extensive training modules, which are suitably structured to help participants gauge and streamline their existing capabilities, and formulate and implement appropriate business strategies. A total of 1350 applications were received under the DST-Lockheed Martin India Innovation Growth Programme 2014. After following a rigorous selection procedure comprising of technology validations, 50 innovations were shortlisted and given week long advanced training in basic principles of product commercialization, readiness for market, business models, IP rights, competitive positioning, and mechanisms for generating revenue. The trainings were led by experienced faculty members from the Stanford Graduate School of Business. Top 10 innovators were shortlisted for a Washington DC and TiE Silicon Valley Program during September 3-12, 2014. Two technology expositions were also organized to showcase innovative products and technologies tapped under IIGP and the commercialization deals signed by the Indian innovators with leading industry partners.

IIGP 2014 Award Function, May 23, 2014 in New Delhi

8. New Initiatives

Launch of the Anita Borg Institute – IUSSTF- DST partnership for Women Entrepreneurs Quest Program 2014-15

To create an entrepreneurial ecosystem for women entrepreneurs, NSTEDB has partnered with Indo-US Science and Technology Forum (IUSSTF) and Anita Borg Institute (ABI), a non-profit organization based in US focused on the advancement of women in computer science and engineering. The partnership will be facilitated through the Women Entrepreneurship Quest (WEQ) Program of ABI. WEQ is an innovative technology business plan competition to promote innovation by scouting and supporting technology based Indian women entrepreneurs. As per this partnership, selected women entrepreneurs will be exposed to the entrepreneurial culture in Silicon Valley and will be provided with extensive mentoring, networking opportunities and connect them with government agencies and other support organizations.

9. Support to Knowledge Sharing and Dissemination Events- Seminars, Workshops and Conferences

In an effort to nurture innovative & entrepreneurial culture, events mentioned below were supported by NSTEDB during 2014-15.

- Entrepreneurship Conference - TiEcon 2014 was organized by The Indus Entrepreneurs (TiE), Delhi during 17-18 October, 2014 , Delhi
- Innovation and Entrepreneurship Conclave-2014 (IEC-2014) organized at Engineering Staff College of India (ESCI), Hyderabad on 18-19 December, 2014.

- Support was extended to APIN (Asia Pacific Incubation Network) secretariat at PSG-STEP, Coimbatore for 6 Week International Programme on Promoting Innovation & Entrepreneurship through Incubation during January 6- February 14, 2015 at EDII Ahmedabad under the aegis of ITEC (Indian Technical and Economic Co-operation) program of Ministry of External Affairs.
- Business Plan Competition 'Eureka 2014' by IIT Bombay.

DEVELOPING SCIENTIFIC TEMPER IN SOCIETY

Field Capacity & Outreach Activities

1.1 Science Express : Biodiversity Special (SEBS)

The exhibition – on wheel has invited the visitors on a fascinating expedition into the mysteries of our world – to groundbreaking discoveries, emerging issues of cutting-edge science and future-oriented technologies. It showcased the entire universe from the smallest elements of our world to the largest structures in the outer space. Exciting images, video clips and interactive exhibits offering fascinating insights into the hidden worlds of atoms, cells, neurons and bytes, as well as the complex interactions of civilizations, planets, stars and galaxies. The exhibition took modern research out of the lab and revealed just how relevant science is to everyday life and how science was enabling society to face the global challenges of the 21st century.

With United Nations declaration of the current decade (2011-2020) as Decade on Biodiversity and India holding Chair of the Conference of Parties (COP 11) to Convention of Biological Diversity during 2012, Science Express was redesigned on the theme 'Biodiversity' and since 2012 it has been running as Science Express: Biodiversity Special (SEBS). The Biodiversity Special primarily showcases the wide array of biodiversity in India and the conservation measures adopted thereof. Of the 16 coaches of the SEBS, 8 coaches are solely dedicated to showcasing the myriad biodiversity spread across the bio-geographical zones of India like Trans-Himalaya & Himalayas, Gangetic Plain, North- East India, the Desert & Semi-Arid Zone, Western Ghats, Deccan Peninsula, Coasts & Islands. The exhibition also covers various other facets like marine, coastal, forest, microbial, agro biodiversity and their linkage with livelihoods besides challenges of conservation. In rest of the rake, the exhibition includes themes like Climate Change, Water, Energy Conservation and Science Education in India.

Science Express- Phase VII (SEBS Phase III) was flagged-off from Delhi Safdarjung Railway Station on 28 July 2014 by Shri Prakash Javadekar, Union Minister, Environment, Forests and Climate Change, Shri D. V. Sadananda Gowda, the then Minister of Railways, and Dr. Jitendra Singh, the former Minister, Science and Technology, Govt. of India. In the current seventh phase, from 28 July 2014 to 06 February 2015, the Science Express has travelled to 57 locations across India. Biodiversity teachers' Kit, based on the theme of the SEBS exhibition, was distributed to school. *More than 1.30 crores people have visited science express so far including 23 lakhs during the ongoing run.*

Science Express- Phase VII flagged-off from Delhi Safdarjung Railway Station on 28th July 2014

1.2 Celebration of the National Science Day (NSD)

National Science Day (NSD) is celebrated every year on February 28 to commemorate the discovery of the 'Raman Effect'. The theme of NSD-2014 was "Fostering Scientific Temper". NSD Theme had been chosen for the purpose of raising public appreciation of the scientific issues involved. NCSTC acts as a nodal agency to support catalyze and coordinate celebration of the National Science Day throughout the country in scientific institutions, research laboratories and autonomous scientific institutions associated with the Department of Science and Technology. NCSTC supported various programmes countrywide by giving grants to its State S&T Councils & Departments for organization of lectures, quizzes, open houses, etc. On this occasion the persons chosen for the year 2013 were awarded for their outstanding contribution in communication of science and technology and promoting scientific temper which had the widest impact in the country during the past five years were by Dr. T.Ramasami, Secretary, DST and DG, CSIR and Dr.K.Vijayraghawan, Secretary, DBT. Shri Gopal Krishna Gandhi, formerly the Governor of West Bengal delivered the National Science Day Lecture on February 26, 2014 on the topic "Fostering Scientific Temper" at Jawaharlal Nehru University, Delhi.

1.3 Celebration of the National Mathematics Day (NMD)

To popularize Mathematics among students, women and general public and to arrest the decline in Mathematical Sciences, Government of India declared December 22, "Srinivasa Ramanujan's birthday as the "National Mathematics Day". NCSTC, DST is catalysing and supporting programmes related to NMD, ranging from one day to a month or longer. The activities include debates, quizzes, exhibitions, lectures, training programmes, hands on activities, Math-lab activities and other innovative and challenging programmes etc. Programmes are implemented in schools, colleges, universities in various districts of states by the state agencies. National Mathematics Day was observed in many states like Andhra Pradesh, Arunachal Pradesh, Chhatisgarh, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Mizoram, Nagaland and Punjab.

1.4 National Children Science Congress (NCSC)

This year the 22nd National Children's Science Congress 2014 was organized in the campus of Sri Jagadguru Balagangadharantha (SJB) Institute of Technology, Bengaluru from 27-31 December by Karnataka Rajya Vijnan Parishat (KRVP). The inauguration of the congress was done with a colorful rally on 27th December 2014 comprising 950 delegates including child scientists, resource persons, evaluators, state coordinators etc. Additionally, child scientists from Bangladesh and United Arab Emirates took part in the inauguration rally in their traditional attires. Bharatha Ratna Prof. C.N.R. Rao delivered the keynote address on the occasion. The 650 odd projects from 35 states and UTs of India including Kendriya Viyalaya Sangathan (KVS) on the focal theme "Understanding Weather & Climate" were presented in the event. As many as 30 stalls were installed in the venue to serve as activity corners wherein books and materials relating to science and technology were exhibited. Daily news bulletins were published on all the days on this occasion.

The participants of National children Science Congress attended the inaugural session of 102nd Indian Science Congress (ISC) 2015. The 102nd ISC was inaugurated by the Hon'ble Prime Minister Shri. Narendra Modi on 3rd January, 2015. The theme of ISC 2015 was 'Science and Technology for Human Development'. It was held at the main pandal of Kalina campus of the Mumbai University, with an estimated 12,000 delegates.

Rashtriya Kishore Vaigyanik Sammelan of NCSC was inaugurated by Dr. A.P.J. Abdul Kalam, ex- President of India, on 4th January 2015. He also conferred the 'Infosys Foundation Travel Award ISCA -2015' on 5 meritorious school children and also felicitated 4 outstanding children.

1.5 Initiative for Research and Innovation in Science (IRIS)

The Initiative for Research & Innovation in Science (IRIS) is a research based science fair for students since 2006. The Department of Science and Technology, Government of India (DST), the Confederation of Indian Industry (CII), and Intel have come together in a public-private partnership to create this platform that aims to inspire budding scientists in India. IRIS National Fair winners get a chance to represent India at global science competitions like the Intel International Science and Engineering Fair (Intel ISEF). IRIS 2014, held from December 4 – 7 received additional support by the Department of Science and Technology, Government of Gujarat; that also supported merit awards in each of the 17 subject categories under which research applications are invited. The

highest numbers of awards were given out this year with 5 special award categories in addition to the Grand Awards. With 4 national level mega-fairs - National Children Science Congress (NCSC), Science Fair by National Council of Science Museums (NCSM), Jawaharlal Nehru Science Fair by National Council of Educational Research & Training (NCERT) and Central Board of Secondary Education (CBSE) Science Exhibition affiliating to IRIS, it has emerged as the largest research-based science fair in India.

The four day event was inaugurated by Smt. Anandiben Patel, Hon'ble Chief Minister of Gujarat. A total of 18 students showcasing 12 projects represented India at the Intel ISEF in May 2014, winning 13 awards. From Jan to Dec 2014, 43,573 students and 2,867 teachers were impacted directly in 2014 through workshops by IRIS co-ordinators. A new IRIS website www.irisnationalfair.org was launched and 2,782 direct online and offline entries of synopsis were received for evaluation towards gaining an entry into the IRIS National Fair. 7,235 offline synopsis were also received from students of Kasturba Gandhi Balika Vidyalayas across the country. The IRIS Facebook page www.facebook.com/irisnational Fair received over 50,000 likes and is a source of information and discussions for all those interested in Science Technology Engineering and Mathematics.

1.6 India Innovation Initiative- i3

India Innovation Initiative- i3, an initiative of Confederation of Indian Industry (CII), Department of Science & Technology, Government of India (DST) had a total of 1600 innovative entries. In 2014 All India Council of Technical Education (AICTE) and i4C Pune joined hands to support and facilitate the initiative as organizers. For the last 5 years i3 has evolved as a platform from recognizing innovations with awards/certificates to incubate and commercialize potential innovations across India. Top 64 innovations based on expert screening were given opportunity to participate at the i3 National Fair held on 18-20 December 2014 at India Expo Mart, Greater Noida, Delhi NCR. Further, a panel of high level National Jury selected top 3 innovations for i3 Awards, top 2 young innovators for Yi Awards, top 2 innovators for Maharashtra University of Health Sciences (MUHS) award and top 5 innovators for India Private Equity and Venture Capital Association (IVCA) Awards. The top 3 innovations at i3 were awarded with a certificate & cash prizes.

1.7 i – STEM Demonstration: Initiatives for Innovation and STEM (Science, Technology, and Engineering & Mathematics)

Science exhibitions are supported to help develop scientific attitude in our people, to make them realize the interdependence of science, technology and society, and the responsibility of the scientists of tomorrow. Various S&T communication media/formats have been prioritized for themes like Environmental quality, Clean & Green Technologies, S&T solutions for rural sector, Home grown technologies, low cost Innovation.

Science exhibition is participatory in nature where audiences learn by participating. Activities displayed in majority of exhibitions supported by NCSTC are results of training modules developed by the NCSTC. Almost 45 Science fair/Science exhibitions were held at various places in several states, like Uttar Pradesh, Jammu & Kashmir, Uttarakhand, Haryana, Bihar, Punjab, Delhi, Andhra Pradesh, Arunanchal Pradesh, Chattisgarh, West Bengal, Orissa, Rajasthan, Tripura, Kerala, Maharashtra, Haryana, Tamilnadu and Assam. Perfect health Melas were organised every year since last more than 20 years by Heart Care Foundation, New Delhi in which representatives from various NGOs and other organizations were deputed to put up display cum demonstrations about their people oriented scientific activities. These organizations put up their various science popularization-related activity corners on Vermi- composting, Nature Study, Soil & Water Testing, Explaining Science behind Miracles, Detection of Food Adulteration, Low – Cost Teaching Aids, Hydroponics etc.,

Students participating in science fair

Students participating in model showing competition

Science Exhibition on Wheels: The main objective of generating awareness on Wheels is to create awareness in remote areas, especially the students community, villagers, rural people, cultivators etc. and to disseminate scientific information, know how on various aspects of Physics, Chemistry, Math's & Astronomy. The activity include science model exhibition, regular SKY GAZING CAMPS through Telescope and miracle activities magic show etc... The target group for these activities will be the general masses, particularly the school, college students, youths, women, teachers, gram panchayat members, voluntary organizations and policy makers etc. Various themes and S&T communication media/formats have been prioritized as Environmental quality, Clean & Green Technologies, S&T solutions for rural sector. Various S&T Communication media/ formats include Chaupals, film screening, folk media, debates, lecture/demonstration workshops,

technology appreciation trainings, celebration of events of national significance, etc. Activities displayed in majority of exhibitions supported by NCSTC are results of training modules developed by the NCSTC.

Students watching Mobile Exhibition operational in Madhya Pradesh

Visit to Establishments where S&T are at work: Science and Technology (S&T) help to grow and develop every important sector, namely agriculture, housing, environment, defense, health, transport, industry, communication and others. These sectors are utilizing S&T as the tool for development. Establishment like, research organizations, factories, telephone exchanges, steel plants, power stations, milk plant, railway control rooms, TV kendra's, dams, hospitals, petroleum refineries, weather forecasting centre, automatic bakeries, news paper, printing presses, automobile repair workshop, modern agriculture and poultry farms etc. 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. State S & T councils/ Non Government Organizations/ Science Clubs /Individual Schools together can organize such activity. The industrial tours were organized at several places like Bihar, Uttar Pradesh, Jammu & Kashmir, Andhra Pradesh.

Students' visit at CCMB, Hyderabad

Ganit Yatra in the state of Maharashtra: A state level campaign in the tribal districts of Maharashtra was undertaken as "Ganit Yatra", a regional jatha was catalysed and supported by NCSTC and locally organized by the field agency Jidnyasa Trust, Thane in collaboration with Homi Bhabha Centre for Science Education (HBCSE), Mumbai, schools, Jila Ganit Adhyapak

Mandal, Dr. Hedgewar Education Resource Centre, Prayas Foundation, etc. in a few districts of Maharashtra like Nashik, Dhule, Nandurbar, Jalgaon, Aurangabad, Buldhana, Akola, Amravati which culminated in Nagpur. The aim was to reach out to the unreached through rallies, exhibitions, lectures, etc. Resource materials in terms of dramas, CDs, ganit geet, booklets, calendar, etc. were brought out. There were lectures, exhibitions, workshops on popular mathematics during the course of Jatha.

Mangal Mahotsava: To celebrate the 'Mars orbit insertion' of 'Mangal Yaan' "Mangal Mahotsav" was organized from 23rd to 26th September 2014 at Nagpur. An exhibition with about 200 posters was inaugurated by Dr. Ashok Joshi, Head, ISRO, Nagpur on 23rd Sept 2014 and was visited by about 3000 visitors every day, which included students, teachers and general public. In the evening hours, documentary films were shown and arrangements for sky watching were also made. About 30 models explaining the 'Solar System' were demonstrated by trained demonstrators. Shri V S S Sastry from Karnataka demonstrated 'paper models' of various 'Jantar Mantars' and other astronomical observatories and tools used by ancient Indian astronomers. He also guided how to prepare these models. Mr. Dhananjay Rawal, Ahmedabad demonstrated the functioning of various types of telescopes.

Popularization of Astronomy through mobile planetarium: The support towards popularizing astronomy was continued and a project for 2 year duration was supported to SPECS, Dehradun.

Regional Innovation Science Hubs for Innovators (RISHI): The support to the RISHI programme was continued and a two years project was supported to Pushpa Gujaral Science City, Kapurthala, Punjab.

Motivational Programme for Talented School Students : To encourage bright students to select careers in science, motivational programme has been developed for class IX, X and XI science students. These are field level awareness programmes where talented brilliant students of +2 level spend quality time in research laboratories with leading scientists. The programmes aim at Sensitizing students about research in frontier areas of science; To give students an exposure of various sophisticated instruments, facilities and work going on in S&T laboratories; Programmes have been sanctioned to many agencies, to name a few Punjab State Council for Science &

Technology, Chandigarh, State Council for Science & Technology, Manipur and Institute of Himalayan Environment Development , Srinagar.

1.8 Ecological & Water, Sanitation, Hygiene (Eco & WaSH) Futures

The programme aims at fostering skills, capacity and understanding to handle actionable S&T ideas and growing the base of popular support for scientific solutions. The current phase is dedicated to developing capacity of youth leadership and grass root institutions in ecological and water & sanitation literacy. Key takeaway of the programme is Improvement of quality of life of target groups with an approach of '*Being- on- their -Own*' and '*Collective response*' to challenges and location specific developmental/socio-scientific problems.

Mission 'Youth Leadership: *Learning Exchanges (Lx)*, have been organized at regional States level for sensitizing and promoting the leadership capacity of National Service Scheme (NSS) youth with sharing of best practices, innovations & lessons learned, fostering cross-specialization linkages, promoting torch bearers/ community innovators/young visionaries in Eco & WaSH issues. A Regional Meet, Learning Exchange (Jal Vigyan Shala), was organized on 4th July 2014 which was inaugurated by Hon'ble Governor, Madhya Pradesh. A representative group of Water Trainers from World Wild Life Fund for Nature (WWF- India) was also engaged with this WWF-NCSTC initiative. The South Regional "Learning Exchange & Youth Leadership Workshop for Eco & WaSH Futures" was organized on 21st October 2014 in collaboration with Centre for Water Resource Development & Management (CWRDM), Kozhikhode & Rajiv Gandhi National Institute for Youth Development (RGINYD), Sriperumbudur.

WaSH Futures: *Serving the unserved, with down to earth science*

Public engagement has been created for facilitating access to/usage of WaSH solutions (Outreach, Field Action Research, & Capacity Building). Stress has been placed on interventions for remote, inaccessible, marginalized, and challenging areas & populations. *Strategic Outreach Initiatives* have stress on development, testing, replication & scaling up the models in S&T Communication on Eco & WaSH issues, to catalyse communities to help them being on their own, employing novel methodologies & down to earth scientific solutions in S&T communication, research & innovations, including Case Studies/ Success Story Documentation. A few notable outcomes out of many are,

Community Informatics and Participatory Eco & WaSH Science Communication: Quantum GIS, a FoSS (Free and Open Source Software) have been effectively employed in E. Palaguttapalli gram panchayat, Chittoor district, Andhra Pradesh, for spreading Eco-WaSH literacy especially water balance understanding among farmers. School students have been trained in resource mapping using mobile GPS and netbook GIS. One half-yearly, five day, village level based Training of Trainers (TOT) workshop was conducted during 28th September to 2nd October 2014. 5 more trainings will be conducted during the course of the project. The criteria were developed in consultation with stakeholders for the assessment of ability of teachers and students to prepare GIS material for promoting Eco-WaSH literacy.

South Regional "Learning Exchange & Youth Leadership Workshop for Eco & WaSH Futures" organized on 21st October 2014 in collaboration with Centre for Water Resource Development & Management (CWRDM), Kozhikhode & Rajiv Gandhi National Institute for Youth Development (RGINYD), Sriperumbudur.

Regional Meet, Learning Exchange /Jal Vigyan Shala, inaugurated by Hon'ble Governor, Madhya Pradesh at NITTTR, Bhopal on 4th July 2014

Panchayat Water Collectives and a model Eco-WaSH literacy village are being promoted through participatory S&T communication. For impact assessment, baseline survey of Eco-WaSH literacy in the village is being carried out. The community participation has changed the cropping pattern in two blocks and water level risen due to pooling of bore wells.

To Conserve Water, a Natural Resource- Know Your Watershed: Training has been imparted to students in map reading by Centre for Water Research, Satyabhama University, Chennai, so as to help them know the watershed as a key element in understanding the aspects of water conservation and quality. Strong linkages have been fostered with S&T institutions/government agencies.

Awareness creation and Eco-literacy on "Water, Health & Hygiene" in Rural Schools and Villages: S&T communication has introduced technological options in 15 rural schools in Thirupurur Block, Kancheepuram District, Tamil Nadu, like microbially safe water filters, innovative solar water purification stills, four pit vermi-composting chambers, prototype-demo-eco-tech kits for teaching/popularizing eco-sanitation/hygiene and liquid & waste treatment, water filters, disinfectant foot mats and hand-wash dispensers, use of water analysis kit and CDs for training.school children.

Promotion and capacity building of Paani Panchayats for watershed management in Rikkipurwa Micro-Watershed of Hindora, District Sitapur, UP: Paani Panchayat have been formed for Watershed Management in Rikkipurwa Micro-Watershed of Hindora, District Sitapur, UP. Existing Self-help group (SHG) have been activated for water conservation and improved sanitation Collective resolutions for various water related community works are based on participatory mapping of water sources and flows, water logging, rainfall water flow paths and sites for water harvesting structures. As major hands-on outcome, micro watershed plan have been developed with the participation of local villagers for 30 hectares for the conservation of water. Situation analysis of wells and hand pumps, construction of check dams, chlorination of wells, adoption of long ladle mugs for taking out water are key community led solutions.

Capacity building of local institutions for water management planning in micro-catchments of Hiyunl River valley, Pauri- Garhwal: Creation of Paani Panchayat in the catchments area of Hiyunl River valley, Pauri- Garhwal has been catalysed and technological options have been introduced through S&T communication for water conservation and water harvesting suitable for hilly areas. Participatory resource mapping of the area has enhanced the natural resource literacy & capacity of target beneficiaries.

Role of existing Paani Panchayats meant to handle water coming from Indira Gandhi Canal has been complemented in 50 villages of Rajgarh Block, Churu, Rajasthan with participatory science communication for ameliorating poor conditions of sanitation & hygiene created by ill handling of excess water. Information, Education & Communication (IEC) Modules have been developed with help from IIHMR, Jaipur and activities sustained in 50 villages in order to help people "Being on their Own" in solution finding. Important takeaways are soak pits inside the village & with households, improvement of stagnant water drainage, Practice of boiling of tanka water during illness, availability of ORS packs in households, high awareness levels about techniques/safety from polluted water, handwashing techniques widely learnt, even by women, elderly women, water & sanitation committees constituted, private tankas/kunds being preserved, rain water also being harvested, increased demand for S&T solutions for water and water meant for cattle also, complementing development efforts of state, and a proactive local governance.

More of such interventions have been supported during the year in districts like Kendrapara (Odisha), (Tamilnadu), (Karnataka), (Andhra Pradesh), Almora (Uttrakhand), (Chhatisgarh), Faridkot (Punjab), Banswara (Rajasthan)

WaSH Magnet Schools : The mechanism shall be setup as a modular component of the local

school system with functions that - promote special additional focus-curricular or extracurricular, or both, on WaSH theme; inquiry and outcome based hands on learning, science communication as alternative mode & unique approach to learning; draw students outside their traditional school zones and from other school zones also, especially from challenged locations; help mainstream (through festivals, events, adoption of WaSH sites/action locations etc.) and institutionalize actionable WaSH learning with neighbouring communities.

Eco Futures: *Youth Leadership & Eco-interpretation:*

Field engagement & outreach workshops/innovations/initiatives have been designed on S&T Communication for Youth Leadership and Interpretive Capacity Building at grassroots & institutional level for outreach on Eco & WaSH issues. The 177 concept notes have been taken up for evaluation and due mentoring for generation of full-fledged proposals. The eco-contextual strand of the programme has been strengthened further with the launch of the following initiatives

Eco Eureka: Eco-Exploratory Workshops for field engagement & outreach are being promoted which are based on hands –on-science, discovery science and experiential learning for strengthening Nature, Labs & Youth Connections, science communication, nature conservation and eco- restoration, nature based solutions, co- creation & innovation, Communication, education & public awareness, documentation, and impact & outcome mapping.

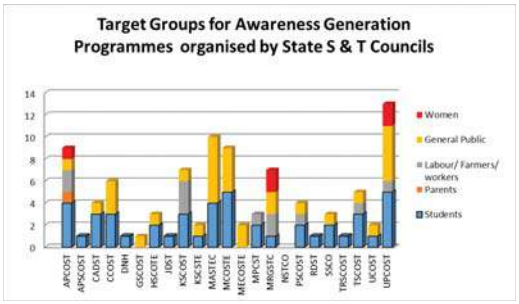
Youth Eco-Media Leadership: The initiative consists of Field Engagement & Outreach Workshops for harnessing and promoting potential of Young Professionals' (Eco/ WaSH Creatives) through field exposure & engagement coupled with 3/6 weeks of internship for promoting Youth Media Leadership in Eco & WaSH Science.

Eco-regional Youth Dialogues: An intensive outreach format has been announced as part of call for concept notes for building understanding in community science of natural water heritage including river basin ecosystems along side river channels, archaeological installations, insecure and water challenged sites. Capacity Building Modules for institutions and networks have been worked out for the purpose of harnessing existing & in-progress capacity in Eco & WaSH *Science Communication* through events/activities with interpretation, youth media, IEC/ICT tools, community/stakeholder mobilization, developing dialogue platforms for youth & youth leadership in community science communication; enabling the networking, sharing & exchange of learning & solutions, etc.

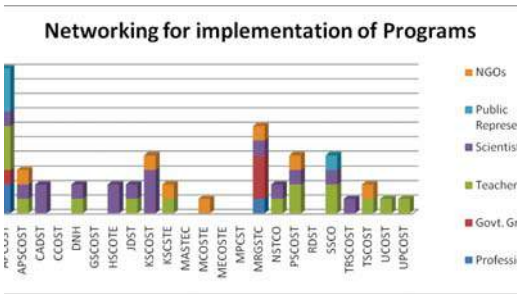
Collaborative Support from States : *Networking for WaSH (NWaSH)*

Science for Sanitation Month (SSM), now a very pertinent contribution to *Swachh Bharat* mission, has been supported to State S&T Councils every year on 2nd October. The collaborative events have been upscaled to six month duration as 'Networking for WaSH : *Communicating Science*' for awareness creation and/or capacity building. Networking approaches have helped develop linkages with subject experts and institutions and utilized a variety of formats such as lectures, demonstrations, vaad-vivad, exhibitions, television spots, demonstrations, lectures, elocution, quiz shows, display charts, stickers, handouts, group discussions, written presentations,

water quality measurements to CD shows. A study has been launched during 2014 for outcome mapping of the NWaSH programme implemented nationwide with States covering over 100 projects supported since 2007 which have generated huge resource material, groups of subject matter experts, and sensitized/mobilized a variety of target audiences. to develop actionable understanding of issues involved.



Target groups in focus during awareness and programmes conducted by S&T Councils



Networking for implementation of programmes people mobilized by S&T Councils (NWaSH & SSM)

1.9 Nutrition & Health

Strengthening Nutrition and Health services: Model Cluster approach: To design and pilot a 'Model Cluster Approach' for strengthening quality in services (health, nutrition awareness and education) with scope for replication and scaling up; to design and develop nutrition and health education programme for creating awareness among target group; and to facilitate better informed utilization of the services provided for the target groups, a year long pilot programme was carried out in the Mehrauli/Bhatti Mine ICDS project in South District, Delhi. From within these projects, one cluster of 4 Anganwadis (out of 10-12 AW in the Neb Sarai Area) was identified for developing into a 'Model Cluster'. Based on the baseline survey, women groups were organized. This group consisted of women in the reproductive age group (18-45 years of age), pregnant and lactating women, mother-in-laws/mothers. In addition adolescent girls residing within the 4 anganwadi clusters were identified as target groups for the project.

Home visits and public hearings were initiated within the community to ascertain the status of the services provided in the anganwadi for the community members. Based on the feedback received, and keeping the available resources in mind it was planned to focus on verbal and visual form (print media - leaflets/pamphlet/handouts etc) of communication and education strategy to reach out to beneficiaries.

For the project, the messages were identified based on the preliminary focus group meeting with the community: It was revealed that messages/educational information

On (i) nutrition and care of women during pregnancy, (ii) breast feeding and infant feeding practices for young children and (iii) adolescent nutrition and care may be useful. Three leaflets were designed and developed as part of the project for use during the nutrition education sessions. A total of four Women groups were organized. 100 women (with children 0-2 years of age, pregnant and lactating mothers) were enrolled and participated in the awareness camp. 40 adolescent out-of-school girls participated in educational programme.

Multi-Media Action Plan for Nutrition-and-Health Awareness : A project was supported on Multi-Media Action Plan for Nutrition-and-Health Awareness Building among tribal adolescent girls and women for explaining relationship between malnutrition and women's diseases and role of local food and herbal remedies in containing malnutrition in three tribal-dominated States of Chhattisgarh, Jharkhand and Madhya Pradesh for women. The nutrition-and-health mapping of more than 1000 target women has been carried out in a set of five districts selected in each state: Bastar, Jashpur, Korba, Koriya and Surguja in Chhattisgarh; Ranchi (rural), East Singhbhum, West Singhbhum, Saraikela and Chaibasa in Jharkhand; and Jhabua, Barwani, Dindori, Mandla and Dhar in Madhya Pradesh). The views of perceptions of 15 nutrition experts from local colleges and hospitals, and 22 indigenous health care practitioners and doctors have been collected to identify the ways for managing malnutrition and the occurrence of diseases among the target women. As its final deliverable and based on the analysis of the information collected, the project will work out a comprehensive mass media action plan for holding awareness building campaign among the women by local organisations and colleges to build awareness on how malnutrition leads to various women-related diseases and how the potential of local food and herbal remedies can be used in containing malnutrition and reducing risks of ill-health in a big way.

Sensitization programme on science behind Disorders of Sex Development: A project on Dissipation of information on Disorders of Sex Development (DSD) in North-East regions of India to unravel science behind DSD and sensitizing common people through workshops and educational media is going on by a team of experts and specialists from AIIMS, New Delhi. The aim of this programme is to spread awareness in the community and to popularize science behind DSD with an alternative aim to train clinician, scientists, medical lab, technologists, nurses and other staff engaged in the field of DSD in order to develop better treatment protocol for the patients with DSD in India. Eight short term training programmes have been conducted at AIIMS with an active participation of North-East States. Hands-on training has been provided to them together with standardization of procedures and quality check. In the next phase, educational programme will be organised in two states of N-E region.

2. Manpower Development

2.1 14th Indian Science Communication Congress (ISCC-2014)

The 14th Indian Science Communication Congress (ISCC-2014) on the focal theme

'Communication Strategies for Science Governance' was held at Indian National Science Academy (INSA), New Delhi during 25-29 December 2014. The conference was organized by Indian Science Writers Association (ISWA) and catalyzed & supported by NCSTC, DST, New Delhi. Several topics were discussed and deliberations made during the conference on varied aspects of the theme. The deliberations covered a wide range of sub themes, such as Science for people, Science for policymakers, Institutional strategies, Policy issues, Scientists as communicators, and a special session for young scholars' et al.

2.2 Training workshop on Science & Technology Communication for Journalists & Writers

(a) Association for Active Service in Rural Areas, Vizia Nagaram, a leading NGO in the Costal Andhra - involved in science popularization Activities over the last 10 years, with the support NCSTC, conducted two workshops titled on Science Journalism for Women in Andhra Pradesh. This is the first of its kind of Science Communication Activity benefitting thousands of women in the costal A.P. The main objective of the programme was to identify the young women science writers / journalists/ communicators in local language (Telugu) and to impart in-depth training in S&T communication and popular science programming and science writing. 50 women delegates were selected from among women science graduates/ post graduates/ science researchers/ journalists in the print and electronic media/editors and women social workers for imparting training.

(b) Janapriya Vigyan Manch, Bhubaneswar, a pioneer popular science forum conducted a training workshop on science and technology communication for journalists and writers from 04th June to 07th June'2014 at Pantha Nivas, BBSR where more than fifty participants attended the programme.

The objective was to spread and focus on innovative creative writing with an aim to inspire participants for developing scripts on popular science topics which will create desired impact in the society & common man in particular. The target areas were lab and land concept on health and hygiene, agriculture, horticulture, energy conservation, climate change, environment, pollution control, safe drinking water, eradication of blind belief and superstition and many more on society based issues. The target groups were school/ colleges students, & common men.

2.3 8th Indian Science Communicators' Meet 2015

The 8th Science Communicators' Meet was held during 4-5 January, 2015 at University of Mumbai as an event of the 102nd Indian Science Congress. The meet was inaugurated on 4th January, 2015 by Padma Bhushan Dr. R. A Mashelkar. The two day meet witnessed a total of 15 Oral and 11 Poster presentations by ISCA selected presenters from different states of India on Advances in Science and Technology, Improving its Communication and Improvement in Science Educational Tools in School/University. A series of invited lectures focusing on Policies on Science Communication, Use of online tools, Reporting of Mars Orbiter Mission, Science Communication in effective Conservation, Science Communication in improving public perception of use of peaceful use of Atomic Energy, Cheaper diagnostic tools lead to constructive deliberations to improve the effectiveness and outreach of various forms of Science Communication. Speakers from top media houses including the National Broadcaster Doordarshan and academic/ research institutes of the country and abroad have elaborated on science communication and its relevance to the society. Nobel Laureate of 2013 in Physiology and Medicine Prof. Randy Schekman gave a talk on the steps for communicating research papers to peer reviewed journals and had a lengthy Q&A session with the delegates. He threw light on the dissemination of scientific research through publication in journals.

2.4 Water Educators (Jal Shikshaks)

Youth leaders in *WaSH Science Communication (WaSH Educator Fellows)* are supported by 6 months of field assignments as Fellows which is extendable by 6 months. Project on "Building grass-root human and institutional capacity for mobilizing communities on Eco-WaSH issues" has been implemented by Association for Rural Advancement through Voluntary Action and Local Involvement (ARAVALI), Jaipur for rural youth & NGOs from 10 southern districts of Rajasthan. Intensive science communication and mentoring support has been provided for building youth leadership capacity, harnessing the collaboration with Central University of Rajasthan, and strengthening more than 20 non-governmental institutions. Water Educators, hosted as Fellows in selected NGOs for field assignments, are engaging with the rural communities to raise awareness, promote scientific literacy and build capacity for informed decision making on concerned issues in their region. **Support to more of such initiatives is envisaged in 13 more states as Concept Notes have been invited through a national call on DST website and evaluated for mentoring and support.**

Water Educators Trainings (WET) has been implemented by Vikram Sarabhai Centre for Development Interaction, Ahmedabad for 2 batches, each of 25 participants, from 11 states from civil society organizations (teachers and NGO staff) and government officials. Participatory approach was adopted to facilitate technology and information access & transfer, based on a training plan and networking with Center for Environment Education (CEE), Ahmedabad, WASMO, Gandhinagar, Paryavaran Mitra, Ahmedabad, UNDP, Chetna, Ahmedabad, and GIDR, Ahmedabad. Two more batches are being trained by VIKSAT, Ahmedabad this year, one being exclusively for training of women Water Educators at national level and another for western eco-regions in 18 states. Such initiatives have also been supported in *Odisha*, *Tamil Nadu* & *Karnataka*.

Water Educators at VIKSAT, Ahmedabad

2.5 Learning Mathematics through Origami

Three training programmes on learning Mathematics through Origami were conducted by Samanta Chandrasekhar Vigyan Cub, Balasore, Odisha at Koraput, Sambalpur and Bhubaneswar. A total of 119 high school Mathematics teachers were trained in three days training programme. The objective of the programme was to introduce origami as a low cost science activity and to learn the subject through various mathematical figures, angles and geometrical shapes.

3. Science Communication Resources

3.1 Science for women's health and nutrition through Community Radio

With the objective of reaching out women of the marginalized sections of the society (semi-urban and rural areas) in order to increase their awareness and knowledge on health issue through community radio, 365 episode programmes were developed, produced and broadcast by each of the Community Radio Stations (CRS) such as Rudi Na Radio, Ahmedabad; Sarang Radio, Mangalore, Radio Mattolli, Mananthawadi, Wayanad; Radio Namaskar, Konark; Hamara Solan, Solan; Radio JU, Kolkata; and PARD Vanoli, Madurai.

Recording going on in the studio

Community members participating in production of radio drama

Popularizing health based programme is also one of the needs of CRS station as it is observed that women were reluctant towards their health and so it is necessary to educate them on several health issues like anaemia, low birth weight, non communicable diseases, HIV & TB, menstrual hygiene, occupational health and reproductive problems. Some of the other topics covered were food habits of women, adulteration in food, food poisoning, mental illness, leprosy, skin problems, cancer, reproductive health & malaria. The programme also included myths related to health, malnutrition, occupational health.

Daily fresh programmes of 15 minutes duration is broadcasted in the morning and the same is repeated in the afternoon slot with a repeat of previous day programme too. All the programmes are designed giving priority to the need of the community. The radio team records the problems and the questions of the community which is then answered by the doctors.

Special effort is taken to package the content in multi segment formats such as mini radio drama, panel discussions, expert talks, interviews, radio features etc. This ensured variety in the program production and presentation and evinced greater interest and appreciation of the listeners. Programmes are produced in regional language and in local popular formats like interview, talk, drama and magazine. Well known doctors from the City Hospitals & Nutrition Experts participated in the live phone-in programmes.

Health Awareness meetings with the experts and camps were organized for the community so that experts can personally interact with the community and can resolve their problems. Those doctors whose interviews were played are invited for the event so that listeners can relate easily.

Women participate from different villages in the events. Especially those women who were facing gynecological problems and had asked their queries during the broadcast were invited for the event. Feedback survey tells that the listeners are of the opinion that the series helped them to be aware of many health related topics which they were ignorant of, or not concerned in the past. It also helped the masses to increase their awareness level on the importance of science in alleviating superstitions associated with various diseases, pregnancy, nutritional aspects etc. They also opined that expert talks by medical and health professionals were highly informative and educative.

Doctor explaining functions of bone

3.2 Radio Mathematics

NCSTC with its mandate to popularize science has the responsibility of spreading mathematical thinking and way of life by creating Maths awareness among millions of rural community who are not reachable. This country takes its pride from the fact that not only the concept of zero was evolved but also the fact that world renowned Mathematics wizard Srinivasan Ramanujam was born in India, lived and postulated his thesis on this soil. To create curiosity and interest of Mathematics and reduce its fear among the school going children and to find out the efficacy of Community radio in supplementing understanding of Mathematics of rural community & urban poor NCSTC is catalyzing and supporting a project titled Radio Mathematics. Presently over 182 episode programme are being produced & broadcast by ten Community Radio Stations. They are Mumbai University, Mumbai; Radio Active, Bangalore; Mewat ki Awaaz, Mewat; Alwar ki Awaaz, Alwar; Kumao Vani, Mukteshwar; Rathinavani, Coimbatore; Janadhwani, Mysore; Radio JU, Kolkata; Vasundhara Vahini, Baramati; and Periyar CR, Periyar. Targetting a variety of target group such as women farmers, textile workers, small scale industry workers, MNREGA workers, housemaids, tribal students , each episode is being produced in radio magazine format. The content is based on application of mathematics in everyday life – problems faced by them and their solutions.

3.3 A Study for Enhancing Mathematical Potential through facilitative Resource Material

The study aims to assess the existing potential of learners in mathematics at the upper primary level through pretest and survey of pedagogical practices; development of resource material for facilitating the enhancement of mathematical potential and their impact assessment. The same is undertaken in collaboration with Central Institute of Education (CIE), University of Delhi, schools, science based agencies, etc. The study is being done through inter-institutional consultative approach in the matters of need identification, existing and prevailing institutional practices, available resource materials, etc. at the upper primary level. Survey and pretesting is being done in 60 schools in Delhi and NCR region.

3.4 Monitoring (Exploring) Nature through Birds

Exploring Nature through Birds (ENTB) is a citizen science education programme organized through Sálim Ali Centre for Ornithology & Natural History (SACON), Coimbatore. After development and printing of the module, a national level orientation program was held on 13th and 14th August 2014 at SACON. Through this programme, a module of science communication with three books and four postures were made and are being distributed as tools for the customized ENTB programmes. Children from different parts of the country are motivated to observe birds, record their finding and communicate it through a web based interphase. A website (www.saconeducation.org/entb) on this programme was dedicated for the dissemination of all the materials and information and also to upload the bird observations of participating children across the country.

4. Incentive Programmes

National Awards for Science & Technology Communication

Outstanding efforts in S&T communication are recognized through national awards under six categories. National Council for Science & Technology Communication (NCSTC) instituted six national awards in 1987 to stimulate, encourage and recognize outstanding efforts in the area of science popularization and communication.

I. National Award for Outstanding Efforts in Science & Technology Communication through Print Media including Books and Magazines: The award is presented to an individual or an institution for outstanding efforts in popularization of science & technology and/or promoting scientific temper through books, magazines, Internet, etc, during the past five years. The award consists of Rs.1, 00,000/- (Rupees One Lakh), a memento and a citation. The awardees for 2014 in the category are -

Dr. P.S. Shankar

Dr. Ramesh Chandra Goswami

Dr. S. Narendran

"M.M. Publications Limited, Kottayam"

II. National Award for Outstanding Efforts in Science & Technology Popularization among Children: The award is presented to an individual or an institution for outstanding work in popularization of science & technology and/or promotion of scientific temper among children which has had the widest impact in the country during the past five years. The award consists of Rs.1, 00,000/- (Rupees One Lakh), a memento and a citation. The awardees for 2014 in the category are –

"Bhartiya Vidya Bhavan's Muktangan Exporatory Science Centre, Pune"


Dr. Shripal Rathi


Dr. Abhijit Sarma Barua


Shri Parveen Singh


Shri Prem Singh

III. National Award for Outstanding Efforts in Science & Technology Communication through Innovative and Traditional Methods:


Dr. Anil Kumar Sharma

It is presented to an individual correspondent or an institution for outstanding efforts in communication of science & technology and/or promotion of scientific temper through print media during the past five years. The award comprises Rs.1,00,000/- (Rupees One Lakh), a memento and a citation. Dr. Anil Kumar Sharma has been awarded in this category.

IV. National Award for Outstanding Efforts in Science & Technology Communication in the Electronic Media: This award is presented to an individual correspondent or an institution for outstanding efforts in communication of science & technology and/or promotion of scientific temper through radio and/or television media during the period under consideration. The award comprises Rs.1,00,000/- (Rupees One Lakh), a memento and a citation. The awardees for 2014 in the category are -


Shri Sarasvatichandra Acharya


Dr. A. Subbiah Pandi

UNESCO Kalinga Prize for Popularization of Science

Prof. Xiangyi Li, winner of UNESCO Kalinga Prize for Popularization of Science for 2013 visited India as a guest of Government of India from 10th to 19th September, 2014. He was presented a certificate and an honorarium of US $ 5000 in a function held at Indian National Science Academy, New Delhi on 10th September, 2014. He delivered a lecture entitled " The Development and Practice of Science & Technology Museum in China at National Science Centre, New Delhi.

CHAPTER 6

INPUTS TO SCIENCE, TECHNOLOGY AND INNOVATION POLICY

STRENGTHENING STI INFORMATION SYSTEM

The National Science & Technology Management Information System (NSTMIS) 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.

(i) S&T Resources Studies

The next national survey for collection of data on resources devoted to research and development activities for the year 2014-15 is being launched in e-mode. The questionnaires for launching the national survey have been finalised. This paves the way for next issue of national publication "Research and Development Statistics".

Another publication of the NSTMIS entitled **'Directory of R&D Institutions 2015'** has been brought out. The present directory is tenth in the series containing list of around 5210 R&D institutions with complete addresses arranged alphabetically within the sectors to which they belong. Details on various communication modes such as phone, fax, email, web site addresses have also been provided wherever possible. The scope and coverage of this directory has been enlarged by adding 160 private universities, 499 CMIE private sector industries. The number of agricultural universities has increased from 38 to 56 and number of institutes of national importance has increased from 11 to 46.

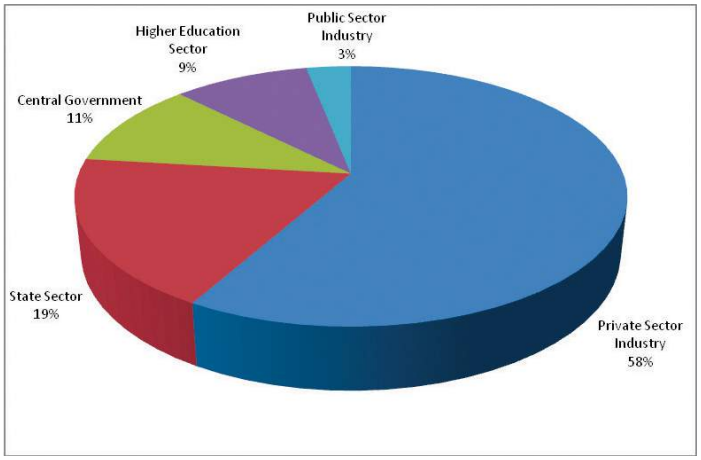


Fig 1.1: Distribution of R&D Institutions in India, 2015

As a part of the new initiative, **'Science, Technology, Innovation and Creation of Knowledge (STICK)'** Programme, the National Innovation Survey report entitled **'Understanding Innovation: Indian National Innovation Survey 2014'** with special focus on MSMEs was released upon in-depth discussion with stakeholders in the country.

The national report, first of its kind, benchmarks innovation potentiality of Indian firms in terms of innovation activities, sources of innovation, linkages, human resource, effects and factors affecting innovation activities. 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, are spread across 26 states and 5 Union Territories covering 96 industrial sectors in the country.

The report highlights fundamental issues related to innovations in the context of developing economies and provides inputs for devising evidence based policy prescriptions or recommendations for strengthening the innovation infrastructure and growth of MSMEs in the country. The same is available on the NSTMIS homepage www.nstmis-dst.org and http://nationalinnovationsurvey.nstmis-dst.org/

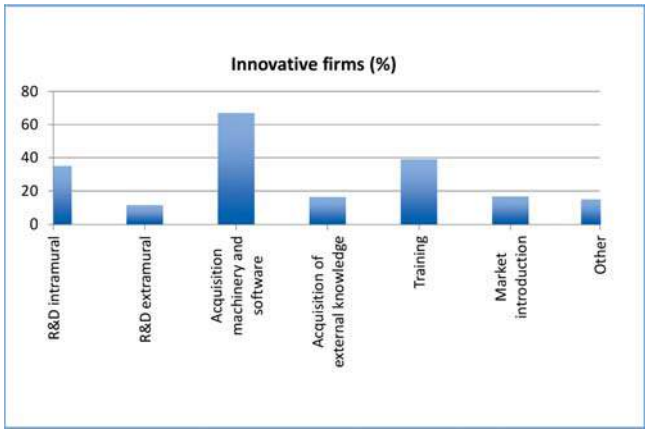


Fig 1.2: Innovation Activities

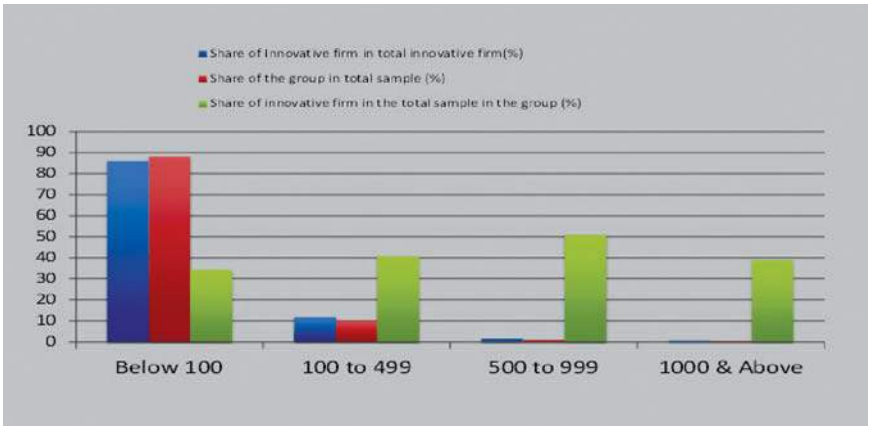


Fig 1.3: Size of Firm and Innovation

Studies have been commissioned for the development of **Bibliometric Indicators** in Indian context based on the two globally popular databases namely SCI, Thomson Reuters and SCOPUS, Elsevier to understand the dynamics of India's Research Landscape. This would provide the basis for evidence based evaluation and monitoring of scientific research for policy planning.

(ii) 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, NSTMIS continued its effort 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 since 1990-91 has been publishing an annual ***Directory of Extramural R&D Projects.*** Directories for the years 2011-12 and 2012-13, twenty-second and twenty-third in the series have been brought out simultaneously this time. Further, the preparation of **Directory of Extramural R&D projects for the years 2013-14 and 2014-15** is being initiated.

Based on the **Extramural R&D** projects database, the fifth report in the series entitled **"Funding Pattern of Sponsored Research by Scientific Agencies 2005-06 to 2009-10"** was brought out. Preparation of another report, third in the series, entitled **"Analysis of Outcome of Extramural R&D (EMR) Projects 2005-10"** is under progress.

The pattern of sponsored research funding during various periods provides us interesting insights as given below:

Period			
1990-1995	1995-2000	2000-2005	2005-2010
Total number of R&D Projects Funded			
6791	9134	12523	20497
Total R&D Funding			
Rs.547.64 crore	Rs.1341.79 crore	Rs.2198.47 crore	Rs.6331.76 crore
Average cost of R&D Projects			
Rs.8.06 lakh	Rs.14.70 lakh	Rs.17.55 lakh	Rs. 30.89 lakh
Number of projects costing Rs.25 lakh and above			
315	688	1488	4158
Number of projects costing Rs.1 crore and above			
46	88	227	606

Coverage of Institutions

1095	1491	1773	2634

Number of PIs Reached out

-	8484	9231	16731

(iii) NSTMIS Sponsored Studies

Apart from the in-house efforts in bringing out the R&D statistics at national level, the NSTMIS 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:

i) Mapping foresight activities in the Indian biotechnology sector.

ii) A study of research and consultancy activities of NIT system of India.

iii) Strategies to meet manpower requirements in Power sector of India up to 2020.

iv) Innovation indicators analysis.

(iv) 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.

Academy for Science, Policy Implementation and Research (ASPIRE)

ASPIRE was launched in 2010 by Department being incubated in project mode at the Administrative Staff College of India (ASCI), Hyderabad. It aims to provide a common platform for interconnecting and enhancing competencies in policy development and implementation emphasizing Science Technology and Innovation across various stakeholders and arms of the Government leading to evidence based decision making.

Some of the Areas in which policy studies have been carried out include food price inflation, R&D in agriculture, pharmaceuticals, patents, steel related R&D and Innovation etc. Further efforts are on to upscale the level of engagement of socio-economic ministries and public sector industries in ASPIRE for R&D management, Innovation and Policy including Capacity building.

FORMULATION OF ENABLING POLICIES FOR S&T

The Department of Science and Technology is mandated to develop and deliver public policy support for the promotion of research and development in the country. As a Twelfth Plan Initiative, Department has established a new dedicated Policy Research Division 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.

Major objectives of the Policy Research Division includes commissioning preparation of study reports of Science, Technology and Innovation (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.

Five Policy Research Centres (PRCs) have been established at Indian Institute of Technology Delhi, Panjab University, Chandigarh, Babasaheb Bhimrao Ambedkar (Central) University (BBAU), Lucknow, Indian Institute of Science, Bangalore and Entrepreneurship Development Institute of India (EDII), Ahmedabad. 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.

The Division had organized two discussion cum review meetings of the above Centres at EDII, Ahmedabad and BBAU, Lucknow. A round table meet on Industry-Academia linkage was organised at Panjab University, Chandigarh. The Centre at IIT Delhi has conducted an Innovation Assessment workshop. The Division has supported two international level workshops (i) Conclave of Scientists on STI Policy: Foresight, Growth, Roadmaps, Sectoral Impact Assessment and Alliance organized by Zaheer Science Foundation at Indian national Science Academy, New Delhi and (ii) Bridging Development Divide for Inclusive Growth through STI at DST-Centre for Policy Research, BBAU, Lucknow.

CHAPTER 7

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 221 Group 'A' and Group 'B' (Gazetted) officers as per the break-up given below:-

Group 'A'	**General**	**SC**	**ST**	**OBC**	**PH**	**Total**
Scientific	101	06	02	-	04	113
Non-Scientific	32	-	01	-	-	33
Group 'B'						
Scientific	10	01	01	02	-	14
Non-Scientific	49	12	00	-	-	61
Grand Total						**221**

Department has a total number of 266 non-gazetted staff on its rolls as per the break-up given below:-

Group	**General**	**SC**	**ST**	**OBC**	**PH**	**Total**
Group 'B' (Non-Gazetted)	77	04	04	05	02	92
Group 'C'	77	60	16	18	03	174
Grand Total						**266**

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.

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 Hindi translation of the material received from various Sections / Desks of the Department from time to time.

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, notification, cabinet note, annual report and any paper which is to be laid in 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 8 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 is in the process of reconstitution.

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 awards are given for doing noting and drafting in Hindi.

Celebration of Hindi Pakhwara

Hindi Pakhwara was organized from 12 to 26 September, 2014 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 1217 applications and 94 Appeals were received by the Department during the year 2014-15. 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 1476 public grievances were dealt with by different Sections/Divisions during 2014-15. Out of these, 907 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 exhibition. In addition it has also assigned responsibility of coordinating the work related to participation of Department of Science & Technology along with its organization in the exhibition.

The Exhibition Cell has coordinated participation of DST in IITF-2014 and participation in 102nd session of Indian Science Congress 2015 during 3-7 January, 2015 by setting up DST's Pavilion for both the events. The Cell has also played an active roll in Inspire Exhibition during 6-8 Oct., 2014. The Cell also participates in a number of other exhibitions in various States

AUDIT OBSERVATIONS

Detailed position of Action Taken Notes (ATNs) to be included in the Annual Report for the year 2014-15 is as per the table given below:

SL. No.	Year	No. of Paras/ PA Reports on which ATNs have been submitted to PAC after vetting by Audit	Details of the Paras/PA reports on which ATNs are pending		
			No. of ATNs not sent by the Ministry even for the first time.	No. of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	No. of ATNs which have been finally vetted by audit but have not been submitted by the Ministry to PAC
1	5 of 2004 UG(SD)			1 (3.1 to 3.11)	
2	5 of 2005(SD)			1(5.1)	
3	1 of 2006(SD)DST			1(3.1 to 3.8)	
4	PA 13 of 2007			1(5.3.1 to 5.3.8)	
5	CA 3 of 2008(SD)DST			1(5.1)	
6	CA 3 of 2008(SD)DST			1(5.2)(	
7	CA 16 of 2008-2009(SD) DST			1(5.1)	
8	CA 16 of 2008-2009(SDs)			1(5.2)	
9	CA 16 of 2008-2009(SDs)			1(5.3)	
10	CA 16 of 2011-12(Civil)			1(15.1)	
11	22 of 2013(Compliance Audit),Union Government Scientific and Environmental Ministries/ Departments			1(5.1)	
12	22 of 2013(Compliance			1(5.2)	
13	27 of 2014(Compliance Audit),Union Government Scientific and Environmental Ministries/ Departments		1(3.1)		
14	27 of 2014(Compliance Audit),Union Government Scientific and Environmental Ministries/ Departments		1(3.2)		

(*)ATNs have been delivered to O/o PDA (SD) on 22.08.2014 (Sl. No.1), 15.12.2014 (Sl. No. 2), 23.07.2014 (Sl. No. 3), 15.12.2014 (Sl. No. 5), 15.12.2014 (Sl. No. 6), 29.08.2014 (Sl. No. 7), 09.01.2014 (Sl. No. 9), 28.10.2014 (Sl. No. 10), 15.12.2014 (Sl. No. 12) respectively for vetting.

Significant audit points printed in Audit Reports of 2014

Audit Report no. 27 of 2014-Union Government, Scientific and Environmental Ministries/ Departments (Compliance Audit)

Department of Science and Technology

Fraudulent payment of legal fees

(1) Para No. 3.1 of 27 of 2014 - Indian Association for the Cultivation of Science and Bose Institute paid legal fees of Rs.83.55 lakh to an advocate without verifying actual attendance in court. Out of this, payment of Rs.54.93 lakh was found to be fraudulent.

(Paragraph 3.1)

Non-installation of equipment

(2) Para No. 3.2 of 27 of 2014 - Indian Association for the Cultivation of Science, Kolkata failed to identify site in time for installation of equipment, delayed preparation of site and also failed to ensure proper storage of the equipment in the interim period. As a result, equipment procured at a cost of Rs.3.40 crore remained uninstalled for more than five years and suffered damage due to improper storage which was repaired at an additional cost of Rs.21.17 lakh.

(Paragraph 3.2)

DEPARTMENT OF SCIENCE AND TECHNOLOGY
SUMMARY OF FINANCIAL REQUIREMENTS

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2013-2014			BE 2014-2015			RE 2014-2015			BE 2015-2016		
		Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
		(Rs. in crores)											
1	SECRETARIAT ECONOMIC SERVICES												
1.1	SECRETARIAT, EXHIBITION & FAIRS & Pr. ACCOUNTS OFFICE	0.00	58.06	58.06	0.00	68.74	68.74	0.00	62.30	62.30	0.00	69.91	69.91
	TOTAL - SECRETARIAT ECONOMIC SERVICES	0.00	58.06	58.06	0.00	68.74	68.74	0.00	62.30	62.30	0.00	69.91	69.91
2	R&D SUPPORT												
2.1	RESEARCH AND DEVELOPMENT SUPPORT	179.75	0.56	180.31	300.00	1.00	301.00	260.00	0.75	260.75	330.00	0.75	330.75
2.2	DRUGS AND PHARMACEUTICALS RESEARCH	24.31	0.00	24.31	25.00	0.00	25.00	19.00	0.00	19.00	25.00	0.00	25.00
2.3	NATIONAL MISSION ON NANO-SCIENCE & NANO-TECHNOLOGY	64.87	0.00	64.87	85.00	0.00	85.00	65.00	0.00	65.00	85.00	0.00	85.00
2.4	SWARAN JAYANTI SCHOLARSHIP FOR OUTSTANDING SCIENTISTS	0.00	0.00	0.00	0.00	12.00	12.00	0.00	12.00	12.00	0.00	15.00	15.00
	TOTAL - R&D SUPPORT	268.93	0.56	269.49	410.00	13.00	423.00	344.00	12.75	356.75	440.00	15.75	455.75
	TOTAL - R&D PROMOTION PROGRAMMES	268.93	0.56	269.49	410.00	13.00	423.00	344.00	12.75	356.75	440.00	15.75	455.75
3	TECHNOLOGY DEVELOPMENT PROGRAMME	106.34	0.00	106.34	140.00	0.00	140.00	131.27	0.00	131.27	154.00	0.00	154.00
	TOTAL - TECHNOLOGY DEVELOPMENT PROGRAMME	106.34	0.00	106.34	140.00	0.00	140.00	131.27	0.00	131.27	154.00	0.00	154.00
4	S&T PROGRAMMES FOR SOCIO-ECONOMIC DEVELOPMENT												
4.1	SCIENCE AND SOCIETY PROGRAMME	5.60	0.00	5.60	10.00	0.00	10.00	10.00	0.00	10.00	13.93	0.00	13.93
4.2	SCIENCE AND TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT												
	AND EMPLOYMENT GENERATION	39.99	0.00	39.99	50.00	0.00	50.00	44.00	0.00	44.00	40.00	0.00	40.00
4.3	SCIENCE AND TECHNOLOGY COMMUNICATION AND POPULARISATION	19.98	0.00	19.98	21.00	0.00	21.00	20.00	0.00	20.00	20.00	0.00	20.00
	TOTAL - S&T PROGRAMMES FOR SOCIO ECONOMIC DEVELOPMENT	65.56	0.00	65.56	81.00	0.00	81.00	74.00	0.00	74.00	73.93	0.00	73.93
5	SPECIAL COMPONENT PLAN FOR SCHEDULED CASTES												
5.1	S&T COMMUNICATION AND POPULARISATION	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.2	S&T ENTREPRENEURHSIP DEVELOPMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.3	SPECIAL COMPONENT PLAN FOR THE DEVELOPMENT OF SCHEDULED CASTES	25.99	0.00	25.99	27.00	0.00	27.00	10.00	0.00	10.00	18.04	0.00	18.04
5.4	AUTONOMOUS SCIENTIFIC INSTITUTIONS	11.00	0.00	11.00	16.00	0.00	16.00	16.00	0.00	16.00	18.00	0.00	18.00
5.5	TECHNOLOGY DEVELOPMENT PROGRAMME	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.6	STATE SCIENCE & TECHNOLOGY PROGRAMME	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.7	SCIENCE & ENGINEERING RESEARCH BOARD	3.93	0.00	3.93	5.00	0.00	5.00	5.00	0.00	5.00	25.00	0.00	25.00
5.8	DISHA PROGRAMME FOR WOMEN IN SCIENCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.9	ALLIANCE AND R&D MISSION	15.00	0.00	15.00	25.00	0.00	25.00	15.00	0.00	15.00	24.00	0.00	24.00
5.10	SUPER COMPUTING FACILITY & CAPACITY BUILDING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.11	NATIONAL GEOGRAPHIC INFORMATION SYSTEM	0.00	0.00	0.00	2.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
5.12	TECHNICAL RESEARCH CENTRES	0.00	0.00	0.00	3.125	0.00	3.13	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL - SCSP	55.92	0.00	55.92	78.125	0.00	78.13	46.00	0.00	46.00	85.04	0.00	85.04

DEPARTMENT OF SCIENCE AND TECHNOLOGY
SUMMARY OF FINANCIAL REQUIREMENTS

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2013-2014			BE 2014-2015			RE 2014-2015			BE 2015-2016		
		Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
6	SCHEDULED TRIBE SUB-PLAN												
6.1	S&T COMMUNICATION AND POPULARISATION	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.2	S&T ENTREPRENEURHSIP DEVELOPMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.3	TRIBAL SUB-PLAN	15.48	0.00	15.48	32.00	0.00	32.00	17.00	0.00	17.00	62.04	0.00	62.04
6.4	AUTONOMOUS SCIENTIFIC INSTITUTIONS	6.50	0.00	6.50	16.00	0.00	16.00	9.30	0.00	9.30	15.00	0.00	15.00
6.5	TECHNOLOGY DEVELOPMENT PROGRAMME	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.6	STATE SCIENCE & TECHNOLOGY PROGRAMME	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.7	SCIENCE & ENGINEERING RESEARCH BOARD	5.93	0.00	5.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.8	DISHA PROGRAMME FOR WOMEN IN SCIENCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.9	ALLIANCE AND R&D MISSION	9.00	0.00	9.00	25.00	0.00	25.00	10.00	0.00	10.00	8.00	0.00	8.00
6.10	SUPER COMPUTING FACILITY & CAPACITY BUILDING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.11	NATIONAL GEOGRAPHIC INFORMATION SYSTEM	0.00	0.00	0.00	2.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
6.12	TECHNICAL RESEARCH CENTRES	0.00	0.00	0.00	3.125	0.00	3.13	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL - TSP	36.90	0.00	36.90	78.125	0.00	78.13	36.30	0.00	36.30	85.04	0.00	85.04
7.	INTERNATIONAL COOPERATION PROGRAMMES												
7.1	INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH	11.00	0.00	11.00	13.00	0.00	13.00	12.50	0.00	12.50	14.50	0.00	14.50
7.2	SCIENCE COUNSELLORS ABROAD	0.00	7.11	7.11	0.00	9.60	9.60	0.00	8.55	8.55	0.00	9.95	9.95
7.3	INDO-US SCIENCE AND TECHNOLOGY FORUM	9.92	0.00	9.92	10.00	0.00	10.00	9.50	0.00	9.50	10.50	0.00	10.50
7.4	INDO-GERMAN SCIENCE & TECHNOLOGY CENTRE	3.00	0.00	3.00	6.00	0.00	6.00	6.00	0.00	6.00	10.00	0.00	10.00
7.5	S&T COOPERATION WITH OTHER COUNTRIES	47.80	0.00	47.80	61.00	0.00	61.00	51.00	0.00	51.00	64.00	0.00	64.00
	TOTAL - INTERNATIONAL COOPERATION PROGRAMMES	71.72	7.11	78.82	90.00	9.60	99.60	79.00	8.55	87.55	99.00	9.95	108.95
8	STATE SCIENCE AND TECHNOLOGY PROGRAMME	29.70	0.00	29.70	35.00	0.00	35.00	33.00	0.00	33.00	35.00	0.00	35.00
9	TECHNOLOGY DEVELOPMENT BOARD	0.00	13.50	13.50	0.00	7.50	7.50	0.00	6.75	6.75	0.00	10.00	10.00
	TOTAL- OTHER SCIENTIFIC RESEARCH	635.06	21.17	656.23	912.25	30.10	942.35	743.57	28.05	771.62	972.00	35.70	1007.70
10.	SCIENTIFIC SURVEYS (MODERNISATION OF MAPPING ORGANIZATIONS (SoI & NATMO)												
10.01	SURVEY OF INDIA	15.15	290.22	305.36	26.35	320.58	346.93	17.25	310.90	328.15	27.16	331.01	358.17
10.02	NATIONAL ATLAS AND THEMATIC MAPPING ORGANISATION	2.76	10.55	13.31	3.65	13.70	17.35	1.80	11.77	13.57	2.84	14.70	17.54
	TOTAL - SCIENTIFIC SURVEYS	17.91	300.77	318.68	30.00	334.28	364.28	19.05	322.67	341.72	30.00	345.71	375.71
11	AUTONOMOUS SCIENTIFIC INSTITUTIONS	667.50	9.00	676.50	753.00	9.00	762.00	675.70	8.10	683.80	830.50	9.00	839.50
	TOTAL - SCIENTIFIC INSTITUTIONS	667.50	9.00	676.50	753.00	9.00	762.00	675.70	8.10	683.80	830.50	9.00	839.50
12	SYNERGY PROJECTS (O/o the PRINCIPAL SCIENTIFIC ADVISER) (including CHAIN)	10.44	0.00	10.44	26.00	0.00	26.00	23.25	0.00	23.25	26.00	0.00	26.00
	TOTAL	10.44	0.00	10.44	26.00	0.00	26.00	23.25	0.00	23.25	26.00	0.00	26.00
13	INFORMATION TECHNOLOGY	0.59	0.00	0.59	2.00	0.00	2.00	0.50	0.00	0.50	5.00	0.00	5.00

DEPARTMENT OF SCIENCE AND TECHNOLOGY
SUMMARY OF FINANCIAL REQUIREMENTS

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2013-2014			BE 2014-2015			RE 2014-2015			BE 2015-2016		
		Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total	Plan	Non-Plan	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	TOTAL	0.59	0.00	0.59	2.00	0.00	2.00	0.50	0.00	0.50	5.00	0.00	5.00
	NEW SCHEMES (Eleventh Five Year Plan)												
14	SCIENCE & ENGINEERING RESEARCH BOARD	520.14	0.00	520.14	595.00	0.00	595.00	530.00	0.00	530.00	635.00	0.00	635.00
15	MEGA FACILITIES FOR BASIC RESEARCH	28.00	0.00	28.00	90.00	0.00	90.00	61.93	0.00	61.93	99.00	0.00	99.00
	TOTAL	548.14	0.00	548.14	685.00	0.00	685.00	591.93	0.00	591.93	734.00	0.00	734.00
	NEW SCHEMES (Twelfth Five Year Plan)												
16	POLICY RESEARCH CELL	6.96	0.00	6.96	17.00	0.00	17.00	8.00	0.00	8.00	17.00	0.00	17.00
17	DISHA PROGRAMME FOR WOMEN IN SCIENCE	42.84	0.00	42.84	53.00	0.00	53.00	44.00	0.00	44.00	53.00	0.00	53.00
18	ALLIANCE AND R&D MISSION	290.78	0.00	290.78	445.00	0.00	445.00	393.00	0.00	393.00	512.50	0.00	512.50
19	SUPER COMPUTING FACILITY & CAPACITY BUILDING	0.00	0.00	0.00	17.00	0.00	17.00	0.00	0.00	0.00	84.00	0.00	84.00
20	NATIONAL GEOGRAPHIC INFORMATION SYSTEM	1.00	0.00	1.00	36.00	0.00	36.00	0.00	0.00	0.00	0.00	0.00	0.00
21	FUND FOR INCLUSIVE INNOVATIONS FOR COMMON MAN	0.00	0.00	0.00	30.00	0.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00
22	TECHNICAL RESEARCH CENTRES	0.00	0.00	0.00	118.75	0.00	118.75	1.00	0.00	1.00	137.50	0.00	137.50
	TOTAL	341.58	0.00	341.58	716.75	0.00	716.75	446.00	0.00	446.00	804.00	0.00	804.00
	GRAND TOTAL	2221.22	388.99	2610.22	3125.00	442.12	3567.12	2500.00	421.12	2921.12	3401.50	460.32	3861.82

ABBREVIATIONS

ACCMS	-Asian Consortium on Computational Materials Science
AIR	-All India Radio
AMOS	-Advanced Mechanical and Optical Systems
ARI	-Agharkar Research Institute
ASEM	-American Society for Engineering Management
ASSCP	-Amorphous Silicon Solar Cell Plant
BARC	-Bhabha Atomic Research Centre
BMD	-Bone Mineral Density
BRNS	-Board of Research in Nuclear Sciences
CAT	-Centre for Advanced Technology
CAZRI	-Central Arid Zone Research Institute
CBERD	-Centre for Building Engineering Research and Development
CCMB	-Centre for Cellular and Molecular Biology
CDRI	-Central Drug Research Institute
CEPT	-Centre for Environment Planning and Technology
CIAE	-Central Institute of Agricultural Engineering
CIGS	-Copper Indium Gallium Selenide
CIMPA	-International Centre for Pure and Applied Mathematics
CMIE	-Centre for Monitoring Indian Economy
CRSI	-Chemical Research Society of India
CSIR	-Council of Scientific and Industrial Research
CSMCRI	-Central Salt & Marine Chemicals Research Institute
CURIE	-Consolidation of University Research for Innovation & Excellence
CZTS	-Copper Zinc Tin Sulfide
DAE	-Department of Atomic Energy
DBT	-Department of Biotechnology
DD	-Door Darshan
DIHAR	-Defence Institute of High Altitude Research
DOPT	-Department of Personnel and Training
DPMS	-District Planning Map Series
DRDO	-Defence Research and Development Organisation
DSSC	-Dye Sensitized Solar Cells

DST	-Department of Science and Technology
ESCA	-Electronic Spectroscopy for Chemical Analysis
FCIPT	-Facilitation Centre for Industrial Plasma Technologies
FFPTF	-Fibre Fabry Perot Tunable Filter
FGF	-Fibroblast Growth Factor
FGFR	-Fibroblast Growth Factor Receptor
FIST	-Fund for Improvement of S&T Infrastructures in Universities and Higher Educational Institutions
FLC	-Ferroelectric Liquid Crystal
GC-MS	-Gas Chromatography-Mass Spectrometry
GIS	-Geographical Information System
GITA	-Global Innovation and Technology Alliance
GLP	-Good Laboratory Practices
GPS	-Geographical Positioning System
GUI	-Graphical User Interface
HFOSC	-Hanle Faint Object Spectrograph Camera
ICAR	-Indian Council of Agricultural Research
IC-IMPACTS	-India-Canada Centre for Innovative Multidisciplinary Partnerships to Accelerate Community Transformation and Sustainability
ICPMS	-Inductively Coupled Plasma Mass Spectrometry
IICPT	-Indian Institute of Crop Processing Technology
IICT	-Indian Institute of Chemical Technology
IIEST	-Indian Institute of Engineering Science and Technology
IISc	-Indian Institute of Science
IISER	-Indian Institute of Science Education and Research
IIT	-Indian Institute of Technology
IL	-Ionic Liquids
IMRS	-Isotope Ratio Mass Spectroscopy
IMSc	-Institute of Mathematical Sciences
IMTECH	-Institute of Microbial Technology
INSPIRE	-Innovation in Science Pursuit for Inspired Research
IPR	-Intellectual Property Rights
IRHM	-Intelligent Remote Health Monitoring
IRHPA	-Intensification of Research in High Priority Areas
JNASR	-Jawaharlar Nehru Centre for Advanced Scientific Research
JRF	-Junior Research Fellow

KIRAN	-Knowledge Involvement in Research Advancement through Nurturing
LC	-Liquid Crystal
LSTV	-Lok Sabha Television
MBCs	-Minimal Bactericidal Concentrations
MICs	-Minimal Inhibitory Concentrations
MRSI	-Materials Research Society of India
MTB	-Micobacterium Tuberculosis
MSME	-Ministry of Micro, Small and Medium Enterprises
NABI	-National Agri-food Biotechnology Institute
NABL	-National Accreditation Board for Testing and Calibration Laboratories
NCERT	-National Council of Educational Research and Training
NCSM	-National Council of Science Museums
NCSTC	-National Council for Science & Technology Communication
NFMC	-National Facility for Marine Cyanobacteria
NGCMA	-National GLP Compliance Monitoring Authority
NID	-National Institute of Design
NIFTEM	-National Institute of Food Technology and Entrepreneurship Management
NIH	-National Institute of Health
NIO	-National Institute of Oceanography
NIPER	-National Institute of Pharmaceutical Education and Research
NIR	-Near Infrared Radiation
NITTTR	-National Institute of Technical Teachers' Training and Research
NPCS	-National Programme for Carbon Sequestration
NRD	-Non-radioactive-dielectic
NSDI	-National Spatial Data Infrastructure
NSF	-National Science Foundation
NSTEDB	-National Science & Technology Entrepreneurship Development Board
NWaSH	-Networking for Water, Sanitation, Hygiene
OECD	-Organisation for Economic Cooperation and Development
OTDR	-Optical Time Domain Reflectometer
PAC	-Programme Advisory Committee
PEC	-Photo Electron Spectroscopy
PURSE	-Promotion of University Research and Scientific Excellence
PV	-Photo Voltaic
RA	-Research Associate

R&D	-Research and Development
ROS	-Reactive Oxygen Species
SCI	-Scientific Citation Index
SDR	-Software Defined Radios
SERB	-Science and Engineering Research Board
SHG	-Self Help Group
SIDBI	-Small Industries Development Bank of India
SINP	-Saha Institute of Nuclear Physics
SLD	-Super Luminescent Diode
SRF	-Senior Research Fellow
SSM	-Science for Sanitation Month
SS-OCSM	-Swept Source Optical Coherence Scanning Microscope
S&T	-Science and Technology
STI	-Science, Technology and Innovation
TDB	-Technology Development Board
TIFR	-Tata Institute of Fundamental Research
TMT	-Thirty Meter Telescope
UKIERI	-United Kingdom India Education and Research Initiative
VC	-Venture Capital
VLF	-Very Low Frequency
VNTR	-Variable Number Tandem Repeat
WTP	-Women Technology Park

Notes

Notes

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