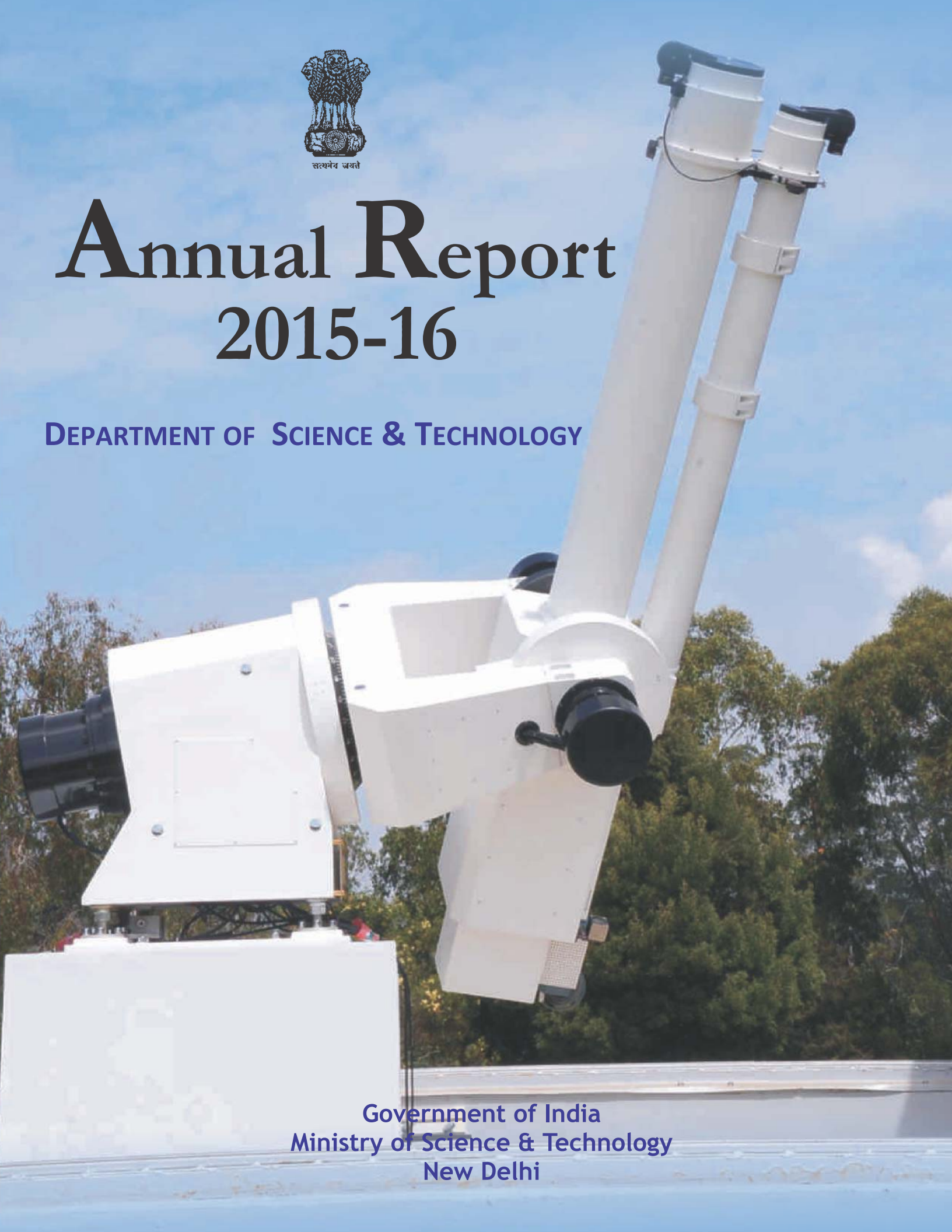
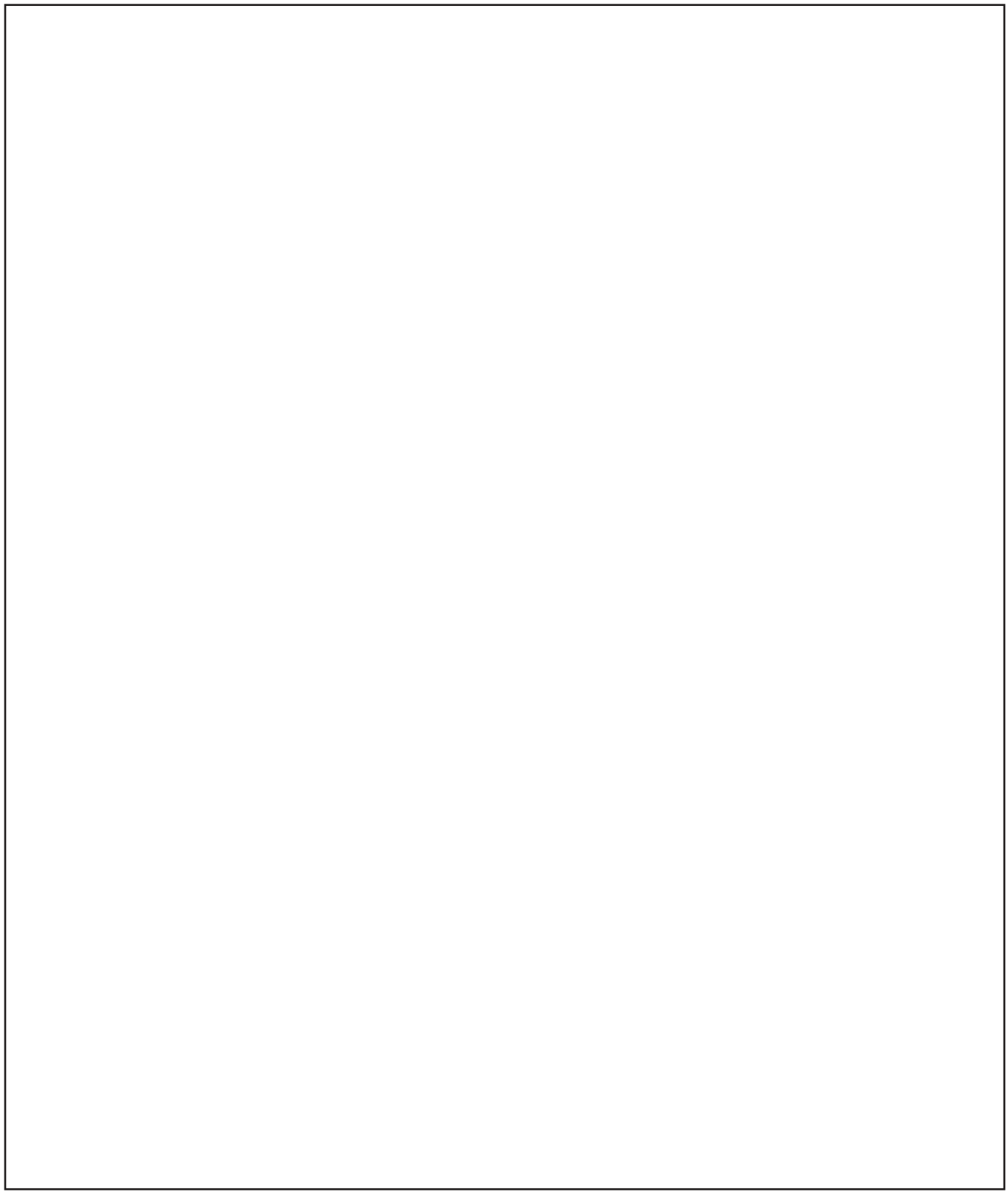


Annual Report 2015-16

Department of Science & Technology

Government of India
Ministry of Science & Technology
New Delhi



H-alpha Telescope at Kodaikanal

Annual Report
2015-16

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CONTENTS

OVERVIEW

The Annual Report for the year 2015-16 of the Department of Science & Technology presents a detailed account of its activities and achievements. All scientific activities of the Department have been grouped into six chapters viz. 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; Science, Technology and Innovation Policy.

The Department has given major emphasis to align its activities with the National Agenda of the Government towards Make in India, Startup India, Digital India, Swachch Bharat, Swasth Bharat, etc. Some of the new initiatives conceptualized and launched during the year under report are as following:-

National Supercomputing Mission

National Supercomputing Mission which is a visionary program to enable India to leapfrog to the league of world class computing power nations. Implementation of the mission jointly by the Department of Science and Technology (DST) and Department of Electronics and Information Technology (DeitY) has been started in a full-fledged manner.

The Mission envisages empowering our national academic and R&D institutions spread over the country by installing a vast supercomputing grid comprising of more than 70 high-performance computing facilities. The Mission also includes development of highly professional High Performance Computing (HPC) aware human resource for meeting challenges of development of these applications. Supercomputing capability would add a great value to realize the goals of Digital India.

DST-MHRD Collaboration in Impacting Research Innovation and Technology (IMPRINT) Project: Department of Science & Technology (DST) has joined hands with Ministry of Human Resource Development (MHRD) to implement IMPRINT projects. IMPRINT projects will address major societal and developmental needs such as healthcare, information and communication technology, energy, sustainable habitat, nano technology, water resources and river systems, advanced materials, security and defence, and environment and climate.

DST-Ministry of Railways (MoR) Joint R&D Initiative : Department of Science and Technology (DST) and Ministry of Railways (MoR) worked together for shaping a joint R&D initiative to address research problems of immediate and direct relevance to MoR by taking up suitable projects within time span of 3-5 years with well defined deliverables. Collaboration between MoR and DST are in the areas of fuel efficiency and emission control technologies, alternate fuels, fuel conservation in diesel traction etc. and to derive synergy based on mutual strengths. This collaboration would add value in Swachch Bharat Mission of the Government.

Technical Research Centres - Five Technical Research Centres (TRCs) in the existing autonomous

institutions of the Department of Science & Technology have been set up. TRCs are expected to further enhance translational research being carried out by these autonomous institutions and bring out innovative products.

Industry-relevant R&D

Recognizing the need to facilitate increased Public Private Partnerships, the Science and Engineering Research Board (SERB) has approved a scheme that provides an opportunity for collaborative research between academic institutions and industry. This scheme aims to bridge the gap between public funded research and industrial R&D. The new scheme seeks to target solution driven research to address industry specific problems.

Technology Development for Waste Management

With the objective to contribute towards Swachch Bharat, a new programme under the Technology Development Scheme has been initiated to come up with technological solutions for the problems faced by the country in waste management. Areas under this include hospital waste, plastic waste, e-waste, etc. First call for proposals has received an overwhelming response.

Collaboration on National Mission for Electric Mobility

Department has formalized collaboration with Department of Heavy Industry (DHI) on working jointly for implementation of R&D Component of DHI's National Mission for Electric Mobility. A Joint Technology Platform for Electric Mobility (TPEM) is being set up in the Department of Science & Technology to implement the programme.

Advanced Manufacturing

Aligning with the Make in India agenda of the Government, the Department has initiated a programme to promote development of advance manufacturing technologies in the country. The areas include robotics and automation, nano-materials, precision manufacturing, etc. Call for proposals has already been given.

Innovation and Incubation at National Institutes of Importance

Department of Science & Technology (DST) and Ministry of Human Resource Development (MHRD) have launched a joint initiative of promoting Start-up Ecosystem in National institutes of repute. DST has been promoting establishment of Technology Business Incubators and MHRD has been establishing Research Parks in the country. Under this joint initiative, it is proposed to establish a 'Start-up Centre', a 'Technology Business Incubator' or a 'Research Park' depending on the preparedness of the institution in commercialization of technologies, supporting industrial research and nurturing and mentoring start-ups. It is proposed that the Research Parks shall be funded by MHRD, TBIs by DST and Startup Centres shall be jointly funded by DST & MHRD. IIT Hyderabad

and IIT Gandhinagar have been recommended for establishing Research Parks, 11 IIT/NITs have been recommended for establishing Technology Business Incubators and 10 IIT/NIT/ IIITs have been recommended for initiating Start-up Centres.

Scheme for funding High Risk-High Reward Research

Science and Engineering Research Board (SERB) has approved a new and significant initiative to support proposals that are conceptually new and risky, and if successful, expected to have a paradigm-shifting influence on the S&T landscape. Outcome could be new and significant theoretical or experimental advances, formulation of new hypotheses, or breakthrough science which will lead to new technologies.

Early Career Research Award

A new scheme *viz*. Early Career Research Award (ECRA) has been launched to provide quick research support to the researchers who are in their early career for pursuing exciting and innovative research in frontier areas of science and engineering. The award carries a research grant up to Rs.50 lakhs for a period of three years. More than 600 young scientists have responded in November 2015 for the Award.

National Postdoctoral Fellowship (N-PDF) scheme

In order to attract and retain young scientists and discourage brain drain in academic/R&D institutions, a National Postdoctoral Fellowship (N-PDF) scheme has been launched. It aims to identify motivated young researchers and provide them support for doing research in frontier areas of science and engineering. The fellow will work under a mentor, and it is expected that the training will provide him/her a platform to develop as an independent researcher.

Encouraging Innovations among School Children

Reorientation of Innovation in Science Pursuit for Inspired Research (INSPIRE) Scheme has been conceptualized during the year. The programme has been modified to encourage children to visualise/ analyse needs of the nation; develop critical thinking about national issues and problems pertaining to everyday life, as well as create awareness and inspire them to devise innovative ideas to address them. Follow-up mechanism to further fine tune the best creative ideas/concepts will be put in place.

The second component of the INSPIRE scheme deals with organizing Science Camps for science students of Class 11th based on their performance at the Class 10th Board examination. Through the Science Camps, these students are provided an opportunity and exposure for interaction with scientists and academicians including Nobel Laureates. Now, “Innovative Idea Writing” has been introduced on specific themes like Water, Energy, Security etc. in keeping with the current initiatives of the Government like Make in India, Swachch Bharat etc. In each Camp, the ideas are being screened for finding the 3 best innovative ideas.

Development of Bio-medical Devices

Establishment of a Technical Research Centre at Sree Chitra Tirunal Institute of Medical Sciences and Technology, Thiruvananthapuram has been supported to give a big push to the development and commercialization of biomedical technologies in this institution which has an enviable record in this domain.

Science and Technology of Yoga and Meditation (SATYAM)

DST has launched a new programme "Science and Technology of Yoga and Meditation (SATYAM)" in 2015-16 to rejuvenate research in yoga and meditation. Given the ever increasing prevalence of physical and mental health problems, the holistic approach of Yoga and Meditation is believed to have the potential to find beneficial treatment that is relatively safer and more cost-effective. Cutting-edge research under SATYAM will seek to identify related issues and challenges and address these to enhance human well-being.

North Eastern Centre for Ethno Medical Research

Establishment of an Ethno Medicinal Research Centre in Manipur with budgetary support of approx. Rs.6.00 crores has been approved. This Centre aims to undertake ethno phyto-chemical research of wild herbs available in the NE region that have unique medicinal and aromatic properties, particularly in our traditional systems. The Centre will not only give scientific validation of traditional herbs but aims to improve quality of life and economic status of local community through product development and better livelihood.

Leveraging International S&T Cooperation

A few key initiatives for promotion of S&T through international cooperation during 2015-16 are:

- Joint research project based networking of researchers under active bilateral S&T programs of cooperation with more than 44 countries including substantive program with Africa under India-Africa S&T Initiative;
- Co-investment of resources including funds for symmetric joint research projects and strategic joint initiatives with Australia, Canada, Germany, Hungary, Norway, Russia, South Korea, Switzerland, UK, and USA;
- Execution of Africa-India S&T Initiative Program including fellowships, trainings and strengthening of R&D institutions through twinning;
- Launch of India Science & Research Fellowship (ISRF) for scientists from neighboring countries to undertake R&D work in India;

- A new programme with Russian Science Foundation was concluded by DST for cooperation in Basic Sciences (Physics, Chemistry, Earth Sciences, Biology (Medical and Agriculture), Mathematics) during 8th Session of India - Russia Working Group on Science & Technology in Moscow on September 3, 2015; and

- Launch of Indo-US fellowship programme on Climate Research.

Besides some of the new initiatives conceptualized and launched during the current year, the Department continued to implement its mandated schemes and programmes within the available resources to serve the cause of Science and Technology in the service of the nation.

CHAPTER 1

HUMAN CAPACITY BUILDING IN S&T

HUMAN CAPACITY BUILDING THROUGH SCIENCE & ENGINEERING RESEARCH

Science and Engineering Research Board (SERB)

Operationalization of the Science and Engineering Research Board (SERB) has catalyzed the research and development activities in several frontier areas of science and engineering across the country. 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:

1. Fast track delivery system-Restructuring of Processes: A new structure for peer review committees and processes have been approved for implementation. Proposals are to be invited through "Call for Proposals" with clear timelines announced for submission, review, decision and fund disbursal. No funding commitments are to be carried forward to the next funding cycle. The Advisory Committees to grade the R&D proposals under four categories, viz. A, B, C and D and only top ranked proposals be funded based on the availability of funds.

2. Young Scientist's Project Scheme: Board approved restructuring of Young Scientist Scheme into two parts: (i) One-time research grant to regular faculty who is starting research career (Early Career Research Award) (ii) Fellowship amount with some contingency grant to those who have completed doctorate degree in recent years and are not in regular position (National Postdoctoral Fellowship (N-PDF).

3. Policy on Conflict of Interest & Code of Conduct: SERB has given its nod to go ahead with the much awaited policy on conflict of interest for grant applicants (including collaborators), reviewers, committee members and officers dealing with various programs. All the stakeholders are required to sign an undertaking to adhere to the policy on conflict of interest. The approved policy aims to bring more transparency, increased accountability in funding mechanisms and provide assurance to the general public that processes followed in award of grants are fair and non-discriminatory.

4. Hosting 2016 Annual Meeting of Global Research Council: SERB has won the bid to host 2016 Annual Meeting of the Global Research Council (GRC) which has membership of over 70 research funding organizations around the world. Board approved it's hosting in 25-28 May in New Delhi along with Co-host RC UK. Hosting the fifth edition of the annual meeting ahead of many other

countries signifies the recognition of rising levels of S&T in the country.

5. Scheme for funding Industry Relevant R&D: SERB recognizes the need to facilitate increased Public Private Partnerships in its funding mechanism and recently approved a scheme that provides an opportunity for collaborative research between academic institutions and industry. The scheme aims to bridge the gap between public funded research and industrial R&D. The new scheme seeks to target solution driven research to address industry specific problems. Project will be jointly designed and implemented by the academic partner and industry and the cost will be shared between SERB and Industry with industry share not to be less than 50 % of the total budget. All industries (including MSME & industrial R&D Centres) are welcome to participate in this scheme.

6. Scheme for funding High Risk High Reward Research: Board has approved a new and significant initiative to support proposals that are conceptually new and risky, and if successful, expected to have a paradigm shifting influence on the S&T. Outcome could be new and significant theoretical or experimental advances, formulation of new hypothesis or breakthrough science which will lead to new technologies.

7. SERB Overseas Doctoral Fellowship: In order to augment quality manpower in niche areas of research, Board approved the launch of SERB Overseas Doctoral Fellowship. Under this programme, SERB provides fellowship to Indian students graduating from Indian universities/ institutes to pursue Ph.D. in select areas of science, technology, engineering and medicine in academic institutions of international repute abroad. SERB has entered into Memorandum of Understanding (MoU) with Cambridge University, London, UK; Stanford University, California, USA; The University of British Columbia, Canada; University of Southern California, Los Angles; Carnegie Mellon University; University of California, Irvine; Rice University, Houston; and The University at Buffalo, New York, USA. The hallmark of the alliance is that through the MoU it is ensured that each and every SERB Overseas Doctoral Fellow will be getting tuition fee waiver from the University concerned.

8. S.N. Bose Scholar Program: Board approved continuation of S.N Bose Scholar Program which provides an opportunity to the best and brightest Indian students to gain exposure and access to world-class research facilities in U.S. academia and labs for a period of 10 - 12 weeks. The program also supports U.S. students to intern at a recognized Indian educational institution for a similar duration.

9. Honorarium for Retired Scientists: Board approved payment of honorarium of Retired Scientists working in Extra Mural R&D Projects and other programs of SERB @ Rs. 40,000/- pm (consolidated) w.e.f. 1st August, 2015.

A wide variety of ongoing schemes/programmes were supported in the reporting period. Some of the notable ones are:

Ramanujan Fellowship is for brilliant scientists and engineers from all over the world to take

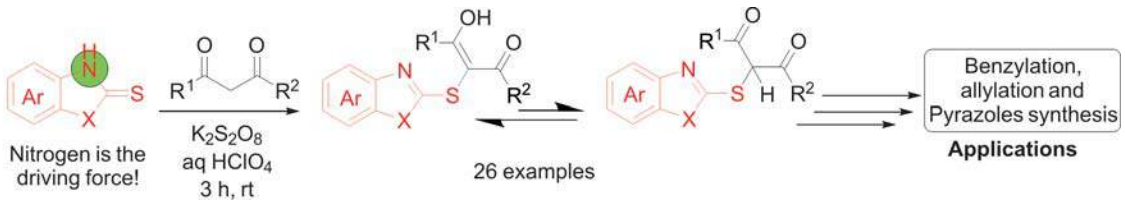
up scientific research positions in India. This fellowship is open to scientists and engineers below the age of 55 years. Twenty-five scientists received Ramanujan Fellowship. The J.C. Bose National Fellowship is meant to recognize active, performing scientists and engineers for their outstanding performance and contribution. Forty scientists received JC Bose Fellowship.

Studies on the possible impact of electromagnetic radiation exposure from mobile towers and handsets on life (Humans, living organisms, flora & fauna and environment) have been undertaken jointly with Department of Telecommunication, Ministry of Telecommunication and Information Technology. Ten proposals were sanctioned at a total cost of Rs.5.2 crore for the duration of three years.

A total of 38 scientists were supported through projects worth Rs.15.56 crore in the "Empowerment and Equity Opportunities for Excellence in Science" Scheme. The scheme provides research support to scientists belonging to SC/ST categories and it received overwhelming response.

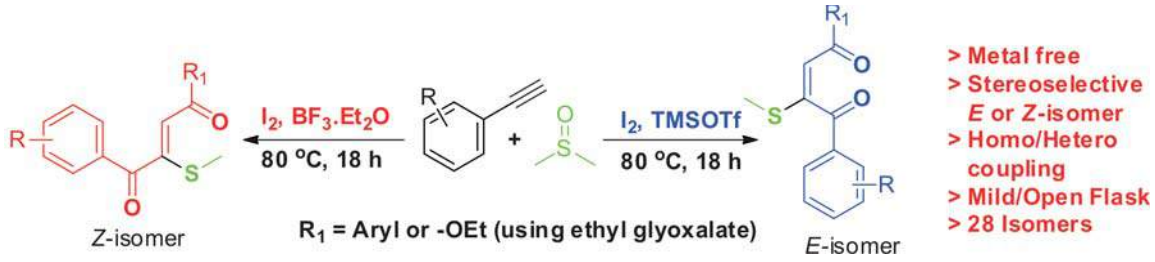
Programme Advisory Committees continue to play a decisive role in providing core research support to scientists. 463 scientists were supported through projects worth Rs.183.40 crore through this scheme. Some of the significant results emanated from the projects were:

- Organosulfur compounds are abundant in nature, and they play a prominent role in the efficient functioning of the living system. Therefore, the discovery and development of new C−S bond forming reactions is of prime importance for organic chemists. Sulfenylation of β-diketones is challenging as β-diketones undergo deacylation after sulfenylation in the reaction medium. Therefore, researchers from Indian Institute of Science, Bangalore have carried out sulfenylation of β-diketones without deacylation under metal-free conditions at ambient temperature via a cross dehydrogenative coupling (CDC) strategy which is the highlight of this work. Since the reaction has been shown to generate an asymmetric quaternary carbon center, there is scope for developing enantioselective methods. The resultant products can be further manipulated to form α,α-disubstituted β-diketones and pyrazoles.



Org. Lett. 2015, 17, 2944−2947

- In an ongoing project at Indian Institute of Integrative Medicine (IIIM), Jammu, an efficient metal free self-sorting tandem protocol for stereospecific synthesis of 2-thio-1,4-enediones involving C-C double bond formation via direct coupling of terminal alkynes has been developed by Dr. Shah etal. The method was also extended to the first synthesis of β-thio-γ-keto-α,ß-unsaturated esters via cross coupling reaction with ethyl glyoxylate. The reaction relies on a first of its kind use of Bronsted and Lewis acid to switch selectivity for the synthesis of E or Z-isomer respectively.



Chem. Commun. 2015, 51, 5013

- Organomercurials including methylmercury are ubiquitous environmental pollutants and highly toxic to humans. Research group at Shiv Nadar University has demonstrated that N-methylimidazole-based thiones/selones having N-CH2CH2OH substituent exhibit remarkable effect in detoxifying various organomercurials to produce less toxic HgE (E = S, Se) nanoparticles. Compounds lacking the N-CH_2CH_2OH substituent failed to produce HgE nanoparticles upon treatment with organomercurials, suggesting that the N-CH2CH2OH moiety plays a crucial role in the detoxification by facilitating the desulfurization and deselenization processes. Herein, their group has reported that the N-methylimidazole-based thione (1) and its selenium analogue (2) having a 2-hydroxyethyl substituent exhibit remarkable effect in the detoxification of various organomercurials such as RHgOH (R = Me, Ar; Ar = -$C_6H_4CO_2Na$) and RHgCl (R = Me, Et) by producing insoluble HgS and HgSe nanoparticles as the end products at 35 °C **(Figure 1).** Compounds 3-8 that lack the N-CH_2CH_2OH group failed to produce the corresponding HgE nanoparticles under identical reaction conditions. This novel way of detoxifying organomercurials may lead to the discovery of a new potential molecule to treat patients suffering from methylmercury poisoning.

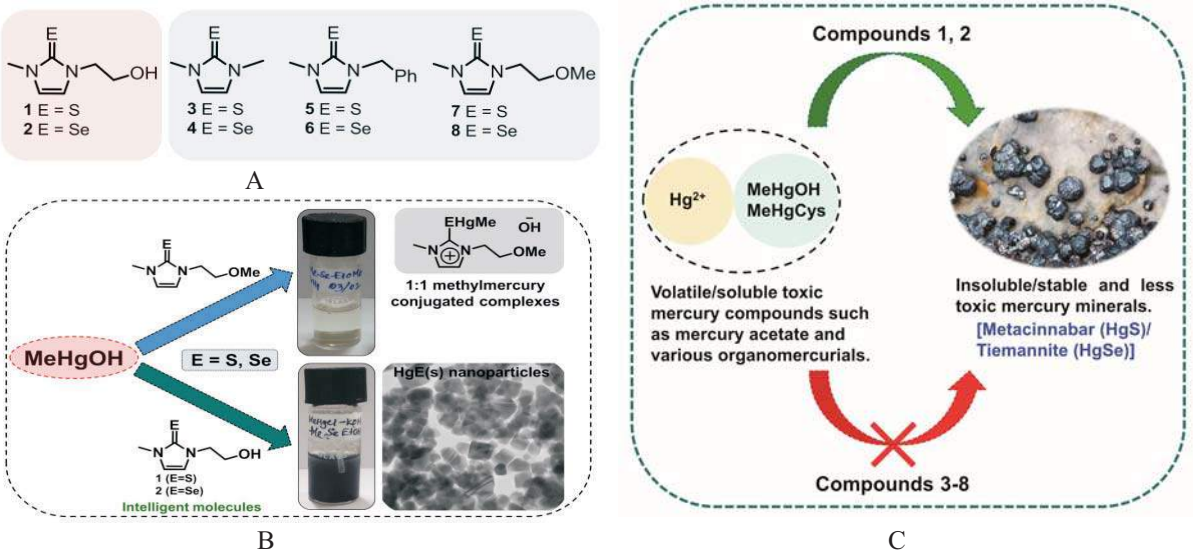


Figure 1. (A) Chemical structures of some imidazole-based thiones and selones. (B & C) Formation of HgS and HgSe nanoparticles in the reactions of various organomercurials including MeHgOH with **1** & **2** at 35 °C.

Angew. Chem., 2015, 127, 9551.

- Receptor modelling of residential-indoor PM2.5 of slum areas, row-houses and high rise buildings has been carried out at Raipur to address particulate matter (PM) mass and associated species source apportionment. Results have shown that local sources are mainly affecting ground floor, where as industrial emissions penetrating more deeply into the indoor of 8th floor. Chemical mass balance receptor model (PMF5.0) indicates that Fossil fuel combustion activities has shown 53 to 79% contribution to residential indoors, where as local biomass burning has contributed 20 to 37%. Additionally, contribution from other major source categories were due to construction related dusts (9 to 23%). Findings of this study underscore the need for detailed microphysical characterization of aerosols and their subsequent inclusion in radiative transfer models.

- Observations were undertaken during the pre-monsoon and monsoon periods with the indigenously developed prototype of the Stratosphere Troposphere Wind Profiler (ST Radar) with 205 MHz frequency of operation at Cochin University of Science and Technology, Cochin. Experimental validation results of this prototype wind profiler derived vertical velocities with Radiosonde **(Figure-2)** observations are highly encouraging towards undertaking advanced research in monsoon dynamics.

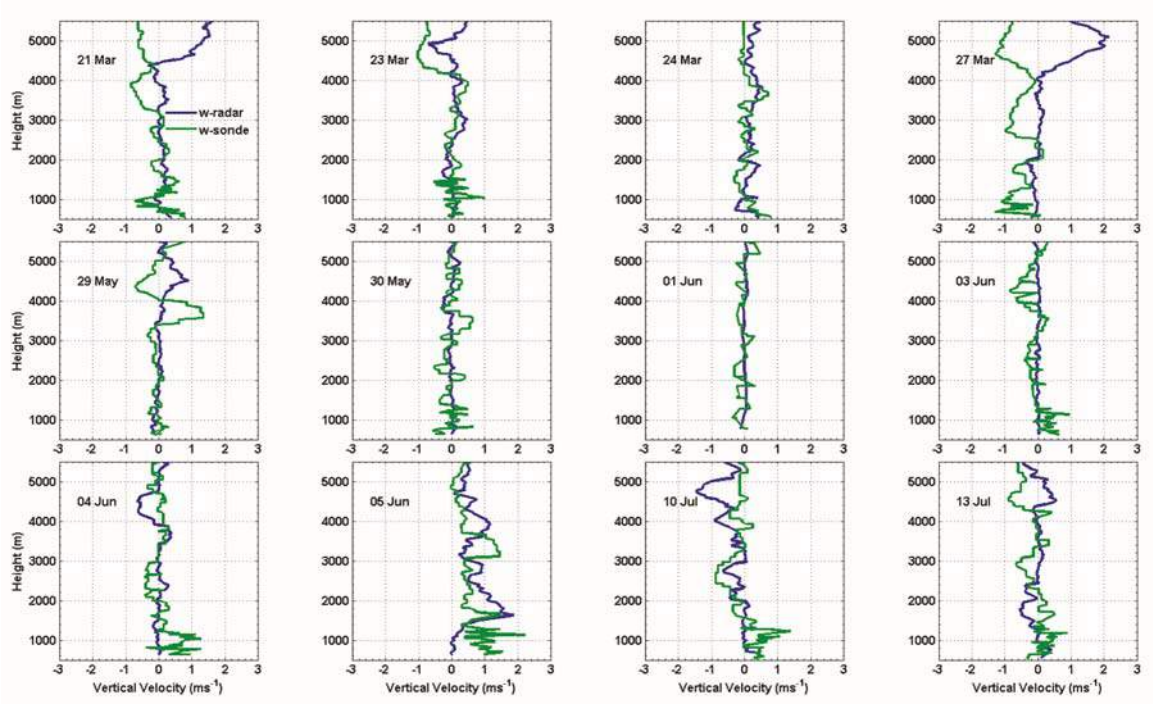


Figure-2: Comparison of vertical velocities of wind using Radiosonde (green) with 49-element Antenna sub-array of ST Radar (blue) developed at CUSAT, Kochi during (March to July 2015).

- Observations were captured on Thunderstorm event occurred at Cochin on 24 April 2015 during 1851 to 1941 hours. The continuous profiles of wind speed and direction are shown in **Figure-3**.

As expected, these experimental results demonstrated that during severe convective conditions like thunderstorm, the 49 element ST Radar (Mini-Profiler) is able to profile the atmosphere up to 12 km displaying various physical processes within the Cumulonimbus clouds. The building infrastructure and other essential civil and electrical works have been completed. Installation of all sub-systems have been completed and their integration is in progress.

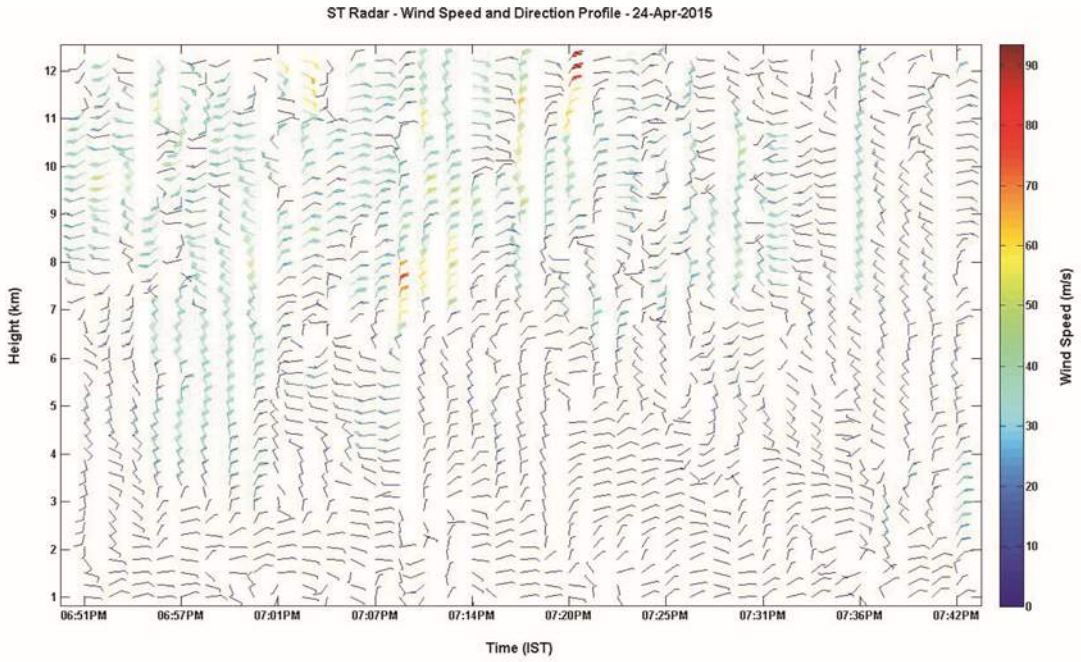


Figure 3. Radar Observations during Thunderstorm event on 24 April 2015 at Kochi

- Analysis of remote sensing observations during the past 40-year period over the Pastio glacier indicated decreasing trend in the glaciated area and upward shift in equilibrium line altitude. When compared to the nearby Baralacha-la and Panchi-nala glaciers, Pastio glacier was found to be faster retreating glacier at the rate of 22.5 ma-1, whereas others showed slower (9.2 to 10.0 ma-1). The high rate of retreat of Pastio glacier was attributed to large slope variations with less debris cover. Non-climatic factors such as size of the glacier, variation in slope and debris cover may be possible drivers in the same climatic zone.

- The mangrove region is a dominant and productive ecosystem along most of the world tropical coastlines and a source of methane emissions. As part of this ongoing work the influence of season on depthwise distribution of culturable and non- culturable methanotrophs (ANME-1, ANEME-2) in mangrove sediments was found to be in the order: monsoon>post-monsoon>pre-monsoon **(Figure-4).** The non- culturable methanotrophs were highest during the post-monsoon season and lowest during the pre-monsoon. Along the depth, the methanotrophic population and its activity were highest in the subsurface sediments. There was a spatial influence on the environmental

parameters that governed the net methane production and methane oxidation rates in the study area.

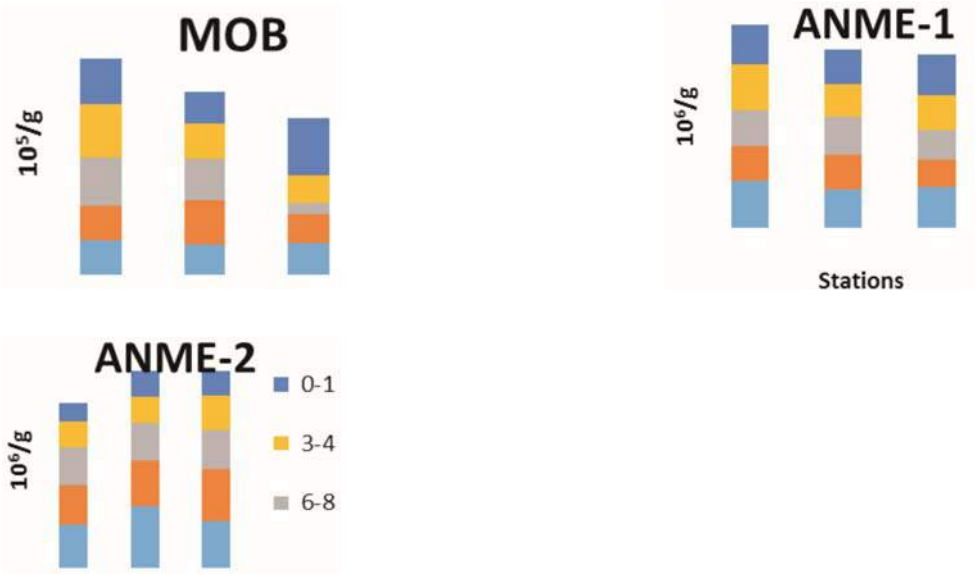
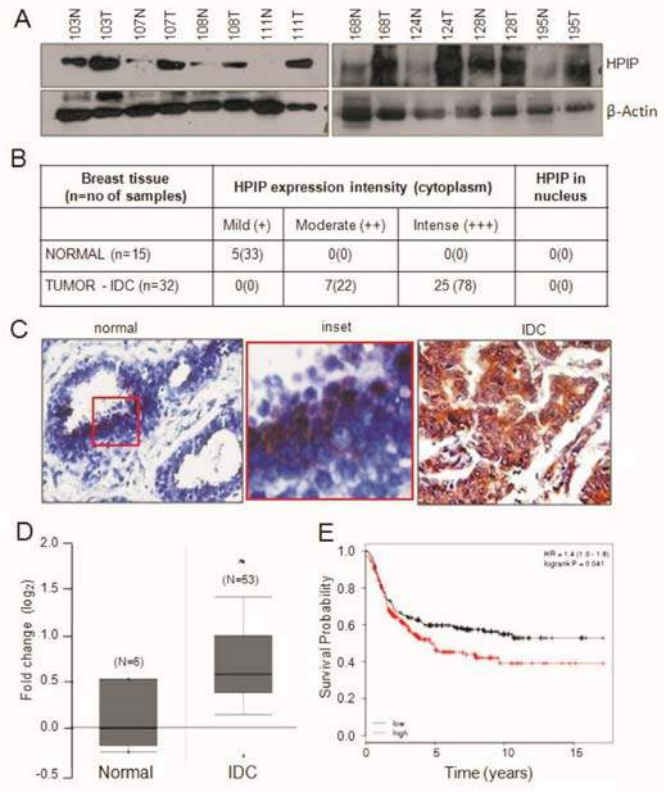


Figure 4: Depth wise distribution of culturable (MOB) and non-culturable methanotrophs (ANME-1, ANEME-2) in mangrove sediments

- High tenacity biodegradable monofilament fibers based on cross-linked PCL are produced via melt spinning of PCL in presence of BCY which have high potential to be used in tissue engineering applications and sutures (or as a woven fabric/nonwoven mesh).
- Development of process models for dilute acid pretreatment with focusing on bagasse as feedstock leading to the production of the desired products such as sugars and acid soluble lignin as well as their subsequent degradation into undesirable degradation products such as furfural and HMF.
- Developed a thick film of Ag-ACF/CNF-PVA nanocomposites with enhanced mechanical strength and thermal stability as a contractor for separation and purification applications & successful fabrication of microchannels of different depths and widths, with an effective exposure of the materials incorporated in situ within the film, to the outside fluid.
- Developed a synchrophasor assisted frequency and voltage stability based load shedding scheme for self-healing of power system by a dynamic voltage stability criterion formulated as Voltage Stability Risk Index (VSRI).
- Developed unique transduction mechanism and fabrication of self-packed resonant pressure sensor with stainless steel using wire cut EDM process in which sensitivity can be further improved by modifying the single degree of freedom resonating beam to two degree of freedom resonating beam.

- Developed a platform technology which can perform high-resolution refractometry (resolution of or better than 10-6 RIU) using a compact, handheld unit with enormous applications ranging from healthcare to inline process monitoring in chemical or pharmaceuticals industries.

- Interesting results were obtained in a biochemistry project being implemented at University of Hyderabad. The scaffolding protein, hematopoietic PBX interacting protein (HPIP/PBXIP1) regulates cell migration necessary for cancer cell dissemination. However, the mechanism that governs this process remains unknown. The project results demonstrated that HPIP expression is associated with stages of breast cancer where cell dissemination results in poor patient outcome. In support of this hypothesis, the group noted 100% (32/32 cases vs. 5/15 healthy primary tissues) of the infiltrative ductal carcinoma (IDC) tissue expressing very high (78%, 25/32) to moderately high (22%, 7/32) levels of HPIP and also found a significantly poor overall survival (P= 0.041) in breast cancer patients with elevated levels of HPIP in cancerous tissue compared to normal controls suggesting that HPIP could serve as a potential marker for IDC **(Figure-5)**. It has also been found that miR-148a negatively regulates HPIP expression posttranscriptionally during mammary gland development. This study will help to understand the mechanism of *HPIP* gene expression during mammary gland development and its role in oncogenesis.



Breast tissue (n=no of samples)	HPIP expression intensity (cytoplasm)			HPIP in nucleus
	Mild (+)	Moderate (++)	Intense (+++)	
NORMAL (n=15)	5(33)	0(0)	0(0)	0(0)
TUMOR - IDC (n=32)	0(0)	7(22)	25 (78)	0(0)

Figure 5. Expression of HPIP in primary breast tumors. (A) Western blot analysis of HPIP expression in 8 matched- sets of infiltrative/invasive ductal carcinoma (IDCs) vs. adjacent normal breast tissues. (B) Summary of immunohistochemistry (IHC) analysis of HPIP expression in normal vs. breast tumors.

Number in parentheses refers to the percentage of samples either positive or negative. (C) Representative pictures of IHC analysis of HPIP expression in cancer tissues (IDC) and adjacent normal healthy breast tissues. (D) Oncomine microarray data was used to analyse HPIP expression (mRNA) in cancer (IDC) (N=53) vs. normal breast tissues (N=6). Samples were organized by fold change of HPIP mRNA from normal were graphed by a box plot. $^{*}P < 10^{-6}$. (E) Kaplan–Meier plot of relapse-free survival of breast cancer patients expressing high or low HPIP in KM-plot database. Log-rank test p value is displayed (P =0.041). Red line: cases with high expression of HPIP, black line: cases with low expression of HPIP.

- A link between the theory of special functions and unified theory of multivariable special functions via Lie algebra has been established. Various classes of generating functions has been derived from space-time fractional anomalous diffusion problem, Volterra integral equations, matrix polynomials and from other identities unifying these consequences.
- Numerical solution of Fredholm integral equation of second kind with weakly singular kernel is obtained by employing Legendre multi-wavelet basis. The low- and high pass filters involving Legendre multi-wavelet have been derived and used to evaluate integrals for the multiscale representation of integral operator.
- States of an Intuitionistic Markov Chain have been classified and an algorithm to find greatest and least eigen vector for membership and non-membership degree matrix have been developed.
- An infinite horizon risk sensitive control problem has been studied. It is found that the sensitivity of the criterion due to high cost excursions through risk—sensitive parameter can be controlled. The variational formulation for the positive eigenvalue that reduces to Donsker-Varadhan Characterization is obtained by using Krein-Rutman theorem.
- The efficiency of the multiple dependent state (MDS) plan has been compared with the existing sampling plans such as Single Sampling Plan and the Repetitive Group Sampling (RGS) Plan using Weibull life time model. The comparison was made in terms of average sample number (ASN). The ASN is observed to be smaller than RGS plan for all combinations of AQL (Acceptable quality levels) and LQL (Limiting Quality Level).
- Studied relaxation dynamics of Li+ ions of LiF doped lithium metaphosphate glasses in the frequency range 10Hz to 2 MHz in wide temperature range.
- A new, all-electrical study of excitonic physics using frequency & time domain investigation of dynamic dielectric response of the active lasing junction has been carried out. This seemingly untouched area of all-electrical manipulation of excitons can certainly help to probe many body physics of excitons, exciton-polaritonic Bose-Einstein Condensation (BEC) in solid state quantum structures and related phenomena as well as it can pave the way for innovative applications based on efficient electrical control of excitonic devices or the so called “Exictronics”.
- 14.8 W of green (532 nm) cw power by optimally focusing the of 40.0 W, 1064 nm pump beam has been generated. This SH efficiency of 37% in a single-pass configuration was the highest reported. Even at such high cw power, the measured M2 was ≤ 1.10 for the SH beam which was marginally

greater than pump beam (M2 ≤ 1.08). The linewidth of SH output was measured to be 5 MHz and the power stability of the output beam was ~ 5% at the maximum pump power.

- A wide band gap material, CaGa2O4 co-doped with Eu3+/Na+ has been developed. The material has good transparency (≥ 95%) in the visible region and efficiently absorbs solar blind UV radiation.

Ministry of Food Processing Industries (MOFPI) extends financial assistance as grant-in-aid to various institutions/universities, Public funded organizations and recognized R&D laboratories both in public and private sector to promote and undertake demand driven R&D work in the field of Food Processing Sector for product and process development, design and development of equipment, improved storage, shelf-life, packaging etc.

The objective of the scheme is that the end product / outcome / findings of R&D work should benefit Food Processing Industry in terms of product and process development, improved preservation, packaging, storage and distribution technologies, value addition, standardization of additives, colouring agents, preservatives, pesticide residues, etc. with focus on enhancement of production, quality, consumer safety, public health and trade.

From April 1, 2012 the scheme is being implemented by SERB. Few highlights of the output generated from the ongoing projects were:

- Development of technique where the biological activity of the metabolite is retained by efficient downstream processing where maximum metabolites are extracted and simultaneously the cells viability is not lost by generating in vitro cultures from elite germplasm of M. alba that are able to produce higher amount of stable pigment and key nutraceuticals.
- Developed an indigenous potent probiotic strain and characterized with efficient biological activities including cholesterol assimilation, bile hydrolase activity, resistance to different antibiotic and anti-oxidant properties for Indian nutraceutical market.
- Developed the Ozone pre-treatment method for bulk storage of onion to prevent the huge losses involved due to microbes during storage with minimum losses and modified atmosphere packaging using diffusion channels for transport of onions in corrugated boxes especially for exports market.

In the reporting period, 682 projects costing Rs.186.21 crore were supported to Young Scientists under the Fast Track Scheme for Young Scientists. A significant number of high impact SCI publications have emanated from several projects. A few results from the ongoing projects are given below:

- Measurement of field strength in a 3D space requires a sensor capable of measuring all three components of electric field (Ex, Ey, Ez). The 2D sensor array developed through this work can be used only to map electric field distribution in a plane. Thus electric field components in the sensor plane alone can be measured with the 2D sensor array. Such sensors are useful for plane wave measurements and to map transverse components of near field electric field radiated by microwave antennas developed for medical applications. The dipole antennas and resistive detector lines are fabricated using thin film technology and higher precision (nm scale) for broadband frequency

response. Fabrication of 3D electric field measurement system was developed using commercial electric field sensor.

- In a rainfall simulation experiment, it was observed that Hortonian overland flow generation mechanism was the dominant overland flow mechanism in both the plots (forested and degraded). Static and dynamic characteristics of watershed also played very important role in runoff generation mechanism. One of the major innovations of this study is conducting in-situ rainfall-runoff experiments in the lesser Himalayas. In authors view, this is one of the first rainfall simulator experiment performed in this terrain. Enormous data set generated from this study will be utilized to develop numerical model for complex hillslope hydrology. In due-course, one can develop these sites as the state-of-the-art long-term instrumented sites in India, which could be utilized in transferring knowledge of hillslope hydrology to undergraduate and graduate students. In addition, it will help to develop a reference data set of hillslope rainfall-runoff response for hydrology community.
- Mechanism of glucolipotoxicity in pancreatic islets: Palmitic acid exerts its cytotoxic effects by increasing ROS production which in turn leads to increased oxidative damage to biomolecules in cells. Molecular mechanisms need to be elucidated to understand the relative contributions of lipotoxicity and glucotoxicity under glucolipotoxic conditions.
- Investigating the antioxidant enzyme activity, in dually localized glutathione peroxidase of Plasmodium falciparum: integration of membrane enzymes in liposomes for testing activity is being standardized for the malaria parasite Plasmodium falciparum for the first time.
- Exploitation of abnormal DNA repair in cancer as a strategy for cancer therapy: Temozolomide was found as most active single strand break DNA damaging agent in vitro and cell based assay in comparison to other anticancer drug such as mitomycin C, YM-121, quercetin, gallic acid, Genistein, Apigenin, etc.

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. Some of the notable ones are:

- SERC Schools on “Single Crystals of Functional Materials and their Applications” in SSN College of Engineering, Chennai during September 2-22, 2015.
- “Topology and Condensed Matter Physics” in Ramkrishna Mission Vivekananda University, West Bengal, during November 23 - December 12, 2015.
- “Modern Optics & its Applications” was held in Indian Institute of Technology, Patna, during November 30-December 18, 2015
- Theoretical High Energy Physics in BITS Pilani, Rajasthan during November 16-December 5, 2015.

- "Nonlinear Dynamics" in Department of Physics, Manipur University, Imphal during November 30-December 18, 2015.

One-week training program on 'Earthquake Hazard: Basic Approaches, Field Investigations and Modelling' was organized by the Shri Mata Vaishno Devi University (SMVDU), Katra, J&K from 10 to 16 November 2015 in association with The Seismological Observatory, Department of Earth Sciences, Indian Institute of Science Education & Research (IISER) Kolkata **(Figure-6).** The focus of this training program was to impart an understanding of earthquake science and methodologies to quantify earthquake hazard. The program included lectures, tutorials with hands on exercises and field investigations **(Figure-7).** Eminent academicians and scientists from India and abroad mentored the participants.

Figure-6

Figure-7

More than 950 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. 680 events were supported.

The online portal www.serbonline.in has been made operational for submission of R&D proposals under the PAC and Young Scientist Schemes. The ITS Scheme also now fully managed electronically.

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. The

internal analysis of the achievements of the Fellows selected during the first 10 years (1997-1998 to 2007-2008) of implementation of the SwarnaJayanti Fellowship scheme depicts the following:

i. Some of the areas in which India has taken leadership includes Time Resolved Resonance Raman Spectroscopy (TR3); Flow of Granular Materials; Mechanisms of apoptosis in T-Cells; Heavy Ion Collisions; Image processing; Quantum Dynamics; Asymmetric Synthesis; Epigenetic Research; Enriched Hodge Structures; Genomic Fluidity in tumorigenesis with human model; Digital Circuits; Role of interfaces on deformation; Automorphic Forms; Protein Sequencing and Stability; Transgenic approaches to studying brain development; Quantum Computing; Phase Transition; Nanolithography and Nanoelectronics; Biology of Microorganisms; Experimental Physics; MD Simulations; Polymer Degradation studies; Combustion Instability; Spin resolved photoemission Spectroscopy; Parallel Programming; Fracture & fatigue studies in Amorphous Alloys; Novel studies in mammalian cell nucleus, DNA structure mediated gene regulation and Cell cycle regulation of two human pathogens and Biology interface with Engineering through MicroRNA studies.

ii. Each SJ Fellow on an average has published 12 to 16 papers in reputed journals and has guided a minimum of 2 PhDs.

iii. A few Fellows have been awarded TWAS Fellowship or Fellowship of International Society and recognitions.

The list of fellows who have been provided fellowship under the scheme during 2015-16 is given below:-

S. No.	Name and Address of Fellow	Discipline
1.	Dr Fayaz A. Malik, CSIR - IIIM, Jammu	Life Science
2.	Dr Nitin Saxena, IIT – Kanpur	Mathematical Science
3.	Dr Gautam Bharali, IISc – Bangalore	Mathematical Science
4.	Dr Pritam Mukhopadhyay, JNU– New Delhi	Chemical Sciences
5.	Dr Satish A Patil, IISc – Bangalore	Chemical Sciences
6.	Dr Navin Kashyap, IISc – Bangalore	Engineering Sciences
7.	Dr Saptarshi Basu, IISc – Bangalore	Engineering Sciences
8.	Dr Atul Srivastava, IIT – Mumbai	Earth & Atmospheric Sciences
9.	Dr S Suresh Babu, VSSC – Thiruvananthapuram	Earth & Atmospheric Sciences
10.	Dr Aninda Sinha, IISc – Bangalore	Physical Sciences
11.	Dr Sushil Mujumdar, TIFR – Mumbai	Physical Sciences

During last year, 344 applications covering all areas were received and scrutinized rigorously by the Subject Area Expert Committees. These Committees finally recommended 21 candidates, out of 63 called for presentations, to the National Core Committee. The National Core Committee finally recommended 12 candidates for award of Fellowships. The Empowered Committee of Secretaries

during the current financial has also given its approval for award of fellowship to following candidates:

S.No.	Name and Address of Fellow	Discipline
1.	Dr. Sunish Kumar Radhakrishnan, IISER- Thiruvananthapuram	Life Science
2.	Dr. G. Venkatasubramanian, NIMHANS, Bengaluru	Life Science
3.	Dr. Suvendra Nath Bhattacharyya, CSIR-IICB, Kolkata	Life Science
4.	Dr. Suhrit Ghosh, IACS, Kolkata	Chemical Science
5.	Dr. Chilla Malla Reddy, IISER-Kolkata	Chemical Science
6.	Dr. (Ms.) Poonam Chandra, NCRA, TIFR, Pune	Physical Science
7.	Dr. Surajit Dhara, University of Hyderabad, Hyderabad	Physical Science
8.	Dr. (Ms.) Neena Gupta, ISI, Kolkata	Mathematical Science
9.	Dr. Amritanshu Prasad, IMS, Chennai	Mathematical Science
10.	Dr. Neelesh B. Mehta, IISc., Bengaluru	Engineering Science
11.	Dr. Ramesh Singh, IIT-Bombay, Mumbai	Engineering Science
12.	Dr. Amol A. Kulkarni, CSIR-NCL, Pune	Engineering Science

ATTRACTION OF TALENT FOR SCIENCE

Innovation in Science Pursuit for Inspired Research (INSPIRE) is one of the innovative programs of the Department of Science & Technology for attraction of talent to science. The basic objective of INSPIRE is to communicate to the youth population of the country the excitements of creative pursuit of science and attract talent to the study of science at an early stage and build the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base.

INSPIRE Programme covers students in the age group of 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) @ Rs.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).

INSPIRE Award

Under this scheme, during the Five Year Plan period, two students (from classes 6 to 10) are selected from each middle and high school of the country for an INSPIRE Award of Rs.5000/- each, for preparing a Science Project / Model. These awardees, then participate in a three tier competition at District, State and National Level. The projects exhibited are evaluated by a jury of experts.

INSPIRE Award Warrant was being issued directly in the name of selected student and sent to him/her through State/school authorities. However, after implementation of Direct Benefit Transfer (DBT), the award money is being transferred into the students Bank A/c directly through Public Finance &

Management System (PFMS). 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 based on the recommendations of the State /UTs, the award money is sent to the students directly in his/her account through PFMS.

Present Status of Implementation of INSPIRE Awards Scheme

The INSPIRE Award scheme envisaged selection of one million (10 lakh) students during the Five Year Plan period @ of 2 lakh awardees per year. There are about 4.5 to 5 lakh schools in the country which have classes of 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, 12.94 lakhs INSPIRE Awards have been sanctioned till date. About 47.15 % of the awardees are girls and 26.00% SCs/STs. (state wise details at **Table-I**).

Under the INSPIRE Award Scheme, more than 7 lakh awardees have participated in the DLEPCs and 60000 best entries of DLEPCs have participated in the SLEPCs. The Department has so far conducted five National Level Exhibition and Project Competitions (NLEPCs) starting from 2011, every year. A total of 4136 awardees have so far exhibited their projects/models in these five exhibitions held so far. A number of projects have been shortlisted by the Patent Facilitating Centre of TIFAC for detailed examination for possible patenting in some cases and a small number has been finally selected for filing patent application.

Entire expenditure in connection with conduct of DLEPCs, SLEPCs and NLEPCs is borne by DST. As on date, an amount of Rs.777.89 crore has been spent so far on the scheme, out of which Rs.130.86 crore has been released to the States/UTs to meet the expenditure in connection with DLEPC SLEPC/ NLEPC.

E-management of the INSPIRE Award Scheme.

Under the Scheme, large number of nominations, running into lakhs, have to be processed for selection of the students for INSPIRE Award. DST e-manages the entire INSPIRE Award Scheme by using State-of-the-Art latest Information Technology which enables e-filing of nominations by the schools across the country; 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 website, credit of Award amount directly to the bank accounts of selected Awardees through Public Finance Management System (PFMS) platform; and all such activities related to implementation of the scheme, management of the data, generation of various MIS returns etc.

Table-I

State/UT wise list of INSPIRE Awards sanctioned (As on 30.10.2015)				
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	103432	5171.60	1391.86
2	Arunachal Pradesh	439	21.95	15.01
3	Assam	7755	387.75	140.39
4	Bihar	54762	2738.10	261.40
5	Chattisgarh	64194	3209.70	852.03
6	Goa	659	32.95	6.68
7	Gujarat	109894	5494.70	159.50
8	Haryana	24815	1240.75	262.82
9	Himachal Pradesh	14937	746.85	233.00
10	Jammu and Kashmir	17507	875.35	153.94
11	Jharkhand	33132	1656.60	634.65
12	Karnataka	137092	6854.60	1070.63
13	Kerala	14256	712.80	153.44
14	Madhya Pradesh	137531	6876.55	1710.73
15	Maharashtra	116392	5819.60	1588.87
16	Manipur	1375	68.75	30.71
17	Meghalaya	2817	140.85	29.53

18	Mizoram	3312	165.60	74.35
19	Nagaland	719	35.95	19.53
20	Odisha	54338	2716.90	379.11
21	Punjab	27205	1360.25	273.58
22	Rajasthan	136899	6844.95	348.88
23	Sikkim	1398	69.90	15.81
24	Tamil Nadu	68199	3409.95	905.80
25	Telangana	12111	605.55	189.25
26	Tripura	2219	110.95	43.60
27	Uttar Pradesh	109544	5477.20	1742.38
28	Uttarakhand	7197	359.85	92.18
29	West Bengal	19641	982.05	180.93
30	A&N Islands	308	15.40	11.15
31	Chandigarh	594	29.70	11.51
32	Dadra and Nagar Haveli	525	26.25	12.77
33	Daman and Diu	393	19.65	7.62
34	Lakshadweep	33	1.65	1.73
35	NCT of Delhi	4640	232.00	54.49
36	Puducherry	1416	70.80	4.30
37	Kendriya Vidyalaya Sangathan	2377	118.85	22.38
	Total	**12,94,057**	**64702.85**	**13086.49**

Table-IIA

List of Projects/ Awardees of 1st NLEPC in which Patent have been Filed with complete specifications.

S. No.	Title	Inventor	School	Date of provisional filing	Date of complete specification filing
1	Multipurpose fuel saving chulha	Bhangre Subhash Vithoba	New English School & Jr College Taked Ta Igatpuri, Distt Nasik	13.8.2012	12.8.2013
2	Automatic fire extinguisher cum Alarm	Ch. Mahesh Babu	Z.P.H. School Vakkal Gadda, 521126, Krishna	13.8.2012	12.8.2013
3	Sewage clearing device	Devarat Shashikant Kulkarni	Silver Oak Universal School, Nasik	13.8.2012	12.8.2013
4	Natural fridge	Piyush Agrwal	Caramel Convent School, Namnakala, Ambikapur	13.8.2012	12.8.2013

5	Petrol from orange peel and plastic	Krishna Kumar Saxena	Govt Excel. H.S, school.M.P.	13.8.2012	12.8.2013
6	Low cost cement type mixture	Prasenjit Dey	Belabar H/S School, A.D. nagar Bishalgarh	13.8.2012	12.8.2013
7	Stable construction to withstand earthquake	Chandra Prabha	Govt Girls Higher Secondary Scholl, Kathirkamam azhudhavur Main Road	13.8.2012	12.8.2013
8	Air purifier	Sravani	Z.P. High School Madanapalle, A.P.	13.8.2012	12.8.2013
9	Telerecording	K. Naveen Reddy	Excellent High School manugur(V) and (M) khamman(D), A.P.	13.8.2012	12.8.2013
10	Multi purpose mixture	Falguni Patel	Govt Middle School Devka nani Damana Ut of Daman and Diu	13.8.2012	12.8.2013

Table-IIB

List of Projects/ Awardees of 2nd NLEPC in which Patent are being Filed

S. No.	Students name	Teacher	Project	Student's address	School details	Remarks
1.	Prathamesh Uppar VII	M. D. Budni	Sugarcane bud cutting machine and sugarcane cutting machine		Higher Primary school, Banahatti Tota, Tq: Jamakhandi Dist: Bagalkot, Karnataka	letter to school for details
2.	Ayush Deva IX	Amir Gandhi	Recovery of waste heat from ac to save/ generate electricity	9415224682	Delhi public school , Varanasi, U.P.	for complete specifications.
3.	K. Mathumitha IX		Oxygen level alarm system and IV fluid level alarm system	04639245398 9443365398 diya_mathu@ yahoo.com	Kamlavati Hr Sec School, Sahupuram Post, Thoothukudi,Tamil Nadu	for cs after receiving details
4.	C. Kamalesan IX	Kausalya suresh	Glowing bulb without electricity	9655269299	Panchayat Union Middle School, venkatanoor, Solaikottai(P.o.), Dharmapuri, Tamil Nadu	letter to school for details

5.	Aatishya VII	Parul Singal	Prototype Human Transport Vehicle for unknown terrains	0172-2628946 ashiairi@gmail.com 9988094641	Delhi Public School, Sector- 40 C, Chandigarh, UT of Chandigarh	for complete specifications.
6.	Harsh Pandey VIIIth		Multipurposer objective crutcher		Bharat Mata English Medium School, Bilaspur, Chhattisgarh	letter to school for details

Table-IIC

List of Projects/ Awardees of 3rd NLEPC in which provisional Patent have been Filed.

Sl. No.	Name of Awardee	School's Name	Name of the Project
1	Chinta Gurjar	Govt.Sec. School Amargath Pisangan Ajmer	Domestic AC Cum Blower
2	Amruta Adhik Kamble	Smt. M.S.Parulkar S.S.Vadavaili, Rajapur, Dist Ratnagiri, Maharashtra	Technology for human Safety
3	Mihir Deepak Patil	Baliram Patil Vidyalaya, N-9, CIDCO Aurangabad, Maharashtra	We will save the world, Let the cloud burst
4	Pawar Suresh Jaywant	Madhaymik Vidyalaya Kasaba arale, Ghanvade, Karveer, Dist Kolhapur, Maharashtra	Modern Bullock cart
5	SANGEETHA. G	G.H.P.School Ankasamudra, H. B Halli tq, Bellary dist, Karnataka	Electricity regeneration from Lift
6	Sharadha Nalvade	G.H.P.S.B., Gudihal, Dharwad, Karnataka	Mosquito repellent natural air conditioner
7	Finu Muhammed Shaheem	AUPS Manipuram, Koduvally, Kozhikode, Kerala.	A study to find out a suitable medicinal plant extract to destroy mosquito larvae.
8	Amrit Horo	PRAKASH High School, Hulhundu, Ranchi	SOLAR A.C.
9	Ruben Das	MS Ratanpur , Barharwa, Sahebganj, Jharkhand.	Fuel less Water Pump
10	Pallabi Rava	Barokodali High School, Cooch Behar, W.B.	Eco-Friendly Cold Storage
11	Anvitha G.	Mythri HPS, Shikaripura tq , Shimoga dist	Laser micro projector, Laser ray scope
12	Apeksha VK	GPUC Boys High School Section, Sorabha Road, Shiralakoppa, Shikaripura Taluk, Shimoga, Karnataka	Biological Liquid

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**. Such Science Camps are being covered entire country in length and breadth i.e. from Leh to Portblair in one side and Goa to Arunachal Pradesh in other side. However, these Science Camps have been organized with the cooperation of Academicians, Scientists, Academic Institutions, Research Institutions, Indian Army, Indian Navy as well as NHPC to motivate the national youth to take up science as a career. During the year 2015-16, 198 Science Camps were sanctioned and organized covering 36000 students and provided an opportunity to the young scientists to interact with eminent mentors of national and international repute including two Nobel Laureates till December, 2015 (**Fig.1**).

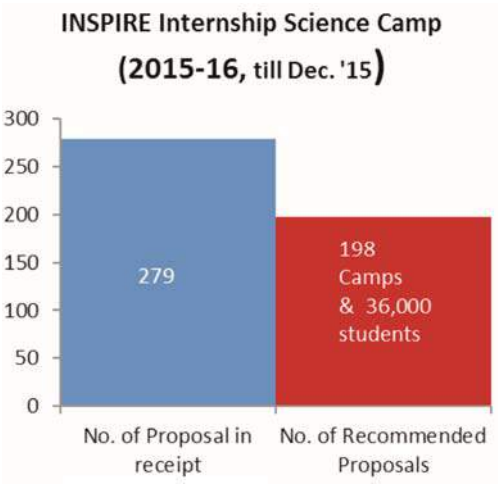


Figure - 1

This year Shri Mata Vaishno Devi University (SMVDU), Katra (J&K) organized the INSPIRE Internship Camp with excellent logistical support of Army in this hostile terrain for the students of Ladakh Region. The residential camp was hosted by Ladakh Scouts Regimental Centre (LSRC) of 14 Corps.

Scholarship for Higher Education (SHE) aims at 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 Scholarships 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 to carry out research during vacation period for every scholar through **INSPIRE Scholarship**. So far, more than 50000 INSPIRE Scholars have been offered INSPIRE scholarship to pursue a career in sciences. Out of these, 13749 INSPIRE Scholars have

been offered INSPIRE Scholarship during 2015-16 till December, 2015. This includes 12929 students offered INSPIRE Scholarship provisionally based on their performance (top 1%) in + 2 examination of any Boards and 820 through competitive examination basis **(Fig. 2 & Fig. 3**). All these Scholars are pursuing their academics at undergraduate level in basic and natural sciences.

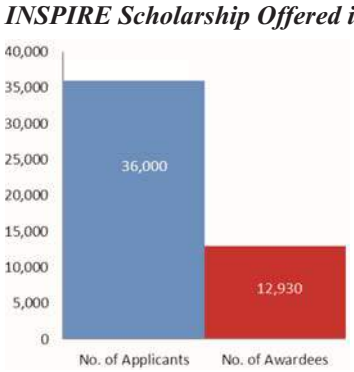


Figure – 2

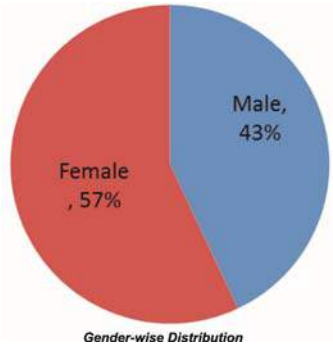


Figure – 3

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 in the age group of 27-32 years through contractual and tenure track positions for 5 years in both basic and applied sciences area.

NSPIRE Fellowship, the first component of AORC is offered 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 as well as Inspire Scholars having secure 65% marks in aggregate at the MSc level which are 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 as per GOI norms & regulations. So far, more than 5000 students have been awarded the INSPIRE fellowship and are pursuing their Ph.D. in Basic & Applied Sciences including engineering, medicine, agriculture, veterinary at the University/ academic institute of national importance. Out of these, 780 Fellowships have been offered in the year 2015-16 till December, 2015 (Fig. 4, Fig. 5 & Fig. 6). However, the applications (1543nos.) received against the 8th advertisement are presently at various stages of their evaluation for award of INSPIRE fellowship. Besides this about 10 INSPIRE Fellows have been selected for participating at the 4th HOPE meeting in Japan. Nearly 30 INSPIRE Fellows have been selected for participating short-term Research Internship at the various Laboratories/ Universities of UK through Newton-Bhabha Program of DST and UK.

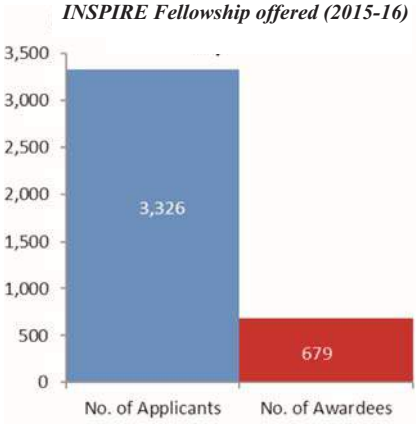


Figure – 4

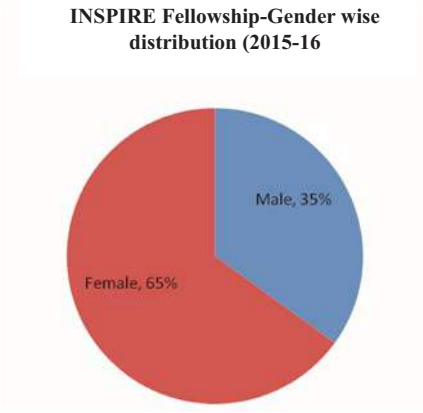


Figure - 5

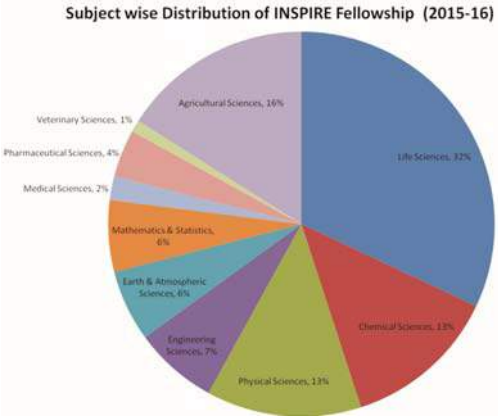


Figure – 6

INSPIRE FACULTY AWARD, the second component of **Assured Opportunity for Research Careers (AORC)** 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 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.

So far, 842 fellows have been provided opportunity to pursue post- doctoral researcher through contractual and tenure track position for 5 years in both basic and applied sciences area including engineering, agriculture, veterinary and medicine. Out of these, 561 awardees have already been positioned at various host institutes in India and remaining are in process of selecting their host. During the current year 239 candidates have been offered the award (Fig.7 & Fig. 8).

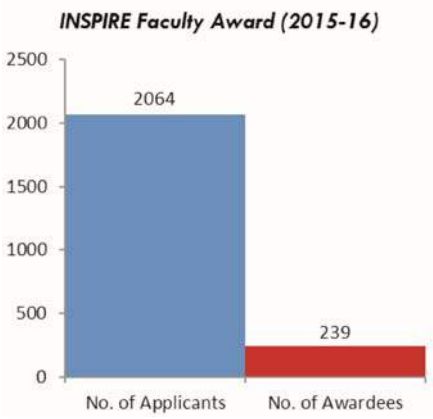


Figure – 7

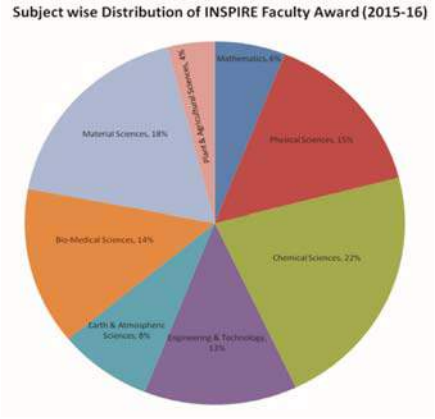


Figure – 8

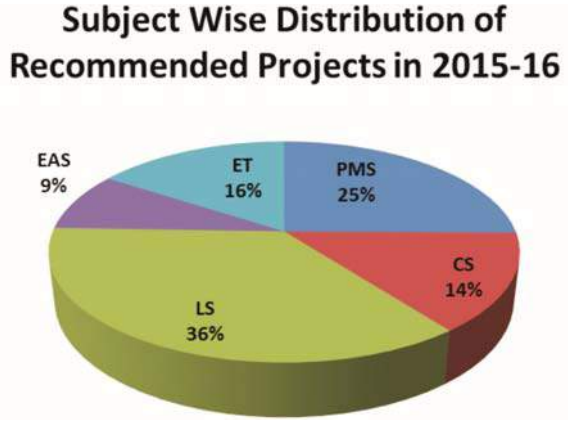
EMPOWERING WOMEN SCIENTISTS

KIRAN (Knowledge Involvement in Research Advancement through Nurturing) Programme embraces women-exclusive schemes of the Department of Science & Technology. The mandate of programme is to bring gender parity in S&T through gender mainstreaming. Different schemes under KIRAN deal with various crucial issues (break in career due to family responsibilities, self employment, part time career, relocation etc.) faced by women scientists in their career path. The achievements of various schemes under KIRAN during the year 2015-16 are as follows -

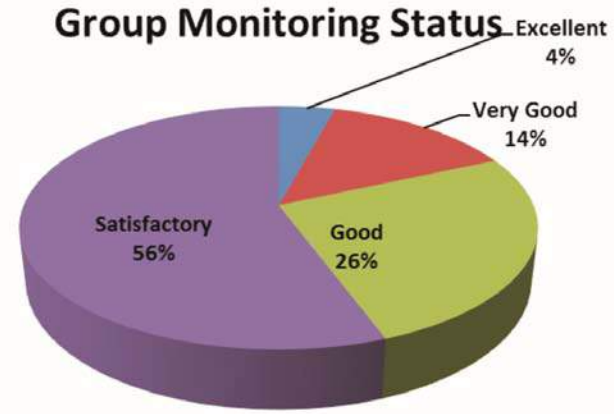
1. WOMEN SCIENTIST SCHEME – A (WOS-A):

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 a total of **729** new proposals (Life Sciences–410, Chemical Sciences –92, Physical and Mathematical Sciences–96, Earth and Atmospheric Sciences–26, and Engineering Sciences–105) against which a total number of **139** projects were recommended. The percentage of subject-wise distribution of recommended projects is given in the Chart



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, **230** ongoing projects, funded under this Scheme, were also monitored.



2. WOMEN SCIENTISTS SCHEME-B:

The Women Scientists Scheme-B is focused on Science & Technology 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.

35 new projects under the Project mode and 12 under Internship mode were also sanctioned in different areas such as animal and human health & nutrition, natural resource management, sustainable agriculture, engineering, artisanal technology development and value addition. Emoluments were enhanced for all three components of Women Scientist Scheme.

During the year, two Sensitization Workshops have been organized at different locations namely, i) Panjab University, Chandigarh, and ii) Jiwaji University, Gwalior to popularize the scheme among women scientists.

3. WOMEN SCIENTISTS SCHEME-C:

The Women Scientists Scheme-C aims to create opportunity of self employment for the women scientists who had break in their career. The scheme provides one year internship in the domain of Intellectual Property Rights (IPRs) which include theory as well as hands on training in different law firms.

This year, for the first time, online examination was introduced in WOS-C selection process. The exam was conducted at 41 centers in 33 cities. Total 3244 candidates have applied against advertisement and a total of 1496 candidates, out of 3041 eligible candidates, appeared in online examination. Interviews are going on at different centres for final selection of 8th batch.

View of Online Examination Centres at Chandigarh, November 1, 2015

4. SCIENCE AND TECHNOLOGY FOR WOMEN: "Science and Technology for Women" Scheme is aimed to improve the living conditions of women by reducing their drudgery, improving health and environment and by providing opportunities for income generation through application of Science & Technology. The program involves network/support to R&D Institutions, Universities, Colleges, S&T based field groups (NGOs), etc, in developing appropriate packages for socio economic development of women through S&T inputs. Besides individual projects for technology development, upgradation, modulation and replication, the scheme also focuses on All India Coordinated Programmes (AICP) and Women Technology Parks (WTP). About 25 individual projects in diverse technology areas were supported in 2015.

a. ***All India Coordinated Programmes (AICP's):*** The main objective of these programmes is to replicate successful technologies developed in individual projects in other regions for adoption and modulation of technology, if required. Examples of a few programmes that had made significant impact on women at grassroots level are given below.

- **Coordinated Program on Biomass Dryers :** The coordinated program for economic upliftment and empowerment of livelihoods of women through food processing involving biomass based tray dryers in North and Northeast Himalayan region was implemented in the states of Himachal Pradesh, Uttarakhand and Assam. Drying protocols were developed for a range of horticultural products. Trial production and test marketing demonstrated that

biomass based drying is a viable enterprise for rural women. Nearly 1000 women had been trained in this program. The programme has been expanded to other geographical areas like Odisha, Karnataka, Andhra Pradesh, Tamil Nadu, Kerala etc.

- ***Coordinated Programme on Large Scale Employment Generation in Coastal India through Sustainable Utilization of Marine Bio-resources:*** This coordinated programme was initiated not only as an alternative source of livelihood but also as an environmentally friendly technology for biomass supply to the seaweed industry. The focus of the programme is potential cultivation, processing and value addition of seaweeds with direct benefits for coastal women on priority species (keeping in view of environmental considerations), socio-economics, post harvest technologies, ecological sharing and post tsunami effects on cultivation. The programme has been launched at 6 different coastal locations of the country (coastal areas of Tamil Nadu, Kerala, Odisha, Maharashtra, Gujarat). Nearly 5000 women had been trained of whom 500 had become entrepreneurs with an increase in monthly income up to Rs.10,000/- pm.

b. **Women Technology Parks (WTP):** The Department of Science & Technology under its scheme "Science & Technology for Women" supports establishment of Women Technology Parks (WTPs) in different geographic and agro-climatic zones of the country for improving the socio-economic status of women, especially in rural areas, through capacity building and adoption of location specific technologies, thereby reducing drudgery and improving the health conditions. So far, thirty two (32) Women Technology Parks have been set up in Andhra Pradesh (2), Arunachal Pradesh (1), Assam (2), Gujarat (1), Karnataka (3), Kerala (2), Maharashtra (4), Mizoram (1), Nagaland (1), Odisha (1), Puducherry (1), Rajasthan (3), Tamil Nadu (3), Uttarakhand (2) and West Bengal (2).

5. TRAINING AND CAPACITY BUILDING: There are number of training programmes specifically for women scientists working in various sectors covering multifarious themes in partnership with premier Institutions.

a. National Programme for Training of women Scientists & Technologists working in Government sector: A National training programme for working women scientists covering multifarious themes in partnership with premier national level institutes has provided an opportunity to over 1000 women scientists to upgrade their knowledge base and skills.

b. International Training Programme for Women Scientists and Technologists: Two International training cum Workshops on 'Leadership and Career Advancement' were organized in collaboration with Indo US Science and Technology Forum (IUSSTF) and COACh International, USA. In the year 2015, two training workshops were organized at Indian Institute of Science Education and Research (IISER), Pune and Indian Institute of Entrepreneurship (IIE), Guwahati. Over 100 Indian women scientists across universities, R&D institutions were trained during these training programmes. These training programs provide opportunity to

the women scientists and engineers to enrich their knowledge and prepare them to undertake challenging assignments and attain leadership roles.

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

The CURIE programme was started in the year 2009 in order to enhance the standard of teaching and research in Women Universities and make them centres of excellence in research. Since then Department is continuing financial support to Six (6) women universities in different parts of the country. In the year 2015-16, Department has started 3rd phase of CURIE with support of Rs. 422 lac to Banasthali University, Banasthali. The major investment (Rs.350 lac) of the grant is for sophisticated instruments like Fourier Transform–Nuclear Magnetic Resonance Spectroscope (FT-NMR), Gas Chromatography-Mass Spectroscope (GC-MS) with emphasis on focused approach towards quality research.

COGNITIVE SCIENCE RESEARCH INITIATIVE (CSRI)

Cognitive Science Research Initiative (CSRI), a unique programme of DST, was launched in the year 2008, to promote research, train and retain human resource in Cognitive Science. Multi-centric mega projects, individual projects and Post Doctoral Fellows (PDFs) are sponsored under CSRI besides supporting infrastructure development and other promotional activities.

229 individual proposals and 79 applications under PDF programme were received in the year out of which 26 individual projects and 6 PDFs were supported in Cognitive Science.

Achievements in the domain of 'Learning Disorder' among Children: Hon'ble Minister of S&T and ES released a monograph on "Specific Learning Disorder: Indian Scenario" and "Dyslexia Assessment for Languages of India (DALI)" in 2015. The highlights are given below:

a. **Monograph on 'Specific Learning Disorder: Indian Scenario':** Specific Learning Disorder (SLD) is one of the hidden and least understood conditions that affects children. In the light of very limited literature on SLD in Indian context, this monograph is one of the first efforts in order to enhance current understanding of the SLD in Indian context as elaborated in 19 chapters. The monograph presents perspectives of various experts from different fields which enhance our understanding about SLD, its underlying phenomenon, contemporary research findings especially from India. The book also describes management strategies which provide a ready reference for professionals working in the area of SLD and educational system.

b. **DALI– Dyslexia Assessment for Languages of India (Screening Tool):** "DALI" is a screening tool for Dyslexia for teachers and assessment tool for psychologists in four languages namely Hindi, Marathi, Kannada and English. This tool has great social relevance as it will be helpful in identification of 5-17% of school going children suffering from Learning Disabilities (dyslexia, dysgraphia & dyscalculia).

New Initiatives:

a. **Establishment of "Extensive Cognitive Neuroimaging" at CBCS, Allahabad:** Creating State-of-the-art infrastructure is one of the mandates of Cognitive Science Research Initiative. DST has already established one fMRI at NIMHANS, Bangalore and now Department is establishing 'Extensive Cognitive Neuroimaging' facility at Centre of Behavioural and Cognitive Sciences (CBCS), University of Allahabad. The Functional MRI neuro-imaging methodology has become a basic requirement of infers cognitive processes and localizes them in the brain. fMRI facility at Allahabad will not only improve research programmes at CBCS covering various aspects of cognitive science, yoga and meditation but also encourage researchers of large area of North India.

b. **New project on 'Alzheimer's Disease and Fronto Temporal Dementia' under Top-down Approach:** This 5-year longitudinal multicentre prospective study aims to look at the early appearance of biomarkers in prodormal AD and FTD, their order of appearance with time and their trajectory of progression. Meetings were held to finalize the stakeholders and now the project is at final stage of approval.

Support for Conferences/Workshops:

DST has provided financial assistance to following Conferences and Brain Storming Meetings:

1. ***Second Annual Conference of the Association for Cognitive Science:*** The second annual conference was organized by IIT-Kanpur with the objective to bring eminent researchers actively working in cognitive science areas to a common platform.

2. ***Consciousness, Cognition and Culture: Implications for the 21st Century:*** The said conference was conducted at National Institute of Advanced Studies, Bangalore. Broad themes for discussion 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'.

3. ***Cognition, Brain and Computation:*** The conference aimed to bring forward the interdisciplinary dialogue between neuroscientists and computational experts in order to strengthen cognitive science programme through cross-disciplinary collaborations. This Conference was organised by IIT-Gandhinagar.

New Programme : Science and Technology of Yoga and Meditation (SATYAM)

In 2015, DST has conceptualized a new research programme '*Science and Technology of Yoga and Meditation (SATYAM)*' under Cognitive Science Research Initiative (CSRI). Research proposals were invited from scientists/academicians having prior research experience in 'Yoga & Meditation'. This new programme is aimed to foster scientific research on the effects of yoga and meditation on physical & mental health and on cognitive functioning in healthy people as well as in patients with disorders. Basic themes for this programme include (1) investigations on the effect of Yoga and Meditation on

physical and mental health, and (2) investigations on the effect of Yoga and Meditation on the body, brain, and mind in terms of basic processes. Out of 578 research proposals in the field of Yoga & Meditation from across the country, 96 have been screened and would be presented before the Task Force for final selection.

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 X Plan to meet the challenges of national development and international competitiveness in S&T area. Considering the efficacy of the Scheme, the programme is being continued in XI and XII Plan also.

During the year 2015-16, 28 training programmes are being held under "National Programme for Training of Scientists and Technologists working in the Government Sector" and a total number of 700 scientists will be benefitted from these training programmes.

Women Component Plan:Under Women Component Plan of the Training Programme, 11 programmes are being conducted exclusively for women scientists during 2015-16 in which 300 (approx.) women Scientists would avail the opportunity.

CHAPTER 2

INSTITUTIONAL CAPACITY BUILDING

PROMOTING R&D THROUGH AUTONOMOUS INSTITUTIONS AND PROFESSIONAL BODOIES

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATION SCIENCES (ARIES), NAINITAL

Areas of Focus

Astronomy & Astrophysics and Atmospheric Sciences including measurements of earth's atmospheric trace gases, aerosols and meteorological parameters, observations and modeling of transient phenomena on the Sun, space weather and solar atmosphere, and studies in galactic and the extragalactic astrophysics. Developing state-of-the-art observing facilities for national as well as international scientific community.

Some Major Accomplishments

- The installation of the 3.6m Devasthal Optical Telescope (DOT) has been completed. The functional tests of the telescope and the sub-systems are in progress. The technical first light has been obtained. The images are being analyzed to understand the quality of data obtained by the telescope.
- An imager of 4kX4k CCD has been developed by ARIES and successfully integrated with the 3.6m DOT on 10th of December 2015. A test image of the Crab Nebula was taken with it. This instrument will be used with the telescope for scientific observations once the telescope is formally accepted.
- Fabrication and assembly of the mechanical structure of the ARIES Devasthal Faint Object Spectrograph and Camera (ADFOSC) has been completed and transported to Devasthal. The slits have been fabricated at ARCI, Hyderabad and are ready to get integrated with the other sub-systems of the instrument.
- ARIES and TIFR are jointly developing a Near Infrared Spectrograph as a second-phase backend instrument for the 3.6 m DOT. The spectrograph is designed to work in the wavelength range of 0.5 to 2.5 micron.
- Several experiments have been conducted with few clusters of ST Radar and test profiles have also been compared with balloon-borne winds that showed reasonable agreement.
- Measurements of ozone, CO, NO-NOy, SO2, and aerosols at surface show influence of the pollutants on the cleaner environment of the central Himalayan region.

- Balloon-borne ozone observations show the influence of downward transport and biomass burnings.
- ARIES is actively participating in the Thirty Meter Telescope (TMT) project. Recently, a high level committee was constituted to evaluate the technical proposals submitted to manufacture Segmented Support Assemblies (SSAs) by various Indian manufacturers. The leaf springs for TMT have been fabricated at factory.

Important collaborations 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. To achieve the goal of the project, a catalogue of 242 chemically peculiar (CP) stars was compiled from the existing photometric and spectroscopic catalogues for the observations from 1.3-m and 1.04-m telescopes of ARIES, Nainital-India and 6.0-m telescope of SAO, Russia; (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 IUSSTF/JC-Solar Eruptive Phenomena/99-2010/2011-2012 project on "Multiwavelength study of solar eruptive phenomena and their interplanetary responses" was carried out. To studied the temporal, spatial and spectral evolution of the M1.8 flare, which occurred in the active region 11195 (S17E31) on 22 April, 2011, a multiwavelength study was carried out. This study was also vital in understanding the underlying physics; (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 under the Indo-Russian DST-RFBR collaboration has been sanctioned on the topic "Magnetic activities in low mass stars". The object of the project is to understand the evolution of magnetic activities in Sun-like stars, which will help to understand the evolution of our Sun and its activities; (vi) A project entitled "Observations and analysis of stars in the Kepler field" in collaboration with Dr Chris Engelbrecht, University of Johannesburg, SA was initiated; (vii) Setting up of CRDS (cavity ring-down spectroscopy) based instrument for measurement of greenhouse gases under an ISRO-ATCTM (Atmospheric Chemistry Transport and Modeling) project has been initiated.

Some Important Output Indicators

S. No.	Parameters	Output
1.	Papers in refereed journals	25
2.	Number of Ph. Ds. produced	Awarded-03; Submitted-05
3.	Technical manpower trained	30
4.	B. Tech/UG Project guided	6
5.	M. Tech/M.Sc./M. Phil project guided	8

AGHARKAR RESEARCH INSTITUTE (ARI), PUNE

Areas of focus

1) Biodiversity and palaeobiology, 2) Bioenergy, 3) Bioprospecting, 4) Developmental biology, 5) Genetics and plant breeding, and 6) Nanobioscience.

Some Major Accomplishments

Biodiversity and palaeobiology **:** 136 species of wild edible plants consumed by local people of Northern Western Ghats were documented and their distribution was mapped (**Figure 1**). One new plant species from Vietnam *Capparis gialaiensis* was discovered. Significant correlation of maslinic acid content in fruit pulp extracts of eight *Ziziphus jujube* cultivars in India and hepatoprotective activity thereof was demonstrated for the first time. Two new fungi, *Exosporium gymnemae* (**Figure 2**) and *Mycoenterolobium flabelliforme* were discovered, and a rapid and efficient method of genomic DNA extraction from fungi developed.

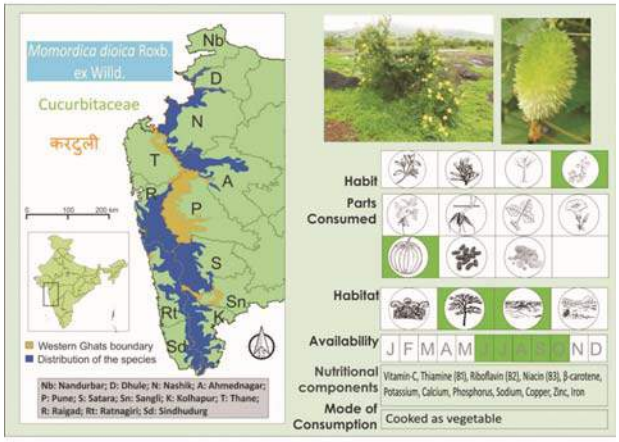


Figure 1 *Momordica dioica* – wild edible plant

Figure 2 *Exosporium gymnemae* – new fungus discovered. **1-5.** *Exosporium gymnemae* AMH 9666, 1: Synnemata on substrate, 2: Enlarged view of erect synnmeta arising from substrate (dead stem), 3-5: Conidia attached to conidiophores, and dark glazed synnemata. – Bars 3=10 µm; 4, 5=20 µm

Bioenergy: For recovering oil from depleting oil wells we have developed a microbial consortium and a nutrient medium for injection in depleting oil wells. Oil recovery in excess of 60% was achieved by using this consortium during simulated sand pack experiments (**Figure 3**). For the bioremediation of oil contaminated produced water that contains toxic hydrocarbon contaminants we have developed

a microbial process that is economical and effective in removing the hydrocarbon contaminants at an efficiency of > 97 %.

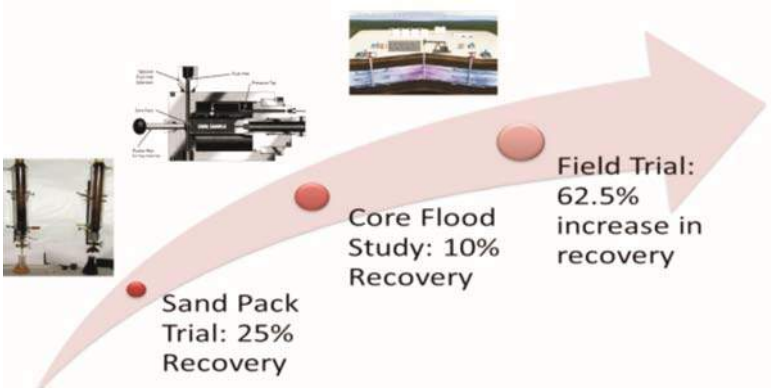


Figure 3 Microbial Enhanced Oil Recovery

Bioprospecting: To address long term effects of maternal calcium and vitamin D deficiencies on the metabolism in adult offspring, we developed chronic calcium deficient (CaD) and vitamin D deficient (VDD) models in rats. In the progression of Alzheimer's disease (AD) aggregation of amyloid-β peptide (Aβ) is an important event. Therefore, inhibition of Aβ aggregation is widely studied for development of treatments for AD. We synthesized novel 3-acetyl coumarin thiosemicarbazone(ACT) and studied its efficacy toward inhibition of Aβ (1-42) aggregation.

*Developmental biology***:** We use Hydra, *Drosophila* and Zebrafish as model organisms to study evolution of signaling and pattern formation, neural and cardiac development and processes such as autophagy. Presence of microhomology-mediated end joining pathway involved in repairing the double stranded breaks is found for the first time in hydra. Using tissue-specific reporter lines we show the existence of different circulatory system in zebrafish heart and their developmental time windows.

Genetics and plant breeding: ARI is one of the centers of All India Coordinated Research Projects sponsored by ICAR, New Delhi on wheat, grape and soybean. Three soybean varieties MACS 1480, MACS 1488 and MACS 1491 were included in all India initial varietal trials. Frontline demonstrations conducted on the farmer's field, using MACS 1188, MACS 1281 and RKS 18, indicated 13% increase in seed yield over farmer's practice with improved technology. Under ICAR fruit scheme, cuttings (2986) of grape variety ARI 516 were supplied to progressive farmers and other centers.

Nanobioscience: We are fabricating microdevices for synthesis of polymeric nanoparticles. An active microreactor containing a magnetic microneedle for achieving mixing was designed and fabricated in polydimethylsiloxane We are also working on Carbon nanospheres as delivery agents for protein therapeutics. The utility of carbon nanospheres in the nuclear delivery of His5 (DNA binding domain of SMAR1), was demonstrated for the first time. To elucidate the mechanisms underlying the antidiabetic activity of zinc oxide nanoparticles (ZON), comprehensive *in vitro* studies are being carried out.

Important collaborations established: A Memorandum of Understanding (MoU) was signed between Agharkar Research Institute, Pune (ARI) and International Biological Material Research Center, Korea Research Institute of Bioscience & Biotechnology, South Korea (IBMRC, KRIBB) on 21 July 2015.

Some Important Output Indicators

Sl . No.	Parameters	Output
1	Papers in refereed journals (SCI)	41
2	Numbers of PhDs produced (Thesis)	9
3	Indian patents filed	2

BOSE INSTITUTE (BI), KOLKATA

Areas of Focus

Plant Functional Biology of Stress Responses for Improvement and Exploring the Plant Genetic Resources; 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.

Some Major Accomplishments

- Comparative root proteomics of susceptible and resistant chickpea revealed several novel proteins that have a role to play in resistance towards the plant pathogen *Fusarium oxysporum.*
- A novel model for promoter escape by RNA polymerase during the elongation phase of prokaryotic transcription has been proposed based on an investigation performed using a two component *Bacillus subtilis* sigma factor system.
- TALEN based knockdown of the gene encoding an enzyme that synthesizes a Tumor derived ganglioside (GM2) was found to result in reduced tumor cell motility.
- Metagenomic studies revealed that the sustainability of high temperature microbiomes depends on the resilience of incumbent population and receptiveness towards immigrants.
- *Plant Functional Biology of Stress Responses for Improvement and Exploring the Plant Genetic Resources:* 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.
- *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.

- *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.

- *Molecular Medicine:* The primary focus 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.

- *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.

- *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. MicroRNA let-7 has been shown to regulate inflammatory signalling during mycobacterial infection. Mathematical modelling has been employed to understand stress responses in mammalian cells and in bacterial pathogens.

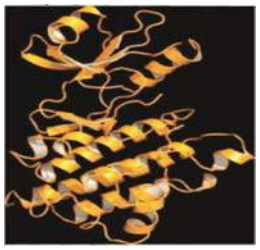
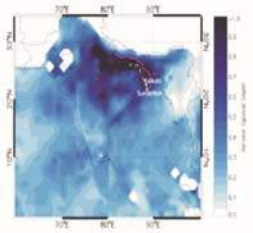
- *Basic and Applied Problems in Physical and Environmental Sciences:* This programme contributes both to fundamental knowledge as well as applications relevant to industry. The Institute's current research activities in this program are in the areas of Radiation Physics, Statistical Mechanics, Quantum Mechanics, Astroparticle Physics, Physics of Strongly Interacting Matter, Nuclear Physics, Materials Science, Soft Condensed Matter Physics, Nanoscience, Millimeter-Microwaves and 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 sanctioned area is 4010 Sqm and the anticipated cost is INR. 224 crores. The project is due to be completed in 2016.

- *Important collaborations established:* (i) ALICE Collaboration - A Large Ion Collider Experiment (ALICE) is an ongoing experiment at the Large Hadron Collider (LHC), CERN, Geneva which started taking data in 2010. This experiment is for studying both hadronic as well as heavy ion collisions at ultra relativistic energy; (ii) CBM Collaboration - The Institute is a collaborator at the Facility for Antiproton and Ion Research (FAIR) at Darmstadt, Germany. The group from Bose Institute is involved in the Compressed Baryonic Matter (CBM) experiment which will study nuclear matter at very high density and moderate temperatures. Bose Institute is also the nodal Indian institution for FAIR; (iii) Indo-Korean Collaborative Programme (DST) - Understanding the role of microRNAs in regulating the immune response of macrophages; (iv) Indo-Swedish Collaborative Programme - Latency of Mycobacterium tuberculosis: evaluating drugs and drug targets using innovative models.

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	268
2	Chapters in Books	3
3	Papers in Conferences	107
4	Number of Ph.Ds. produced	13
5	Number of Technology leads awaiting transfer	1
6	Research Manpower trained (other than Ph.Ds)	12
7	Technical Manpower trained	120
8	B.Tech/ UG projects guided	42
9	M.Tech/M.Sc./M.Phil projects guided	28

Left to right: (i) Determination of the structure of a Plant symbiosis receptor kinase (SymRK). (ii) Aerosol loading over Indo-Gangetic Basin within the Indian Subcontinent in terms of Aerosol Optical Depth obtained from NASA sensor MODIS onboard AQUA satellite. (iii) Rain water harvesting at Purulia under the 'Scheduled Tribe-Specific Rural Biotechnology Programme Program'. (iv) Artist's view of the Unified Academic Campus of Bose Institute at Salt Lake.

BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY, LUCKNOW

Areas of Focus

Research activities deal with data ranging in age from Archaean to Recent (3200 million years before present to 400 AD) for deciphering the past plant life, evolution, palaeoclimate, palaeoecology and palaeobiogeography, archaeobotany and dendrochronology and allied aspects. Current emphasis is on addressing research problems in palaeosciences with a multi-disciplinary approach. A variety of new analytical facilities have been established in BSIP.

Some Major Accomplishments

Precambrian Palaeobiology: Based on the study of enigmatic tubular structures closely associated with Microbially Induced Sedimentary Structures (MISS) on the bedding Planes of Ediacaran Sonia Sandstone indicate presence of cm sized Ediacaran age seaweed in the Marwar Supergroup. 1600 million years old large sized prokaryotic coccoidal microfossils have been documented from the Salkhan Formation of the Vindhyan Supergroup. Their occurrences indicate experimentation in the biosphere.

Phanerozoic Ecosystems: On the basis of fossil assemblage of *Glossopteris* flora recorded from the Singrauli Coalfield, a Late Permian semi-arid ecosystem has been reconstructed. A palynoassembalge showing dominance of monosaccate grains has been recorded for the first time from the *Fenestella* Shale Formation of Kashmir. Record of fossil fruit of *Cocos nucifera* L. from the Early Eocene sediments of Tarkeshwar lignite mine, Cambay Basin (Gujarat) indicate equatorial position of Indian Subcontinent at the time of deposition of the sediments. Record of the oldest known tapiroid (*Cambaylophus*) from the Vastan lignite mine of Gujarat indicates faunal exchanges between India and Eurasia around the time of India-Asia collision. Abundant colonial alga *Botryococcus braunii* from the lignite bearing succession of Gurha (Rajasthan) and Surkha (Gujarat) are important in recognizing petroliferous organic deposits in western India.

Quaternary Palaeoclimate: Study of Quaternary vegetation dynamics and relative sea level changes based on palynoassemblages show four distinct phases of vegetation succession, contemporary climate and human occupation in Karimganj district situated at Indo-Bangladesh border for the last 5,000 yrs BP. Studies of 136 Km stretch between Nimu and Batalik along the Indus River in Ladakh show three phases of lake formation, attributed to deglaciation after the Last Glacial Maxima and Holocene warming.

*Major and unique national facilities created:*New analytical facilities established during 2015-16 are: TL/OSL Reader, Laser Diffraction Particle Analyzer, Frantz Magnetic Barrier Laboratory Separator Model LB-1 used for Mineral Separation, Vibratory Disc Mill RS-200 Retsch, HPGe Gamma Spectrometer Canberra, Confocal Laser Scanning Microscope with Raman spectroscopy, XRD, Field Emission Scanning Electron Microscope and Olympus Microscope.

Important collaborations established: Integrated research activities with institutions in India and abroad have been going on in several areas. Institute is working in close collaboration with overseas institutions like Institute of Botany, CAS Beijing (China); University of Sao Paulo and Guarulhos (Brazil); University of Innsbruck, Austria; 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.

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	70
2	Books and Edited volumes	1
3	Chapters in Books	4
4	Papers in Conferences	48
5	Number of Ph. Ds. produced	03
6	Research Manpower trained (other than Ph. Ds)	30
7	Technical Manpower trained	02
8	Other Products/Indicators	
	Conference/Symposium/Workshop organized	03
	Help to Industry	03
	Collaborative Research (International)	17
	Consultancy Services (in Carbon dating, SEM & Palynology)	27
	Extra Mural Research Projects Awarded	14
	Research Projects Completed	03

CENTRE FOR NANO AND SOFT MATTER SCIENCES (CNSMS), BENGALURU

Areas of Focus

Basic and applied research in liquid crystals, Nano Science and Soft Matter (polymers, gels and membranes).

Some Major Accomplishments

- *Fast photoluminescence switching with a new protocol:* A photoluminescent (PL) system comprising a prolate nematic host with oblate fluorescent dopant which can be switched at fast rates between two anisotropic values of photoluminescence using a two-frequency addressing scheme has been developed. The employed unprecedented protocol, exhibiting the desirable higher contrast, switches two-orders of magnitude faster than the standard mode of addressing.

- *Enhancement of photoluminescence through confinement:* As an additional dimension in our quest for fast photoluminescence switching systems, we have investigated a system aimed at realizing self-supported membranes with the desired property. The surprising feature is that the geometrical

restriction yields higher emission in both the field-on and field-off situations.

- *Electrical properties of anti-ferroelectric phase of bent core liquid crystal:* The temperature, pressure and frequency dependence of the complex dielectric permittivity in the anti-ferroelectric B2 phase of banana shaped molecules are calculated in the framework of Landau theory and comparison is made with experimental data reported earlier by our group.

- *Reduction of splay stiffening in Nematic Physical gels:* The Frank elastic behaviour of composites of calamitic and bent-core nematic molecules exhibiting a nematic to nematic-gel transformation show the thermal behaviour of the threshold voltage and the dependent splay elastic constant are remarkably different in temperature regions identified as weak and strong gels. The X-ray diffraction data suggest that the fibres have a plastic nature in the weak gel, and 3D-crystalline ordering in the strong gel.

- *Novel anchoring transition in composites made of structurally dissimilar molecules:* A new type of anchoring transition (ANT) in composites of disc-like (DL) and rod-like (RL) liquid crystals was observed with local ordering of DL molecules controlling the global behaviour. With proper tuning, control over ANT temperature was established. This work has potential for bio-sensing applications.

- *Structure−property correlations:* Structure-property relations in new class of low molar mass liquid crystals, namely dimer-Like mesogens have been established.

- *Ferroelectric liquid crystalline enantiomers:* Design, synthesis, and characterization of five pairs of ferroelectric liquid crystalline enantiomers have been achieved.

- *Growth and morphology in thin multilayer films:* Aided by thermal annealing, controlled growth, morphology and formation of polymorphs in thin multilayer films of nickel octabutoxy phthalocyanine obtained by Langmuir-Blodgett technique, have been achieved. The field is interesting owing to possible applications ranging from solar cells, gas sensors and in field effect transistors.

- *Photocurrent generation in thin films of photovoltaic materials:* By nanoscale microscopic techniques, photocurrent generation in such thin films is shown to be highly inhomogenous.

- *Metallophthalocyanines for solar cell applications:* For metallophthalocyanines the conductance is seen to depend on molecular packing which in turn depends on substrate surface structure.

- Centre has strong research collaborations with Bharat Electronics Limited, Raman Research Institute, Jawaharlal Nehru Centre for Advanced Scientific Research, Indian Institute of Science, National Chemical Laboratory and so on. Internationally, collaborative research is being carried out with 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, Russian Academy of Sciences and so on.

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	24
2	Patents	1
3	Book Chapters	2
4	Papers in Conferences	3
5	Number of Ph.Ds. produced	1 awarded + 1 thesis submitted
6	Research Manpower trained (other than Ph.Ds)	7
7	Other Products/ Indicators (* Lectures given at schools/colleges under popularization of science / V4 Programme)	23 lectures *

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

Areas of Focus

The activities are carried out in four umbrella areas – Molecular Science, Material Science, Theoretical Sciences and Biological Sciences.

Some Major Accomplishments

Recognition received by Scientists of IACS: Large number of scientists in IACS received prestigious Awards and other academic recognitions. The numbers are being mentioned here - Fellow of Indian National Science Academy (FNA): 2; Fellow of Indian Academy of Sciences (FASc): 2; Fellow of National Academy of Sciences (FNASc): 1; MRSI Distinguished Lectureship Award: 1; Fellow of West Bengal Academy of Science and Technology (WAST): 3; Editorial Board Member of International Journals: 6; MRSI Medal: 2; J.C. Bose National Fellow: 1; CMOA Senior Scientist Medal: 1; DSc (HonorisCausa): 1; Distinguished Visiting Professor: 1; RC Tripathy Young Scientist Award: 1; D. Nasipuri Memorial Award: 1.

Theoretical Sciences: Probing higher curvature gravity at the LHC, left-right super-symmetry following discovery of Higgs boson, Neutrino Mass and Dark Matter in the light of recent experimental results, lattice QCD simulations at zero and finite temperatures are the highlights of research at the high energy scale. The possible realization of partially polarized fractional quantum Hall state, loss of quantum magnetism by repeated quantum interference, looking for emergence of topological spin glass in spin ice, new scaling model for diffusive transport of ions in ionic conductor, study of phase transition and domain coarsening in disordered magnets are the notable contributions in the areas of condensed matter and statistical physics. Computing electronic structure of low dimensional spin systems, coupled quantum dots, graphite, carbon nano-materials, transition metal oxides, geometrically frustrated systems have yielded new results in materials science and related fields. Computations

for quantifying biological processes like cell division and intra-cellular transport have addressed interesting questions in cell biology and biology inspired physics. Understanding of dynamic and non-dynamic electron correlations by coupled cluster methods, photo-redox processes generating solvated electron using many-body and density functional methods, strategies for hydrogen storage, creation of a bound state in a continuum in an ultra-cold atom, controlling energy flow and reaction dynamics of energised molecules and clusters by implementing electronic structure theory within the manifold of non Born-Oppenheimer scheme cover significant ground in research in atomic, molecular and optical physics and theoretical chemistry.

Materials Science: Nano-structured and mesoporous materials including nano-ribbons, nano-rods, nano-composites are designed and synthesized for applications in chemical catalysis, biomedicine, green and clean energy harvesting, H_2 or CO_2 gas storage and water purification. Various metal and metal oxide based materials are being investigated for magnetic, dielectric, magneto-electric and multiferroic properties to exploit their functional properties. Inorganic semiconductor based solar cells, organic materials based electronic devices as well as ZnO based opto-electronic devices are major activities in solar energy and electronics. Graphene oxide based composite systems are synthesized and investigated for magneto-dielectric properties, chemical detector and drug delivery.

Molecular Science: Research focused on preparation, characterization and potential application of organic, inorganic and macromolecular compounds. A number of coordination compounds prepared are being investigated for their application as catalysts for oxygen-dependent oxidation and hydrogen generation. Anion recognition studies towards carbon dioxide sequestration and extraction of anions from aqueous medium have been performed. An Iboga-analogue, which is a potential pain therapeutic agent as a substitute of morphine, has been synthesized. Synthesis of artificial amino acids and their incorporation into the peptide backbone has shown the amide bond stability against peptidases. New synthetic methods for C-C and C-X bond formation have been developed. A magnetoclick approach has been devised to prepare magnetic nanoparticle immobilized catalyst for efficient cycloaddition reactions. A method for synthesis of functional polydisulfide has been developed.

Biological Sciences: Peptide-based soft materials and carbon nanotube-amphiphile hybrid have been prepared for drug delivery applications. Crystal engineering design of topical gels derived from antiallergic drug has been successfully applied to treat allergy induced skin conditions *in vivo*. Fluorescent carbon dots have been developed from natural precursors for enzyme probing, protein sensing and bioimaging. Understood the cellular mechanism of 3-MC induced tumor formation. PARP inhibitors in combination with Top1 inhibitors appear to induce synthetic lethality in human breast cancer cells. The mechanism of monocyte to macrophage differentiation has been elucidated. Spectroscopic and reactivity studies of heme and copper bound amyloid beta peptides associated with Alzheimer's disease and amylin peptides associated with type 2 diabetes are being investigated. Regulation of Lipid-droplets geometry and dynamics in zebrafish embryos has been explored.

Major Facilities created: (i)120KV Transmission Electron Microscope, (ii) Leica-TCS-SPH-Confocal Microscope.

Important collaborations: Indo-Japan Collaborative Research Projects in Molecular Science with Institute for Molecular Science (IMS); National Institutes of Natural Sciences (NINS), Japan; SERIIUS (Solar Energy Research Institute for India and the United States); Solar Energy Centre, MNRE; IACS-BARC collaboration (IBIQuS) on Quantum Structure Research; TWAS-IACS Postdoctoral Fellowship Programme; Tripartite collaboration between IACS, KTH and Peking University; Indian nodal institute for APCTP; Private Collaborative Research Project with Unilever Research Centre, Bangalore

Some Important Output Indicators

Sl. No.	Parameters	Output
1.	Papers in refereed Journals	472
2.	Chapters in Books	07
3.	Papers in Conferences	115
4.	Number of Ph.Ds. produced	45
5.	Foreign Patent Filed	01
6.	Indian Patents Filed	02
7.	M. Tech./M.Sc./M.Phil Projects guided	21

INDIAN INSTITUTE OF ASTROPHYSICS (IIA), BENGALURU

Areas of Focus

Astronomy, Astrophysics, Planetary Science and related subjects, including development of instruments and techniques for meeting Institute's requirements as well as extending expertise to other institutes. Creating experimental and observational facilities for research in Astronomy and Astrophysics for Indian Astronomy community and maintaining and operating them.

Some Major Accomplishments

- The UVIT payload sub-systems successfully went through thermo-vacuum tests. The payload were handed over to ISRO for satellite integration and further testing. The satellite was successfully launched and put into orbit on the 28th of September 2015.

- Using the major optical telescopes of IIA, twelve new variable astrophysical sources were been discovered in the globular cluster NGC 5904. Using high resolution spectra, detailed abundance analysis of four unexplored candidate post-Asymptotic Giant Branch stars were obtained. Black hole masses of 24 sources were also derived using observational data.

- A systematic study using observations from radio, optical, X-ray and gamma-ray bands was carried out to understand the nature of a few gamma-ray emitting Narrow Line Seyfert 1 (NLSy1) galaxies.

- HESP for HCT, Hanle was developed in collaboration with Industrial Research Laboratory, New Zealand through a DST funded project. All preparatory work for installation of the instrument was completed.

- A 20 cm refractor, designed and fabricated by NIAOT (Nanjing Institute of Astronomical Optics & Technology) of CAS (Chinese Academy of Sciences), was installed during October, 2014 and is being operated in the H-alpha wavelength. Installation of White light Active Region Monitor telescope was completed and field trials were performed.

- The 1.3m aperture telescope, jointly designed by the Institute with the manufacturers M/s DFM Inc, USA, was named after Prof. J. C. Bhattacharyya, the former Director of the Institute, on 19th April 2014 at the Vainu Bappu Observatory, Kavalur for his seminal contributions to Astrophysics.

- India formally joined the TMT project as a full member. At a function in New Delhi on December 2, 2014, in the presence of the Hon'ble Union Minister for Science and Technology and Earth Sciences, Dr. Harsh Vardhan, Secretary, DST, Prof. K. VijayRaghavan, signed the necessary documents to change India's formal relationship from an Associate to a Member of the TMT International Observatory (TIO). The groundbreaking and Hawaiian blessing ceremony for construction of TMT at the summit of Mauna Kea took place on October 7, 2014. India was represented by Ambassador Taranjit Singh Sandhu, India Deputy Chief of Mission at Washington, Dr. Srinivasa, Consul General at San Francisco and Dr. B.Eswar Reddy, Project Director of the TMT Project.

- The Governing Council of the Institute had constituted an Expert Committee to examine the implications of Hanle as the site for NLST and submit its recommendations. The NLST team prepared a preliminary report on the required changes in the telescope design taking into consideration the potential to carry out observations at infrared (IR) wavelengths at Hanle, and submitted the same in the first meeting of the Committee.

- The Visible Emission Line Coronograph payload being designed for the ADITYA-1 solar mission of ISRO, cleared initial Design Reviews and development of a prototype was initiated. Necessary augmentation of the MGK Menon Lab at CREST Campus was also initiated.

- As in previous years, large number of bright students have joined the Ph.D. and Integrated M.Tech-Ph.D. programmes offered by the Institute. Seven students were awarded the doctoral degree during this period and five students submitted their theses towards completion of their Ph.D. A large number of University students also participated in pursuing a variety of summer projects.

- The public outreach activities of the Institute were spread across the field stations. Science Day was celebrated and sky watch for general public was organized at Bangalore as well as Kavalur campuses. The implementation of Official Language and activities towards welfare of SC/ST and physically challenged staff members were carried out as per guidelines..

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	128
2	Book published/edited	4
3	Papers in Conferences	29
4	Number of Ph.D. awarded/thesis submitted	12
5	Research Manpower trained (other than Ph.Ds)	26
6	Technical Manpower trained	4
7	B.Tech/ UG projects guided	35
8	M.Tech/M.Sc./M.Phil projects guided	9

Prof. K. VijayRaghavan, Secretary, DST signing the documents in the presence of Dr. Harsh Vardhan, Hon'ble Minister for Science and Technology and Earth Sciences, Govt. of India.

The Hanle Echelle Spectrograph with all its assemblies.

H-alpha Telescope at Kodaikanal.

INDIAN INSTITUTE OF GEOMAGNETISM (IIG), NAVI MUMBAI

Areas of Focus

Geomagnetism and allied fields.

Some Major Accomplishments

- The computer simulation modelling of coherent wave structures in Earth's magnetosphere is a unique program that has been undertaken recently by the space plasma group of the Institute. The computer simulation gives more insights into the generation processes of these wave structures and helps to bridge the gap between theory and observation.

- Scientists from the Institute have developed a new forecast model based on Shanon entropy for predicting the descent time of the forthcoming solar cycle (SC). The applicability and accuracy of the prediction model equation is verified by way of association of least entropy values with the Dalton minimum.

- On the modeling and theoretical simulation front, a non-linear fluid theory and fluid and particle-in-cell (PIC) simulations were used to model the Cluster spacecraft observations of slow electrostatic solitary waves (SESWs) in the Earth's plasma sheet boundary layer region.

- Under the solid Earth studies, a crustal magnetic anomaly of the Deccan trap covered region of Maharashtra was generated using the ground magnetic data collected from several campaigns. Sub-basalt imaging in the Chikotra River basin, Kolhapur district, Maharashtra suggests that the traps in this region have an average thickness of 210m underlain by almost 900m thick Proterozoic Kaladgi sediments resting on the northward continuation of the Western Dharwar craton.

- Resistivity imaging studies were carried out along the coastal tract of western Maharashtra to analyze the effects of sea water intrusion and in locating fresh groundwater pockets to meet the water demands of society.

- The Rayleigh wave group velocity from observations of seismo-ionospheric plasma perturbations following the April 25, 2015 Nepal earthquake has been delineated for the first time.

- The response of the equatorial and low latitude ionosphere to the largest geomagnetic storm of the current solar epoch that occurred during 17-18 March 2015, when Dst reached its minimum of -228 nT, was investigated using multiple instruments. The peculiar features reported for this event were: increase of h′F to ~560 km with vertical drift of ~70 m/s at 13:30 UT, occurrence of intense plasma density irregularities at wide latitudes (up to the location of Allahabad), equatorward surge of meridional winds and presence of travelling ionospheric disturbances. Another study examined the substorm associated magnetic pulsations (Pi2s) at the topside of the ionosphere using CHAMP satellite data. A mechanism for the occurrence of daytime Pi2s was proposed in this work.

- The presence of magnetic minerals is confirmed by rock magnetic studies in sample collection of artifacts from Maharashtra archaeological sites (Ter, Latur district and Junnar, Pune district). Historical sites were archaeomagnetically studied to obtain different palaeointensity values. Moreover, palaeomagnetic and rock magnetic investigations have been carried out on 60 oriented block samples belonging to 9 dolerite dikes situated at Haludpukar and Onlajorito regions (south of Jamshedpur town), Singhbhum Craton.

Major Facilities created: State-of-the-art Environmental and Archaeomagnetism Laboratories are maintained and run for research. They have played a major role in training a host of students and professionals in the country.

Important collaborations: A new collaborative project has been initiated with Solar Terrestrial Environment Laboratory (STEL) of Nagoya University, Japan. A collaborative project has been initiated with the Research Institute for Sustainable Humanosphere, Kyoto University Japan under India-Japan Cooperative Science Programme (IJCSP). An Indo-Russian project has been initiated with scientists from the Russian Academy of Sciences.

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	46
2	Chapters in Books	2
3	Papers in Conferences	85
4	Number of Ph.Ds. produced	1
5	Research Manpower trained (other than Ph.Ds)	7
6	Technical Manpower trained	5
7	M.Tech/M.Sc./M.Phil projects guided	54
8	Workshop conducted	1

INSTITUTE OF ADVANCED STUDY IN SCIENCE AND TECHNOLOGY (IASST), GUWAHATI

Areas of Focus

Theoretical and experimental plasma physics, materials science, nano science and technology, mathematical and computational sciences and life sciences.

Some Major Accomplishments

- Collision of dust acoustic solitons, Dust acoustic shock excitation, Higher order Peregrine breathers. Proton exchange membrane fuel cell.
- Development of sensor using organics, organic-inorganic composites as well as plasma process based material for application in energy and environment.
- Development of sensor for detection and discrimination of organic and inorganic sulfur in milk.
- Fabrication of flexible high-performance visible photodetector using PAni-AuNP composite.
- Development of polymer based explosive sensor (nitro aromatic explosive) for security and environment protection.
- The notion of ideal has successfully been applied in investigating different properties of topological and bitopological spaces.
- Complete analysis including the optimization problem of an optimal policy for an unreliable service system has been done with the help of stochastic process.
- Three strains of bacteria of muga silkworm gut, namely *Staphylococcus aureus* FLG1, *Pseudomonas aeruginosa* DRKI and *Bacillus thurengensis* MK1 have been found to produce Flachrie disease symptom of the worm which will now be useful in devising the strategy for its control.

- A bioflocculant producing bacteria from HPE was found to be effective in removal of hydrocarbon and heavy metals from formation water generated due to oil drilling activity in Upper Assam.
- Antifungal property of Rhamnolpid biosurfactant of bacteria from HPE was exploited in effective biocontrol of fungal disease of maize of chilli in green house experiment.
- A survey of protected forest ecosystems of Assam yielded 392 actinobacteria strain of which 12 showed broad spectrum antimicrobial activity.
- Based on next generation sequence data of bacterial diversity in guts of 15 tribal communities of India, we showed that Gut Microbiota Profile (GMP) of the Indian population was similar to that of Mongolian population.
- Based on traditional knowledge, rhizome juice of *Musa balbsiana*, an indigenous banana and mix formulation of *Clerodendron colecrookianum* and *Allium sativum* showed positive effect in reducing complications associated with diabetes and hypertension in separate experiments conducted using rats.
- Essential oil of *Cymbopogon nardus* was found as an effective agent in reducing infection of diabetic wounds caused by opportunistic fungus *Candida albicans*.
- The efficacy of chloramphenicol antibiotic was enhanced by its encapsulation in PCL-pluronic composite nanoparticles for topical application to cure the MRSA infected burn wounds.
- *Traditional knowledge based drug discovery:* Based on traditional knowledge, rhizome juice of *Musa balbsiana*, an indigenous banana and mix formulation of *Clerodendron colecrookianum* and *Allium sativum* showed positive effect in reducing complications associated with diabetes and hypertension in separate experiments conducted using rats.

Some Important Output Indicators

S.No.	Parameters	Output
1.	Papers in refereed journals	**92**
2	Chapters in Books	**6**
3	Papers in Conferences	**53**
4	Number of Ph.Ds. produced	**7**
5	Indian Patents filed	**5**
6	Number of Technology leads awaiting transfer	**2**
7	Research Manpower trained (other than Ph.Ds)	**58**
8	Technical Manpower trained	**2**
9	B.Tech/ UG projects guided	**10**
10	M.Tech/M.Sc./M.Phil projects guided	**16**

INSTITUTE OF NANO SCIENCE AND TECHNOLOGY (INST), MOHALI

Areas 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, 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 nanoscale.

Some Major Accomplishments

- INST Scientists in collaboration with IISER, Mohali and IIT, Delhi have demonstrated Unconventional Superconductivity at Mesoscopic Point-Contacts on the 3-Dimensional Dirac Semi-Metal Cd3As2.
- INST Scientists have demonstrated rGO/CNT nanostructured aptasensor for label-free detection of cardiac biomarker Myoglobin.
- INST Scientists have demonstrated that Amyloid Aggregates can be used to develop advanced enzyme matrices for potential industrial applications.
- INST Scientists have achieved high quality atomically well-defined nano-steps and terraces surface of SrTiO3 perovskite oxide by using a unique chemical free “hot” water etching technique.
- INST Scientists have also made low-cost cartridges for purification of industrial and domestic waste water.
- INST Scientist have developed Carbon-based nanostructures (NEMS) device for early stage detection of plant disease and nanoporous silica/graphene based antireflecting coating.
- INST and IISER, Mohali have initiated joint research in areas of superconductivity and two dimensional nano materials.
- INST has initiated collaborative research with DIHAR, DRDO on projects related to high altitude ailments and food packaging.
- INST has initiated collaborative research with Panjab University on water treatment using nanoparticles.
- INST has initiated collaborative research with IIT, Delhi on toxic insults of nanoparticles on natural microbial population and habitat.
- INST has initiated collaborative research with CECRI, Karaikudi in areas of computational nanoscience.
- Collaboration with Punjab State Council for Science and Technology (PSCST) has been also

initiated for dissemination of Science and Technology to the weaker sections of the society.

- A total of 11 sponsored research projects have been sanctioned during the year to the institute for implementing innovative research ideas.

Some Important Output Indicators

Since start of its academic and research activities in 2013, nearly 50 research papers in highly reputed journals like Nature Materials, Nature Communications, Angewandte Chemie have been published by INST. Two patents are also in the process of getting filed. INST is strong initiative in developing technologies to supply safe potable drinking water to rural and suburban areas of Punjab. During this year, INST also initiated discussions on industrial research collaborations with several industries, like Indian Oil Corporation, Luminous Batteries and few projects have been sponsored. Most of the projects at INST have relevance to National Programmes like Swachh Bharat Abhiyan, Swasth Bharat, Make in India and Clean & Renewable Energy and the Strategic Sector**.**

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 Coatings, Fuel Cells, Solar Energy Materials, Automotive Energy Materials, Carbon Materials

Some Major Accomplishments

Nanomaterials: i) Scaled-up the synthesis of $LiFePO_4$ by flame spray pyrolysis process to achieve cost-effective, simple and scalable carbon coating process to synthesize bulk quantity of carbon coated $LiFePO_4$ for Li-ion battery electric vehicle applications; ii) 1000 ppm stable nano silver suspension developed to impart antibacterial property to ceramic water filters with a flow rate as high as 60 l/hr; iii) Developed a modified technique for the synthesis of nanostructured 2D-transition metal disulfides; vi) Inhibitor intercalated nano-containers designed for inclusion in the sol-gel matrix to generate barrier coatings to provide corrosion protection at par with hexavalent chrome-based conversion coatings on Aluminium alloys.

Multi-material Joining Technology: Al-steel joining by CMT and laser brazing process was developed and demonstrator assemblies fabricated for automotive applications.

Solar Energy Materials: i) Molybdenum (Mo) thin film back contact and aluminum doped zinc oxide (AZO) thin film front contact coating developed by sputtering on glass. A non-vacuum route based nanostructured stoichiometric CIGS absorber layer developed on the Mo-sputtered glass by pulsed electro-deposition. ii) Fabricated 50mmx50mm size dye sensitized solar cell module. iii) All-ambient condition processed perovskite solar cell (PSC) developed. iv) Dust repellent coatings developed on large silicon based photovoltaic panels.

Automotive Energy Materials: Fabricated Lithium ion (1Ah, 3Ah, 10Ah) prototype cells.

Fuel Cell Programme: Exploring naturally occurring carbon materials for energy storage. Alkaline rechargeable zinc-nickel battery of 800mAhr capacity developed, efforts are on to improve energy efficiency, cyclability etc. Developed hydrogen storage materials and low cost supercapacitor electrode materials from various agricultural raw materials.

Major Facilities created : *Processing* - Electrochemical cell for the preparation of Alane, Lithium ion battery plant, Magnet processing facilities to develop prototype anisotropic hard magnets, RF sputtering unit, Lithium ion coin cell fabrication unit, High purity glove box, Tape caster, Progressive reactive hot press, Laser Brazing system, Robotized cold metal transfer and welding; *Characterization* - Multichannel electrochemical and impedance system, High resolution opto-digital microscope, Lithium ion battery testing facilities, Electrochemical workstation for corrosion analysis, four probe electrical conductivity measurement system at different load pressures, High intensity rapid micro-area X-ray diffraction facility with the induction of Rigaku RAPID-II D/MAX system, Current-voltage source measurement unit (pulse and continuous mode).

Important collaborations: *National:* BHEL, Mahindra REVA, Tata Motors, BEL, DRDO, BRNS, ARDB , ATHER Energy, PI Beam Labs, MMI India Pvt Ltd. CGCRI- Kolkata, LASTEC, ARIES, BARC, IIT-B, IIT-H, IIT-M, NIT-W, CSIR-CECRI, Velammal Engineering College. *Global:* JAIST, Japan, Corning Incorporated, USA, The Boeing Company, USA, IPMS, Ukraine, Liotech, Russia, The University of Texas El paso, USA

Some Important Output Indicators

Know-How Transfer:

- 'Silica aerogel flexible sheets for thermal insulation'
- 'Decorative sol-gel nanocomposite coatings on glass'

Technology / Application Development :

- Autogenous Laser and Laser-MIG hybrid welding process of plates and tubes of Nickel based super alloys for advanced ultra super critical (AUSC) boiler application.
- Micromachining of low-temperature co-fired ceramic (LTCC) multilayer module boards using ultrafast laser.
- Fabrication of Micro heaters for membranes of MEMS sensors by ultrafast lasers welding of solenoid valve and laser welding of EMI shielding boxes.
- Portable cold spray technology is ready for adaptation and application development.
- State-of-the-art ceramic protective systems for vehicle applications (partly sponsored by ISRO).

- Hardfacing of fast breeder reactor components by laser cladding process (sponsored by BRNS).

S.No	Parameters	Output
1	Papers in refereed journals (SCI)	61
2	Books & Chapters in Books	2
3	Papers in Conferences	54
4	Indian Patents filed	10
5	Number of Technologies Transferred/applications developed/products supplied*	8
6	Number of Technology leads awaiting transfer*	15
7	Research Manpower trained (No. of SRF/JRF)	28
8	Technical Manpower trained (Employees/fellows/trainees/students deputed for training/participation in workshops etc)	305
9	B.Tech/ UG projects guided (including ongoing)	64
10	M.Tech/M.Sc./M.Phil projects guided (including ongoing)	66
11	No. of current Ph.D Scholars (non ARCI-regular employees)	32
12	Training provided to fresh post graduates/graduates/diploma holders	76

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH (JNCASR), BENGALURU

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.

Some Major Accomplishments

- The current student strength is 305. 185 students registered for Ph.D, 14 for M.S. (Engg./Research), 101 for Integrated Ph.D, 2 for M.S.–Ph.D. and 3 for Postgraduate Diploma in Materials Science programmes.
- During the current year, 23 patent applications were filed and 10 patents were registered.
- IPO Special Mention Award instituted by Indian Patent Office, has been conferred upon Jawaharlal

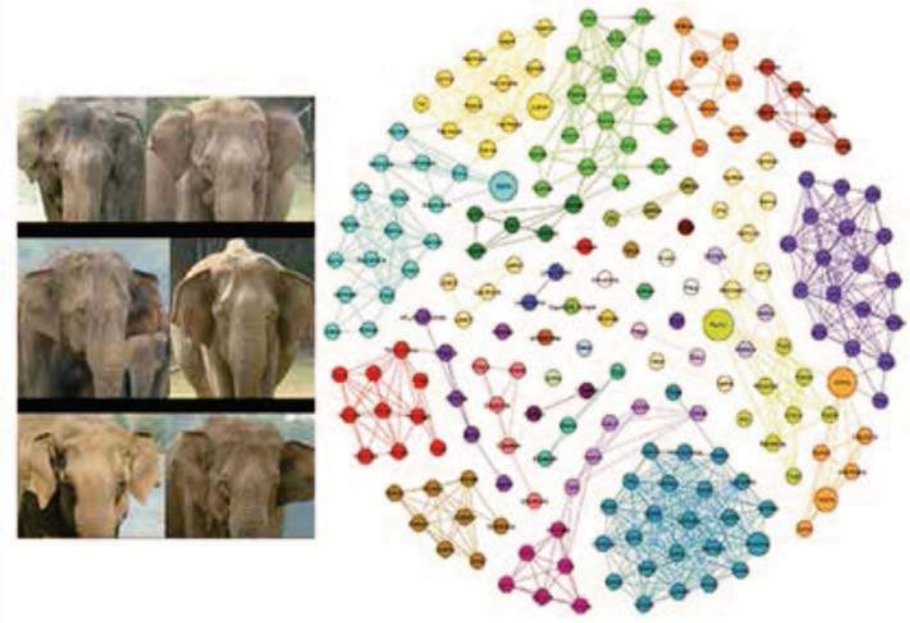
Nehru Centre for Advanced Scientific Research.

- First start up - Sankhya Sutra Labs Pvt. Ltd., is likely to be inaugurated soon.
- JNCASR had continued its involvement in the popularization of science in remote areas within Karnataka region.
- *Science Popularization Programme:* 76 science students of Class XI from Jawahar Navodaya Vidhyalaya & Kendriya Vidhyalaya have been invited to one-day exposure to the laboratories at JNCASR under student buddy programme. More than 800 students and teachers have participated in these programmes since April 2015.
- The Book 'Lives and Times of Great Pioneers in Chemistry (Lavoisier to Sanger)' authored by Prof C N R Rao and Dr Indumati Rao is published by World Scientific Publishers.
- *Important collaborations:* Memorandum of Understanding (MoU) with Public Health of England and JNCASR was signed for research and development of antimicrobial compounds and exploration of their pharmaceutical applications during the year.

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	277
2	Books	01
3	Chapters in Books	01
4	Papers in Conferences	01
5	Number of Ph.Ds. produced/awarded	29
6	Other degrees awarded: M.S (Engg.) Degrees as part of Integrated PhD Programme	 03 17
7	Foreign Patents filed	16
	Foreign Patents obtained	10
8	Indian Patents filed	07
9	Summer Research Fellowships availed	69
10	Project Oriented Chemical Education - Diploma awarded	10
11	Project Oriented Biological Education - Diploma awarded	03
12	Visiting Fellowship Programme - offers made	13
13	JNCASR-CICS Programme - offers made	06

Signing of MoU with Public Health England (PHE) for the research and development of antimicrobial compounds and exploration of their pharmaceutical applications



Association network of adult female elephants (right) and some identified females (left)

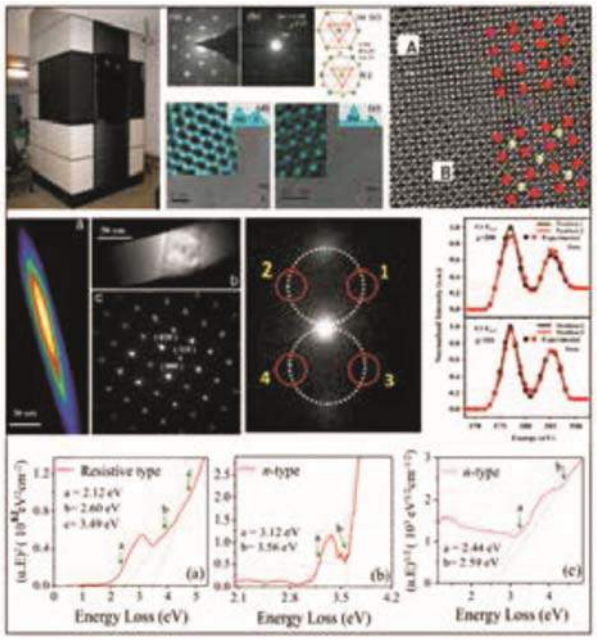


Image of the electron microscope, high-resolution images, EMCD and optical band gap by EELS

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

Areas of Focus

To promote, coordinate, guide, implement and maintain an accreditation system for laboratories suitable for the country in accordance with the relevant national and international standards and guides.

Some Major Accomplishments

At the end of the financial year 2014-15, NABL had a total of 2352 accredited laboratories including testing, calibration, medical, PTP and RMP.

Some Important Output Indicators

S.No.	Parameter	Output
1	Technical Manpower trained (Assessors Training) as per ISO 15189:2012, ISO/IEC 17015:2005,ISO/IEC 17043:2010, ISO Guide 34:2009.	200

NORTH EAST CENTRE FOR TECHNOLOGY APPLICATION AND REACH (NECTAR), SHILLONG

Areas of Focus

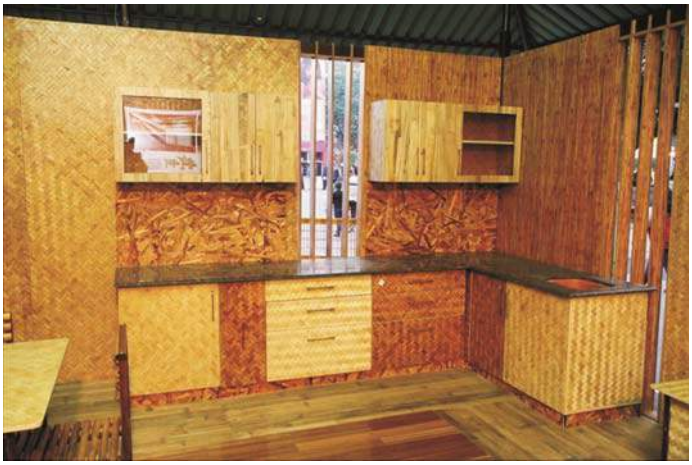
NECTAR has been identifying and developing relevant technologies for supporting development in the North East.

Some Major Accomplishments

- NECTAR has pioneered the indigenous development of 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. Team of Engineers from NECTAR has completed the task of providing SDRs in Arunachal Pradesh. MORSE Code/Conventional Radio System in Polie Stations have been replaced by the NECTAR SDR. This provides seamless connectivity without repeaters from Zimithang on the Chinese Border to Vijay Nagar on the Burmese Border. The first SDR network is also under planning 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.
- In Shillong 120 numbers of cameras have been installed of which 30 numbers are PTZ cameras and 90 veri-focal full High Definition bullet cameras. In Tura 14 PTZ cameras and 45 bullet cameras have been installed.
- The most recent venture of NECTAR is the development of state of the art Remotely Piloted Aerial System (RPAS) technology to become premier leader in acquisition of ultra high resolution aerial imageries of large geographical extents and the image processing capabilities for different value added products best suitable to not only water resources application/management but also for diverse geospatial applications.

Treated Water supply planning to nearby rural villages using surface models.

- 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.
- NECTAR has been assisting the Bamboo industry in developing a market for its products. There is a growing market and acceptability of the boards. Large number of people benefited from the project scheme of NECTAR, employment generated in a span of 9 months was 2.7 lakh man days, which was in addition to the employment generated through the normal structural/construction activity.



- NECTAR has taken the initiative to encourage the Agriculture practices in the region. The farmers are happy with the price realisation for their produce which is better then what they were receiving from the open market.
- NECTAR has introduced the "Natural Dye Technology" in the Ri-Bhoi District of Meghalaya, with the successful growth of the indigo plants that had become extinct from the Meghalaya region. The natural dyes have also been extracted from the successfully grown indigo plants.

NATIONAL INNOVATION FOUNDATION-INDIA, AHMEDABAD

Areas of Focus

Incubation and promotion of contemporary technological grassroots innovations and add value to India's outstanding traditional knowledge base

Some Major Accomplishments

- NIF facilitated hosting of the First Festival of Innovation (FOIN) at the Rashtrapati Bhavan, New Delhi under which NIF's 8th National Biennial Award Function, Global Roundtable for Inclusive Innovations, etc. were organized

8th National Grassroots Innovations and Outstanding Traditional knowledge Award Function during Festival of Innovations (FOIN) at Rashtrapati Bhavan, New Delhi

- NIF has developed thirty one working prototypes based on the innovations/ideas of grassroots innovations and school students.
- NIF had launched a national campaign to eradicate ectoparasite infestation in livestock using effective low cost sustainable solutions (herbal preparations). Efficacy of these formulations was demonstrated against resistant tick population thereby curtailing re-occurrence.
- Extensive programme for the screening of 800 herbal practices was started under NIF-ICMR collaboration and about eighty prospective leads were shortlisted for validation.
- His Excellency the President of India, Shri Pranab Mukherjee, gave away the 'Dr. APJ Abdul Kalam IGNITE Awards 2015' of NIF. IGNITE, a national competition of technological ideas and innovations by school students, aims to trigger and harness the creativity of the children and promote original inclusive and compassionate thinking among them.

Dr. A P J Abdul Kalam IGNITE Awards 2015 at Ahmedabad

- NIF received about 26000 submissions of ideas, innovations and traditional knowledge practices from grassroots and school students from different parts of the country.
- The claims of 200 innovators and outstanding traditional knowledge holders were validated through public funded and private institutions of the country.
- NIF established Technology Business Incubator for grassroots innovations (NIF Incubation and Entrepreneurship Council (NIF-ientreC), section 8 company).
- Digital Fabrication Laboratory (FAB LAB) established with support the Massachusetts Institute of Technology (MIT) USA.
- NIF collaborated with Lawrence Berkeley National Lab Institute for Globally Transformative Technologies for developing long term strategies and plan of action to help in the advancement of individuals particularly disadvantaged youth, grassroots innovators, students and others to think creatively and ultimately contribute to the increase in the pool of innovative talents.

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	14
2	Books/booklets	06
3	Chapters in Books	01
4	Papers in Conferences	20
5	Indian Patents filed	51
	Indian Patents granted	03
6	Design Registration Applications filed	02
7	New applications filed under PPV&FRA	10
8	Registration granted under PPV&FRA	02
9	Number of Technologies/Designs and other intellectual products commercialized	05
10	Number of Technology leads awaiting transfer	10
11	Research Manpower trained (other than Ph.Ds)	28
12	Technical Manpower trained	01
13	B.Tech/ UG projects guided	02
14	M.Tech/M.Sc./M.Phil projects guided	08

RAMAN RESEARCH INSTITUTE (RRI), BENGALURU

Areas of Focus

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

Some Major Accomplishments

- The Institute has actively participated in research and development leading to the International Square Kilometre Array (SKA). RRI has contributed to the International SKA Science Book, that defines the science goals of the SKA. In collaboration with MIT, Harvard and other US, Australian and New Zealand Universities and research institutions, RRI has contributed to the building, and implementation of competitive research with the Murchison Widefield Array (Pic1-MWA), which is a precursor to the International SKA and located in the Australian SKA site. SKA is slated to be the world's largest and most sensitive radio telescope ever built. RRI has defined its role as part of the SKA-India Consortium - building a cluster of compact radiometers that will be interspersed amongst the SKA telescope antennas and will enable and lead SKA research into the Key Science of Cosmic Dawn and formation of first stars and galaxies in the Universe – this will be an identifiable Indian contribution to the SKA.
- RRI has developed totally indigenously an X-ray polarimeter that, when launched, will be the first

ever mission that can explore polarized X-rays from the cosmos. Also, in collaboration with ISRO, RRI participated in the Large Area X-ray Proportional Counter on board the ASTROSAT.

- RRI has commissioned a Nano-Biophysics lab that investigates the role of chromatin in packaging DNA inside a eukaryotic cell nucleus through sensitive nanopore based measurements.
- DISTORTION (DetectIon of Spectral signaTures of cOsmic baRyon evoluTION) is a collective in RRI working towards the goal of building precise spectral radiometers to detect weak spectral distortions in the Cosmic Radio and Microwave Backgrounds from the Epochs of Recombination all the way to Reionization. Towards detecting this signal, researchers have developed and built precision radiometer systems called SARAS and APSERa. The study into these Epochs is interesting because it will throw light into how the very first atoms, stars and the first ultra-dwarf galaxies formed, whether the first stars were a unique population, and how they heated and reionized the Universe.
- RRI is engaged in design, development and deployment of a wideband Sky Watch Array Network (SWAN) across India to facilitate and conduct research on fast (typically of sub-second duration) and slow transient radio radiation and high angular resolution imaging of discrete galactic and extragalactic sources at low radio frequencies. The SWAN project also aims to develop a collective effort between 40+ S&T institutes such as IITs, NITs, IISERs and NISERs as well as many universities across India to train manpower through formally introducing undergraduate and master's students to radio astronomy as a part of special schools/workshops. The first such school was conducted in 2015.
- The RRI cluster of Quantum optics laboratories is now a leading center for cold-atom and quantum information research in the country. The RRI Quantum Interactions (QuaInt) lab has succeeded in the creation of ultra-cold molecules and molecular ions in hybrid ion-atom-molecule and photon trap experiments. The novelty of the hybrid trap created by this group is that the number of trapped species and their internal states are precisely controlled and their long survival times have permitted the study of interactions between the species with unprecedented accuracy, thus improving our understanding of quantum physics in the atomic systems.
- The Theoretical Physics group derived and explained the approach of a resetting (initial condition resetting) stochastic process to a non-equilibrium steady state. This group is studying how this non-equilibrium steady state (NESS) is approached in time by the system. They have shown that as time progresses, an inner core region grows around the resetting point where NESS is reached while outside the core the system remains transient/stochastic.
- Members of the soft condensed matter group at RRI are engaged in experiments that improve our understanding of the physical properties of the plasma membrane of nerve cells or axons using a novel laser-based force measurement technique developed and built at RRI. The work advances our understanding of the biophysics of nerve cells and further investigation of these cells is expected to lead to a better understanding of neurodegenerative mechanisms and strategies for axonal loss.

- There are 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.

- Dr. Urbasi Sinha was awarded the Templeton Grant for her proposal for theoretical and experimental research to understand quantum reality employing non-destructive weak measurements. Dr. Sanjib Sabhapandit's CEFIPRA (Indo-French grant) project was awarded excellent grading. Dr. Sumati Surya has been awarded a Foundational Questions Institute Grant for the second time in two years.

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	153 (20 in press)
2	Papers in Conferences	18 (3 in press)
3	Number of Ph.Ds. produced (awarded and submitted)	15
4	Foreign Patents under process	7
	Foreign Patents granted (total)	1
5	Indian Patents filed – under process	9
6	Indian Patents granted (total)	3
7	Research Manpower trained (other than Ph.Ds)	Nil
8	Visiting Students (includes M.Tech/M.Sc./M.Phil projects)	150

S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES (SNBNCBS), 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: (Theory, Experiment and Simulations).

- 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.

Some Major Accomplishments

Astrophysics & Cosmology:

- Fitted RXTE Satellite data of several black hole spectra using Chakrabarti-Titarchuk solution after its implementation in NASA/XSPEC Package.
- Numerical simulations established the desegregation of an accretion flow into Keplerian and Sub-Keplerian components in presence of intermediate viscosity.
- Analyzed stellar content of a young cluster NGC~2282, a young cluster in Monoceros constellation, using deep optical *BVI* and *IPHAS* photometry along with infrared (IR) data from UKIDSS, and *Spitzer-IRAC*.
- Long term monitoring of MASTER Optical transient J212444.87+321738.3 which was earlier discovered by us.
- We performed an analysis of elemental abundances of ejecta of the recurrent nova RS Oph using the CLOUDY photoionization code.

Chemical, Biological & Macro-Molecular Sciences:

- Thermodynamics of metal ion induced conformational changes on functions of protein complexes has been explored.
- Clinical feasibility of a residual gas analyzer (RGA) system coupled with a high vacuum chamber (Figure 1) for accurate evaluation of the 13C-enriched glucose breath test exploiting 13CO2/12CO2 isotope ratios in the diagnosis of PD and T2D has been studied.
- THz time domain spectroscopy (TTDS) study has been conducted for studying the interaction between urea and water.
- A clay based nanocomposite has been developed through selective modification of the outer surface of HNTs with an organosilane to make the nanocomposite a novel solid-phase adsorbent to capture toxic gases from the atmosphere.

Condensed Matter Physics and Material Sciences:

- Properties of disordered graphene and silicene, other low dimensional materials in search of quantum phase transitions, looking for magnetism in a few monolayers, metallic nano clusters, 2-D thermal conductivities, spin crossovers in metalorganic complexes, magnetization dynamics of nano dots etc.
- The other group worked on modeling of mechanical properties and dislocations, mesoscopic systems, calculation of Cooper pair instability etc.
- A major proportion of research work involves studying various properties of nano particles,

thin films, magnetic nanodots, complex oxides etc. These include ultrafast Kerr effect, photo response in oxides, attempts for biological use, nanofabrication and nanlithography etc.

- The remaining group works on aspects like magnetocaloric effects, super capacitors, magnetorheological effects etc.

Theoretical Sciences:

- Gauging of Galilean symmetry, non-relativistic diffeomorphism invariance and its applications in fractional quantum Hall effect, Horava-Lifshitz geometry etc.
- A realization of SU(2) lattice gauge theory in terms of Hydrogen atoms.
- Formulation of a mean-field model of interacting synapses on a directed neural network.
- Study of non-equilibrium steady-state systems in contact with each other.
- Study strong phase separation in a one-dimensional periodic system forming pure domains at all temperatures.
- Study of the density field in an active nematic.
- Study of the fiber bundle model using equal load sharing dynamics.

*Major Facilities Created:*Ultra-fast spectroscopy set-up; Upgradation of nanofabrication and device fabrication facility including clean room facility; Cluster Computing facilities; 75 TeraFlop Massively Parallel Cray Supercomputing Facility; Time and Space resolved Kerr Effect Measurements.

Some Important Output Indicators

Sl. No.	Parameters	Output
1.	Papers in refereed journals	162
2.	Books	0
3.	Papers in Conferences	3
4.	Number of Ph.Ds. produced	11
5.	Indian Patents filed	0
	Indian Patents granted	1
6.	Technical Manpower trained	7
7.	M.Tech/M.Sc./M.Phil projects guided	28
8.	Other Products/ Indicators (M.Sc. Degree under Integrated Ph.D. Programme):	10

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY (SCTIMST), TRIVANDRUM

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

Some Major Accomplishments

- New registrations crossed 17400 and admissions crossed 10000 last year and bed occupancy rate was over 92%.
- The accreditation of the quality system was extended up to 2018 after surveillance audit by the French Agency, COFRAC.
- The Achutha Menon Centre for Health Science Studies continued its research and training in various public health projects in the areas of non-communicable diseases, gender and health, health policy and management.
- SCTIMST also continued to offer various academic programs including PhD, DM, MCh, PDCC, MPH, M.Tech (Clinical Engg), M.Phil and other diploma courses.
- Preliminary work towards setting up Technical Research Centre (TRC) for Biomedical Devices at SCTIMST was initiated.
- Institute has set up a Technology Business Incubator (TBI) for medical devices and biomaterials (TIMed). Three incubatees occupied the TIMed during the period and started their development work.
- Central Drugs Standard Control Organization(CDSCO), Govt. of India, approved issuance of License to M/s IFGL Refractories, Kolkata for manufacturing and marketing the Hydroxyapatite based bone graft material - BioGraft HA New Ortho developed and transferred to the industry by the Institute.
- Faculty Members of the Institute Dr. Roy Joseph and Mr. C.V. Muraleedharan won the 4th National Award for Technology Innovation in Petrochemical & 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".
- New Imaging Complex with 3 Tesla MRI was inaugurated by Shri K.M.Chandrasekar, President of SCTIMST on 14th December 2015.

- 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.

- Projects that made progress in pre-clinical evaluation stage included cartilage tissue engineering, hemostatic scaffold using biodegradable polymer and biomimetic extracellular matrix components for healing of chronic dermal wounds.

- Industry supported projects like fluoropassivated and hydrogel sealed vascular graft, development of paediatric and neonatal membrane oxygenators and arterial filters recorded good progress.

- The product development projects like cardiovascular stent, paediatric and Neonatal membrane oxygenators and arterial filters, valve conduit with decellularised bovine pericardium, dispensable and biodegradable polymeric bone cement, novel scaffold materials for tissue engineering of different tissue types, scaling up of fibrin glue, urinary tract infection test kit, in vitro pyrogen test kit etc. were in various stages of development.

- 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, gene/drug co-delivery for anticancer therapy, hemostatic scaffold using biodegradable polymer and biomimetic extracellular matrix components for healing of chronic dermal wounds, bioengineered hybrid skin substitutes for burn wounds, smart dental composites consisting of calcium containing resins and fillers, cost effective non enzymatic methods in an easy to read out format for the detection of glucose in fluids such as blood, urine and tear, transforming growth factor, in vitro slice model for epilepsy, injectable hydrogel for cardiac tissue engineering, dural substitutes for cranial neurosurgery, cell sheet engineering, skin tissue engineering, *in vitro* alternative test system development for ocular irritation etc.

- The ISO 17025 accreditation from NABL for the calibration services was extended for two years.

- *Major Facilities created:* 'M.S.Valiathan Medical Devices Engineering Block' was inaugurated on16th May 2015; laboratories in the new engineering block at BMT Wing were occupied.

- *Important collaborations 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; MOU signed between Public Health Foundation of India and SCTIMST on 28th December 2015.

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	125
2	Papers in Conferences	18
3	Number of PhDs produced	18
4	Foreign Patents filed	2
5	Indian Patents filed	12
6	Number of Technology leads awaiting transfer	4
7	Research Manpower trained (other than Ph.Ds)	12
8	Technical Manpower trained	50

The Hon'ble Union Minister for Science and Technology, Dr.Harsh Vardhan, delivering the Convocation Address

New Imaging Complex & 3 T MRI being inaugurated by Shri K.M.Chandrasekar, President of SCTIMST

Dr. Roy Joseph & Shri. C.V. Muraleedharan received the 4th National Award for Technology Innovation in Petrochemical & Downstream Plastics Processing Industry

TECHNOLOGY INFORMATION, FORECASTING AND ASSESSMENT COUNCIL (TIFAC), NEW DELHI

Areas of Focus

Technology Foresight, Nurturing Innovation, Supporting MSMEs, Capacity Building, Collaborative Linkages

Some Major Accomplishments

Technology Foresight: Under Technology Foresight, the following activities were taken up -

- **Technology Vision 2035** was prepared which captures the technological needs to fulfil the aspirations of Indians by the year 2035. The document was released by the Hon'ble Prime Minister of India in the 103rd Indian Science Congress held during January 3-7, 2016 at University of Mysore. To realise the vision, technology roadmaps on 12 select sectors are also being prepared.
- **Horizon Scanning** was routinely done for feeding forward technology intelligence in foresight activities for India and generating thematic reports for potential opportunities and threats linked with future technologies.
- **Thematic Foresight:** Regular foresight exercises are undertaken on technology areas of social and economic importance to the country. Such areas include Electric Mobility, Security Technologies and the Solar Photovoltaics. An Interim Project Report for National Mission for Electric Mobility prepared by TIFAC and submitted to the Department of Heavy Industry helped in formulation of the Technology Platform of the scheme "Faster Adoption of Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India)".

Nurturing Innovation: TIFAC Supports innovations in academic institutions, R&D institutes, industry and individuals through its various pioneering programmes. It facilitates filing and securing patents and other IP rights, technology refinement and marketing, up scaling the technologies from pilot to industrial production, thereby keeping the innovation ecosystem vibrant. During the period, 12 new patents were granted. Four (4) workshops on IPR and patents and a three-day Advanced Training Programme on IPR with DRDO were organized. With the TIFAC-SIDBI Revolving Fund for Technology Innovation Programme (SRIJAN) five innovations were successfully commercialized. In addition, five new technology innovation based projects were sanctioned for scaling up.

Breeding Innovators: In an effort to inculcate innovative acumen in students and faculty of technical institutions and to enhance the otherwise technologically deficient MSMEs through the 'MSME Internship Scheme', TIFAC has supported 150 students at five different institutions. Further, five (5) interaction workshops/meets were organized for students, faculty and industries at the empanelled institutes.

Under its 'TIFAC - MSME Program' that aims to provide R&D and technical support to MSMEs by leveraging Academia Industry interaction, TIFAC has covered 29 MSME clusters with 22 technology gap analysis studies.

MSME Exports Program: As a follow up of the recommendations of the Inter Ministerial Group (IMG) of Government of India, TIFAC was entrusted with the task of coordinating, nucleating to facilitate infusion of appropriate new technologies for boosting of exports in select sectors. In consultation with Ministry of Commerce, Ministry of Finance and Ministry of MSME four sectors viz. Guar Gum, Electronic System Design and Manufacturing (ESDM), Technical Textiles and Essential Oils - Flavors & Fragrances, were identified. The study report prioritizes dissemination of best practices and requisite R&D and presents an action plan towards boosting exports, and also identifies import-intensive products for chalking out R&D road map for our country.

Capacity Building: TIFAC imparts training in the domains of technology foresight, technology management and IPR. These capacity building exercises build synergistic relationship between TIFAC, MSME, academia, R&D institutions, industry and technology-related service providers. Knowledge Involvement in Research Advancement through Nurturing (KIRAN-IPR) is another scheme that aims at mainstreaming women having qualification in science & technology who have not been able to pursue their career due to domestic compulsions. It prepares them towards self-employment by providing on-the-job training in the area of IPR. For the 8th batch, final selection was underway.

International Collaborations: To add synergy to TIFAC activities, TIFAC has been pursuing meaningful international collaborative linkages. Some of the active collaborations include International Institute for Applied System Analysis (IIASA), Austria, UK Foresight Group, UK and Global Foresight Network, UK. India-IIASA Programme focuses on undertaking collaborative research projects among scientists from Indian S&T organizations/academic institutions with IIASA researchers and facilitates organizing of training workshops. Under the Young Scientist Summer Programme (YSSP), held in Vienna in 2015, researchers were trained on variety of scientific and policy-oriented topics viz. Ecosystems and climate change to energy, water and education systems.

TIFAC hosted the '6th Government Foresight Organizations Network (GFN)' Meeting during November 25-26,2015 at New Delhi. Participants from 10 countries, including EU, deliberated on emerging issues requiring policy action and shared experiences in Horizon Scanning and Foresight activities.

Some Important Output Indicators

S.No.	Parameters	Output
1	Papers in refereed journals	3
2	Papers in Conferences	5
3	Number of Technologies/Designs and other IP products commercialized	5
4	B.Tech/ UG projects guided	13
5	M.Tech/M.Sc./M.Phil projects guided	9
6	Other Products/ Indicators - DPR and other reports	2

VIGYAN PRASAR (VP), NOIDA

Areas of Focus

Vigyan Prasar engages in development of knowledge products that highlight the method of science and technology communication, thereby popularizing the spirit and veracity of science to enable rational value based thinking. Vigyan Prasar, in collaboration with several institutions /departments generates content and engages in the design, development and delivery of uniquely adapted materials.

Health, sanitation, gender harmony and other cross cutting areas of science and technology are areas of special interest. Publication of inspirational biographies of renowned Indian scientists, astronomy popularization programme, scientific literacy campaigns, preparation of video compendium on several topics including women friendly tools for drudgery reduction for women farm workers are some of the major outputs. A web Portal for Vigyan Prasar provides a robust platform for interactions and access to materials.

Some Major Accomplishments

Organization of Events:

- One month Summer Science Festival, wherein about 3,000 children participated.
- Three programmes on Science writing, 5 programmes on hands-on chemistry, 05 programme on robotics, 02 programme on food diet and health (700 children participated), 05 science lectures (800 children benefited), 06 programme on mathematics through origami (500 children participated), 08 popular lectures on International Year of Light.
- Production of Video Science Programmes, Short Science Films, Science Monitor/ Gyan Vigyan, Documentary Films on Indian Scientists, Dubbing of Video Serials, Activity Kit on toys development programme, Activity based programme for children, Sensitization programme on mathematics for teachers.
- Popular science videos shows through EduSat.
- Contributing to the cause of Ham Radio promotion in India and abroad.
- Public outreach programmes were organized on April 2,3 at Chennai to dispel unfounded fear on the India-based Neutrino Observatory (INO) project and provided scientific information. On May 5th, 2015 a public debate was organized between experts from INO team and organizations expounding unfounded fears.
- During the lunar eclipse on April 4, 2015, completion of one year of MOM on Sep 24, 2015 and on other occasions participated in the round-table discussions.

- Special lectures on astronomy were delivered in more than 25 location reaching out to more than 5000 people. Workshop on telescope making and significant contributions to the India International Science Festival were additional outputs.
- Teacher training programmes were organized in tribal areas.
- Radio programmes for tribal areas are in advanced stages of development. Radio based materials are being digitized.
- In association with number of grass root level agencies developed and delivered, education campaign in the post-flood Chennai and surrounding regions.
- Science communicators training workshops included a national level two-week short term course on "science writing" organized at IISER Pune in association with Science Media Center, IISER Pune between Oct 12- 24, 2015.
- Regional science communication workshops for journalist and media professionals.
- Two major books were released on leading women scientists – Released by the Honorable Vice President of India.
- A technological source book on woman friendly tools and technologies for rural women.
- Dream 2047, a bilingual science magazine reached out to nearly 50,000 institutions including 8,000 e-version of Dream 2047.
- VIPNET newsletter distributed to hundreds of school clubs.
- Partcipated in the 6th National Science Film Festival. Workshop on science films encouraged new and young film makers, access to materials to Vigyan Prasar information system as a repository available online (www.vigyanprasar.gov.in)

Important collaborations: Department of Biotechnology, National Council of Science Museums, Prasar Bharti, CRIDA, NCERT, United Nations Population Fund (UNPF), National Book Trust (NBT), Rajya Sabha television, Academic institutions including IISER Pune, IIT Bombay, Pandit Deendayal Petroleum University, APJ STYA University, Nehru Planetarium and several others plus a number of other governmental and non-governmental organizations. Vigyan Prasar, led the development of strategy for science and technology communication as part of the India Canada bilateral initiative, India-UK and India-Australia programmes.

Some Important Output Indicators

S. No.	Parameters	Output
1	Papers in referred journals	15
2	Books	25
3	Chapters in Books	6
4	Papers in Conferences	26
5	No. of Technologies/Designs and other intellectual products commercialized (Activity Kits, Poster, Exhibitions, Films, TV and Radio Serials)	896 (including 171 films, 360 dubbing and others
6	Technical Manpower trained (S&T Communication)	8,560
7	B.Tech/UG projects guided	7
8	Other products (Popular Science article in different/ Magazines/ Newspapers/ Radio/ TV Talks)	80
9	Teaching Undergraduate / post graduate Courses	02
10	Guidance for Ph. D.	02

WADIA INSTITUTE OF HIMALAYAN GEOLOGY (WIHG), DEHRADUN

Areas of Focus

Geological, geophysical and geo-dynamic investigations on the Himalaya.

Some Major Accomplishments

- Systematic glacier lake inventory has been completed for the Uttarakhand Himalaya using satellite images of years 2011-2013. Assessed the fate of glaciers and disaster potential (GLOF) of identified 1266 lakes in the region.
- In a demonstration project, in Chumathang region of Ladakh, for the first time in the country, geothermal energy was harnessed for room heating.
- Organized five days training programme for the officers of the Rail Vikas Nigam Ltd (RVNL) which is making 110 km rail route in the Himalayan terrain between Rishikesh and Karanprayag (Garhwal Himalaya).
- After the Jammu & Kashmir Flood, on the request of District administration, survey was carried out to demarcate the safer areas for rehabilitating people in the Udhampur district.
- Identified pigments used in Indian Architectural monuments by employing Raman Spectroscopy.
- The study of sedimentation rate of the Rewalsar Lake, Himachal Pradesh, using isotope dating techniques (^{137}Cs and ^{210}Pb) revealed that the lake had experienced an average sedimentation rate

of 3.35 cm/year during the last ~50 years. The higher sedimentation rate, in comparison to the other lakes in the region, is attributed to enhanced human interference in the catchment area of Rewalsar Lake.

- Speleothem proxy records from Mawmluh Cave, Meghalaya reflect abrupt increase in Indian Summer Monsoon strength during the Bølling-Allerød and early Holocene periods and pronounced weakening during the Heinrich and Younger Dryas cold events.
- The Late Miocene stratigraphic records of the Himalayan foreland basin demonstrates an oscillation amongst the lithofacies expressed by floodplain facies assemblage (FFA), channel facies assemblage (CFA) and Alluvial fan facies assemblage (AFFA). The sediment flux and grain-size suggest the role of both tectonic and climate.
- The strain estimates have been made in the Lower Himalayan Paleoproterzoic rocks of Mussoorie and Garhwal synclines. The discrepancy results because the petrofabric strain reflects the early deformation and the magnetic strain reflects the superposed deformation.
- In and around the Doon Valley, the sonant frequency, the soil thickness, and the mean S-wave velocity of the sediments in the uppermost 30 m have been characterized from the ambient noise measurements undertaken at 240 sites in the valley.
- The study of spatio-temporal behavior of seismicity in Garhwal-Kumaun region of Himalaya suggests that in recent times the seismic activity has increased in the region northwest Garhwal and Kumaun as compared to the region of southeast Garhwal (low b-value) thereby indicating accumulation of high stresses in the SE Garhwal region.
- The calculation of ablation for debris-covered and clean ice of Dokriani Glacier using thirty stakes observed over a period of 4 years suggests that thinning glacier rapidly becomes debris-covered over the ablation area, which reduces the rate of ice loss.
- *Major Facilities created:* The Hon'ble Minister of State for Science and Technology and Earth Sciences, Sh. Y.S. Chowdary inaugurated the new instrumental facility 'LA-MC-ICP-MS' on October 9, 2015.

Some Important Output Indicators

S.No.	Parameters	Output
1.	Papers in refereed journals	52
2.	Papers in Conferences	4
3.	Number of Ph.Ds. produced (4 awarded and 4 submitted)	8
4.	Research Manpower trained (other than Ph.Ds)	74
5.	B.Tech/ UG projects guided	18
6.	M.Tech/M.Sc./M.Phil projects guided	6

Organization / Participation

- Organized 'The Himalayan-Karakoram-Tibet (HKT) Workshop' during October 5-12, 2015 wherein 48 foreign and around 170 Indian delegates participated.
- Participated in the 'India International Science Festival' held at IIT-Delhi, New Delhi during December 4-8, 2015.
- Participated in the *Pride of India Expo held during the 103rd Indian Science Congress* at Mysore University during January 3-7, 2016.
- The Foundation Day Lecture on *"Climate Change: An Overview"* was delivered by Professor V.K. Jain, Vice-Chancellor, Doon University on June 29, 2015.

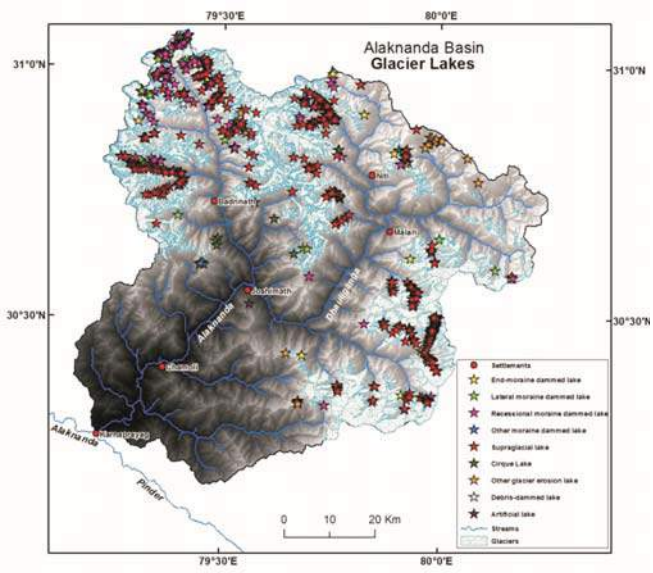


Fig. 1 Glacier lake inventory map of the Alaknanda basin.

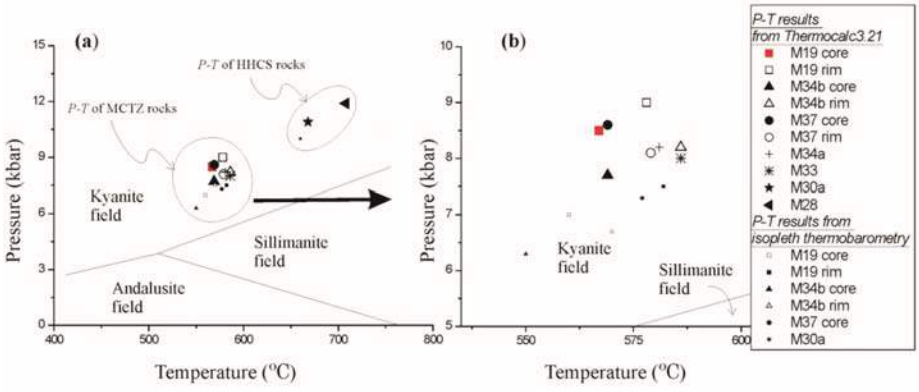


Fig. 2 a *P–T* diagram showing the results of multi-equilibrium thermobarometry in the MCTZ and HHCS rocks along Alaknanda valley, NW Himalaya; **b** Enlarged view of *P–T* results from MCTZ rocks

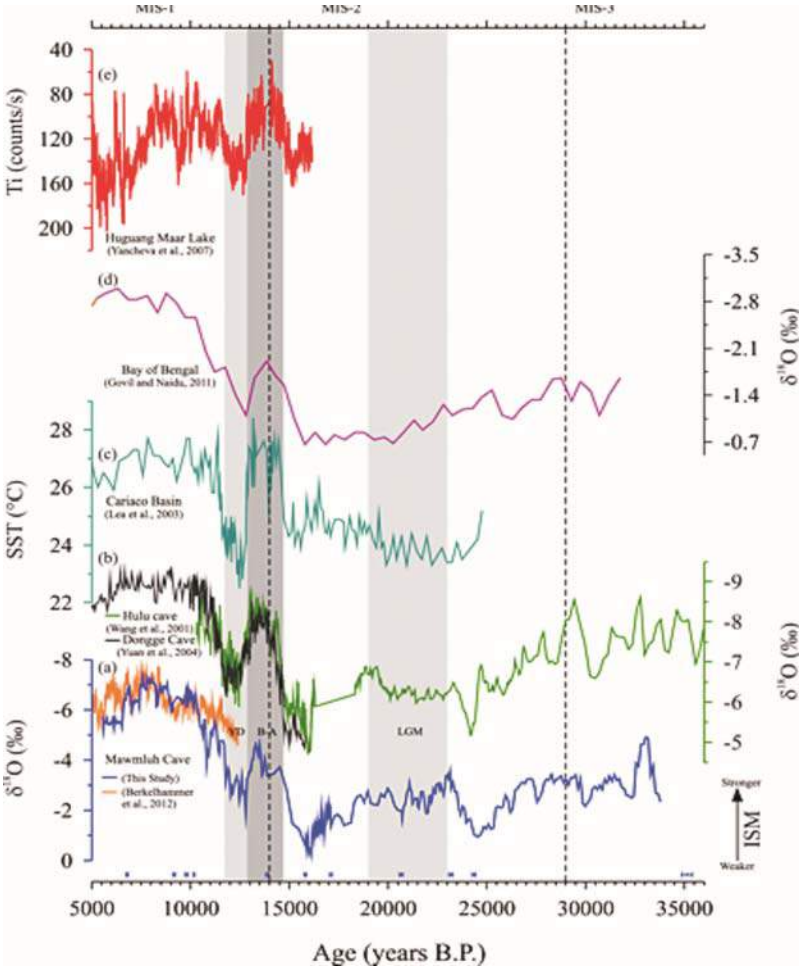


Fig. 3 Indian summer monsoon (ISM) proxy record from the Mawmluh Cave, Meghalaya, India, compared with cave and lake records from China, and marine records from the Bay of Bengal and Cariaco Basin.

INDIAN ACADEMY OF SCIENCES (IASc), BENGALURU

Areas of Focus

Promotion of original research and dissemination of scientific knowledge to the community through discussions, seminars, symposia, meetings and science education workshops. Publication of scientific journals. Election of Fellows and selection of Young Associates, Fellows' repository, Women in Science programme, Endowment Chair.

Some Major Accomplishments and Outputs

Publication: Published 10 thematic journals and the entire content of these journals were made available on an open access platform. Print version of the journals was distributed to about 22500

individuals / universities / other institutions. The journal wise account for 2015 are indicated below:

Name of the Journal	No. of articles received	No. of articles published	No. of issues published	No. of pages published	Circulation figures
Pramana	592	183	12	2388	2102
Journal of Astrophy. & Astron.	151	47	4	420	1188
Proceedings Mathematical Sci.	396	45	4	576	1767
Journal of Chemical Sciences	795	238	12	2500	1845
Bulletin of Materials Science	1166	256	7	1965	1706
Sadhana-Proceedings in Engg. Sci.	1086	140	8	2550	1573
Journal of Biosciences	1020	82	5	968	1886
Journal of Genetics	721	114	4	809	1518
Journal of Earth System Science	505	125	8	1850	1264
Resonance- J. of Science Education	132	99	12	1170	5126

Science Education Programmes: Under Summer Research Fellowship programme**,** a total of 1321 students and 136 teachers availed 2 months Fellowship and worked with Fellows and other mentors spread across 197 research institutions.

19 refresher courses in Physics, Life Sciences, Engineering and Earth & Planetary Science were conducted for university science teachers in different parts of the country. 61 Lecture Workshops were held, in different parts of the country, in Physics, Life Sciences, Engineering, Earth & Planetary Science, Mathematics and Chemistry.

Election of Fellows and Associates: 458 nominations for Fellowship and 57 nominations for Associateship were considered for 2015.

*Organizing Scientific Meetings***:** The mid-year meeting was organized during 3-4 July 2015 at the Indian Institute of Science, Bengaluru. The annual meeting was organized at IISER-Pune during 6-8 November 2015; Symposia, public lectures and scientific talks by Fellows/Associates were held in these meetings.

Fellows' Repository: Through this initiative, 92757 metadata of important researches in all branches of science carried out by Fellows of Academy is freely made available online. The number of full text made available as of now is 20788.

Important collaborations: The Academy collaborated with the other two National Science Academies in the country viz., INSA, New Delhi and NASI, Allahabad for implementing Science Education Programmes. Collaboration with Springer was put in place for marketing online versions of Academy journals overseas.

INDIAN NATIONAL ACADEMY OF ENGINEERING (INAE), NEW DELHI

Area of Focus

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

Some Major Accomplishments

(a) Seminars/Workshops/Conferences: The following seminars/ workshops/ conferences were organized - (i) INAE-NATF Workshop on "Technology and Healthcare", April 15-17, 2015, at National Institute of Advanced Studies (NIAS), Bangalore; (ii) INAE Roundtable: Landslide Disasters in India – Some Vexing Issues Related To Landslide Control, 11 May 2015, Central Road Research Institute, New Delhi; (iii) 9th National Frontiers of Engineering Symposium (NatFOE), June 5-7, 2015, IIT Jodhpur; (iv) The 3rd Engineers Conclave 2015 (EC-2015, BARC, Mumbai, September 7-9, 2015; (v) INAE-CAE Young Leaders Conclave, Indian Institute of Technology Gandhinagar, October 7- 9, 2015; (vi) INAE, MHRD (GoI) and NAE (USA) Joint Symposium on Engineering Education in the 21st Century: Issues Related to IMPRINT (India) and Grand Challenges (USA); (vii) 2nd Round Table Meeting on Landslides Risk Reduction, Nov 4, 2015, Central Road Research Institute (CRRI), New Delhi.

Hon'ble Minister of Defence, Shri Manohar Parrikar delivering the Inaugural Address during Engineers Conclave 2015

Inaugural Session of the INAE, MHRD (GoI) and NAE, USA Joint Symposium on Engineering Education in the 21st Century: Issues Related to IMPRINT (India) and Grand Challenges (USA) with Smt Smriti Irani, Hon'ble Minister for HRD as Chief Guest

(b) International Affairs: (i) 2nd CAE-INAE Workshop on Clean Coal Technologies - The 2nd Canadian Academy of Engineering (CAE) -INAE workshop for stakeholders in Clean Coal Technologies was held in Toronto, Canada on July 9-10, 2015. A ten member INAE delegation participated in the conference and technical visits. A special session was organized to identify the clean technology options of mutual interest and the likely participating institutes from both countries and the possible funding sources. It is envisaged that these efforts will pave the way for specific projects to be taken up for joint execution;

Dr Harsh Vardhan, Hon'ble Minister for Science and Technology & Earth Sciences delivering the Inaugural Address during CAETS 2015 Convocation

(ii) CAETS 2015 Convocation on '*Pathways to Sustainability: Energy, Mobility and Healthcare Engineering'* was held on Oct 13-14, 2015 at Hotel Ashok, New Delhi. The Convocation was inaugurated by Dr. Harsh Vardhan, Hon'ble Minister of Science & Technology and Earth Sciences. This Convocation was attended by over 350 participants from 24 countries, including 21 Member Academies of CAETS, besides Fellows of INAE and experts from Academia, R&D and Industry.

(c) Promoting Excellence in the Field of Engineering: (i) Life Time Contribution Award in Engineering 2015 - Prof BL Deekshatulu, Formerly Director, National Remote Sensing Agency, Hyderabad and Prof DV Singh, Former Director, IIT Roorkee and Former Vice-Chancellor, University of Roorkee were conferred Life Time Contribution Awards in Engineering 2015; (ii) Prof. Jai Krishna and Prof. SN Mitra Memorial Award 2015 - Dr LK Singhal, Director, JSL Ltd, Hisar and Prof Sankar K Pal, DAE Raja Ramanna Fellow, Distinguished Scientist and Former Director, Indian Statistical Institute, Kolkata were conferred the Prof. Jai Krishna Memorial Award 2015 and Prof. SN Mitra Memorial Award 2015 respectively; (iii) INAE Outstanding Teachers Award - Prof Kripa Shanker, Emeritus Fellow, Indian Institute of Technology Kanpur and Prof Dipak Mazumdar, Ministry of Steel Chair Professor, Indian Institute of Technology Kanpur were conferred the INAE Outstanding Teachers Award 2015; (iv) INAE Young Engineer Award 2015 - Ten candidates were selected for INAE Young Engineer Award 2015; (v) Innovative Student Projects Award 2015 - Five theses at Doctoral level, five at Master's level and eight projects at Bachelor level were selected for conferment of Innovative Students Project Award 2015.

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

*(e) The Fellowship:*Twenty five Fellows and five Foreign Fellows were elected during the year.

Some Important Output Indicators

The following important publications have been brought out during the year 2015-16 -

Annals of INAE; INAE e-Newsletter; Fourth Report on "Role of Technology in Capacity Augmentation and Railway Development"; Mind of an Engineer.

INDIAN NATIONAL SCIENCE ACADEMY (INSA), NEW DELHI

Areas of Focus

INSA was established in January 1935. Its objectives are: (i) promotion of scientific knowledge

in India including its practical application to problems of national welfare; (ii) coordination among Scientific Academies, Societies, Institutions, Government Scientific Departments and Services; (iii) to act as a body of scientists of eminence for the promotion and safeguarding of the interests of scientists in India and to present internationally the scientific work done in the country; (iv) to act through properly constituted National Committees, in which other learned academies and societies may be associated, for undertaking scientific work of national and international importance which the Academy may be called upon to perform by the public and by the Government; (v) to publish such proceedings, journals, memoirs and other publications as may be found desirable; (vi) to promote and maintain liaison between Science and Humanities; to secure and manage funds and endowments for the promotion of Science; (vii) to perform all other acts that may assist in, or be necessary for the fulfilment of the above-mentioned objectives of the Academy.

Some Major Accomplishments

- Academy hosted the Joint Session of IAP Executive Committee, IAC Board and IAMP Executive Committee during September 28-30, 2015 at its premises. Around 51 delegates including Presidents of IAP/IAC/IAMP member academies, representatives, delegations, observers and invited guests participated in this event.

- International workshop on "Big and Open Data: Evolving Data Science Standards & Citation Attribution Practices", jointly organized by INSA, Indian Institute of Public Administration, Committee on Data for Science & Technology (CODATA) International and other funding agencies at INSA ,November 5-6, 2015.

- During 28-30 December, 2015, two symposia, viz. i) To Celebrate *International Year of Light* and ii) *Research at IISER Bhopal: Quest for Some New Frontiers*, were organized. In addition to these, a special lecture on *Making Sense of Science, an Indian Science Journalists Perspective* by Mr Pallava Bagla, and a public lecture on *Rock Paintings in Central India* by Professor GL Badam (Retd), Deccan College, Pune were also delivered.

- The following award lectures were delivered during the Anniversary meeting held on 30th December 2015: i) INSA Medal for Promotion & Service to Science (2014) Lecture on *Evolving Approach of Biology to Ayurveda* by Professor MVS Valiathan, FNA, National Research Professor, Manipal University, Manipal: ii) The Aryabhata Medal (2015) Lecture on *Exotic Organisms and Novel Biology: World of Parasites* by Professor Alok Bhattacharya, FNA, School of Life Sciences & School of Computational and Integrative Sciences, Jawaharlal Nehru University, New Delhi.

- The Academy continued its linkages with 59 overseas Academies / Organizations in 50 countries.

Some Important Output Indicators

S. No.	Programme	Number supported
1	Research Professorships	4
2	Senior Scientist Fellowships	54
3	Honorary Scientist Scheme	68
4	INSA Visiting Fellowship	5
5	Seminar/Symposia/Conferences/Workshops	67
6	Young Scientist Research Programme	55
7	Research in History of Science	7 new projects + 21 ongoing projects
8	ICSU and other important scientific meetings	Delegations of Indian scientists sent to over 8 such meetings
9	Inter-Academy Bilateral Exchange Programme	25 Indian Scienists from India to other countries + 14 overseas scientists visited India
10	Publications	*Proceedings of Indian National Science Academy* - 3 issues along with *Academy News* *IJPAM* (Indian Journal of Pure and Applied Mathematics) - 5 issues *IJHS* (Indian Journal of History of Science) - 3 issues Annual Report in English & Hindi INSA Year Book 2016
11	Science and Society Programme	10 lectures by Fellows
12	Summer Research Fellowship Programme	Continued
13	Local Chapters	18 Chapters continued functioning
14	CICS, Chennai	Continued 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, organization of lecture series.

Interactive session of Summer Research Fellows and their mentors held on June 22, 2015 at INSA premises

Dr DM Salunke, Vice-President INSA delivered a lecture on September 28, 2015 during the Joint Session of IAP Executive Committee, IAC Board and IAMP Executive Committee.

Dr R Chidambaram, Principal Scientific Adviser to the Government of India delivered a lecture on September 29, 2015 during the Joint Session of IAP Executive Committee, IAC Board and IAMP Executive Committee

THE INDIAN SCIENCE CONGRESS ASSOCIATION (ISCA), 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.

Some Major Accomplishments

- Holding of 103rd Indian Science Congress at Mysore University, Mysuru under the General Presidentship of Dr A K Saxena, Kanpur in the presence of the Hon`ble Prime Minister of India.
- Recommendations on focal theme of 103rd Science Congress "Science and Technology for Indigenous Development in India" will be published, and forwarded to Department of Science and Technology and will be printed in Everymans' Science and to be hosted in ISCA Web site.
- 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. Asutosh Mookerjee fellowships for seniors scientists have been started since 2013-2014.
- The Association carried out constructive work for the popularization and advancement of science by organizing seminars, symposia, discussions, popular lectures, quiz contest, 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 organized joint collaborative programmes with other organizations .
- The Journal of the Association "Everyman's Science", which is circulated to all members free of cost, was published regularly.
- ISCA started microfilming of old ISCA publications.

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

Areas of Focus

Promotion & Popularisation of Science & Technology; Aid & advise the Government in Policy Making.

Some Major Accomplishments and Output Indicators

Publications:

- Regular publication of Proceedings of NASI, Sec. A & B, each in IV parts & Science Letters in VI parts.
- Published two books in collaboration with Springer - (a) on Light to celebrate the International Year of Light; and another (ii) on Dengue (in Hindi).
- Published a Monograph by Prof P N Tandon, world famous medical scientist giving account of his tryst with bio-medical research.

Science Communication Activities:

- Organized - Children Science Meet, Summer and Winter Schools, Vocational Training Programmes, Teachers Workshops, Scientific Writing Contest, Vigyan, Jal & Health Chaupals, Seminars, National Technology Day, National Science Day and World Environment Day.
- Recognized the teachers for out-of-the-class science activities by presenting NASI-Science Teacher's Awards to them.
- Hundreds of science communication activities, benefitting more than 10,000 students and teachers were organized by 18 Chapters of NASI in their respective regions throughout the year.
- A series of workshops on Scientific Paper Writing was organized, in Varanasi, Lucknow, Allahabad, Udaipur, Mumbai, Dehradun and Pune to train young researchers to clearly express their views and research findings. Two awareness programmes for the Army personnel was also organized.
- Exhibitions in villages were organized for motivating the rural youth to take up self- employment.
- NASI in collaboration with the other two Science Academies - Indian National Science Academy, New Delhi and Indian Academy of Sciences, Bangalore jointly sponsored 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.

Annual Session/Symposia/Seminars & Scientific Discussions:

- Coinciding with its 84th Annual Session, a symposium on "Desert Science- Opportunities and Challenges" was organized at Jai Narayan Vyas University, Jodhpur, Rajasthan during December

4 - 6, 2014. Brainstorming Sessions on climate change and its impact on our ecosystem, Safe Water & Sanitation (in Allahabad & Delhi), Climate Change (inaugurated by Hon'ble Minister at Jammu) were organized. Several sensitization programmes on Nutrition & Health; Environment, Pollution & Conservation Issues and Marine & Fresh Water Ecosystems, were also organized.

Fellowship / Membership: Recognizing the outstanding scientific contributions made by scientists, the Academy awarded more than 100 Fellowship/Membership to scientists in different areas of science & technology, selected from all across the country. Awarded limited Foreign Fellowships to those scientists working in collaboration with the Indian scientists from abroad.

Institution of Awards: Every year NASI recognizes outstanding contributions made by scientists by giving away the following awards:

- **NASI-Reliance Industries Platinum Jubilee Awards** for Application Oriented Innovations covering both Physical and Biological Sciences.
- **NASI-Young Scientist Platinum Jubilee Awards** in the fields of Biological/Physical/ Chemical Sciences;
- **NASI Scopus** Awards.
- **NASI-Senior Scientist Platinum Jubilee Fellowships**
- **Prof. M. G. K. Menon Lecture Award (for the first time in 2015),** given to **Prof. Govind Swarup,** a world famous scientist.
- **NASI – Swarna Jayanti Puruskars** for Best Paper Presentation in the Annual Session.
- **NASI – Springer Award** for Best Paper Presentation in the Annual Session (started from this year, in collaboration with the Springer India Pvt. Ltd.).
- **Memorial Lecture Awards** to the eminent scientists.
- **NASI – Science and Maths Teacher Awards**

Establishment of Brahmaputra Gallery at Guwahati, Assam; and another at Mysore on Cauvery

After the establishment of Ganga-Gallery at Allahabad, the Academy established Brahmaputra river gallery in Guwahati, Assam. A booklet on Brahmaputra was released by the Hon'ble Minister. Work on the third gallery on Cauvery has been initiated at Mysore, Karnataka with the financial support of the Govt. of Karnataka. These galleries show case our socio-scientific heritage, with enormous potential of depicting ecological, economic and ethnic importance of the river basins.

Sensitization Programmes for Women Researchers/Scientists & on DISHA Programme: **Four workshops on Technological Empowerment of Women** were organized at different centres of the country. About 2500 women scientists/researchers were sensitized under this programme; a booklet

published with pragmatic solutions to the problems of women scientists/researchers was distributed. Collaborations were established with ICAR, ICMR and other institutions for developing some mechanisms to reduce the problem of malnutrition and drudgery of farm/rural women.

Rejuvenation of Baolies (Step wells) in Bundelkhand area: Under the safe water programme, in collaboration with MPCOST, restored 5 wells in the Bundelkhand area to assure availability of safe water to the local tribals.

CAPACITY BUILDING OF R&D INSTITUTIONS

Fund for Improvement of S & T Infrastructure in Universities and Higher Educational Institutions (FIST)

FIST Program is the flagship infrastructure program and was the Millennium year initiative by the Government. Formally launched in FY 2000-01, the FIST Program facilitates 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 I 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 circumscribes four basic purposes i.e. Equipment, Networking & Computational Facilities, Infrastructural Facilities and Maintenance. The quantum of support is limited to Rs 1.50 Crore, Rs 3.0 Crore and Rs 10.0 Crore for Level 0, Level I and Level II respectively, depending on the level of support.

Highlights of activities during 2015-16: The 15th round of operation was initiated and fresh proposals were invited in March 2015 through advertisements from eligible S&T related departments and PG colleges for considering support under this program. During this year, 459 new proposals in all levels (L0-175, Level I- 189 and Level II – 95) were received and finally166 proposals (L0-57, Level I-90 and Level II-19) were identified to consider financial support for varying quantum (from Rs.20 lakh to Rs.725 Lakh) at a total budget of about Rs.227.38 crores for 5 years. Alongside the process of evaluation of new proposals, progress of ongoing projects at departments/ PG Colleges was reviewed. DST also adopted some pro-active measures towards encouraging research at the College level by making provision of additional support to the performing colleges.

Besides the new proposals, grants to the ongoing projects were also released during this year. So

far, nearly 2315 S&T departments and PG colleges (Level 0-301, Level I-1796 and Level II-216) have been supported with a total investment of Rs.2152 crores.

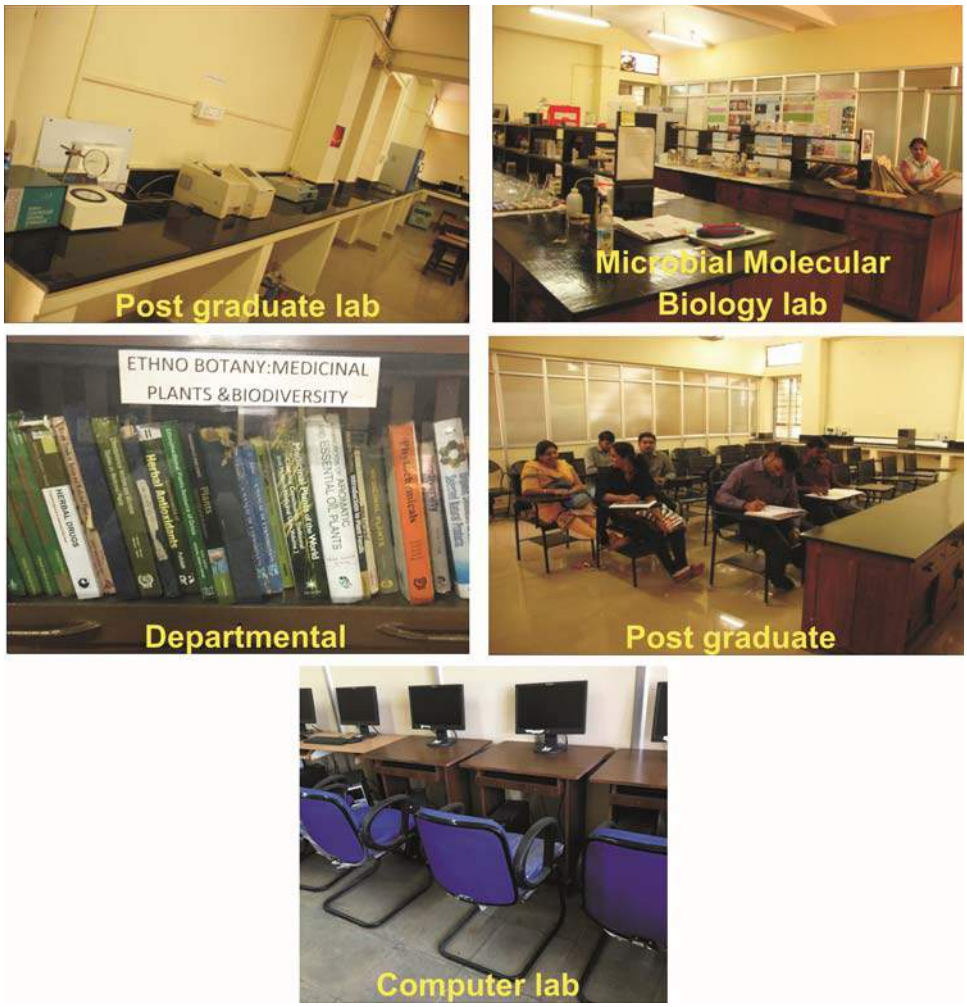
Outcome: Ever since its inception, the FIST Program has provided sustainable funding over last fourteen years that has made deep impacts in many departments across the country to carry out advanced research in contemporary areas of science and technology and also set-up modern teaching facilities. FIST Program has been instrumental in establishing state-of-the-art facilities for performing high end research and have thus benefited academicians and researchers across the country. 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.

The realm of the FIST Program has engendered many prestigious medical/ veterinary/ paramedical 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.

Further, several departments of renowned Agricultural Universities have been regular recipients of the FIST Projects both at level I and II. This Program has significantly contributed to the enhancement of teaching and research infrastructure in many Universities inluding Assam Agricultural University, Johrat; University of Agricultural Science, Bangalore; University of Agricultural Science, Dharwad; CCS Haryana Agricultural University, Hisar; CSK Himachal Pradesh Krishi Viswavidyalaya, Palampur; Dr Y S Parmar University of Horticulture & Forestry, Solan; Punjab Agricultural University, Ludhiana; Tamil Nadu Agricultural University, Coimbatore; GB Pant University of Agriculture, Pantnagar etc..

Alongside facilities for capacity building of teaching and research, Computational facility is also provided to the Departments supported under this Program. The Program has benefited Communication technology based infrastructures such as Grid Computing, Networks and Communications systems, Cloud Computing infrastructure in many engineering Departments. The Departments of small colleges and universities have also been supported with grant to acquire Books for the Departmental Library.

More than 300 PG Science/ Engineering/ Medical Colleges have undergone rejuvenation of teaching and research facilities during the last fourteen rounds of support.



Life sciences related research infrastructure provided at the Department of Agricultural Microbiology, University of Agricultural Sciences, Bengaluru and Dept. of Botany, Osmania University, Hyderabad.

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) 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 4 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 flexibility 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.

PURSE supported major research facility at the Panjab University, Chandigarh.

Outcome of the Scheme

Based on "performance linked" investment model exclusively for Universities, the first 14 Universities were again considered for support under PURSE Phase 2 Program as an incentive for maintaining excellent growth rates both in overall publications and h-index. Against an investment of Rs 890 crore as planned for 44 performing Universities (listed below in **Table 1** – 14 Universities in

Phase I & II and 30 Universities in Phase I) since the year 2009 till now, an amount of ~Rs 500 Crores has been made available, so far, to the various Universities. In the current year, an amount of Rs 90 crore has been released under this Program.

A study through an external agency to assess the performance of 10 year period is underway for considering fresh as well as existing supported Universities under the PIURSE Program in next financial year.

Table-1 : List of 44 Universities supported under PURSE (Phase I and Phase II Program)

Name of the University		
Phase I	**Phase II**	**Phase I**
University of Delhi, Delhi		University of Calcutta, Kolkata
University of Hyderabad, Hyderabad		Annamalai University, Annamalainagar
Punjab University, Chandigarh		Bharathidasan University, Tiruchirapalli
University of Pune, Pune		Bharathiar University, Coimbatore
Jadavpur University, Kolkata		University of Burdwan, Burdwan
Banaras Hindu University, Varanasi		Guru Nanak Dev University, Amritsar
University of Madras, Chennai		Sri Venkateswara University, Tirupati
University of Bombay, Mumbai		Mahatma Gandhi University, Kottayam
Jawaharlal Nehru University, New Delhi		University of Jammu, Jammu
Aligarh Muslim University, Aligarh		Cochin University of Science & Technology, Cochin
Karnataka University, Dharwad		M S University of Baroda, Vadodara
Anna University, Chennai		Shivaji University, Kolhapur
Andhra University, Visakhapatnam		Utkal University, Bhubaneswar
University of Rajasthan, Jaipur		Madurai Kamaraj University, Madurai
		University of Kerala, Thiruvananthapuram
		Osmania University, Hyderabad
		Dr Harisingh Gour University, Sagar
		Mangalore University, Mangalore
		University of Kalyani, Kalyani
		University of Mysore, Mysore
		University of Lucknow, Lucknow
		Pondicherry University, Pudducherry
		CCS Haryana Agricultural University, Hisar
		Bangalore University, Bangalore
		Punjab Agricultural University, Ludhiana
		Tamil Nadu Agricultural University, Coimbatore
		University of Agricultural Sciences, Bangalore.
		Alagappa University, Karaikudi
		Sardar Patel University, Anand
		North Eastern Hill University, Shillong

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.

Sophisticated Analytical Instrument Facilities (SAIF)

Sophisticated analytical instruments are vital for research in many areas of science and technology. Although, research infrastructures in the different Universities/ Institutes have been augmented and modernized in the last two decades, many institutions in the country still lack the existence of specialized facilities to carry out both basic and advanced research in contemporary areas of science and technology. The Department of Science & Technology has thus set up Sophisticated Analytical Instrument Facilities (SAIFs) in different parts of the country to provide the facilities of sophisticated analytical instruments to the researchers in general, and specially from the institutions that do not have such high end instrumentation facilities, to enable them to pursue R&D activities and keep pace with developments taking place globally. At present there are 18 Sophisticated Analytical Instrument Facilities (SAIFs) 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; Sophisticated Test & Instrumentation Centre (STIC), Kochi; IIT Patna; IIEST, Shibpur, Guru Ghasidas University, Bilaspur; Shivaji University, Kolhapur; University of Rajasthan, Jaipur; MG University, Kottyam; and Karnataka University, Dharwad.

The SAIFs are equipped with instruments such as Scanning Electron Microscopes, Transmission Electron Microscopes, Electron Probe Micro-analyzer, 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.

a) Instrument Facilities Strengthened in Various SAIFs

Instrument facilities were strengthened during the year in the areas of Electron Paramagnetic Resonance Spectroscopy, High Resolution Mass Spectrometry, Elemental Analysis and Thermal Analysis to meet the current and emerging needs of research community. Some of the major instrument facilities installed at the SAIFs during the year are FE-SEM with EDAX at the SAIF, Mumbai and at SAIF Chandigarh, Energy Dispersive Spectroscopy (Photograph) at SICART, Vallabh Vidyanagar and 200 KeV TEM, at the SAIF, Kochi. Accessories including Ultramicrotome and Dimple Grinder were added to the SAIF, Kochi to make them more useful to the users. 500 MHz FT-NMR Spectroscopy with Microprobe and Solid State Accessories, Dual source Single Crystal X-Ray Diffractometer and HR-LCMS/MS (Orbitrap) are being added to the SAIFs at IIT Chennai and at SAIF at IIT Mumbai, to further strengthen them.

b) Analysis provided/ Usage of the facilities

- 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, Research in Condensed matter physics/material science, Nano-science & technology, studies related to crops/seeds, insecticides, various diseases etc. About 2,500 research papers were published by the users of the SAIFs with the support from the facilities provided by the SAIFs during the year. The facilities at the SAIFs also helped Ph.D. students in their research work.

- About 20,000 research workers from all over the country utilized and benefited from the facilities provided by the SAIFs during the year. These included research workers from almost all the universities in the country. About 90% of the users are from academic sector.
- About 1, 35,000 samples were analyzed at the facilities during the year.

c) Workshops/Training programs/Short term courses organized

Sixteen Workshops and training programs were organized by various SAIFs on use and application of various instruments and analytical techniques to create awareness among the research community about them and on maintenance/repair/operation of the instruments for technicians. About 30 participants attended each of these workshops/training programs.

Instrumentation facilities at SAIF Centres at CDRI, Lucknow and NEHU, Shillong

Apart from above, workshops/training programs for researchers, the SAIFs also organized short term training on various instruments/techniques for Post Graduate students.

d) Analytical techniques developed/significant analysis done/research work facilitated

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

- Diffusion Ordered Spectroscopy (DOSY) has been implemented in the AVIII FT-NMR (500 MHz) Instrument. This technique is successfully employed for determining the diffusion coefficient of polymer samples and also for the spectral separation of individual components of sample mixtures by SAIF at IIT Chennai.
- In a research work carried by KLE College of Pharmacy, Balgaum, synthesis of novel pyrazole-thiadiazole hybrid as potential potent and selective cycloxygenase -2 (COX -2) inhibitors was facilitated by SAIF, IISc, Bangalore
- Sensitivity enhancement in slice selective NMR experiments through polarization sharing was carried out by IISc., Bangalore
- Novel crystals of dimeric copper (ii) complexes of 5-Methlisalicylaldehyde and 5-bromosalicylic acid with 2, 2, 0 bipyridine and 2, 2, 0- biimidazole were synthesized; Crystal structures were elucidated. The work was carried out by Dept. of Industrial Chemistry, Allagappa University, Karaikkudi and facilitated by STIC, Kochi.

Joint Collaborative R&D activities between DST and RCUK

Since 2008, towards enhancement of linkages between India and UK, the Department of Science & Technology 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 aim of such joint research and development collaborative programs is also raising the impact & profile of collaborative activity and facilitate 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.

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.

a) Indo-UK Advanced Centre of Excellence in Next Generation Systems & Services-Phase-2

The Indo-UK Advanced Technology Centre Phase 2 project with nine participating institutes was sanctioned in October 2012 at a total cost of Rs.18 Cr. The project has ended its tenure in September 2015. The project comprised of three main groups to tackle the challenges. 1. Applications and Services, 2. Core Networking Systems and Cloud, 3. Heterogeneous Wireless Access Networks. The consortium comprised of leading universities in India and UK with industrial participation from both countries. The project has provided solutions for creating hardware and software solutions at affordable prices and next generation research in Computer Science/Electrical Engineering, Information communications and Technologies.

b) DST- RC UK Research Collaborations in the areas of Solar Energy

Indo UK joint collaborative project "Advancing the Efficiency and Production Potential of Excitonic Solar cells (APEX)" project was sanctioned at a total cost of Rs. 5.4 Crores for 2 years at seven participating institutes, NPL, New Delhi, NCL, Pune, JNCASR, Bangalore, IITD, IICT, Hyderabad, IISc, Bangalore and IIT Kanpur and the first installment of funds was released in August, 2015. The project had been focusing on the development of new functional materials, device structures, materials processing and engineering of photovolataic modules, utilizing excitonic solar cells.

c) Research Initiatives on Smart Grid and Storage

DST in collaboration with the Research Councils UK (RCUK) led by the Engineering and Physical Sciences Research Council (EPSRC) is aiming at strengthening collaboration between UK and Indian research institutions. Smart Energy Grids and Energy Storage have been identified by India and the UK as areas of significance in providing solutions to the problem of meeting future energy needs. 5 research proposals has been supported focusing in the areas namely, Appropriate distributed storage technologies, On/off grid energy systems, DC networks and Control & communications. These projects are currently under joint implementations.

Nine National Institutions has been supported under the RCUK i.e. Indian Institute of Technology Delhi, Indian Institute of Technology Kanpur, Indian Institute of Technology Kharagpur, Indian Institute of Technology Madras, Delhi Technological University (DTU), Visvesvaraya National Institute of Technology- Nagpur, Indian Institute of Technology Roorkee, Malaviya National Institute of Technology (MNIT)- Jaipur and Indian Institute of Technology Bombay. The name of UK institutes supported are The University of Manchester, Imperial College London, University of Strathclyde, University of Exeter, Queen's University of Belfast, University of Bath, Cardiff University, Durham University, University of Nottingham, University of Warwick

The following 5 proposals have been approved for funding under DST-RCUK under the areas of

Smart Energy Grids and Energy Storage (SEGES) Technologies. The approximate commitment of DST is Rs.35.01 Crores for 3 years.

Principal Investigator & Institute	Project Title
Dr. Prabodh Bajpai, IIT Kharagpur	Reconfigurable Distribution Networks
Prof. Chandan Chakraborty, IIT Kharagpur	Reliable and Efficient System for Community Energy Solutions- RESCUES
Dr. Prakash C Ghosh, IIT Bombay	Intelligent Microgrids with Appropriate Storage for Energy (IMASE)
Dr. Nilanjan Senroy, IIT Delhi	Advanced Communication and Control for the Prevention of Blackouts (ACCEPT)
Prof. N. P. Padhy, IIT Roorkee	High Energy And Power Density (HEAPD) Solutions to Large Energy Deficits

d) Research Initiatives on Advanced Manufacturing

Department of Science and Technology (DST) and the Engineering and Physical Sciences Research Council (EPSRC), UK jointly identified and supported seven research projects within a total investment of Rs.16.0 crore from India side in the area of Advanced Manufacturing with an investment plan of 3M UK Pound by each country during 3 years of project duration:

e) Initiatives on Applied Mathematics has 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.

On different theme areas, eight workshops (4 each in India and UK) have been organized in which around 300 Faculty Members and students participated from both the Nations. They have immensely benefited from these joint workshops, organized by DST and RC-UK.

PROVIDING MEGA FACILITIES FOR BASIC RESEARCH

This programme is aimed 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 further momentum during the year. India has to supply following items to FAIR as its in-kind contribution: Power converters, Vacuum chambers, Beam stoppers, Superconducting magnets and Advanced detector systems. During the year, significant progress was made in each segment as given below:

Power converters: About 600 power converters are to be built by ECIL-Hyderabad. The first prototypes were built at VECC-Kolkata, RRCAT-Indore, BARC-Mumbai and ECIL-Hyderabad. During the year, controllers for power converters supplied by FAIR were integrated successfully with one of the prototypes. ECIL team got the final design document (FDR) approved by FAIR and the production of pre-series prototype started during the year. Technical specifications and contract documents for another set of 120 power converters were also completed during the year.

Vacuum chambers: About 70 ultra high vacuum chambers are to be built in India. During the year, after extensive technical and financial level discussions, iDesign-Pune was given the order to build a pre-series prototype vacuum chamber.

Beam stoppers: The purpose of this device is to absorb high energy and high intensity primary and secondary beam particles. There will be 3 such absorbers and Indian contribution will be to design, built and test the entire system. The design is a specialized work as the system is in high radiation environment and needs to deal with static and dynamic beam profiles. CMERI, Durgapur completed preliminary design of one chamber during the year.

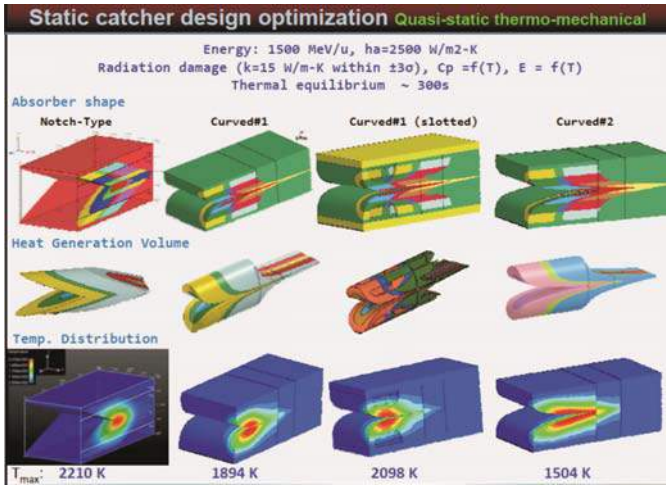


Fig. 1: Part of the beam stopper design by CMERI, Durgapur

Superconducting magnets: Several large-aperture superconducting magnets are to be designed and built in India. During the year, VECC engineers completed the first set of design as per the specifications given by FAIR. The cost was found to be higher than the FAIR cost-book price. Rework on the design is underway for finding a cost-effective solution.

Participation in FAIR experiments: Indian researchers will participate in a big way in two large experimental collaborations of FAIR i.e., Nuclear Structure and Reactions (NuSTAR) and Compressed Baryonic Matter (CBM). A large number of teams from national labs and universities submitted proposals for their participation. The proposals were then evaluated by an Expert Committee.

A Discussion Meeting on "CBM-Electronics" was organized by Bose Institute in January 2016 at their Darjeeling campus involving participants from research labs and industry.

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

Support to CMS, ALICE and GRID projects continued during the year. Indian researchers and Ph.D. students from different institutions across the country continued their research work under these projects.

Associate Membership of CERN

India submitted the detailed application for India's Associate Membership of CERN to CERN during the year after deliberations at the national level. The CERN Task Force would be visiting India during February, 2016.

India-based Neutrino Observatory (INO), Madurai

Support to 13 university groups for INO-related R& D work continued during the year.

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

Support to this important project continued during the year. India continued participation in scientific studies on infrared guide star catalogue work package, case study of polarimetry observations with TMT, first light instrument Wide Field Optical Spectrometer design studies. Indian scientists also continued work towards prototype development of hardware systems (edge sensors, segment support assembly, actuators), software (telescope control system, observatory software) and M1 Segment polishing.

Fig.2. First batch of prototype sensors

A Dynamic Loading Assembly set up was developed in-house to test the performance of the actuators.

Fig. 3. Dynamic Loading Assembly Set up

Besides scientific results and development work, 18 research publications emerged from the project during the year. 4 Project Engineers, 3 Post-Doctoral fellows, 4 Ph.D students, 3 M.Tech. students and 2 Project Interns received training regarding different aspects of the project. The Executive Council for the project was constituted during the year.

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

Scientific deliberations on this project continued during the year. SKA will be the largest radio telescope to be built in the world and it will be located in South Africa and Australia. India has also joined this project. National Centre for Radio Astrophysics (NCRA) of the Tata Institute of Fundamental Research (TIFR), Pune and Raman Research Institute, Bengaluru (RRI) are the Lead Institutions. NCRA is being funded by DAE and RRI by DST through its institutional support.

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

Support to 8 institutions involved in the project continued during the year. Indian faculty members and Ph.D. students from different institutions across the country continued research work on different experiments at Fermilab.

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

Support to this project continued during the year. Installation and commissioning of XRD2 and Xpress beamlines were successfully completed during the year. A general layout of the developed beamlines is shown in Fig. 4 below:

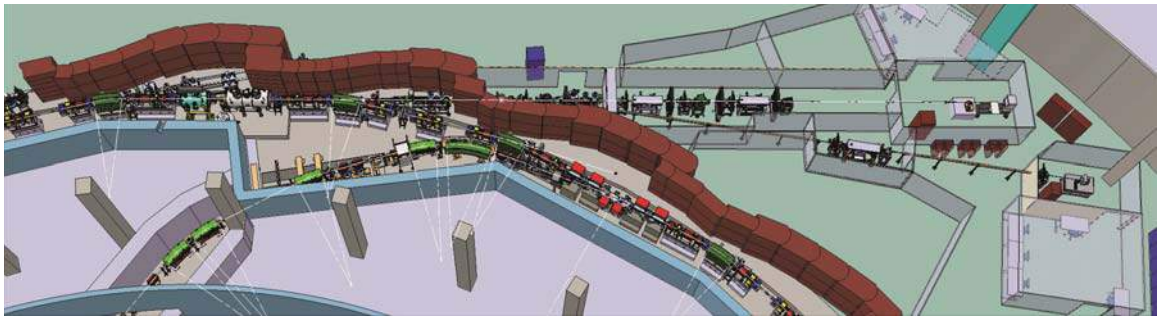


Fig. 4: Layout of XRD2 and Xpress beamlines

5 experiments on Xpress beamline were successfully completed by 3 Indian user groups during the year. Besides development work, the project also resulted in 1 Journal paper and 3 Poster presentations in different international conferences. 2 technical personnel were also trained on the developed beamlines. The progress of the project was also reviewed during the year.

Others

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

STRENGTHENING SURVEY AND MAPPING CAPABILITY

SURVEY OF INDIA

Survey of India (SoI) is a sub-ordinate organization under DST, it has a vital role to play in catering the critical needs of the base foundation data-sets in the country. Modernization of SoI would be in-built into serving GIS Ready dataset as a deliverable – to enable SoI support the objective of providing a GIS Platform for Decision Support System.

Highlights of activities of the scheme during 2015-16:

(i) Generation of National Topographical Digital Database on various scales.

(ii) Updation of National Topographical Database on various Scales.

iii) Generation of OSM Hindi version and OSM Regional Languages version.

iv) Preparing OSM vector Data for Web Services like WMS, WFS etc.

v) Specialized Survey for Geodetic and Geophysical data collection i.e. High Precision Leveling, Gravity Survey, Geo-magnetic Survey and Tidal observation etc.

vi) International Boundary Demarcation, Pillar Re-location or Relay Works.

vii) Preparation of 05 State maps, 07 Guide Maps and 13 Tourist Maps.

viii) Execution of various Developmental projects of National Importance such as ICZM, CMPDI, CGWB and NUIS Project etc.

Outputs/Services Produced:

(a) R&D manpower trained/generated :

Indian Institute of Surveying & Mapping (IISM), imparts training to the Officers and Staff of Survey of India and other Government Organisations, Private Individuals and Scholars from various Afro-Asian countries.

IISM, Hyderabad conducts M. Tech (Geomatics) and M.Sc. (Geospatial Science) Post Graduate Programme of two years duration in collaboration with Jawaharlal Nehru Technological University (JNTU), Hyderabad.

11 departmental Officers and 218 extra-departmental trainee (s) have been trained up to November, 2015. Further 88 departmental officers, 10 extra departmental trainee from Centre/State Government organizations, 07 Foreign trainee and 19 others are undergoing the training.

(b) Generation of National Topographical Digital Database on various scales:

Initiative: National Digital Topographical Data Base of the entire country on the 1:250,000 scale,

1: 50,000 scale and of some parts of the country on the 1:25,000 scale has already been completed. Generation of Digital Topographical Data Base of remaining existing maps on 1:25,000 Scale available in the Hard copy as printed maps, PT section, Air survey section, Scribing section etc are in progress.

Achievement: Digitization of 1:25,000 scale maps, QC/ Examination of digital data and OSM preparation completed during the year.

Digitization	=	795 sheets
QC	=	709 sheets
Preparation of OSM	=	265 sheets
Hard & Soft copy examination	=	270 sheets

(c) Updation of National Topographical Database on various Scales:

Initiative: Survey of India (SOI) is the National Mapping Agency (NMA) of the country and bears the responsibility to ensure that the country's domain is surveyed and mapped suitably. SOI provides topographical base maps on 1:25K/50K/250K scales to cater for the Security and developmental needs of geo-spatial data of the country.

To fulfill the requirements of high quality spatial data for socio-economic developmental activities, conservation of natural resources, planning for disaster mitigation, expeditious infrastructure and development works of the Nation, Survey of India has proposed and executed the work of Preparation of updated OSM and DSM datasets (DTDB & DCDB) with pre-field updation using High Resolution Satellite Imagery (HRSI) followed by revision survey on ground and the same is being undertaken by all Geo-spatial Data Centers.

Achievements: Survey of India has completed the updation of topographical data on the 1:250,000 scale, 1: 50,000 scale and 1:25,000 scale as detailed below:

1:50K scale sheets

Pre-field updation (Using latest Satellite Imagery)	=	122 sheets (including 61 Trans border sheets)
Revision survey	=	17 sheets

1:25K scale sheets

Pre-field updation (Using latest Satellite Imagery)	=	575 sheets
Revision survey	=	136 sheets
Post field updation	=	58 sheets

(d) Generation of OSM Hindi version and OSM Regional Language (s) version:

Initiative: Survey of India has completed Open Series Maps (OSMs) on 1:50,000 Scale English version and are available for use by the users. To fulfill the requirements for Hindi version and regional language (s) version preparation of OSM (Hindi) and OSM (Regional Languages) on 1:50,000 scale is under progress.

Achievements: Survey of India has completed the preparation 426 Nos. of OSM Hindi version and 06 Nos. of OSM Regional Language during the year.

(e) Providing OSM DTDB Data for Web Services like WMS/WFS:

Initiative: Survey of India is providing Web Map service (WMS) based on 1:50K OSMs through SoI portal "surveykshan.gov.in" for the open viewing as mandated by the NDSAP-2012. Efforts are underway to provide the data service of feature data through Web Feature Service (WFS).

Achievements: Preparation of Quality controlled base data on 1:50,000 scale for Web Map Service (WMS) was completed for 569 sheets and for Web Feature Service (WFS) 944 sheets have been quality controlled by various GDCs during the year.

Total OSM sheets Quality controlled and hosted as WMS = 3869 Sheets

(f) Specialized Survey:

Initiative: Survey of India is responsible for defining the horizontal and vertical frame work for entire country, maintains a series of tidal observatories located all along Indian Coast and Islands and also has the responsibility to Provide and Maintain the Gravimetric and Geomagnetic control network of country.

Achievements: Geodetic & Research Branch of Survey of India carried out the following activities during the year.

(a) Geo-magnetic observation on 60 stations at central India.

(b) Geo-magnetic observations are continued at Digital Geomagnetic Observatory, Sabhawala Dehradun for determination of Horizontal Force (HF), Vertical Force and Declination (D). These observations are helpful to monitor and record different components of geomagnetic variations and are necessary to control the baseline values of the Magnetogram.

(c) Work of Inspection and maintenance of Tide Gauges at 30 ports, installation of VSAT in 2 ports and HP/Secondary Leveling approx 153 lin. km. (Connecting 23 Ports).

(d) 32 days Tidal observation in Andaman & Nicobar Islands 5 ports and 30 lin. km. HP/Secondary levelling.

(e) Geodetic observations for provision of North alignment for Indian Space Research Orgnisation (ISRO)

(f) Provision of precise Horizontal and Vertical control for Lakhwar-Vyasi H.E. Project, Uttarakhand.

(g) Geodetic Observations for Marking of axis turn table of Inertial Navigation Global Positioning System (INGPS) Test Bench for Air Force, Bidar.

(h) Geodetic Observations for Marking in Flight hangar and provision of Lubber Line for Hindustan Aeronautics Ltd., Nasik.

(i) Geodetic observations for checking the verticality of Qutub Minar, New Delhi and verticality & Structural Stability of Taj Mahal & its minarets.

Observations for checking the verticality of Qutub Minar

(g) International Boundary Demarcation/Pillar Re-location or Relay Survey Works:

Initiative: Survey of India has been given the responsibility by the Ministry of External Affairs for all surveying works i.e. boundary demarcation, relocation of boundary pillars of International boundary with Nepal, Bhutan, Bangladesh, Myanmar, Pakistan and China. SoI also advises State Govts. and Govt. of India on matters of International boundary and States/ UTs boundaries and carries out surveys as and when required to resolve the disputes as Extra-Departmental jobs.

Achievements: All Surveying tasks associated with the International Boundary like Joint Inspection/Maintenance /Relocation of boundary pillars etc along International Border as given below were carried out during the year:

- Joint Inspection/Maintenance of boundary pillars along West Bengal – Bhutan Sector.
  Joint Inspection/Maintenance of boundary pillars along Arunachal Pradesh – Bhutan Sector.
- Indo - Pak Boundary (Punjab and Rajasthan Sector).
- Indo – Nepal Boundary work.

(h) Mapping and Delineation of Hazard Line:

Initiative : To delineate, map and benchmark the coastal hazard line all along the mainland coast of India under World Bank Assisted "Integrated Coastal Zone Management" (ICZM) project, where Survey of India has to generate a 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.
(Strip width of maximum 7 km from line towards main-land)

Achievement Control work consisting of GPS and leveling 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 been completed by Survey of India.

Total area of the Project = 75930 sq.km.

Eight coastal GDCs of Survey of India i.e. Gujarat, Maharashtra, Karnataka, Kerala, Tamilnadu, Andhra Pradesh, Orissa and West Bengal are engaged in various ICZM activities viz. Field control, Quality control works, Data handling etc.

(i) Coal Mine Project

Initiative: - Preparation of Updated Topographical Maps of Major India Coal fields (27 Coal fields) based on remote sensing technique.

This project is being executed by Survey of India with its own man power and resources. All activities covering various work stages are being carried out by the 07 GDCs of SoI i.e. Chhattisgarh, Orissa, Madhya Pradesh, Jharkhand, Maharashtra & Goa, West Bengal and Meghalaya & Arunachal Pradesh GDCs.

Pre-Pointing of Control points for CMPDI Project

Achievement: - Following stages of works are being carried out as part of this project by SoI

1. Primary Control provision i.e. Construction/ of BM/ GPS pillar, GPS observation and DT leveling – completed for all 27 coal field.
2. Model Block Control point provision i.e. GPS observation and ST leveling- completed for 10 Coal Field.
3. 2D feature extraction work - 1232 Sheets of 10 Coal field.
4. 3D feature extraction work - 986 Sheets of 10 Coal field.
5. Field verification - 854 Sheets of 10 Coal field.
6. Preparation of final deliverables.

(j) Survey for A.P. State Capital area:

Initiative: Government of Andhra Pradesh has requested Survey of India to supply the 1:5,000 scale Survey maps with 1m Contour interval for use in physical planning for various infrastructural works in the Proposed capital city area (approximately 220 Sq Km) in Guntur district.

Achievement: Survey of India completed the following job during the year.

GPS observations	=	350 points
Levelling	=	510 lin.kmn.
Feature extraction (Digital Photogrammetry)	=	45 sheets

(k) Study reports produced/generated and their brief findings:

i) Geomagnetic Bulletin for the year 2014, listing magnetic declination, Horizontal & Vertical Force recorded at Sabhawala Geomagnetic Observatory have been prepared.

ii) **33rd & 34th Antarctica Expedition**

Initiative: Survey of India participated in Indian Antarctica Research Programme in 34th Expedition & 35th Expedition. Large scale mapping has been carried out during the Expedition.

Achievement: Digitisation of Survey data collected during 34th Expedition is completed and submitted to NCAOR.

(l) New Plan Schemes conceptualized/approved/launched for implement:

Following sub-schemes under the Main Plan scheme "Modernisation of Mapping Organisation, Survey of India" were approved/implemented:

i) Setting up of Disaster Recovery Site at Hyderabad for National Library of Aerial Photography (NLAP) located at New Delhi is proposed to be implemented during current financial year 2014-15 of XII Plan period.

ii) Procurement of Desktop computers for different GDCs and has been implemented during current financial year 2015-16 of XII Plan period.

(m)Impact of the output on the concerned area of S&T ecosystem

Maps and data produced by Survey of India as part of implementation of various Plan Schemes and Project are being used by various Govt. Departments/Private Agencies/Institutes for planning, execution and implementation of various Strategic and developmental activities.

(n) Indo-Thai Geo-Spatial Cooperation Project:

As per MoU signed between Survey of India (SoI) the National Mapping Agency of Government of India under the ministry of Science and Technology (Department of Science and Technology) and Geo-informatics and Space Technology Development Agency (GISTDA) ministry of Science and Technology of Thailand, Government of the Kingdom of Thailand the training in surveying and mapping techniques to five officials of GISTDA at Indian Institute of Surveying and Mapping (IISM), Hyderabad imparted during the year.

Large scale mapping work is also being undertaken under this project for Thailand Government.

(o) Special Survey for Indian Air Force:

Initiative: Survey of India also prepared IAF-OGM, PGM, JGM, Land Approach Chart (LAC), LNC etc. and Carried out abstracting survey work for Indian Air Force.

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

(i) IAF (OGM) -25 Sheets, IAF- (PGM) – 47 Sheets, & Land Approach Chart (LAC) 15 Parts. JGM-22 Sheets

(ii) Verification of 10 Landing charts on 1:50k Scale including Obstruction Survey for 30 NM from ARP for IAF

NATIONAL ATLAS & THEMATIC MAPPING ORGANISATION

National Atlas and Thematic Mapping Organisation is engaged in preparing thematic maps and atlases that form the essential tool for planning and various other uses. Various activities undertaken during the year under report are as following:-

GOLDEN MAP SERVICE (GMS)

Golden Map Service was launched during the occasion of Golden Jubilee Celebrations in 2005.

It is a project of indefinite duration due to the very purpose of the project. GMS objectives are to provide location maps of any site of the country in black and white on web either by place-names or by geographical co-ordinates; to provide route maps between two points in the country; and to provide a basis for a variety of social, economic, administrative operations related to elections, crime, rural marketing, relief and supply etc.

INTERNATIONAL SCIENCE AND TECHNOLOGY COOPERATION

NATMO has entered into an international collaboration with the MOU signed between Geoinformatics and Space Technology Development Agency, Govt. of Thailand and Department of Science & Technology, Govt. of India, for cooperation in the field of Mapping and Geospatial Technology Applications, project on compilation of an Archaeological Atlas, has been entrusted to NATMO and GISTDA. Accordingly a project titled India-ASEAN Archaeological Atlas from Satellite Data – 'Connectivity of Regional Culture' was taken-up.

Joint Meeting with GISTDA delegates

Project presentation by NATMO Officials

The project aims the use of high resolution satellite images and the advanced geospatial tools to map the Buddhist archaeological sites in India and seven South East Asian countries viz., Thailand, Myanmar, Indonesia, Malaysia, Vietnam, Laos, and Cambodia.

International Collaboration and Achievements

The project was given a target time of two year, that is 2013 to 2015. NATMO has successfully completed all the thematic maps assigned to it well within the time frame. Since compilation of the data by GeoInformatics and Space Technology Development Agency (GISTDA), Thailand is awaited the project is not declared complete.

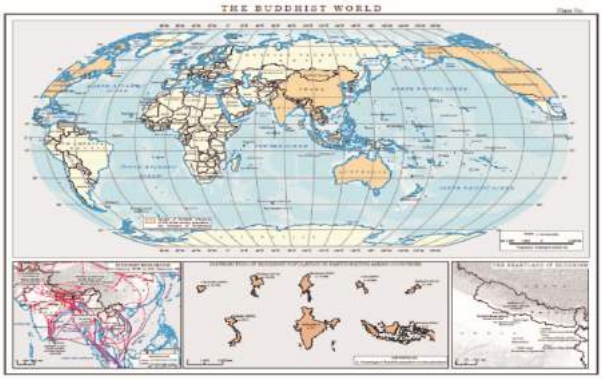


Fig. The Buddhist World – India ASEAN Archaeological Atlas

Fig. Physical Map – India ASEAN Archaeological Atlas

DISTRICT PLANNING MAP SERIES (DPMS)

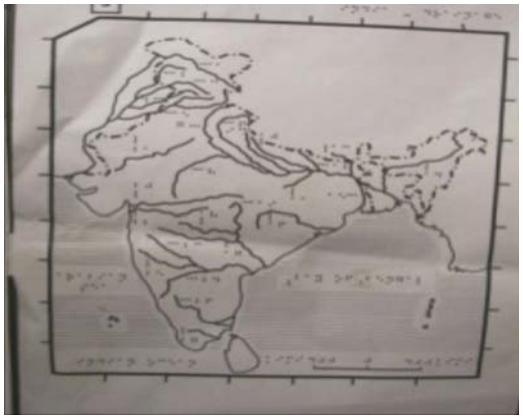
As per the decision of DCUSPC, NATMO has been assigned this project by DST in the year 1992 and work on the same had been initiated in the year 2002 after formulating the detailed specification. The main objective is to provide a ready-reckoner to the planners, researchers, students in respect of complete geographical, geological, geomorphological, demographic, cultural information and features along with administrative boundary, blocks, specialty, etc. of a particular district both in paper format and in digitized format both in Hindi and English.

Achievement: NATMO has completed almost 270 districts and many are in the verge of completion.

Other Maps: India Administrative (in English); India Administrative (in Bengali); Water Resources – Western India; Water Resources - Northern India; Water Resources – Central India.

ATLAS FOR VISUALLY IMPAIRED (BRAILLE MAP)

NATMO initiated the project to prepare Atlas for visually impaired in Braille script for the first time in the world. The objective was to disperse the technological development amongst the people who cannot get it due to their physical disability, i.e. blindness. Publishing Maps and Atlases in Braille Script will definitely provide the utility of maps to the visually challenged person.



One of the Braille Map of India

Atlas for Visually Impaired

'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 Andhra Pradesh 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.

TRAINING AND DEVELOPMENT FOR S&T ADVANCEMENT

NATMO provides training on Digital Cartography, Remote Sensing and GIS, GPS, Aerial Photography, to the officers and staff of various govt. and private departments, university and college teachers, scholars and students of the country. During the year 2015-16, 65 persons were trained in NATMO.

Process for obtaining necessary approval for commencing full-fledged degree and diploma courses on GIS, GPS, Remote Sensing, digital cartography, in collaboration with Universities/Institutions is going on.

Interactive Training Session

DMGIS Training

Major Achievements of NATMO during this period was concentrated under the following titles viz., GMS, DPMS, Atlases, and other Series.

Sl No.	GMS	DPMS	ATLAS	Other Maps
1	Bidhannagar (in 3 sheets)	Darjeeling	Primary School Atlas	Adventure Tourism Sikkim & Darjeeling
2	Bolpur Santiniketan	Sahajahanpur	Assam Secondary School Atlas	
3	Visva Bharati	Mewat		
4	Mahakashi	Karbi Anglong		
5	Gangtok	Tiruvannamalai		
6	Guwahati			
7	Barddhaman			
8	Vellore			

BUILDING GEOINFORMATION CAPACITY

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

Natural Resources Data Management System (NRDMS) is operational since more than three decades. It has gone into different phases with the pace of change of geospatial technologies. The current focus of the programme is to promote use of spatial data management technologies for various applications including R&D in spatial data technologies and developing capability and training in geospatial technologies and its applications. To facilitate this, number of geospatial Chair Professor positions have been created in various academic institutions and universities. The human resource development in this area has gained priority over the last few years to develop a pool of trained manpower in the field of geospatial technologies.

As part of NRDMS programme, number of sub programmes have been evolved such as

- Landslide hazard mitigation and warning system.
- National Geo-technical Facility (NGF)
- National geospatial public health and management system.
- Large Scale Mapping of the hotspot areas in Uttarakhand.
- Development of village information system.
- Revival of village ponds
- Geo-thermal energy and resource mapping / exploration.

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

National Data Sharing and Accessibility Policy (NDSAP) – notified in March, 2012 is being implemented jointly by DST (NRDMS) and DeitY (NIC). As part of this, a national open data sharing portal i.e. data.gov.in has been developed to proactively share the government shareable data to the general public. At present more than 20000 data sets contributed by 92 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 with their own open data sharable policy. At present six State Governments have adopted the Open Data Sharing Policy and notified for their use.

Spatial Data Re-engineering and GIS Data Assets

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

State Spatial Data Infrastructure (State SDIs)

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

Landslide Hazard Mitigation

As part of the integrated landslide programme, efforts have been made to develop forewarning system to monitor the critical landslides in different geo-environmental areas. The critical sites in Kedarnath Valley, Uttarakhand have been selected for large scale mapping and monitoring the landslide for developing suitable preventive measures. Number of R&D projects have been supported to various academic institutions to undertake related R&D studies to understand underlying cause effect of landslides. Specialized training programmes for the geologists to understand the geo-tech techniques for slope stability analysis were sanctioned. Also, the new technologies like Ground Penetrating Radar and Global Positioning System are being used to improve the data acquisition techniques for better analysis and developing suitable preventive measures. At present, 20 R&D projects are operational in various organizations.

National Geotechnical Facility

The National Geotechnical Facility has been set up in Poonch House, Dehradun. State-of-the-art facility on rock and soil mechanics testing facilities have been set up. This facility is providing enough scope to meet the requirement from academic as well as stakeholders to analyse the soil and rock samples for their strength parameters. The specialized training programmes for the scientists of Geological Survey of India, Railway Ministry and State Governments officials have been arranged to acquaint them with the geo-tech facility and its utility for addressing their problems.

National geospatial public health and management system.

"NATIONAL GEOSPATIAL PUBLIC HEALTH DATA AND MANAGEMENT SYSTEM [Health-DMS] evolved with the participation of more than dozens institutions to address issues like

- Methods for disease and Risk mapping
- Spatial patterns of diseases
- Hotspot detection of diseases
- Spatial diffusion of disease outbreak
- Road map for Spatial Epidemiological Model
- Geospatial analysis and visualization
- Healthcare emergency management
- Geospatial public health Interoperability
- Location based hazard vulnerability assessment

This initiative, embodying the spirit of networking would facilitate administrators, technologists, policy makers and medical doctors to synergize towards a better public health management ingenuity.

Large Scale Mapping of the hotspot areas in Uttarakhand.

A massive disaster occurred during June, 2013 in Kedarnath due to sudden, heavy rain and cloudburst on Chaurabari Glacier causing flash floods that further aggravated slope instability at different places on the downstream side of the Kedarnath. For the purpose of economy and safety, the slopes along the national highways are required to be investigated with the details of geology and geotechnical parameters.

Fig 1: Destruction at Kedarnath locality after the Uttarakhand tragedy of June 2013

In order to undertake sector wise studies from Rishikesh to Kedarnath about 150 km long stretch, 12 R&D projects in networking mode have been supported to various agencies to carry out

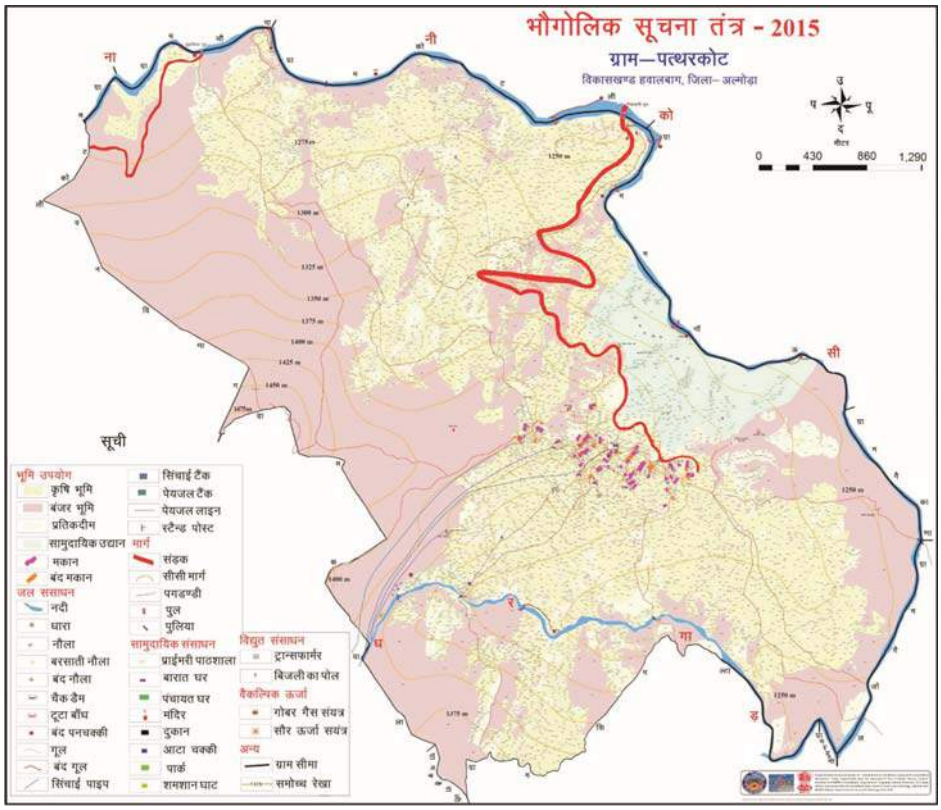
data acquisition, mapping and strategy to reduce the impact of disasters. The final outcome of this programme would be largely used for planning the infrastructure facilities in Uttarakhand State.

Development of village information system.

The Village Information System programme evolved is proposed to be implemented in networking mode. It will comprise of collection of spatial data on demography, natural resources, climate, land use land cover patterns and socio economic aspects etc. The broad objectives of the programme would focus on the following:

1) Identify and design a spatial data model.
2) Assessment, collection and collation of available data and supplement data gaps vis-à-vis developmental activities.
3) Validation of data model.
4) Development of an integrated information system using geospatial technologies.
5) Development of decision support information modules to empower planners and citizens.

To realize the dream of this programme, one dozen R&D projects have been supported to various academic institutions / universities to collect the data and analyse for bringing final outcome.



Revival of village ponds

A sub programme has been evolved to develop demonstrative strategies in different agro-ecological regions in the country for efficient management and utilization of pond water. This programme is under conceptualization. Thrust areas have been identified along with the participating agencies and their work components.

Geo-thermal energy and resource mapping / exploration.

Geothermal energy in India has tremendous scope to explore and develop the capability for harnessing the green energy. In this direction, efforts have been made to develop a concept paper for evolving comprehensive R&D programme including the institutions, the potential areas and the R&D activities to be undertaken by various groups. During the reported year, a small pilot demonstrative project was completed in Chumathang in Laddakh to harness the abundant geothermal energy through the hot springs and converting it into steam with latest technological device i.e. Heat Exchange Mechanism for showcasing the potential of geothermal energy in heating the houses. Also another demonstrative project for ground source heat pump is in progress in Dehradun which would be on the pattern of sucking the 3-4 degree temperature of the ground water and finally it will be converted through a mechanical device into steam for again showing the capability for heating the rooms.

Capacity Building, Dissemination and Training on Geospatial Technologies

Under NRDMS programme, concerted efforts have been made to provide support for conducting short term and long term training programmes on geospatial technologies and applications. During the last year, 03 short term and 25 long term (21 days) training programmes were supported to various universities and institutions. The training programme were meant for faculties and research scholars. In addition to this, a portal on GIS/ Remote Sensing Tutorial has been developed by Bhartiya Vidhyapeeth, Pune to build up the tutorial material and the pool of resource persons. To strengthen this concept, 6 geospatial chair professors were also created in different universities in the country to strengthen the education and training on geospatial technologies to larger community.

PROMOTING GOOD LABORATORY PRACTICES

The National Good Laboratory Practice (GLP) Compliance Monitoring Authority (NGCMA) was set up under the administrative control of Department of Science and Technology (DST) in August, 2002. GLP is a quality system under which non-clinical health and environmental safety studies are conducted on various chemicals for their submission to regulatory authorities e.g. Drugs Controller General of India. This 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, thus removing the technical barriers to trade.

Some of the major achievements of the Indian GLP programme during 2015-16 are as following:

- Four new test facilities were granted the GLP-compliance status and five test facilities were re-certified.
- A Three Day "Training Course for Quality Assurance Professionals of GLP Test Facilities" was organized in New Delhi during December 14-16, 2015.
- NGCMA, India organized the 12th OECD Training Course for GLP inspectors, in Hyderabad during October 12-15, 2015. The training course was a grand success and a letter of appreciation has been given to NGCMA, India by the OECD Secretariat.

12th OECD Training Course for GLP Inspectors organized by NGCMA (October 12-15, 2015)

- India has been elected as a member for conducting the Mutual Joint Visit (MJV) of Thailand and Canada for evaluating the respective country's GLP Compliance monitoring procedures and their adherence to MAD status.

CHAPTER 3

TECHNOLOGY CAPACITY STRENGTHENING

TECHNOLOGY DEVELOPMENT

Clean Energy Research Initiative

During the year 2015-16, Clean Energy Research Initiative promoted novel ideas and cutting edge research in the areas of solar energy and building energy efficiency for new/improved energy materials, processes, devices, sub-systems and systems. The thematic research areas were identified based on national needs. The initiative supports upstream end of research, where knowledge, more advanced than the current practice in the industry finds a space. The initiative also supports translational research utilizing already available know-how to consolidate research outputs and advance current technologies to drive down the costs of delivered energy. These scientific endeavours aim to develop pre-competitive technologies with potential for scale-up. The programme aims to create critical mass of researchers in the area of clean energy and prefers interdisciplinary multi-institutional networked research projects, synergizing strengths' of respective partners to deliver efficient devices/systems meeting global benchmarks.

NEW INITIATIVES

1.1 Solar Power Generation on Railway coaches

Ministry of Science and Technology in close cooperation with Ministry of Railways demonstrated solar power generation from Flexible CIGS Panels, Flexible interdigistised back contact solar cell and bendable mono crystalline solar panels installed on 3 rail coaches of 'Science Express- Climate Action Special' which was flagged off on October 15, 2015.

Solar Modules on Science Express

1.2 Building Energy Efficiency Higher & Advanced Network (BHAVAN) Fellowships: To address the need for human resource development and capacity building in the area of Building Energy Efficiency, a dynamic visitation program between premier Indian and US institutions and universities has been developed. The Building Energy Efficiency Higher & Advanced Network (BHAVAN) Fellowships aim to create a sustainable and vibrant linkage between the building research community of two nations. The term of internship is 3-6 months and fellowships is 3-12 months.

1.3 Technology Mission for Indian Railways (TMIR)

This is joint initiative to promote research in the areas to utilize research prowess of Indian scientific community relevant to Indian Railways. The mission envisages 25 % contribution of Ministry of Science and Technology amounting to Rs.75 crore for a period of 4 years. It is anticipated that more such demand centric projects would leverage the expertise available in scientific institutions.

1.4 Research Initiatives on Methanol Economy & Clean Coal Technologies

A Brainstorming session on methanol economy was organized with various stakeholders to finalize the action point to develop roadmap for production and utilization of methanol and DME. As a sequel to discussions, road-mapping exercise has been initiated in this area. Recognizing the importance of Clean Coal Technologies in the Indian context, the topic was discussed during Indo-US Energy Dialogue in October, 2015 and a national brainstorming is planned during the year under report.

Salient Achievements under Ongoing National projects

The achievements made in the ongoing projects during the year 2015-16 are as under:

A1. Development of Textured ZnO Thin Films for Solar Cells Front Contact Applications using Sputtering Technique on large area 1.1 m x 1.4 m *(Hind High Vacuum (HHV) Co. Pvt. Ltd. Research & Development Unit, Bangalore)*

An indigenous equipment for the cost-effective industrial production of Aluminum Doped Zinc Oxide (AZO) based Transparent Conducting Oxide (TCO) substrates has been developed. This system consists of a total of 5 chambers, a loading station and an unloading station. The instrumentation and the process technology for large area TCO coatings suitable for solar cell applications have also been developed.

The yearly production for the AZO based on a module output of 90 Wp for a single junction amorphous silicon module of size 1.1 m x 1.4 m is estimated at 10 MWp. The cost of indigenously produced AZO in bulk quantities could be about 24 ± 8 % less than the cost of the commercially procured Fluoride doped Tin Oxide (FTO). The suitability of the TCOs for fabrication of amorphous silicon based thin film solar modules has also been demonstrated thus making it possible to deposit all the layers required for the fabrication of the thin film amorphous silicon solar modules indigenously.

Large area AZO Coating System

A2. Development of Multi Layer Coatings for Enhanced Solar Thermal Absorption at High Temperature. (R .V. collage of Engineering)

A novel coating system has been designed and developed with a combination of DC magnetron sputtering and Plasma Enhanced Chemical Vapour Deposition (PECVD) system to deposit multi-layer coatings of metal, dielectric and hybrid composite coatings on metallic tubes. A 1 m long tube has been developed which would be useful for solar thermal power application.

1 m long tube for solar thermal receiver

A3. Development of large area, High Efficiency (19%) Passivated Interface Hetero Junction (PIHJ) solar cells (*Bharat Heavy Electrical Limited (BHEL), Amorphous Silicon Solar Cell Plant, Gurgaon & IIT Delhi)*

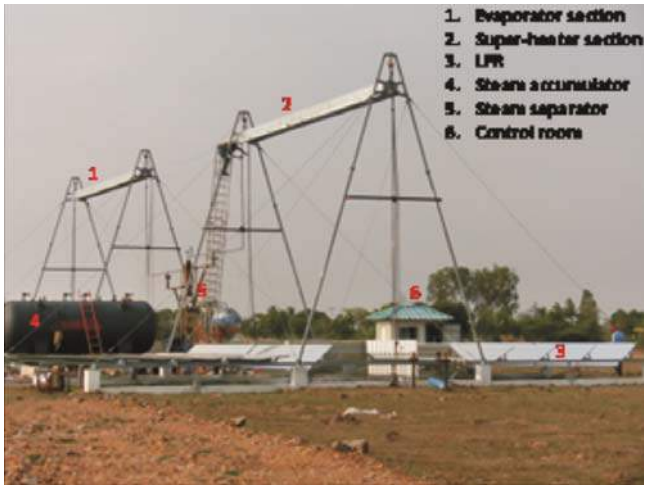
The specially designed Plasma Enhanced Chemical Vapour Deposition (PECVD) system has been commissioned to handle n type wafers with the focus on low thermal budget. The Wet Chemical Bench having High Frequency Ultrasonic Cleaning, High Resistivity DM Water with precise control of temperature and automatic operation with spin drying facility has also been set-up. Amorphous silicon film processing and characterization have been carried out to evaluate critical parameters and detect the possible causes of defects and to improve the efficiency of PIHJ solar cells to achieve 19% efficient solar cells.

A4.Solar Photovoltaic Hub *(Indian Institute of Engineering Science and Technology (IIEST), Shibpur, Howrah networked with several academic and industrial organizations)*

The hub is equipped with pre-commercial base line fabrication facilities for both crystalline silicon solar cells and amorphous silicon solar cells. It envisages R&D activities for enhancement of efficiency of crystalline silicon and amorphous solar cells through metal plasmonic and other nanostructures. Networking of academic and industrial organizations has been developed to synergise complementary expertise. Approximately 400 cells have been fabricated in the hub. Baseline efficiency of 14.5 – 15.5 % is achieved for crystalline -Silicon solar cells. Enhancement of efficiency of crystalline silicon solar cells by 0.5% – 1.5 % from their baseline values through the use of metal plasmonic structures and dielectric nanoparticles and nanostructures on front and back surface of c-Si solar cells have also been achieved. Scientific work relating to the further enhancement of baseline efficiency is being pursued by improving the AR coating, higher sheet resistance (80-100 ohms/square) of the diffused layer and use of new pastes for metallization.

A.5 Development of Solar Collector Fields for Solar Thermal applications (PAN IIT project)

The field analysis of 312 m^2 of Linear Fresnel reflectors established at Pathshala campus in Vallipuram, (Kanchipuram district) designed for 50kW thermal capacity provided new insights to the technological challenges of solar thermal system. In direct steam generation, the absorber tubes experience high pressure environment internally and non-uniform heat flux variation externally as a result of concentration. The heat transfer coefficient varies drastically between the liquid and vapour regions. This leads to severe temperature variation in the peripheral direction. The strong temperature variation coupled with strong variation of pressure across the absorber tube results in bending and structural failure of absorber tubes. A specially designed central tube with welded copper coils helps in uniformly spreading heat and providing structural support against absorber tube bending has been successfully developed. In addition the bench scale research facilities to investigate two-phase flow challenges has also been established at IIT Madras.



Solar Collector field of 50 kW Capacity

Salient Achievements under Ongoing International projects (Indo-US Joint Clean Energy Research and Development Centre)

B1. Solar Energy Research Institute for India and the United States (SERIIUS)

The vision of the Solar Energy Research Institute for India and the United States (SERIIUS), co-led by the Indian Institute of Science at Bangalore (IISc) and the National Renewable Energy Laboratory (NREL), is to create an environment for cooperation and innovation "without borders" to develop and ready emerging and revolutionary solar electricity technologies toward the long-term success of India's National Solar Energy Mission and the U.S. DOE SunShot Initiative.

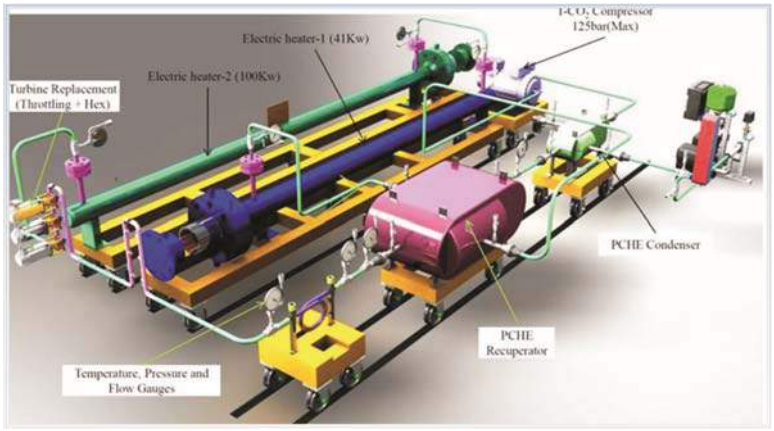
The research activities spanning over last 3 years have resulted in 5 patents (in progress), 74 publications in different journal and 142 conference presentations. SERIIUS outcomes are primarily in the R&D stage, which are listed below:

PV:

- Reliability Studies for Photovoltaics in India
- Soiling Mitigation for PV Modules
- Use of Flexible Glass for Substrates and Encapsulation

CSP:

- Intermediate-or prototype-scale demo of S-CO2 Brayton Cycle
- Scaled up versions of S- CO2 solar receivers
- Low cost Heliostat
- Absorber and reflector coating materials for parabolic trough
- Small scale ORC plant with high efficiency scroll expander
- New ternary low cost molten sale for high temperature storage



Supercritical CO_2 Brayton Cycle Test Loop

B 2. Centre for Building Energy Research and Development (CBERD)

The U.S.-India Joint Centre for Building Energy Research and Development (CBERD) is engaged in collaborative research and promote clean energy innovation in the area of energy efficiency in building with measurable results and significant reduction in energy use in US and in India. CBERD focuses on the integration of information technology with building physical system technology with aim to bring energy efficiency in commercial and multi-family residential high-rise buildings. The activities so far have led to publication of more than 50 papers in peer reviewed journal and conferences, filing of 4 patents and 2 tools have now become available in public domain.

A building design assistance tool 'COMFEN India' to predict daylight availability inside building in Indian context has been developed. A building design assistance tool 'eDOT' has been developed to understand complexity of operational end use energy helps in identifying various building components such as walls, roofs, windows and HVAC system responsible for higher energy consumption. Prototype Phase change material ceiling tiles have been developed to help increase internal thermal mass to operate buildings in naturally ventilated mode and at the same time help reduce HVAC operation hours .Laser cut window panels developed under the project help transport daylight deep inside a building without using any electricity. Dedicated Outdoor Air System (DOAS), with indirect evaporative cooling of fresh ambient air using exhaust from conditioned spaces is a low energy cooling technology meeting adaptive thermal comfort standards saves cooling energy considerable. Diabetic rotating contacting device based evaporative cooling technology for water saves operational energy where water is used in close loop for space cooling. This technology has more potential to provide thermal comfort in hot and dry climates. Low energy wireless motion sensor developed under the project is a wireless device which can be used to switch on/off an air-conditioner or any other gadget which has IR controlling interface such as TV, music system etc. based on the human occupancy in a given space. Affordable smart power strip developed under the project is a WiFi communication based Smart power strip monitors connected devices and provides details such as device IDs, usage time, location, and power consumed. This provides the load profile of the plug loads in a building to help in developing strategies for plug load management. Smart strip also allows users to manage connected device.

WATER TECHNOLOGY INITIATIVE

Water Technology Initiative is a demand oriented user centric initiative which includes development research in laboratories as well as application research in field. The scope of initiative covers the entire value chain of R&D right from water oriented basic and applied research, capacity building of water managers and researchers, development of database to recognize and rank purification technologies, technology based classification & assessment of technology options, pre competitive technology

development, pilot-demonstration of technology leads from laboratories and academic institutions to evolve a basket of technology options and mounting of technically, socially, environmentally and eventually affordable convergent solutions suited to socio-economic context.

During the year 2015-16, convergent solution for augmentation of water resources in Medak district Telangana and Sabarkantha district in Gujarat were successfully provided. Demonstration of a Convergent solution for waste water treatment was supported in Vadodara, Gujarat adopting an energy neutral Dutch technology. Rain water Harvesting systems in the state of Mizoram were established for addressing water scarcity issues across villages located in hilly terrain. 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. A dynamic visitation and capacity building programme has been developed in bilateral mode with University of Nebraska for water researchers and managers. In another bilateral interaction, a joint programme for Indo-French networking projects in the area of Natural Water treatment and Waste Water treatment has been evolved and initiated. 9 R&D projects in the area of water research have also been initiated.

Based on assessment of nations R&D technology and solution needs for meeting water challenges and to accomplish remaining work as per Technology Mission: WAR for Water, a theme based effort was mounted to mobilise proposals for three streams - Research (WR), Technology (WT) and Solution demonstration (WS) under the Water Technology Initiative. The call could evince an overwhelming response of 232 proposals from premier academic and R&D organisations under all the three streams, which were evaluated and screened by Expert Committees. After this phased review process spanning over five and half months, recommendations on all the proposals have been finalised. 47 proposals have been recommended for support. These proposals relate to water and waste water treatment, contaminant detection, water conservation and monitoring of water quality.

1. Development and Proving of Convergent Technology Solutions:-

1.1 Energy efficient enhancing of water availability for drinking and agriculture

A convergent solution has been successfully demonstrated in Narsapur village, Medak district, Telangana for providing improvement in accessing safe drinking water through re-commissioning of defunct bore wells, preventing wastage through diversion to a cistern with taps, education and its impact on water health & sanitation and water-borne diseases. After disinfection, treated water is being used for drinking purposes of the four villages. A homestead nutritious garden is being cultivated to which the spill and excess water is being diverted.

Solar Powered Water availability for storage, for drinking and agricultural needs

1.2 Integrated augmentation of groundwater: Water conservation in 4 districts of Rajasthan:

Community tanks and Household tankas with pop filter/first flush filter

4 clusters covering a population of 40,293 in semi-arid and arid zones of Rajasthan (Jhunjhunu, Dungarpur, Churu and Nagaur Districts), face the challenges of low per capita availability, mismatched rates withdrawal and recharging capacity due to over exploitation of ground water, water winning and mining in water starved areas and high evaporation losses. A community management solution for integrated augmentation of water sources through rain water harvesting was adopted with 20% of cost as beneficiary contribution, which has ingrained strong sense of ownership in community, who takes care of maintenance, protection and cleanliness. A filter to ensure prevention of silt, alongwith the rain water in the ***Kund*** (tank) and disinfection for avoiding bacterial contamination, have been incorporated. A chamber is also constructed

at the inlet of the tank, where the first few liters of rain water, containing inorganic/organic matter (dust/dry leaves/bird droppings) gets collected and clean water alone is allowed into the Kund. By ensuring community participation, the responsibility of upkeep, protection and cleanliness lies with the beneficiary. The cost of construction of Kund, working out at Rs 4 per litre of water, is viable and replicable in supporting the drinking water needs in a place which is arid and mostly dependent on rain water. The projects in the four clusters along with the structures have been successfully taken over by the Gram Panchayats for future sustainability and continuity of the integrated solutions has been demonstrated.

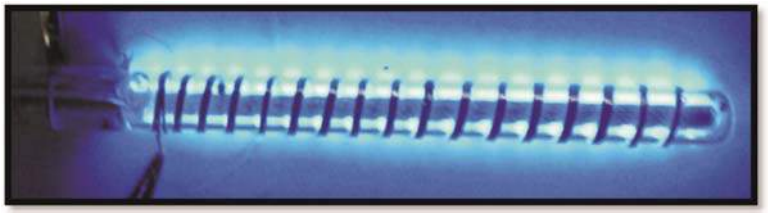
1.3 Rain Water Harvesting in the North eastern region Rupaichari Cluster, South Tripura District:

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

2.0 Augmenting Water Quality:-

2.1 Dielectric Barrier Discharge (DBD) based plasma system for portable water purification.

Based on a few conceptual designs, Dielectric Barrier Discharge (DBD) based micro-discharge systems prototype has been developed at CEERI, Pilani and has been optimized in terms of bacteria deactivation efficiency.



Developed MFP-UV-Lamp

MFP-UV-Lamp and a portable water purifier system

It was observed that the Mercury Free Plasma UV (MFP-UV) lamp is quite effective and shows excellent bacteria deactivation efficiency for less than 10 sec of exposure time in the equivalent domestic water container system.

The optimized MFP-UV-lamp has been demonstrated to interested industries for its commercialization in a technology awareness workshop, which was organized at CSIR-CEERI on 26th June, 2015.

2.2 Development of Colorimetric sensor for Cr (III) detection:

A simple and cost-effective colorimetric probe for Chromium speciation in aqueous solutions using citrate-capped silver nanoparticles without further functionalization has been developed at VIT, Vellore. The technology provides a selective and sensitive detection method of Cr (III). The sensing method was also successfully applied in a portable colorimeter with similar binary combinations paving the way for further on-site applications. The developed probe was successfully tested with chromium containing real samples.

3.0 Waste Water treatment:-

3.1 Recycling of Waste water by improved MBBR (Moving Bed Biofilm Reactor) using probiotics:

Moving Bed Biofilm Reactor

Two STP plants each of having capacity of 200 KLD have been commissioned at Bhimavaram for demonstration of improved MBBR technology with use of pro-biotics. Both the plants are operational.

3.2 Treatment of Mine Process Water in Laboratory and Pilot Scale using High Performance Flocculation

A high performance flocculant has been developed by Indian School of Mines, Dhanbad, based

on functionalized guar gum/silica hybrid nanocomposite (g-GG/SiO_2) as high performance flocculants. The pilot scale study of mine process water was performed at the Tata Steel R&D using laboratory developed flocculant. The laboratory synthesised material demonstrated excellent efficacy towards the treatment of mine process water in laboratory and pilot scale.

4.0 Capacity Building:-

4.1 Water Advanced Research & Innovation (WARI) fellowship program

Recognizing the accomplishments of Daugherty Water for Food Institute, University of Nebraska, Lincoln, USA in the field of water resources vis-à-vis the requirements in the Indian scenario, capacity building programme on water resources has been initiated to support 15 fellowships and 15 interns for a period of 3 years.

5.0 International Cooperation:-

5.1 Demonstration of an energy neutral Dutch technology for Waste Water treatment

The Netherlands and India has forged an alliance in water sector under the aegis 'Dutch Indian Water Alliance for Leadership Initiative (DIWALI)'. A bilateral project between the Netherlands and India to forge alliance in the water sector was evolved under DIWALI, based on clearly felt need and demand from the user has been supported recently under Water Technology Initiative. The project envisages partnership of solution providers (Dutch and Indian companies), as well as the two Governments. A 5 MLD wastewater treatment plant has been supported to VUDA (Vadodara Urban Development Authority) under the DIWALI initiative for demonstration of New Urban Sanitation Systems (NUSS) technology for utilization of novel electro flocculation technology and is developed by Dutch companies for demonstration and cost optimization in Indian context. The NUSS technology is energy neutral that uses electro-flocculation for tertiary treatment producing biogas.

5.2 Indo-French Networking proposals on Water:

A bilateral Indo-French joint initiative has been launched for networking proposals in the area of waste water treatment and natural water treatment systems. The French Embassy in India and the Department of Science & Technology (DST) has joined hands for Indo-French Scientific Networking Programme in the field of water. The Indo-French Joint call was launched initiating a good response and two networking proposals in the area of Waste Water treatment and Natural Water treatment have been selected.

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 Technology Systems Development Programmes is limited to converting proof-of-concepts for development of pre-competitive/commercial technologies/ techniques/ processes. 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.

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.

28 new projects were supported under TSDP during the past one year in the area of materials, process and technology development for biomedical, civil structures, industrial and environmental applications. The focus of the projects was towards development of technologies which are affordable, environment friendly, converting waste into wealth.

New Initiatives:

i) Launch of Advanced Manufacturing Technology Programme

The Govt. of India has laid emphasis to improve the manufacturing sector and this was clearly brought out in the National Manufacturing Policy. "Make in India" is considered to be a powerful strategy for the economic development and sustenance of this country. It is not only an open invitation to the MNCs to establish their manufacturing base in this country but also to encourage the Indian companies to enhance their manufacturing capability and thereby improving the global competitiveness.

The Division has recently launched a programme on "Development of Advanced Manufacturing Technology (AMT)" to augment the Make in India Campaign of the Government of India. Call based proposals from Academicians/Scientists/Technologists were invited during August-September, 2015 in the following areas:

- Nano materials and surfaces
- Robotics and automation:
- Precision Manufacturing
- Manufacturing process of Pharmaceuticals and Bio Manufacturing
- Advanced forming and near net shape processing

About 285 projects were received against the call given by the division. These projects are being processed for further action.

ii) Launch of Waste Management Programme:

Govt. of India has recently launched "**Swachh Bharat Mission**" or "**Clean India Mission**" to keep the country clean and free of any kind of wastage and aims to mobilize masses and seeks to create a clean India within a reasonable time.

Among different waste fractions, plastic waste deserves special attention on account of its heat energy content and its treatment is relevant to energy and emission. A significant part and class of plastic waste can be recycled. Options for collection, segregation and treatment of plastic waste need to be examined with reference to India-specific conditions of the use of plastics, plastic waste generation, and current disposal practices.

Mining, metallurgical and ceramic industries together are known to generate maximum amount of solid industrial wastes and there remains a considerable gap between their generation and utilization. Waste management in its entirety represents a big agenda for the country involving the Governments, every segment of the society and every individual. Keeping technological intervention in view, DST has identified the following four areas, to begin with, to invite project proposals:

- Electronic Waste
- Hospital Waste
- Plastic Waste
- Selected solid wastes from mining, metallurgical and ceramic

The call was given by the division for inviting the proposals in the above said areas during August-September, 2015. About 190 projects were received against the call given by the division. These projects are on different stages of consideration.

Participation in Global/National R&D's Summit & Exhibitions:

Technologies developed through the efforts of the Technology Development Programme of the Department were demonstrated in a Global R&D Summit organized by FICCI during 6th–8th December, 2015 at Vigyan Bhawan Annexe, New Delhi. MRF CNC Machine, Ferro-Fluid related technologies and Device, Freeze drying flower preservation techniques, Banana based conversion in to paper and proto type of 42 GHz, 200 Kw Gyrotron etc. were demonstrated.

Technologies were also demonstrated in the WIN–INDIA Exhibition organized by the Department of Heavy Industry (DHI) during 9th to 11th December, 2015 at New Delhi.

Major achievements: Technologies developed and under-going trials:

1. Design and Development of Multimodal Optical Microscope Using Fourier Optical Image Processing

Sri Sathya Sai Institute of Higher Learning, Andhra Pradesh has developed a multimodal optical

microscopeThe effort was directed to support the development of cost effective diagnostic tools for establishing good microscopic facilities and essential skill set in Primary health care centers (Fig.1). The project aimed at developing a cost effective multimodal optical imaging microscope. This optical microscope encompasses multiple functionalities like Bright Field imaging, Phase Contrasting, Edge enhancement and Fluorescence imaging, all provided in a single platform. The primary necessity for developing such a device arises from the growing need for **affordable diagnostic tools in India.** Apart from being relatively cost effective in its design, it offers a functional advantage of easier live cell imaging with simplicity in operation. Seeing the sample under various modalities is achieved by just changing the filters without disturbing the sample.

Fig.1 Prototype Multimodal optical Microscope

2. Facility for Rheo Pressure Die Casting

The focus of the foundry industry is being shifted towards the modern casting processes,like rheocasting process,to meet the requirement of high performance components, especially with light weight alloys. We have collaborated with Council of Scientific and Industrial Research (CSIR), New Delhi and granted the project entitled "Facility for Rheo-Pressure Die Casting" to CSIR-CMERI in association with Indian Institute of Science (IISc), Bangalore and Jadavpur University, Kolkata, Mahindra & Mahindra Ltd. being the industrial partner.

In this project, a Rheo Pressure Die Casting (RPDC) system has been developed indigenously to produce semisolid casting of automobile components with aluminum alloys. The process has been developed in-house in an end-to-end-manner, carrying out research and development in every step so as to develop a thorough scientific understanding of all the processes involved. The basic objective of establishing a cost-effective indigenous process was established, and the process is ready for transfer to Indian industries with full know-how and know-why. The developed rheo pressure die casting system is simple and readily adaptable in the existing pressure die casting industry (Fig.2).

Fig.2: The developed rheo pressure die casting system

A critical automobile component known as "Steering Knuckle" (Fig. 3) of steering-wheel assembly of SUV has been developed using rheo pressure die casting process. Steering knuckle is generally manufactured through ductile iron casting. But owing to improved properties achieved in rheo pressure die casting, the steering knuckle is developed out of A356 aluminium alloy to reduce its weight. The component is redesigned and mould of the component is manufactured accordingly.

Fig. 3. Machined rheo pressure die cast steering knuckle

3. Environmentally Controlled Manufacturing (ECM) for tea processing

An environmentally controlled machine (ECM) system is developed by Central Scientific Instruments Organization (CSIO), Chandigarh for CTC black tea. It is a miniaturised tea processing unit similar to factory like processing of tea. The ECM system is renamed as "eTeaM" as per the direction of the experts in this related field. It is environmentally controlled tea processing machine designed to take into account the environmental condition of the fields. It is capable in regulating the various processes involved in Withering, CTC cutting, rolling, fermenting, drying & sorting. These units can be either placed horizontally or vertically in-lined with each other depending upon the available space and also can be enhanced in size for the quantity of tea leaves to be processed

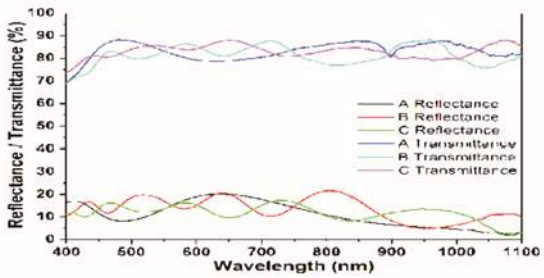
The system has the following significant features:

- ECM system is versatile & is miniaturized unit of tea processing
- User friendly operating system for achieving desired tea quality
- Provides flexibility in simulating experimental conditions
- Use of gravity for easy flow of tea granules in each process
- Can be in-housed in the tea garden itself
- Processing units can be disintegrated for expansion either horizontally or vertically as desired
- Less wattage consumption of electricity
- Electronic Display (Touch screen) of process parameters individually for each processes

4. Development of Transparent Conducting Coatings on Flexible Substrates for Electrochromic Devices

In this project, implemented at Indian Institute of Science (IISc), Bangalore, Karnataka, Indium –tin oxide films were prepared on pre-cleaned glass and flexible PET substrates by Ion Beam Assisted Deposition (IBAD) in a vacuum coater equipped with electron beam gun and home-made ion source.

Highly Transparent (80-85%) and Conducting (30-40 Ω/sq) coatings were developed on both Glass and Flexible substrates using Ion Assisted deposition process. Films made on 3"x3" size PET sheet showed uniform characteristics. The spectral characteristics recorded are shown in the figure below. The results demonstrate that the process developed in this project will provide a practical approach for the fabrication of ITO films on flexible substrates at ambient temperature. The coatings are very useful for the optoelectronic applications like Electrochromic devices, OLED's etc.



Spectral transmittance and reflectance characteristics of ITO films of varying thickness.

Photograph of ITO films on flexible substrates

5. Development & Setting-Up of Pilot Scale Production of Aerogel Supercapacitors For Electronic Applications

Centre for Materials for Electronics Technology (C-MET), (Department of Electronics & Information Technology), Thrissur, Kerala is working to set-up an aerogel production plant and demonstrate the technology of production of aerogel supercapacitor in pilot scale to cater supercapacitor demands of the country for various end applications. Aerogel Supercapacitors are capable of storing large amount of electrical energy (100 to 10,000 times more than that of conventional capacitors) and exhibit low ESR and fast charge/discharge characteristics. The highlights of the achievement and the photographs of the products are given below.

- Finalized the Civil drawing for the construction for aerogel production plant and CPWD will start the civil construction soon
- Synthesized organic gels of different compositions in 500 g level batches and they were cured with TFA for enhancing the polymeric cross-linkages.
- TFA cured gels were washed thorough with distilled water and they were now at the stage of exchange of liquid.

6. Novel Acquisition and Reconstruction Strategies to Accelerate Magnetic Resonance Imaging Using Compressed Sensing (NARAMICS)

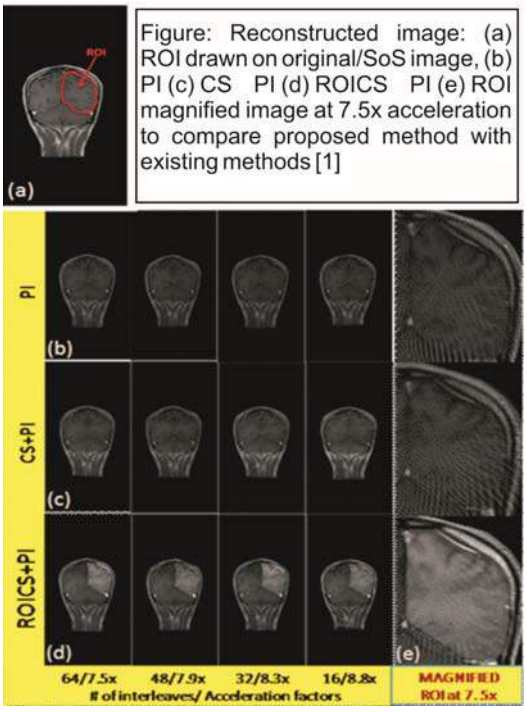


Figure: Reconstructed image: (a) ROI drawn on original/SoS image, (b) PI (c) CS PI (d) ROICS PI (e) ROI magnified image at 7.5x acceleration to compare proposed method with existing methods [1]

The proposal by Dayananda Sagar College of Engineering, Bangalore, Karnataka aims to accelerate MRI scan time based on the framework of compressed sensing (CS). The hypothesis is that upon solving the CS design problem for higher dimensional MRI methods like MRSI, dynamic contrast enhanced MRI (DCE-MRI) and cardiac MRI (CMR) provide significant benefit with respect to reduction of MRI scan time. In addition, the design would be able to incorporate parallel imaging MRI (pMRI) with ease.

Magnetic resonance imaging (MRI) is a well-established whole body imaging modality, which provides soft tissue contrast at high resolution. It has therefore been extensively used in the diagnosis and/or prognosis of various pathological conditions ranging from cancer to psychiatric diseases. However, the acquisition time required for MRI is longer as compared to other whole body imaging modalities such as Computed Tomography (CT) and Positron Emission Tomography (PET). This limits the spatial and temporal resolutions required for imaging of critical physiological processes that have to be imaged rapidly. A compromise on spatial resolution will adversely impact morphology while poor temporal resolution will impact clinical analyses of functions of the organ system. Hence there is a critical need to accelerate MRI scan time.

As an alternative to conventional CS, Region of Interest Compressed Sensing (ROICS) could be used as a reconstruction method as it gives superior CS performance for the fact that CS framework is limited to ROI. Combination of CS and PI results in increased performance than using either of them individually. ROICS combined with PI provide superior performance as compared to CS-PI as shown in figure. Extension of this work is to apply the method on various MR applications which will make a significant Impact.

7. Development of Sol-Gel Derived Specialty Planar Optical Waveguides for Sensor Applications

Sol-Gel Division and Fibre Optics and Photonics Division of CSIR-Central Glass and Ceramic Research Institute, Kolkata have jointly taken a challenge for development of 1D/2D mesoscale patterns on sol-gel based mixed inorganic oxide films by soft lithography using commercially available/ fabricated masters. Now-a-days, unconventional inexpensive soft lithography and their numerous derivatives are widely used for fabricating defect-free, large area, high fidelity periodic structures of soft materials particularly for polymers and gels. The samples could be used as grating-coupled planar optical waveguide sensor chips. Following has been achieved:

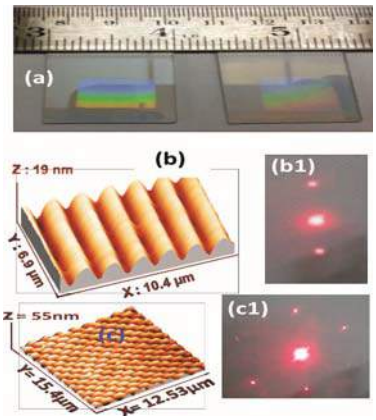
- Developed high fidelity, relatively large area (20 mm × 20 mm) and environmentally stable mesoscale 1D/2D periodic structures on sol-gel based silica-zirconia, silica-titania and titania-zirconia transparent hydrophilic thin films by soft lithography using commercially available polycarbonate compact disk as master (periodicity, 1.5 mm; peak height, 120 nm). The fabricated grating films have the following characteristics: Refractive index range: 1.59 to 1.91; Thickness: 140 to 200 nm; Periodicity: ~1.5 mm; Peak height: 20-30 nm.

- Fabrication parameters that playing the key roles upon generation of patterned structures have been optimized so that different types of grating structures can be fabricated using the masters of different designs for sensor application. In this respect, about 90% absolute diffraction efficiency has been measured in 1D patterned film.

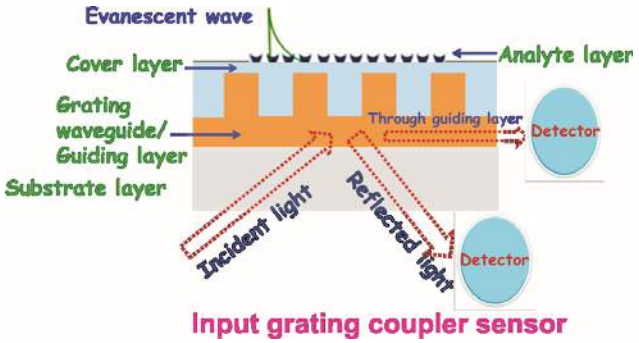
- Nano metal coated 1D grating films have been made. This would enhance the sensitivity of grating films and also it could find application in SERS-active sensor.

- Theoretically simulated 1D structure by Finite Difference Time Domain (FDTD) software of three layer design for fabrication of sensor chip. The fabrication of patterned film as per the design is in progress.

- A preliminary optical set up has been made for checking sensing behaviour of samples.



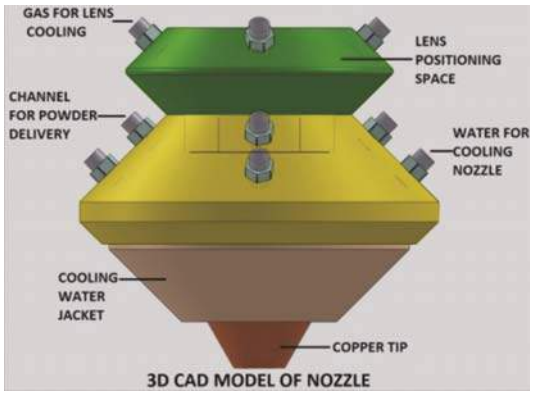
(a) Photograph of one of the fabricated grating films; (b), (c) AFM images with (b1), (c1) diffraction patterns of 1D and 2D silica-titania patterned films cured at 500°C.



Schematic diagram of experimental set-up for grating coupled waveguide sensor film.

8. Design and development of Multi Material Deposition (MMD) system

DST and CSIR-Central Mechanical Engineering Research Institute(CSIR-CMERI) Durgapur, West Bengal have financially supported the development of the MMD system. Multi Material Deposition (MMD) process is the most emerging technology for wide range of application. Inherent characteristics of this process, intricate shaped component with wide range of materials in a single component can be manufactured. Design of the component and the preparation of the 3D model are the primary task in this process. Thereafter convert 3D model to suitable format to slice it horizontally. The motion of the stages takes place according to the slice cloud data fed to the motion controller. With the interaction of metal powder and high power laser, metal deposition on the substrate takes place. Deposition of metal is carried out layer after layer as per the slice thickness obtained from sliced CAD data to build a complete component. The system will be developed with high power diode laser, five axis motion stages and metal powder delivery system. Direct slicing of the CAD model utilizing the surface feature through in-situ and ex-situ is being done at IIT Kharagpur. A co-axial nozzle will be used in this system as shown in fig. The nozzle will be manufactured at CSIR-CMERI. The simulation for the powder delivery path is being done to maximize the powder capture efficiency.



Coaxial nozzle for metal powder focusing to the laser

9. Indigenous Design and Development of Prototype Base Isolation Systems for Earthquake Hazard Mitigation

The research project envisages indigenous design and development of prototype base isolation systems suitable for earthquake hazard mitigation for buildings in India has been initiated at Malviya National Institute of Technology (MNIT) Jaipur, Rajasthan. Under this project, three kinds of base isolations systems, namely, High Damping Rubber Bearing (HDRB), Laminated Rubber Bearing (LRB) and Lead-Core Rubber Bearing (LCRB) shall be developed indigenously with an Indian industry partner. In the project, nonlinear dynamic finite element (FE) analyses of the isolation systems designed will be carried out in the first stage, and stability analyses on the isolation systems will also be conducted in the FE environment.

10. Intelligent Remote Health Monitoring for Bridge

The project initiated at CSIR-Structural Engineering Research Centre, Chennai, 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. Structural Health monitoring is gaining importance, to assess the structural health and to ascertain the safety and integrity of major civil infrastructure. In particular, the application of latest technology, involving a variety of sensors – strain gages, MEMS, WSN, vision, etc., data acquisition cards, computer based data analysis, has increased. This indeed is advancement when compared to the conventional methods commonly in use, for infrastructure monitoring. The technology provides self-diagnosis and self-calibration capabilities with optimum bandwidth and power requirements.

Proposed IRHM scheme

11. Fabrication of Low Cost MEMS Micro-Fluidic Devices using Metal Embossing Technology on Glass for Lab-On-Chip Applications

The project for this fabrication technique is initiated at Rajalakshmi Engineering College, Chennai. First generation micro-fluidic device materials, Glass and Silicon, leverage existing well established

process technology used in microelectronic device fabrication. Glass is a preferred material for lab-on-chip applications owing to several favorable properties including its hydrophilic nature, transparency, impermeability and inertness to very many chemical reagents. Existing technologies for fabrication on glass use powder-blasting technique, DRIE or wet etching using concentrated Hydro Fluoric (HF) acid. These techniques require expensive equipment and/or use toxic acids with attendant hazardous chemical disposal issues.

The proposed fabrication technique is a much simpler approach of embossing on glass using thermo-compression process with patterned metal layer to define device structure. Well established Printed Circuit Board (PCB) fabrication photo-process is used to realize desired planar geometry on metal layer deposited over a glass substrate. The embossing technology offers a relatively safer approach conducive to batch processing to enable repeatable, high-yield low-cost devices to be fabricated using low-cost equipment.

Major challenges in the proposed approach are achieving adhesion of deposited thick Nickel layer without peel-off and control of the thermo compression process to achieve reliable and repeatable embossing without structural distortions On-going research and development work in this activity is focussed on addressing and resolving major issues discussed above and establish optimal process steps for low-cost Micro-fluidic device manufacture. This project has recently been sponsored and an industry namely M/s SEMSIL Technologies, Bangalore has been associated in this project.

12. Flexible Microwave Substrates for Wireless Communication Applications

In order to develop novel high dielectric and economically viable microwave substrates to cater the national requirement, Centre for Materials for Electronics Technology (C-MET) has taken up this project. 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. Currently the requirements of high frequency circuit boards are fully met through imports and world over only handful of industries are manufacturing these technologically and commercially important class of materials. 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. Proprietary high dielectric microwave substrates have been developed for the first time, which are superior in properties compared to imported counterparts in terms of high dielectric constant, ultra low loss tangent and temperature stable microwave dielectric properties. One US and one Indian patent applications have been filed (US Patent Application No. 14104002, 2013 and Indian Patent Application No. 3815/DEL/2012) based on this innovation to protect the intellectual property right and the technology has been transferred to the industry during the year.

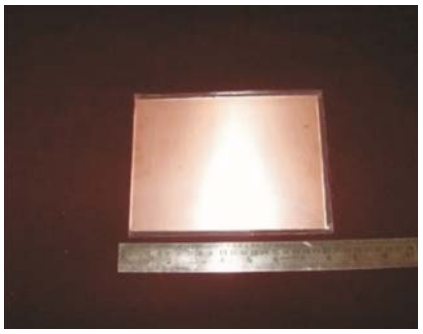
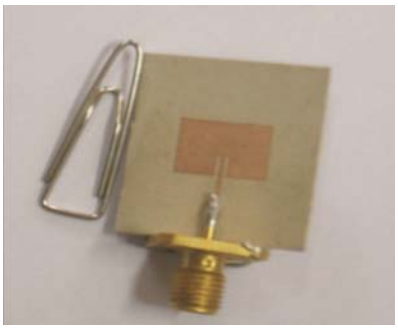
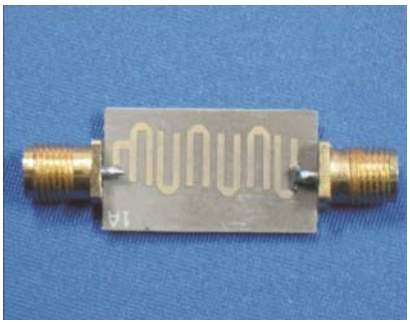
		

Fig.1: 8"x8" size Cu-cladded microwave substrates developed at C-MET through DST funding	Fig. 2: Miniaturized patch antenna fabricated using high dielectric MW substrates	Fig. 3: Band pass filter fabricated using indigenously developed MW substrates

INSTRUMENTATION DEVELOPMENT PROGRAMME (IDP)

Instrumentation Development Programme (IDP) promotes R&D programmes for indigenous development of instrumentation. The thrust areas include Medical and Healthcare, Analytical, Industrial and Sensors & Allied Instrumentation.

New Initiatives/projects

Twenty-four 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.

The initiatives to explore and evolve new areas for instrumentation development have been the prime objective of this programe. Keeping in with spirit of the programme and to sync with Make in India, a call for **Low Cost Comfort Cooling Technologies** was launched by the IDP-DST During August, 2015and 37 pre-proposals have been received. Theniche area was identified to provide ***appropriate indigenous solutions***, which are technically competitive and commercially viable to be adopted countrywide.

Major achievements: Technologies Developed, Transferred & Commercialized under IDP

Design and development of cap based wireless communication system for multichannel EEG recording by Dept. of Electronics & Communication Engineering, PSG College of Technology, Coimbatore, Tamilnadu

An electroencephalogram (EEG) records electrical activity of the brain over a pre-determined period of brain at multiple nodes which is used for clinical diagnosis, research and by hobbyists. A wireless system to communicate with a Cap at 19 different nodes based on the 10/20 Positioning system is developed. The EEG nodes are Wet Electrodes and 3 different size of caps are identified for fabrication. The Cap integrates the electrodes at the respective position with a detachable electrical interface for better cleaning and maintenance.

Electro-CAP fixing

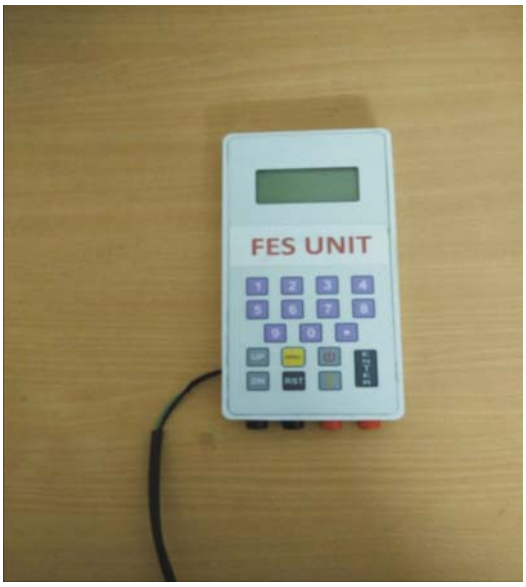
Applying Gel

Connecting Cap and Device

Measurement of EEG signal, mobility enhanced

Design of Smart FES for physically challenged persons by Biomedical Engineering Department, North Eastern Hill University (NEHU), Meghalaya

The Smart FES device is a programmable microcontroller based; low power consuming, high performance, smart and portable (battery powered) eight (08) channel electronic stimulation system designed specifically for Upper Motor Neuron (UMN) paraplegics. The electrical signals generated are sufficient enough to trigger the threshold of excitability of the stimulated muscle and provide enough torque to carry out the desired daily living tasks. Doctor can select the different modes available in the device such as Normal (Mode-1) and Walking Mode (Mode-2) based on patient's history and inputs from the physician. Based on inputs provided by the doctor as per patient condition, the Patient Classifier Algorithm (PCA) automatically decides the stimulator parameters for the application (level and intensity of stimulus) for the patient. The device has inbuilt safety (cut-off) mechanism to avoid high dosage being administered to the patient. Presently, the device is under testing with physicians at different healthcare centres at Delhi, Pune and Kochi and being manufactured by industry partner viz. DRK Test Solutions, Llp, Pune, India.



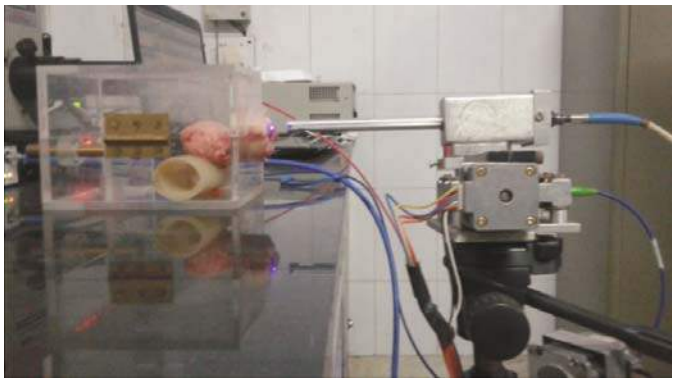
8-Channel FES Device

Portable multi-analyte sensor for detection of renal disease by Biosciences and Bioengineering, IIT Bombay.

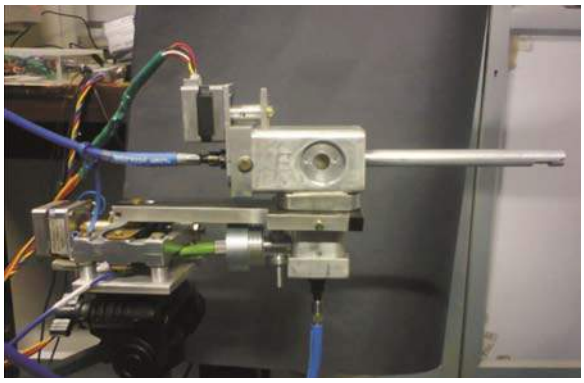
In India, Chronic renal disease (CRD) has a prevalence of around 800 per million. CRD progression to End Stage Renal Disease can be prevented by measuring raised urinary albumin/creatinine ratio in susceptible patients. Our solution is our indigenous, low-cost, albumin/creatinine ratio dipsticks along with a phone-based strip reader (uChek), modified to read our strips, can act as a mass-screening tool thus preventing CRD to take its course. The strips and device performed well with respect to the predicate device and showed a sensitivity of 92% with a specificity of 84%. The device and strip has a Positive Predictive Value (PPV) of 87% while a Negative Predictive Value (NPV) of 89%.

Fabrication and Testing of Hand Held Probe for in Vivo Detection of Cervical Precancer by BIOPSYL Lab, IIT, Kanpur.

A portable device was fabricated to obtain intrinsic fluorescence by measuring polarized fluorescence and polarized elastic scattering signals. In turbid media like tissues, the effects of scattering and absorption modulate the fluorescence information and hence we need to obtain the intrinsic fluorescence which is the native tissue fluorescence free from the effects of absorption and scattering. To extract intrinsic fluorescence we normalized polarized fluorescence spectra by the polarized elastic scattering spectra. This portable device is cost effective, fast, accurate, minimally invasive, and promising results shows that it has the potential to become a part of the regular screening tools for *in-vivo* detection of cervical cancer in the clinic.



Device for detection of cervical precancer based on polarized fluorescence in GSVM Medical college which shows illumination of the sample and detection of light through optical fibers.



Device for detection of cervical precancer based on polarized fluorescence in laboratory.

Development of a system for converting non-woven fabric into fruit bag and a mechanized technique for the fruit bagging for horticultural application by Synthetic & Art Silk Mills Research Association (SASMIRA), Mumbai.

SASMIRA had successfully developed a machinery set-up for converting nonwoven fabric into fruit bags of requisite sizes as per the target fruits. The mechanized system for mounting the fruit bags on banana tree has been developed. The telescopic rod of 4m has been used to mount the bags on the bunch. The study on bagging banana fruit with nonwoven fruit bag has found that the time interval of the harvesting from fruit emergence has been reduced significantly. The fruit maturity has advanced by one week (15 weeks) as compared to 16 weeks in case of the uncovered banana bunches. The weight of the covered bunches has been increased by 10% as compared to the uncovered bunches. In addition, the banana figures were free from spots and blemish. Overall, the maturity period of the fruits under trails has been reduced significantly with increase in the quality of the fruits.

Machinery set-up for converting nonwoven fabric into fruit bags

Banana bunch covered with nonwoven fruit bags

Multispouted Bed Roaster for Roasting Makhana and Certain Value Added Products from Makhana by Food Engineering Department, Central Food Technological Research Institute, Mysore.

Makhana is also known as Gorgon nut (*Euryale ferox),* has a black hard seed coat, separation of starchy kernel out from the seed coat is a laborious and cumbersome work. At present, it has been practiced manually only by traditional type of processing with roasting makhana seeds with earthen pot on the open chulha. Indigenously designed and developed multi-spouted bed roaster (MSBR) eliminates the laborious, tedious unhygienic traditional processing of Makhana seeds. It increases yield & efficiency of Makhana seed processing Adds value to its various products in the form of flakes, health drink and similar roasted products

Prototype of Developed MSBR

Development of an Improved Seed Drill Choke Indicator by Instrument Development & Service Centre, College of Agricultural Engineering, Jawaharlal Nehru Agricultural University (JNKVV), Jabalpur, Madhya Pradesh.

The seed cum fertilizer drill is a tractor driven implement for the purpose of sowing seeds and application of fertilizers in the field. It drops the seed and fertilizers at specified rate with preset arrangement for placement. The main problems with most of the presently available seed cum fertilizer drills are that they get intermittent obstruction in sowing and fertilizer applications due to the blockage of channels which causes non-uniform distribution and also reduces the yield.

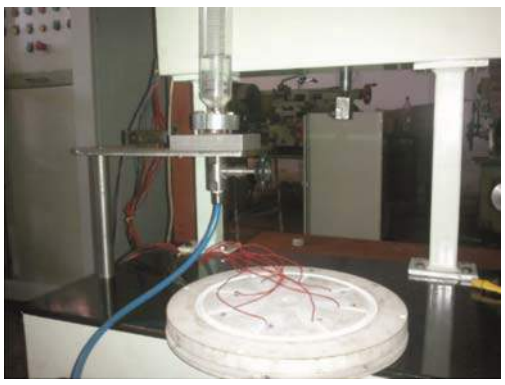
The innovated device eliminates the above said problems by online monitoring of seeding activity and removal of choking channels whenever it occurs. The improved seed cum fertilizer drill choke indicator will be an attachment to the seed cum fertilizer drill available in the market.

Device under field trail at JNKVV farm in Rabi Season

Demonstration of an improved seed drill choke indicator at "JNKVV KishanMela on 01/10/2015"

Design and development of computerized instruments to measure the vertical and in-plane wicking characteristics of fabrics by Department of Textile Technology, Indian Institute of Technology, New Delhi.

A fully computerized instrument has been developed to measure the vertical and in-plane wicking of fibrous materials. This instrument measures the rate of water transmission on the surface of fabric with the help of capacitance principle. The instrumental set-up allows to examine the rate of water flow, the amount of water spreading on the fabric surface and other important parameter in horizontal and vertical conditions. When the fabric is placed between the capacitor plates, it acts as a dielectric. Thus if we know the dry and wet dielectric constants of the fabric, then we shall be able to calculate the distance covered by the liquid in the fabric. An application of Indian patent titled "In-plane wicking measurement system" has been filed. The technology has already been transferred to "M/s Texlab Industries, Ahmedabad, Gujarat.



Instrumental set-up for the in-plane wicking

Major achievements from National Facilities

Two National Facilities were established to assist commercial prototype development and batch

production of instruments in small batches. The technologies ready for transfer/transferred from the facilities are as follows:

1. Sensor Hub at Central Glass and Ceramic Research Institute, Kolkata

The Sensor Hub was established at CSIR-Central Glass and Ceramic Research Institute (CSIR-CGCRI), Kolkata with the grant from the Department of Science & Technology (DST), Government of India and Council of Scientific & Industrial Research (CSIR), New Delhi. Presently, the work plan primarily includes development of tea sensors and sensor arrays (electronic nose), gas sensing devices for methane and carbon monoxide; biosensors for detection of arsenic in water and polyphenols and caffeine in tea. The Handheld Electronic Nose (HEN) is developed and the process of technology transfer is at its final stage.

a. Assessment of quality of Tea based on its aroma

The device can assess the aroma attribute of Tea samples and predict the quality in a scale of 1 – 10.

b. Detection of the optimum Fermentation point during Tea manufacturing process

Fermentation, an important process in the tea manufacturing cycle, determines the quality of the tea. Both over and under fermentation degrades the quality of produced tea. Proper end-point of fermentation can be determined by the generated aroma peak, which in tea industry parlance is known as second nose.

This device can be used in determining this second nose (optimum fermentation end-point) during tea manufacturing process.

Handheld Electronic Nose (HEN)

2. National Hub for Healthcare Instrumentation Development (NHHID) – Anna University, Chennai

The NHHID is a platform for integration of Scientists, Engineers, Technologists, Industrialists, Businessmen and Clinicians to promote and accelerate the development of healthcare instrumentation indigenously. It aids in the transfer of basic research ideas from research institutions to private biomedical companies and vice versa. It will mainly carry out R & D on healthcare instruments as required by indigenous industry and healthcare needs. The Calibration center, one of the prominent activities of NHHID is being established.

CMC daq is a small versatile recording system designed for physiological data. It is suitable for human recordings and it has full electrical isolation. CMC Daq technology transferred last year is being manufactured by TMI Systems for multi-centric validation and marketing.

Leptospirosis detection kit developed by Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) as NHHID partner was transferred to Genomix Molecular Diagnostics Pvt. Ltd.

Synthetic milk tester to Shree Kamdhenu Electronics Pvt. Ltd.: Technology transfer terms are being negotiated after field validation of the device. It works on an electrochemical concept to detect synthetic milk adulteration. This simple dip and read device can be used to screen milk samples at collection centres.

The Antibiogram device is a portable optoelectronic gadget meant for determining the antibiotic susceptibility or resistance within 7-10h or before the second dose of antibiotics so that doctors could decide the safe and effective antibiotic treatment. The device is under field trial.

CMC DAQ

Leptospirosis Detection Ki

Synthetic Milk Tester

Antibiogram Devie

INTER SECTORAL SCIENCE & TECHNOLOGY PROGRAMME

The Department of Science and Technology has played a catalytic role in initiating the STAC mechanism in different socio-economic ministries. The Inter-Sectoral Science & Technology Advisory Committee (IS-STAC) was set up under the Chairmanship of Secretary, DST to provide a forum for the Member Secretaries of STACs of the individual socio-economic ministries, other scientists and technologists to share / exchange their views, expertise and experience, and to provide additional tools to enable utilization of scientific advancements in socio-economic development. The salient features of business transacted in these STACs is given below:

Ministry of Steel : Empowered Committee (EC), met once during the year under the chairmanship of Secretary, Steel. The Secretariat participated in this meeting and facilitated decision making through evaluation of the R&D projects by the experts in the area. Total 15 new projects were discussed and 11 new were approved. The progress made in 6 completed projects were discussed.

Evaluation Group (EG) Empowered Committee is serviced by the Evaluation Group which peer reviews the proposal received for funding from Steel Developmnt Fund and recommends the proposals for approval of EC, met four times during the year . The secretariat participated in these meetings and provided their inputs in the form of comments on number of proejcts discussed in these meetings.

Ministry of Mines: Standing Scientific Advisory Group (SSAG) under Min. of Mines met two times during the year under the chairmanship of Sectrary, Mines. IS-STAC secretariat, DST participated in these meetings and provided their suggestions / commnets on various projects discussed. Total 18 new projects were discussed and 12 new were recommended.

Ministry of Coal: Standing Scientific Research Committee (SSRC) under Min. of Coal met two times under the chairmanship of Secretary, Coal. Total 12 new projects were discussed and 6 new were recommended. 5 completed projects were also dicussed.

NATIONAL PROGRAM ON CARBON SEQUESTRATION RESEARCH (NPCSR)

There is a global concern about GHG emissions especially CO_2 emissions which is a major contributor to global warming. The consequences of climate change on the social systems are expected to vary in different regions of the world on account of several regional and local factors in different geographical and social context Therefore, different modeling studies, adaptation strategies, mitigation actions and technology systems would be required. It is believed that the current measures to adopt green technologies alone may not be sufficient to address the problems of CO_2 build up. This has led to increased interest in a new strategy termed as Carbon Capture and Sequestration (CCS). This scheme aims to promote and encourage research in the areas of CCS and related topics.

Highlights of the activities of the scheme during 2015-16:

During the year, All India Co-ordinated Project on C-Sequestration in Agro-forestry and other Land Use Sector (AFOLU) was launched in North Eastern Region of India. Total eight projects were

sanctioned covering all the NE States. The C-sequestration in AFOLU (agriculture, forest and other land use) sector is considered important in view of the degree of short term low cost opportunity cushion available with very high potential for C-sequestration. This will lead to some sort of regional assessment of C-sequestration potential of particular area.

During the year, the programme has expanded in all 29 States across the country. Programme advisory and Monitoring Committee met five times. Total 30 new proposals were evaluated and reviewed the progress of 32 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. Four projects have been evaluated and closed down.

Major Activities during 2015-16

i. Under the project "**Discovery of novel solvents for enhanced carbon dioxide capture**" implemented by Institute of Chemical Technology, Mumbai novel solvents for enhanced CO_2 capture was studied. Absorption rate in aqueous AMP solutions is enhanced by addition of promoters. HMDA-N,N' shows higher enhancement in the absorption rate than HMDA. **Patent filed for "Novel absorbent composition and method for removing acidcompounds from industrial gases: Application number: 1222/MUM/201.**

ii. Under the project "**Experimentation on biofixation of CO2 using an efficient Photo Bio Reactor & Simulation and development of scale up methods**" implemented by National Institute of Technology, Tiruchirappalli, 130 microalgal strains were studied. Out of which 4 microalgal strains were found to be temperature resistant and 6 microalgal strains were CO2 tolerant. One microalgal strain was found to be high PAR , shear stress , temperature and CO2 tolerant. Three different designs of PBRs Longitudinal fin Photobioreactor (LFPBR), Spiral mixing photobioreactor (SPBR), Parallel disc mixing photobiorector (PDPBR) are fabricated. New types of reactor (LFPBR) is experimentally studied and compared with raceway pond. The areal productivity is increased by 76% compared with raceway pond.

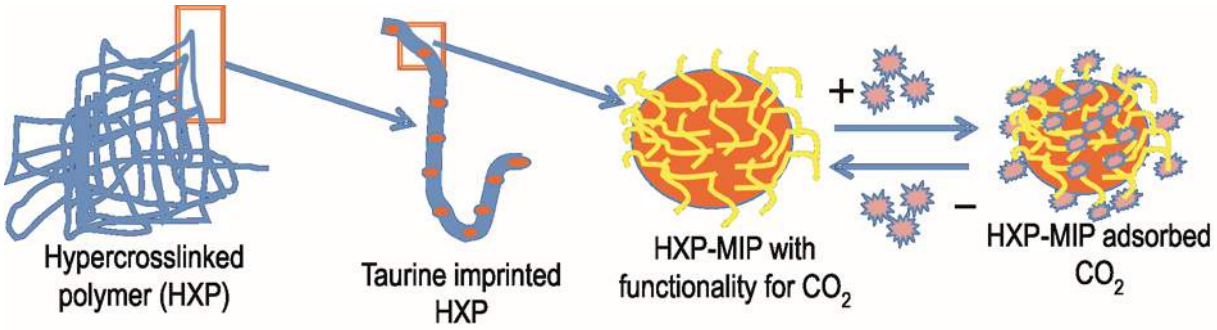
Longitudinal fin Photobioreactor (LFPBR), Spiral mixing photobioreactor (SPBR), Parallel disc mixing photobiorector (PDPBR).

Patent filed for —SURFACE RENEWAL PHOTOBIOREACTOR under application no 1826/CHE/2014 dated 05/04/2014 in the name of NATIONAL INSTITUTE OF TECHNOLOGY (G968).

iii. Under the project "**Development of electrocatalysts for electrochemical reduction of carbon dioxide to formic acid and syn-gas**" implemented by Indian Institute of Technology, Bombay, an oxide compound containing lanthanum and copper has been developed which is more stable and performs equally well as that of citrous oxide. Efforts are on to explore the possibility for patent protection.

iv. Under the project "**Techno-economic Assessment of CO_2 Capture and Storage Potential in India: A Policy Perspective"** implemented by Indian Institute of Management, Ahmedabad, large point source based economic analysis of CCS for India has been done for the first time. India has the potential to mitigate 766 million tons (under integrated compact cluster) of CO_2 emissions below 60$/tonnes - CO_2 through CCS. Proposed storage sites however require geological survey for a more precise estimation of storage volumes.

v. Under the project **Development of Surface Functionalized Polymers (SFPs) for Highly Efficient Separation and Capture of Carbon Dioxide implemented by NEERI Nagpur,** high efficiency polymer for CO_2 capture has been developed using molecular imprinting of amino acid taurine in hypercrosslinked polymer (HXP). Functionality of the amino acid, taurine was imprinted in the matrix of HXP improved seletive adsorption CO_2 with the capacity 5.67mmol g^{-1} at 25 °C which is superior than the reported polymers and polymer nanocomposites in the literature.



Schematic diagram showing the preparation procedure of polymer adsorbent for CO_2 capture applications

vi. 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. Study revealed that by considering the development of the 20% of the community forests; 10% each of Uncultivable lands and Tank Foreshore areas, about 38000 ha of land can be allocated for C stock enhancing plantations.

vii. Under the project **"Utilization of microalgae from Noyyal River basin, Coimbatore for CO_2 sequestration, hydrocarbon production, effluent treatment and for the production of commercially important products**" Co2 sequestration potential of the filamentous green algae namely the *Klebsormidium* sp was studied for the first time. The rate of CO2 fixation by the isolate

was found to be 46.05% and CO2 consumption rate was studied to be 0.338g/ltr/day. The fatty acid profile of the isolate revealed the presence of 32.9% palmitic acid Linoleic acid 30.3% which will make it a suitable candidate for biofuel production.

Technologies developed and transferred:

Developed a technology from Lab-bench-pilot scale cultivation of microalgae using CO2 in sugar mill effluent at industrial premises M/s. EID Parry, Nellikuppam, Tamil Nadu.

Significant projects supported under NPCS during the year 2015-16 are listed below

- Assessment of Blue Carbon Stock in the Mangroves Ecosystems of Tamilnadu
- Atmospheric carbon sequestration potential of trees in Kochi Metro city under the changing environmental scenario
- Biodiesel production from lipid-producing microalgae using industrial CO2 emissions and sewage
- Biomass carbon distribution of major forest types in the northern region of Kashmir Himalayas using field inventory, remote sensing and GIS
- Study of modified Chemical looping combustion process with CO2 utilization
- Evaluating carbon dioxide sequestration potential in plant biomass as well as in soil by tea plantation in Assam, the highest tea producing state in India

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

TECHNOLOGY DEVELOPMENT BOARD

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.

So far, TDB has participated in 12 (twelve) VCFs of repute and committed investment of Rs.310.00 crore leveraging total funds aggregating to Rs.2713.00 crore from other investors.

TDB also took growth-oriented initiative and provided financial assistance to Technology Business Incubators (TBIs) and Science & Technology Entrepreneurs Parks (STEPs) under Seed Support System for Start-ups in Incubators to incubate technological ideas. The assistance is positioned to create techno-entrepreneurs apart from acting as a bridge between development and commercialization of the technologies. The scheme has progressed well and is being continued.

So far, TDB has provided financial assistance of Rs.100 lakh each as grant to 36 (Thirty Six) Technology Business Incubators (TBIs) and Science & Technology Entrepreneurs Parks (STEPs) aggregating Rs.3600 lakh under Seed Support Scheme. This scheme has benefited entrepreneurs from STEPs and Incubators in various fields.

During the year 2015-16, Technology Development Board (TDB) has signed following two (2) agreements and has been in the expansion mode and exploring newer programs / activities to expand its portfolio in a big way. A lot of consolidation of activities have been done during the year.

1. **M/s Villgro Foundation, Chennai** - to implement the Incubation Support Components of Innovative Ventures and Technologies for Development (INVENT) Programme supported by Department for International Development (DFID, UK).

2. **M/s Double-Dee Technology Private Limited, Mumbai -** for implementation of their project titled “Manufacturing and commercialization of SiAION cutting tool inserts and other products”.

An amount of Rs.59.23 crore has been disbursed towards on-going, new projects and schemes. This included Rs.19.69 crore as loan, Rs.11.20 crore as grant to industrial concerns and Technology Business Incubators, Rs.2.40 crore as equity participation and Rs.25.94 crore to Venture Capital Fund (VCF) for investment.

Applications received during 2015-16

During the year, TDB received total 28 applications for financial assistance from various industrial concerns with total project cost of Rs.777.74 crore and TDB's assistance of Rs.340.64 crore.

Products Released / Completed During 2015-16

The following innovative product was released during the year with the financial assistance from TDB:

1. **Commercialization of value added products for agriculture, animal husbandry and human applications derived from sea plants by** M/s AquAgri Processing Pvt. Ltd., New Delhi

New Initiatives during the Year

Innovative Ventures for Technology Development (INVENT) with DFID

Technology Development Board (TDB), Government of India in partnership with DFID India has agreed to implement the incubation support component of 'Innovative Ventures for Technology Development (Invent)'programme.

The INVENT is basically about Inclusive Innovations and will address challenges and barriers across the inclusive innovation lifecycle, for the benefit of up to 1m poor people at the bottom of the economic pyramid in the low income states of India and in low income countries.

An Agreement executed on 1st October, 2015 between TDB and M/s Villgro Innovation Foundation, Chennai to implement the Incubation Support Components of Innovative Ventures and Technologies for Development (INVENT) Programme supported by Department for International Development (DFID, UK) as M/s Villgro has been appointed as a Project Management Unit for the programme.

Technology Day Function- 2015

Technology day was celebrated on 11th May, 2015 in Vigyan Bhawan, New Delhi and the Hon'ble Minister for Science & Technology and Earth Sciences, Dr. Harsh Vardhan, was the Chief Guest on this occasion.

In the awards category, the Chief Guest in the presence of many dignitaries, presented the National Award of Rs.10 lakhs and a trophy to M/s Troikaa Pharmaceuticals Ltd., Ahmedabad for "Indigenous Development of novel technology for topical drug delivery and its commercialization under the Brand name Dynapar QPS".

Interactive Meetings during 2015-16

TDB participated in following exhibitions/seminars during the period:

31st October – 2nd November, 2015

TDB participated in Meri Dilli Utsav 2015 during 31st October – 2nd November, 2015 at Pitampura, New Delhi

14th – 27th November, 2015

TDB participated in 35th India International Trade Fair at Pragati Maidan, New Delhi during 14th-27th November, 2015 under the pavilion of Department of Science & Technology. The focal theme of the event was **"Make in India".** The format of IITF has business, social, cultural and educational dimensions that are weaved together where visitors and exhibitors, media persons, marketing professionals, social activists, NGO's are all come together to explore their objectives.

4th – 8th December, 2015

TDB participated in India International Science Festival (IISF 2015), a joint event of Ministry of Science and Technology (DST, DBT and DSIR/CSIR) and Ministry of Earth Sciences, during 4th – 8th December, 2015 at Indian Institute of Technology Delhi. IISF aimed to provide a single platform to promote interaction among the people and scientists from South Asian Countries to share and spread scientific ideas and discoveries. Around 3500 participants, delegates, invitees, renowned experts had attended various components of IISF 2015.

103rd Indian Science Congress

TDB participated in the 103rd Indian Science Congress (ISC) 'Pride of India (PoI) Expo,' during **January 3-7, 2016** at Mysuru. The major components of PoI Expo was Hall of Pride, Edu Vision, Make in India, Genesis, a one day symposium and Vigyan Jyot (spreading awareness of science). The ISC with the focal theme "Science & Technology for Indigenous Development in India" was inaugurated by Shri Narendra Modi, Hon'ble Prime Minister of India.

The Science Congress witnessed the presence of eminent scientists, Nobel laureates, policy makers, administrators, professors and students from across the nation sharing their experiences and views over a common platform. TDB displayed information about its activities and the visitors were appraised about the schemes of TDB. A large number of national and international delegates participated in the Science Congress.

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.

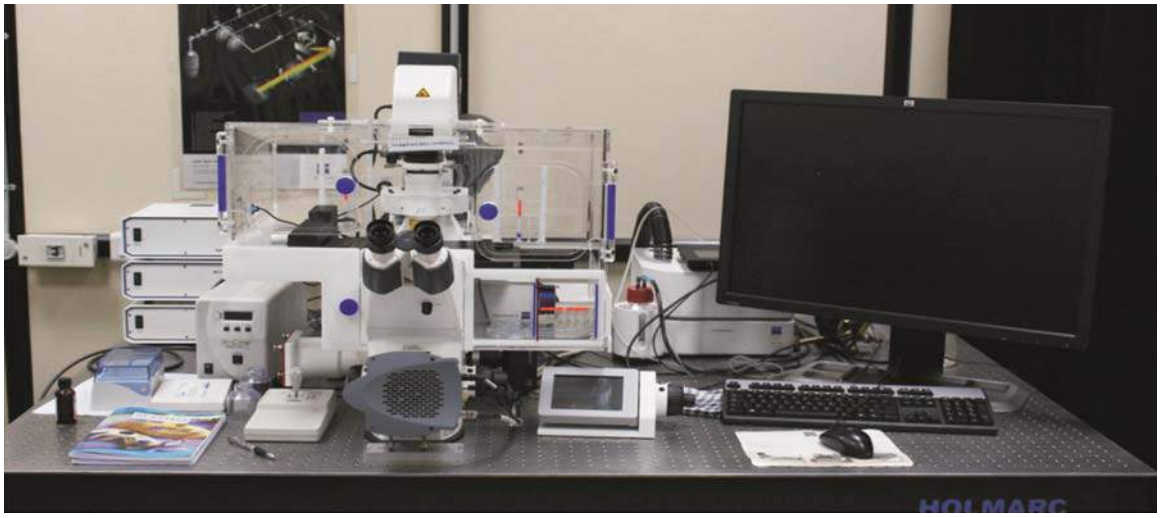
Achievements:

The ongoing project between Sri Ramachandra University, Chennai, Visva Bharati University, Santiniketan and East India Pharmaceutical Works Ltd., Kolkata 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" aims to develop a plant based drug for diabetes and its complications has been scientifically validated for efficacy, safety and reproducibility through multiple in-vitro systems. As a process of product development, two of the five formulations re-analysed evolved as the potential candidates possessing reproducible antidiabitic, anti-oxidant, anti-adepositic and insulin-mimicking/synergistic properties. Acute in-vivo toxicity studies under GLP conditions revealed absolute safety of both the preparations in rat-animal models. Currently, sub-acute studies for toxicology and efficacy studies in High-Fat diet- diabetic animal model are in progress. Parallely molecular mechanism of action studies are underway"

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.

Next Generation Sequencer at IIT, Chennai for the cancer tissue bio-bank project supported under DPRP. This system can be used for Human whole genome sequencing, transcriptomics, whole genome methylation analysis, CHIP-Sequence analysis and SNP analysis.



Live Cell Imaging System at IIT, Chennai for the cancer tissue bio-bank project supported under DPRP. It is used to analysis the cell cycle pattern and protein transport in real-time.

On a DST-DPRP funded project entitled, 'National R&D Facility for Rasayana Products in Indian Systems of Medicine' at Foundation for Revitalization of Local Health Traditions (FRLHT), Bengaluru, has been established. Bioactivity Validation Facility has infrastructure to conduct in vitro

and in vivo studies using the following models : (1) *Saccharomyces cerevisiae*, (2) Human Cell lines (CaCo2, HepG2 & Thp1), (3) *Caenorhabditis elegans*, (4) *Drosophila melanogaster*, (5) Laboratory scale pharma preparation. The facility has got expertise to carry out the following broad tasks :(1) Trans-literation of Ayurvedic texts, (2) Develop ICT resources like website, databases and informative posters, (3) Analyse and develop posters on systemic understanding of Ayurvedic theories, (4) Plant identification based on morphology, microscopy and phytochemical methods (5) Quality analysis of herbal raw materials based on phytochemistry and chromatography (6) In vitro assessment of herbal products toxicity using Brine Shrimp and human cell lines, (7) In vitro anti-oxidant and free radical scavenging activity testing, (8) In vitro bioavailability testing of micronutrients w.r.t. iron, (9) Test the effect of herbal preparations on mitochondrial structure and function using *S. cerevisiae* model, (10) Test herbal products for wellness using Drosophila model, (11) Test nootropic herbal preparations in *C. elegans* model, (12) Laboratory scale preparation of herbal products.

Facility has enabled PhD and Post-Doctoral studies on Rasayanas for Neurodegeneration, Anemia, Diabetes, Nutrition & Wellness. Outreach : Community- Livelihood & health security programmes using Rasayanas.

Lab scale pharma preparation unit

Important Conferences and Workshops supported during 2015-16

1. "Nutraceuticals, Herbals & Functional Foods" by The Associated Chambers of Commerce and Industry of India (ASSOCHAM), New Delhi
2. "Pharmacoeconomics, Drug Discovery and clinical trials" by Delhi Institute of Pharmaceutical Science and Research (DIPSAR), New Delhi
3. 5th Annual International convention of Association of Pharmacy Professionals on "Redefining pharmacy education and regulations for translational drug research in India" at Anna University Chennai, BIT Campus, Tiruchirappalli
4. "Translational Research in Cardiovascular Science" by Anand Pharmacy College, Anand, Gujarat

PATENT FACILITATION PROGRAMME

Department through its Patent Facilitating Cell has been constantly creating awareness and deeper understanding of patents and Intellectual Property Rights (IPR) amongst scientific community in the country by organising workshops and training programmes in different parts of the country and also reaching out through news letters and social media. It supports technically and financially to government R&D institutes and academic institutes in obtaining patents and other IP rights on their innovative and creative work. Patent Facilitating Cell also provides patent information as vital input to the process of R&D in the form of patent search reports or patent analysis reports.

1. Patent/IP Facilitation

As a part of patent facilitation with total technical and financial support PFC took up more than 60 new cases on behalf of academic institutions and government R&D Institutions and more than 150 of INSPIRE cases for filing of patents. It found 26 inventions patentable and proceeded further for filing of new patent applications, including 4 patent applications relating to INSPIRE program of DST and rest 22 on behalf of academic institutions and Government R&D institutions.

During the period, total of **12 patents have been granted**; 7 Indian, 3 US and 2 South Korean. Details of granted patents are as below:

Patents Granted in this financial year: 7 Indian, 3 US and 2 Korean				
Indian Patents				
S. No	**Patent No.**	**Grant Date**	**Applicant**	**Title**
1.	270285	09/12/2015	Indian Association for the Cultivation of Science, Kolkata	Synthesized carbon nanotubes and its process of manufacture
2.	269204	09/10/2015	M D University, Rohtak	Immobilization of proteins onto solid support and its process thereof
3.	269149	01/10/2015	IIT Guwahati	A process for the production of 9, 9-Dialkyl substituted fluoreine monomer and obtaining the polyfluorene polymers (PFC) thereof
4.	268892	22/09/2015	Shaheed Bhagat Singh College of Engineering, Ferozpur	Method for the manufacture of fully stabilised cubic zirconia
5.	268363	09/09/2015	PGIMER, Chandigarh	Root canal irrigation needle
6.	267527	22/07/2015	IIT Delhi	Cross linked protein coated microcrystals and a process for preparation thereof
7.	266115	01/04/2015	IIT Kharagpur	A multipurpose device for processing of high viscous products in particular dairy and food products

US Patents			(Number awaited means after issue fee payment formally patent number will be allotted)	
1.	9077869	07-07-2015	IIT Kharagpur	Method and apparatus for detection and removal of rain from videos using temporal and spatiotemporal properties
2.	9197789	24/11/2015	IIT Kharagpur	Method and system for removal of fog, mist or haze from images and videos
3.	Number awaited		IIT Kharagpur	Method and apparatus for detecting the bad pixels in sensor array and concealing the error
South Korea				
1.	Number awaited		IIT Kharagpur	Method and system for removal of fog, mist or haze from images and videos
2	Number awaited		IIT Kharagpur	Method and Apparatus for detecting the bad pixels in sensor array and concealing the error

2. IPR Awareness Workshops and Training

Four workshops organized on IPR and patents; one each at Manesar, Gandhinagar, Tezpur and Dibrugarh. Manesar in association with Indian Institute of Corporate Affairs (IICA), Manesar and MHRD-IPR Chair at Tezpur University. It was attended by about 60 participants from different parts of the country various IPR's related issues were shared. The participants were given hands on training by creating multiple WI-FI hotspot and enabled them to do patent search by themselves during practical session.

3. Patent Licensing

PFC for the first time has facilitated a patent cum technology licensing. Patent on non invasive jaundice meter owned by S N Bose Institute, Kolkata was licensed to M/S AMIL Ltd on non-exclusive terms with up-front fee of 5 lakhs and royalty of 5% on net sale and a condition of renewal of license after 5 years.

4. Policy Inputs

PFC has provided inputs for Draft National IPR Policy to Department of Industrial Policy & Promotion (DIPP) at all three stages viz. concept note, feedback and cabinet note; also participated in one to one discussion with Think Tank established by the Government to frame this policy under DIPP.

In addition Department has created the 26 Patent Information Centre at various states of the country through which awareness was created on issues related to safeguarding the various type of intellectual property rights.

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 and 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, proto-types or products;

xi. 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

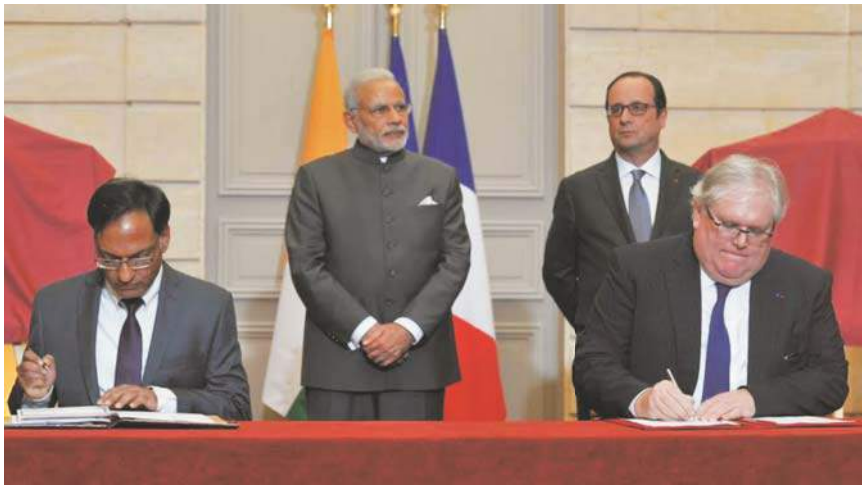
During the year, DST undertook a spectrum of bilateral cooperative activities such as: (i) bilateral S&T Joint Committee Meetings and ministerial missions; (ii) Joint workshops and symposiums; (iii) Joint research projects; (iv) Virtual multi-institutional R&D projects; (v) Setting up of joint bilateral laboratories; (vi) Training programs; (vii) Access to advanced research facilities abroad; (viii) Participation in international mega-science projects; (ix) Continue support to Bi-national S&T bodies;(x) Fellowships and Visitation programs for both Indian and foreign researchers; (xi) Promoting academia-industry partnerships for industrial R&D on bilateral level;(xii) Contributions to international non-governmental scientific bodies; and (xiii) Technology summits, industrial fairs, S&T exhibitions.

SALIENT ACTIVITIES DURING THE YEAR

Joint S&T Committee/Council meetings were held with Australia, Austria, Belgium, Bulgaria, Canada, Italy, Myanmar, Netherlands, Russia, Spain, South Korea, South Africa, and Switzerland. Governing Body meeting of the Indo-French Centre for Promotion of Advanced (IFCPAR) and Indo-German Science & Technology Centre (IGSTC) were held during the year.

New/ Renewal of Inter-Governmental S&T Cooperation Agreements/MoU/ Letter of Intent, Programs of Cooperation (POC) were concluded with Argentina, Bulgaria, France, Finland, Germany, Japan, Russia, Republic of Korea, South Africa and Turkmenistan.

About 200 Joint R&D projects and over 40 Joint workshops/seminars were supported. More than 500 exchange visits took place under various bilateral programs.



Secretary DST concluding the MoU with CNRS, France during the Indo-French Summit meeting in Paris in April 2015

New programs of cooperation were initiated with:

Australia: The Phase II of the Australia-India Strategic Research Fund (AISRF) for promoting socially relevant R&D projects announced during the Summit meeting between the Prime Ministers of India and Australia was launched.

Canada: Multi-institutional projects in the areas of Safe and sustainable infrastructure and Integrated water management was launched under the IC-IMPACTS programme.

Egypt: The S&T relationship with Egypt was revived with the holding of the two joint workshops in the area of Agriculture Biotechnology and Nano-materials in Egypt, leading to the joint call for project proposal.

France: A MoU was signed with Centre National de la Recherche Scientifique (CNRS) of France which will further accelerate scientific cooperation in frontier areas of mutual interest through networked Centres.

Japan: DST-JSPS Fellowship Programme for Young Researcher and DST-JSTA MoU for establishing Indo-Japan Joint Laboratories in the area of ICT were concluded. Phase II of the Indian beam-line at KEK, Tsukuba launched.

Germany: The tenure of the bilateral Indo German S&T Centre (IGSTC) was extended for a period of five years until 2021 with doubling of annual financial allocation from 2m to 4m euro from each side. DST-BMBF cooperation on Civil security research was implemented through support to joint R&D projects.

Russia: During the visit of the President of India to Russia in May 2015, a new agreement on scientific cooperation between DST and Russian Science Foundation (RSF) was concluded at Moscow. Applied R&D projects under DST-RMES (Russian Ministry of Education & Science) were launched.

South Korea: industrial R&D program in areas covering Cleantech, Renewable Energy, Robotics & Automation, and Electronics Design & Manufacturing. Virtual Networked Centres in the areas of Computational materials for energy and Robotics.

Switzerland: It has been agreed to initiate a new Academia-Industry Training (AIT) Program between DST and Swissnex to support young scientists towards the early stage market application of their research output by bridging with industry.

UK: Various facets of cooperation under the newly launched Newton-Bhabha program were initiated through support to joint activities covering people, project and translation strands.

USA: India-USA Climate Research Fellowship established under an arrangement between DST & the U.S. State Department.

India Science and Research Fellowship (ISRF): was launched with Bhutan, Nepal and Myanmar and Sri Lanka.

Bilateral Research Projects & Programs

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.

Australia: Support continued for thirty on-going competitive grant projects and seven major Grand Challenge projects under the Phase I of the Australia-India Strategic Research Fund (AISRF). Seven new projects were supported under the competitive grant category in the areas of water management and agricultural research, Under the Phase II of AISRF a new call for projects has been announced in the area of clean energy technologies.

Austria: Support to twelve 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 in 2015-16.

Argentina: Eleven new bilateral R&D projects in areas of agri-biotechnology, automation engineering, drug discovery and bioenergy were approved out which 09 have been sanctioned and are being fully realized while the 5 ongoing projects were continued to be supported.

Bulgaria: The 8th India-Bulgaria Joint Committee on Science & Technology met January 2015 in New Delhi to expand collaboration between two countries. A Programme of Cooperation (POC) between the two governments in the fields of solar energy, water science, biotechnology etc. for the period 2015-2017 was concluded. A fellowship program for Bulgarian scientists to work in R&D labs in India for a period up to six months was also agreed to.

Belarus: Following the 6th session of the India-Belarus Joint Science & Technology Committee meeting at New Delhi, twelve joint R&D projects are being implemented in the areas of materials, physics, chemistry, and optics & laser sciences. One workshop on Advanced materials was held in November 2015 to explore new cooperation in this field.

Belgium: The 4th meeting of the India-Belgium Joint Science & Technology Committee was held at New Delhi in October 2015. The Joint Committee approved making a new call for R&D proposals. Ten projects are presently under implementation in Exact Science, Life Science and Earth Sciences. Cooperation plans with Wallonia and Flanders regions was also discussed. A 3.2 m telescope, the largest optical telescope in Asia, developed in partnership with Belgium, is being installed at ARIES, Devasthal. The telescope has successfully made trial runs with capturing of first light test pictures.

Canada: Following the India-Canada JCM, five new multi-institutional projects under the maiden IC-IMPACTS call were approved for support in the areas of safe and sustainable infrastructure and integrated water management. Support continued for six Industrial R&D Projects in the areas of Clean Technology, Smart Grid, Information & Communication Technology and Sustainable Environment Technology through the Global Innovation Technology Alliance (GITA) platform.

Egypt: The S&T relationship with Egypt was revived with the holding of the two joint workshops in the area of Agriculture Biotechnology and Nano-materials in Egypt. Following these seeding workshops, a call for joint projects was announced in December 2015 in the areas of Agriculture Biotechnology, Nano-materials and Information Technology.

Finland: Support was continued to six Joint projects in the areas of nano-materials and three new projects in the area of Energy Research were funded. MoU on Industrial R&D was renewed with Tekes.

France: Targeted programs in focused areas enabling research funding agencies of both the nations were supported. These include: (i) Indo-French Centre for Applied Mathematics (IFCAM), between DST and Centre National de la Recherche Scientifique (CNRS). Against the first two joint calls eighteen joint projects are under implementation. An active short-term visitors program and exchange of post-doctoral research fellows and students form important components of this Centre's activities; (ii) Under DST-INRIA ttargeted program on Information and Communication Science & Technology, four joint projects were agreed for support during this period; (iii) DST-ANR joint call in the areas of Neuroscience and Engineering Sciences was also launched; and (iv) Support for reciprocal fellowship under Raman-Charpak Fellowship scheme was continued.

Germany: DST-DAAD project based personnel exchange program, support to twenty on-going joint research projects was continued and ten 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. Twenty new joint projects have been screened in for support from both sides.

Under DST-DFG program support was extended to the twenty five on-going projects. Modalities of launching new call for proposals are being worked out between DST-DFG in subject areas of physics and chemistry during 2016.

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. 6 new projects from 2014-15 call have been selected for support and are under consideration for support by DST.

Under DST-BMBF Civil Security cooperation, three maiden joint projects covering vulnerabilities

& volunteerism; vulnerability of metro transport structures; and warning & evacuation during inland flooding were approved for implementation.

Lindau Nobel Laureates meet: Sixteen bright students from India participated in the 65th Lindau Nobel Laureates meet held in June-July 2015 in the areas of Chemistry, Physics and Medicine. Following a new agreement concluded between DST and Lindau Foundation signed during the 3rd Indo-German IGC meeting in Nov 2015, twenty-one Indian students have been shortlisted for participation in next Lindau Nobel Laureates meeting dedicated in the area of physics to be held in Germany during June / July 2016.

Hungary: Ten projects are presently being implemented under India-Hungary Strategic Research Fund in the areas of Mathematics, Earth Science, Biology & Medical Sciences, Chemical Sciences, and Physics & Astrophysics. A new call for proposal has been launched in December 2015 for joint award during 2016.

India-Africa S&T Initiative: Under the Phase I & II of the India-Africa Forum Summit (IAFS), so far 327 African researchers from 33 countries availed the CV Raman Fellowship. Considering the high impact of the CV Raman Fellowship program towards developing long term relationship with various Africa countries, under the IAFS-III the number of fellowships have been increased to 1000 for a period over five years.

A training course was conducted on 'Highlights of Astronomy- a perspective for African Scientists' from in April-May 2015, at the Inter University Centre for Astronomy and Astrophysics (IUCAA), Pune. Twenty-nine participants from 13 African countries participated in the training programme. Capacity building through twining program was continued for the IMSP in Benin and the Pasteur Institute in Tunisia.

A technology and innovation exposition was organised with FICCI in New Delhi in October 2015 as a part of the India Africa Forum Summit-III (IAFS-III). This exposition showcased Indian home grown technologies having potential in Africa. The exposition also highlighted the vision of `Make in India' technologies that can go global, earn revenues for Indian SME innovators and induce inclusive growth. Exposition was visited by Hon'ble Prime Minister of India and many African leaders.

Israel: seven ongoing projects selected under the previous call in the areas covering engineering materials for energy were continued to be supported. Further, two new Industrial R&D Projects were agreed for joint support in the areas of affordable health care and ICT.

Italy: Support continued to seventeen ongoing joint projects under Indo-Italian bilateral S&T agreement. Under the India-Trento Program for Advanced Research (ITPAR), support continued to four ongoing projects in the areas of nano-photonics, computer sciences, telecommunication and cognitive sciences. Two new projects in the areas of MEMS and Renewable Energy were approved under the ITPAR Programme. ITPAR Joint Scientific Committee meeting held at Jodhpur during December 2015 agreed to launch next Phase of the ITPAR in May 2016. In addition, about 25 Indian

scientists visited Trieste to perform experiments on Elettra Synchrotron Beam-line. A joint workshop in the areas of Nano materials was organized.

Japan: Twenty one new joint projects, two workshops, twenty exploratory visits were supported as agreed by the Indian-Japan Science Council in the areas of Fundamental Sciences. Support continued to forty three ongoing joint projects, two workshops were organized, a 'Mizushima-Raman Lecture' was delivered by eminent Japanese scientist in India under this program. India participated in the Asia Heads of Research Council meeting organized by JSPS in Japan. Under DST-JSTA framework projects on biomedical devises were continued to be supported. The Phase II of the Indian beam-line at the KEK Photon factory in Tsukuba was launched during the visit of the Minister for S&T and ES to Japan in November 2015.

Hon'ble S&T Minister Dr. Harsh Vardhan inaugurating the Phase II of the Indian Beamline at KEK, Photon Factory, Tsukuba, Japan

Mexico: Support continued for twelve ongoing joint projects in areas of seismicity, nanomaterials, renewable energy, drug development and water technology under India - Mexico bilateral program. A joint call for proposals was issued in October 2015 which has received 34 proposals, which are under evaluation on both sides.

Myanmar: The Joint Working Group was held in October 2015 which appreciated the role of IIIT, Allahabad in establishing the cyber security research lab at the University of Computer Sciences, Yangon. In order to build long term research linkages, the JWG agreed to support exchange of researchers in areas of ICT and Agri-biotech. Considering mutual interest on both sides, it was also agreed to hold bilateral expert meetings in the areas of agricultural biotechnology with focus on rice

genomics and in weather forecasting and modeling studies. Myanmar MOST agreed to be the partner agency for implementing the ISRF fellowship scheme from 2016.

New Zealand: Two projects are under implementation in the area of Food & Dairy Technology. Two seminars, one on Reinforced Infrastructure (Auckland) and another one on post-harvest technologies (Sonepat) were organized to discuss and explore mutual strength of each side in these areas.

Norway: Support to two new collaborative projects in the area of Mass balance of Glaciers and Rivers were continued. A call for proposal was launched in 2015 in the area of renewable energy. The joint projects received are under evaluation. Following the joint committee meeting a new Program of Cooperation was concluded for the period 2015-17 with thrust areas of cooperation agreed on bio-economy and ICT.

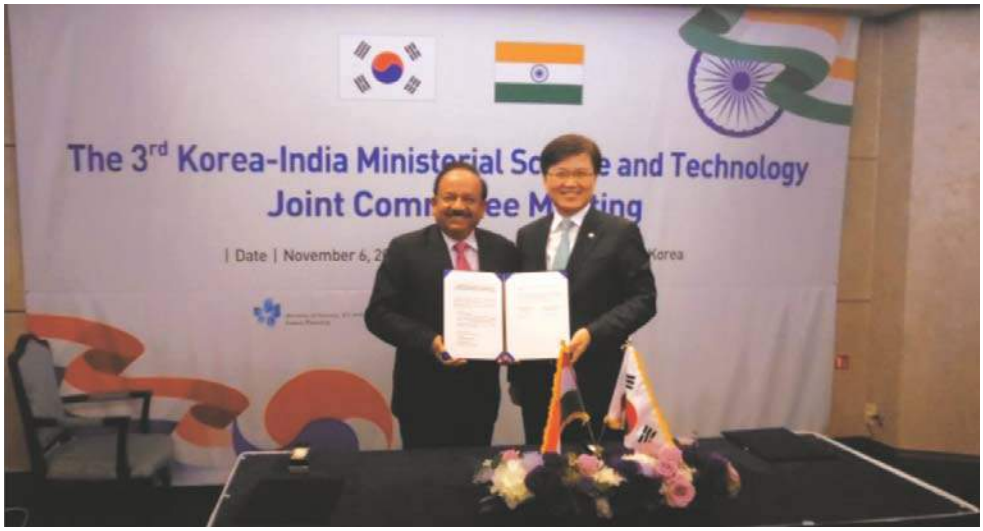
Russia: Joint collaboration continued in multi-agency partnerships. Department continued supporting projects in Basic Sciences in partnership with Russian Foundation of Basic Research (RFBR). Fifty one new projects have been approved in all areas of Basic Sciences. A new call, in partnership with RFBR was launched. Proposals received under this call are being assessed. In partnership with Russian Ministry of Education & Science (RMES), Department supported six maiden projects in the areas of Energy, Environment, Materials. Under a new collaborative arrangement with Russian Science Foundation (RSF) the Department invited R&D proposals targeted for next generation outstanding researchers of India and Russia. 166 proposals have been received which are being examined.

Secretary DST concluded an agreement with Russian Science Foundation in April 2015 during the visit of Hon'ble President of India to Russia

Singapore: Support continued to five joint projects in the area of Materials and Energy. Four new projects in the areas of Advances in Chemistry; Biology & Technology for Medicine were jointly approved for funding by DST and A-STAR.

Slovenia: During the year, fifteen joint projects in areas of digital image processing, advanced manufacturing processes, sensors for various applications, smart textile, solar cells, water technology and health were supported and are being fully realised.

South Korea: Dr. Harsh Vardhan, Minister for Science & Technology and Earth Sciences co-chaired the 3rd India-Korea Science & Technology Steering Committee Meeting with Minister for Science, ICT & Future Planning (MSIP) of the Republic of Korea at Seoul in November 2015 in Seoul. Following the decisions taken during the summit meeting between the Prime Minister of India and President of Korea in May 2015, the two countries had launched a new programme of Industrial R&D cooperation in the areas of Cleantech, Renewable Energy, Robotics & Automation and Electronics Design & Manufacturing. The two Ministers agreed to establish a new mechanism of cooperation through multi-disciplinary joint R&D network centre focused on "Robotics" and "Computational Materials". These Centres will be aimed to leverage convergence of competencies in design, simulation and development for advanced manufacturing techniques. The two Science Ministers concluded a Programme of Cooperation in Science & Technology for coming three years.



Signing of PoC in S&T by Dr. Harsh Vardhan, Minister for S&T and ES and Dr. Choi Yanghee, Minister for Science, ICT & Future Planning of the Republic of Korea

As a follow-up to the Summit declarations, two sides agreed to support three joint business-led collaborative R&D projects which have potential for commercialization. Support continued for the six on-going joint research projects in the area of Nanotechnology. Ten new joint projects were approved in the areas of Robotics & Engineering Sciences; Biotechnology 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 2015-16.

South Africa: Supported twelve new joint projects in the areas of health science & biotechnology, indigenous knowledge systems, astronomy and green chemistry. A new call for proposal for network programme in Astronomy was announced and twelve proposals were received. A new call for proposal was also announced in the area of Agriculture biotechnology and Indigenous knowledge systems. 45 Joint proposals were received which are under review. One joint workshop on HIV/TB biopharmaceutical was held in South Africa.

Spain: Two new Industrial R&D projects were agreed for support in the areas of Affordable health care and Nanotechnology.

Sweden: Against the joint call between DST-VINNOVA four new joint projects on embedded systems have selected for support. Nearly thirty new joint projects have been received under the DST-VR (Sweden Research Council) 2015 call which is currently under review.

Switzerland: The 3rd S&T JCM approved eleven projects for implementation under the Indo-Swiss Joint Research Program and agreed to make a new call in 2016. The program on research in the field of glaciology was extended for the period 2016-19 which would include funding of joint R&D projects and training programs for capacity building. It was also agreed to initiate a new Academia-Industry Training (AIT) Program between DST and Swissnex to support young scientists in the early stage market application from their research output.

Thailand: Under the Indo-Thai Program of Cooperation, support continued to 11 ongoing joint projects.

Tunisia: Support continued to 12 ongoing projects. A new Call for project proposal was announced during Dec 2015 and for making awards in 2016.

Ukraine: Nine new joint R&D projects were approved for implementation under the bilateral scientific cooperation program. These are in addition to eight ongoing projects in the areas of metallurgy, physics, etc.

United Kingdom: Activities were continued to be implemented under Newton Bhabha program as well as under DST-UKIERI program. The Newton Bhabha program envisage undertaking joint activities to build research partnership between Indian and British institutes in jointly identified priority areas through multi-agency participation and funding. The priority areas for support include i) food-energy-water nexus; ii) public health and well-being; iii) sustainable infra-structure; iv) high value manufacturing; and v) big data science.

The joint activities under the Newton Bhabha Program would be implemented in three broad categories of collaboration, namely, i) People: building research and innovation capacity and professional development; ii) Project: collaborative research through Joint Centres, Joint Research Projects and access to Research and Innovation Infrastructures; and iii)Translation: building UK-India research and innovation partnership and capacity to address major societal and economic challenges through programs to build partnership between business and academia.

Since conclusion of the MoU, Fellowships to INSPIRE doctoral candidates (two batches of 30 candidates each) and Entrepreneurship Fellowship (12 candidates) have been awarded. Six industrial R&D projects have been approved under translation mode in the areas of Affordable Healthcare, Clean Technology and Manufacturing Technology.

Fifty joint R&D projects were continued to be supported under DST-UKIERI (UK India Education & Research Initiative) across thematic areas. Since current phase of this programme is coming to an end in March 2016, a review meeting of all ongoing projects was held at New Delhi in November 2015. Both sides have agreed to launch the Phase III of UKIERI in 2016.

As agreed in the Summit meeting between the two Prime Minister's, UK will be the partner country for the 2016 Technology Summit to be organized by DST & CII. This was formally launched in December 2015 in New Delhi.

Minister for S&T Dr. Harsh Vardhan along with the UK Minister for Science & Universities Mr. Jo Johnson announcing UK as the partner country for the 2016 DST-CII Technology Summit

U.S.A.: A new U.S.-India Climate Research Fellowship was announced for launch under support of the Dept. of Science & Technology and the U.S. Department of State. The Fellowship will allow Indian researchers to undertake R&D work on climate in U.S. institutions. Bilateral collaboration on 'Women in Science' was strengthened with the launch of Indo-U.S. Women Fellowship in S&T by the Department. Under the framework of the Joint S&T Commission, a new Joint Working Group in Agriculture Science & Technology has been established to promote collaboration in the areas of pulses & oil seed crops and post-harvest technologies. Two major networked projects in the areas of Astrophysics and Anti-Microbial Resistance have been supported under the NSF's PIRE (Partnership for International Research and Education) Program through SERB, DST.

Under the Partnership to Advance Clean Energy Research (PACE-R) initiative a synergetic network of about 80 Indian & U.S. academic, industry & research institutions has been established to undertake applied R&D projects in the areas of Solar Photovoltaic, Second Generation Bio Fuels and Energy Efficient Building. It was agreed to include research on smart grids and energy storage for grid application as the fourth stream under PACE-R.

Under the US-India Science & Technology Endowment Fund for Innovation, support continued to fourteen ongoing projects on affordable biomedical devices, diagnostics, clean water, sanitation, clean energy, cold chain, financial inclusion, and prosthetics. Under the sixth call, five new bi-national projects have been shortlisted for support.

Bilateral Workshops

Nearly 75 joint S&T workshops/ symposia and training programs were supported in India and abroad in partnership with Brazil, Bulgaria, Chile, Canada, Egypt, 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, Start-up 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. Sixteen PhD and Post Doctorate researchers in the areas of Physics and Chemistry participated in the 65th Meeting of Nobel Laureates and students at Lindau, Germany. DST signed an agreement with the Lindau Foundation to continue sending up to 25 Indian students to the yearly Liandau Nobel meet. Twenty undergraduate science students from across the country along with three supervisors participated in the 8th Asian Science Camp with Nobel Laureates held at Thailand in August 2015. India will be hosting the 9th Asian Science Camp in 2016 in Bangalore.

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 visited UK institutions as a part of DST-Royal Society exchange program under Newton-Bhabha scheme.

Incoming Fellowships for Foreign Scientists to India:

CV Raman Fellowship for Africa: Against the 5th call more than 1000 applications were received from researchers across 42 African nations. 148 applications were shortlisted by the review committee. The shortlisted applications are being sent to Indian Missions in Africa 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.

Under India Science and Research Fellowship (ISRF) scheme for neighboring countries, thirteen researchers from Bangladesh and Sri Lanka were awarded fellowships in 2015 to work in Indian institutions. Ten researchers had availed this fellowship in the maiden call. Second call for ISRF has been launched this year and would include five neighboring countries namely, Bangladesh, Bhutan, Nepal, Myanmar and Sri Lanka.

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 2015-16, under the collaborative scientific research program, sixteen 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 eighty-four ongoing scientific projects. Thirty projects were completed during the year which resulted in more than 100

publications in SCI journals. Under the Industrial Research Program, knowledge-product pathway had been catalysed through seven ongoing projects in the areas of material science; health science; information technology; green technology; chemistry and intelligent transport system. Additionally, two projects, one each in automation systems and aerospace were recommended for support during the year. Through the eleven bilateral seminars, the Centre brought more than 400 scientists/students/researchers from India and France together to share the knowledge in the advanced areas for planning of future collaboration.

CEFIPRA launched High Impact Scientific Research Network Program under which two projects were recommended for support, in the area of Health science and High energy physics. 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 six projects were continued for support; (ii) DST-INRIA-CNRS program, eight projects 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, 15 Indian and 5 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. Under the CEFIPRA-SOLEIL Synchrotron Program, the Centre had supported visits of seventeen scientists & researchers to SOLEIL facility.

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. As a facilitator, under the DBT's Biotechnology Industrial Research Assistance Council (BIRAC)-French Embassy program, two proposals were continued to be supported in the areas of molecular diagnostics for prediction of cardiac disorder. Further, CEFIPRA launched the Indo-French Health technology program in association with BIRAC and bpifrance in the area of Digital healthcare and Individualized medicine. CEFIPRA and the Airbus Group have signed a MoU in 2015 to launch the 'Aerospace R&D program' in the areas of applied mathematics, materials and structures, and avionics. Ten pre-proposals have been evaluated against the maiden call and five were recommended for submission as full proposals.

Indo-German Science & Technology Centre (IGSTC)

Established as a bi-national institution between DST and BMBF-Germany, IGSTC 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. During the year 2015-16, IGSTC continued support to fourteen ongoing joint projects in 2+2 mode in emerging areas of (a) sustainable energy (b) advanced manufacturing (c) biomedical devices and biotechnology (d) water & wastewater technologies (e) nanotechnology and (f) embedded system & ICT. Six new projects in the areas of energy materials, energy storage and water biosensors for wastewater technologies have

been shortlisted for support in the current FY, making a total portfolio to twenty projects involving eighty project partners from academia and industry from India and Germany. Besides creating new knowledge, these projects are aimed to generate new IP, patents and processes with a potential for industrial application and commercial use.

Recognizing IGSTC as a successful model and a flagship initiative of Indo-German R&D partnership, both governments agreed to extend the tenure of IGSTC until 2022 along with increase in annual contribution from 2 to 4 million euros by each side. This would enable the bilateral institution to expand the scope and contents of its scientific activities in promoting industrial R&D through academia-industry partnerships.

Joint declaration to extend the tenure of IGSTC signed at the Ministerial level between Govt. of India (DST) and Govt. of Germany (BMBF) in October 2015

IGSTC continued administering the implementation of 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 fifteen Partner Groups at newly established IISERs, IITs and Central Universities. In the current year seven 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.

Indo US Science & Technology Forum (IUSSTF)

Established under an agreement between DST and the US State Department, IUSSTF 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 six Indo-U.S. bilateral workshops. To foster linkages between the outstanding next generation of scientists and technologists from India and the U.S., the 6th Indo-American Frontiers of

Science Symposium was organized at Irvine, California. Support was continued to the fifteen ongoing Indo-U.S. Joint Centers of Research. Four new R&D Knowledge Networked Centers were awarded for promoting collaborative research. Special training schools for women scientists were organized under Women in Science cooperation program.

Close to 150 Indian and US student and researcher exchanges took place through various internships and fellowship programs namely SN Bose Fellowships, Khorana Scholar Program, Viterbi-India program, Research Internship in Science and Engineering, Bhaskara Advance Solar Energy Research Fellowships, Graduate Research Opportunities World Wide (GROW)-India which is supported by DST, SERB and DBT. Eight Indian and US faculty and students exchange took place under IUSSTF funded visitation programs with the American Physical Society (APS). IUSSTF launched three new visitation programs namely, Water Advanced Research and Innovation (WARI); Building Energy Efficiency Higher & Advanced Network (BHAVAN) Fellowships Fellowship both supported by DST and Bioenergy-Awards for Cutting Edge Research (B- ACER) supported by DBT.

Initiative for Research and Innovation in Science (IRIS), a science and research based initiative for school students is a public-private partnership between DST, IUSSTF and Intel aimed at motivating the next generation student innovators. Indian team comprising of seventeen school children participated in the Intel International Science and Engineering Fair held in Pittsburgh, USA in May 2015. The team won multiple awards which also included a minor planet named in recognition of the young Indian innovators.

In the space of innovation and technology entrepreneurship, IUSSTF continued to implement the US-India Science & Technology Endowment Fund for Innovation supported by DST and the U.S. State Department. In addition to the fourteen ongoing projects, five new projects were approved under the 2015 sixth call. The ongoing projects are in the two broad categories of 'Health Citizens' and 'Empowering Citizens' and include innovative projects on affordable biomedical devices, diagnostics, clean water, sanitation, clean energy, cold chain, financial inclusion, and prosthetics. Several projects supported under this program have been successfully commercialized through establishment of start-up companies.

DST-Lockheed Martin 'India Innovation Growth Program' (IIGP), 50 Indian innovators were trained under the boot camp organized by Stanford Graduate School of Business. Visit of a team of 16 innovators and incubator managers to the Silicon Valley was organized in partnership with FICCI. The IIGP innovators got an opportunity to showcase their innovative products at the India-U.S. Startup 'Konnect' which was visited by the Prime Minister of India. Under the Stanford-India Biodesign Program for biomedical innovation in partnership with DBT, three fellowships were awarded in 2015.

The Joint Clean Energy R&D Centre (JCERDC) is a joint initiative of the Ministry of Science and Technology and the U.S. Department of Energy Partnership for Advancement of Clean Energy Research (PACE-R). The aim is to facilitate joint research and development of clean energy technologies. Support was continued to the three consortia established 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. The first-of-its-kind initiative has brought together more than eighty Indian and U.S. institutional and industrial partners to work jointly in the space of clean energy research and development. The Ministry of New and Renewable Energy (MNRE), Govt. of India and the U.S. Embassy announced the PACEsetter Fund which is being administered by IUSSTF. The mission of the PACEsetter Fund is to accelerate the commercialization of innovative off-grid clean energy access solutions by providing early-stage grant funding that would allow businesses to develop and test innovative products, business models and systems.

Support continued for six 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 U.S. NIH.

INTERNATIONAL MULTILATERAL & REGIONAL S&T COOPERATION

International Multilateral and Regional Cooperation (IMRC) Division 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 positive contributions, achieve 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 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 include 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, BRICS, IBSA, SAARC, 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);** and

- 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).**

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(s) 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 2015 onwards is given below:

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

India signed BRICS MoU on Science, Technology and Innovation cooperation

During 2nd BRICS Science, Technology and Innovation Ministerial Meeting in Brasilia on 18 March, 2015, member countries signed the BRICS Memorandum of Understanding for STI with the broad objectives of addressing global and regional socio-economic challenges, utilizing shared experiences and complementarities in STI and to co-generate new knowledge, innovative products, services and process in BRICS member countries supported by appropriate funding and investment instruments. From Indian side, Hon'ble Minister for Science & Technology and Earth Sciences, Dr. Harsh Vardhan signed the MoU.

Signing of MOU on STI Cooperation by BRICS Ministers for Science, Technology and Innovation at Brasilia, Brazil on March 18,2015.

Moscow Declaration on the theme "BRICS Science, Technology and Innovation Partnership – a Driver of Global Development

The 3rd Meeting of BRICS Ministers for Science, Technology and Innovation was held in Moscow on 28 October, 2015 to build collaboration based on the Memorandum of Understanding in Science, Technology and Innovation. This meeting was preceded by 5th BRICS Science and Technology Senior Official Meeting. The Indian delegation led by Union Minister for Science & Technology and Earth Sciences, Dr. Harsh Vardhan, participated in the meetings.

BRICS STI Ministers signed *Moscow Declaration* on the theme "**BRICS Science, Technology and Innovation Partnership – a Driver of Global Development".** This Joint Declaration reflects BRICS partnership in addressing common global and regional socio-economic challenges utilizing such drivers as science, technology and innovation (STI). BRICS STI Ministers agreed on STI Work Plan 2015-2018 : (i) cooperation within large research infrastructures, including mega-science projects; coordination of the existing large-scale national program of the BRICS countries; (ii) development and implementation of a BRICS Framework Program for funding multilateral joint research projects, technology commercialization and innovation; (iii) establishment of BRICS Research and Innovation Networking Platform. BRICS countries agreed to establish Working Group for Research Infrastructures, Working Group for STI funding and BRICS Research and Innovation Network Platform.

Signing of "BRICS Science, Technology and Innovation Partnership – a Driver of Global Development"by BRICS Ministersfor Science, Technology and Innovation at Moscow, Russia on October 28,2015.

Participants of 5th BRICS Science and Technology Senior Official Meeting held on 27 Oct 2015 in Moscow.

BRICS STI Ministers also endorsed a BRICS Action Plan 2015-18 on BRICS Science, Technology and Innovation Cooperation. The Work Plan outline detailed modalities of BRICS collaboration in previously agreed thematic areas such as Prevention and Mitigation of Natural Disasters led by Brazil; Water resources and pollution treatment led by Russia; **Geospatial technology and its application for development led by India**; New and renewable energy, and energy efficiency with focus on Solid-State Lightning led by China. This Work Plan also added few **new areas for BRICS STI collaboration** such as Material science including **Nanotechnology and Photonics jointly led by India and Russia**; Biotechnology and Biomedicine including Human Health &Neuroscience led by Russia or Brazil; Information Technologies and High Performance Computing led jointly by China and South Africa; Ocean and Polar Science and Technology led jointly by Brazil and Russia. As outlined in the BRICS Action Plan 2015- 16, a series of scientific **events** will be organized in **2015-16**:

- Holding of BRICS Working Group on Geospatial Technology Application for Development (March 2016, India);
- Holding the 2nd Meeting of the BRICS SSL Working Group (November 2015, China);
- Holding the first Meeting of the BRICS Astronomy Working Group (December 2015);
- Holding annual conference "Innovative materials for energy and water saving and environmental protection, new trends in the technological development" (Russia)
- Holding of BRICS STI Funding Working Group Meeting (January,2016,Russia)

BRICS countries also agreed for co-investment of resources including funds for supporting BRICS multilateral R&D Projects in mutually agreed areas.

India on assuming BRICS Presidency in 2016 , will host the 4th BRICS STI Ministerial and 6th BRICS Senior Official Meeting with DST as the Coordinating Department.

BRICS Young Scientist Forum

The idea of creation of BRICS Young Scientist Forum for youth engagement was mooted by Hon'ble Indian Prime Minister in VIth BRICS Summit in Brazil in July 2014. India's proactive role in creation of this Forum has been noted with interest by the BRICS Leaders at the VIIth BRICS Summit held in Ufa, Russia in July 2015 with India as Coordinating Country. **3rd BRICS S&T Ministers Meeting endorsed India's proposal to host the BRICS Young Scientist Forum Secretariat in India with Department of Science and Technology as coordinating point.** It was also agreed to develop a dedicated Website for BRICS Young Scientist Forum with an interactive online component to broadcast opportunities and initiative for young STI community in the BRICS Region.To take this initiative forward, **India will be hosting the 5-day BRICS Young Scientist Conclave** at National Institute of Advanced Studies (**NIAS) Bangalore** in 2016 with intent to create BRICS Young Scientists Corps. This event is seeking 50 to 75 young STI delegates from BRICS countries. The event will allow BRICS youth connectivity & networking to harness their knowledge for resolving common societal challenges through research and innovation and strengthen advancement of skills & research competencies of youth primarily in the age group of 22-35 years drawn from Science, Engineering and other allied disciplines.

DST participation in BRICS Youth Summit at Russia, July 1-7, 2015:

Department of Science and Technology (IMRCD) officer along with DST nominated 7 young Indian S&T professionals participated in the BRICS Youth Summit at Russia (Moscow and Kazan) during July 5-7/1-7, July 2015 as a member of Department of Youth Affairs sponsored Indian official cum- youth delegation.

BRICS Youth Summit aimed at sharing of experiences arising from youth initiatives of BRICS countries and working out a concrete BRICS Youth Summit 2015 Action Plan in areas of Economic Cooperation, S&T Cooperation, Cooperation in Political and Information sphere and Humanitarian Cooperation. BRICS Youth Summit 2015 Action Plan reinforces the mandate and objectives of BRICS Young Scientist Forum being coordinated by India (IMRCD, DST) under the framework of BRICS STI cooperation MoU.

DST sees a value proposition by way of contributing as an affiliated strategic partner to the 'BRICS Technical Meeting on Youth Affairs' envisaged in the, BRICS MoU on Cooperation in Youth Affairs in ex-officio capacity, providing inputs on BRICS young scientist's dimension.

DST participation in the 'BRICS Astronomy Working Group' Meeting in South Africa

Under the BRICS Science, Technology and Innovation (STI) Cooperation, South Africa has leadership role in the prioritized area of Astronomy and accordingly organized first meeting of the

BRICS Working Group and a Workshop on Astronomy during December 10-12, 2015. DST(IMRC) participated in the meeting of the BRICS Working Group in Astronomy.

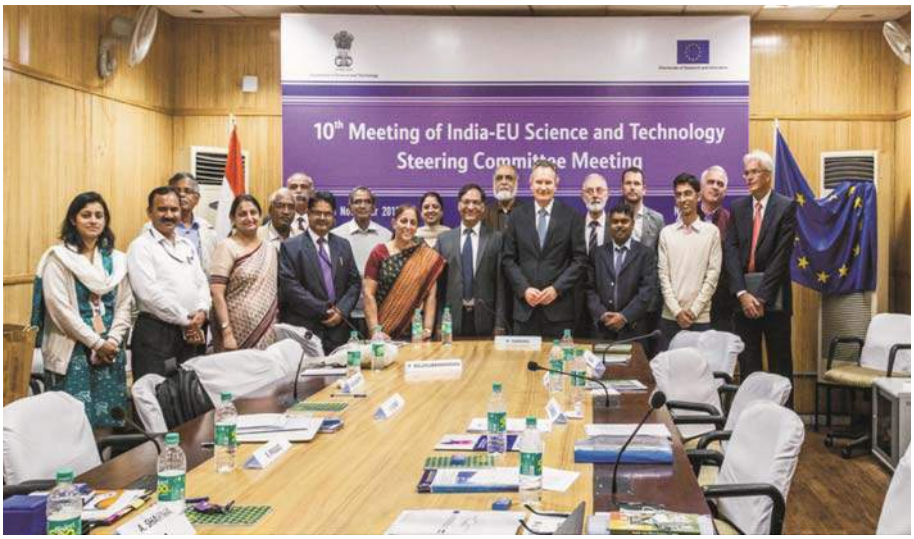
The Meeting finalized the draft Terms of Reference of the 'BRICS Astronomy Working Group'. The Working Group shared the policy instruments, innovations and industrial developments and opportunities in the area of Astronomy in the BRICS countries. Acknowledging the common culture of scientific excellence and complementarities in infrastructure, geographical advantages and technical and industrial capabilities in astronomy among the BRICS countries, the Working Group identified the key elements of co operations as : exchange of information on national policies, priorities, strategies, new initiatives, expertise and key infrastructures in Astronomy in the BRICS countries; new knowledge creation; human resource development including public outreach; BRICS key Science Projects in Astronomy and instrumentation development for key science projects; access to astronomy infrastructure in BRICS Countries & data science.

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 pluri-lateral funding opportunities with EU Member States (MS).

10th Meeting of India-EU Science & Technology Steering Committee hosted by India



10th Meeting of India-EU Science & Technology Steering Committee was hosted by India on 23 November, 2015 in New Delhi under the Co-chairs of Secretary, Department of Science and Technology and Director General, Research and Innovation, European Commission (EC). The meeting discussed a

host of Agenda including exchange of recent developments in STI policy, Program, renewal of India-EU S&T Agreement, review of India-EU S&T cooperation, India-EU/Member States GSO reform, Standard Operating Procedures for reciprocal access of researchers in selected European HORIZON 2020 and Indian Thematic RTD programs and India-EU Major Flagship program involving co-investment of resources including funds.

The meeting agreed in principle for an action plan/way forward for 2016-2017 as given below:

i. Renewal of India-EU S&T Agreement through exchange of note verbale;

ii. India-EU Terminal Review Meeting for 4 India-EU Water RTD Projects- cum- International Stakeholders' Conference on Water (at Pune, India April 21-23, 2016);

iii. India-EU Member States Call in Bio-economy under Inno-Indigo framework;

iv. Establishing Standard Operating Procedure for reciprocal access & participation of researchers in selected Europe Horizon 2020 and Indian Thematic RTD programs. and India-EU Major Flagship program, involving co-investment of resources including funds;

v. India's participation in EU Member States driven JPI with scope and mechanism for collaboration through mutual consultation in water sector;

vi. In health sector, both sides agreed to focus their collaboration on affordable Point to Care Diagnostics, Affordable Medicines, and Implants for diseases such as cancer, cardiovascular diseases. The linkage between Indian initiatives such as IMPRINT, AMRIT, Atal Innovation Mission may be made with similar initiative on EU side; and

vii. In Energy sector, the collaboration will be on solar energy, smart grid, bio energy .

India-EU Member States collaboration in Bio-Economy:

Indian (DST & DBT) and European Member States (Austria, Belgium, Denmark, Finland, France, Germany, Italy, Norway, Spain, Portugal) funding agencies met in Finland during 8-10th June, 2015 to discuss Indo-European collaboration in the area of Bio- Economy. Both sides agreed to launch Joint Call for Proposal in the area of Bio-economy with focus on Post harvest management/storage of food; Waste management as a resource and Bio-based energy. The Call will be launched in April 2016.

India-EU Water RTD Projects' outcomes and spin offs:

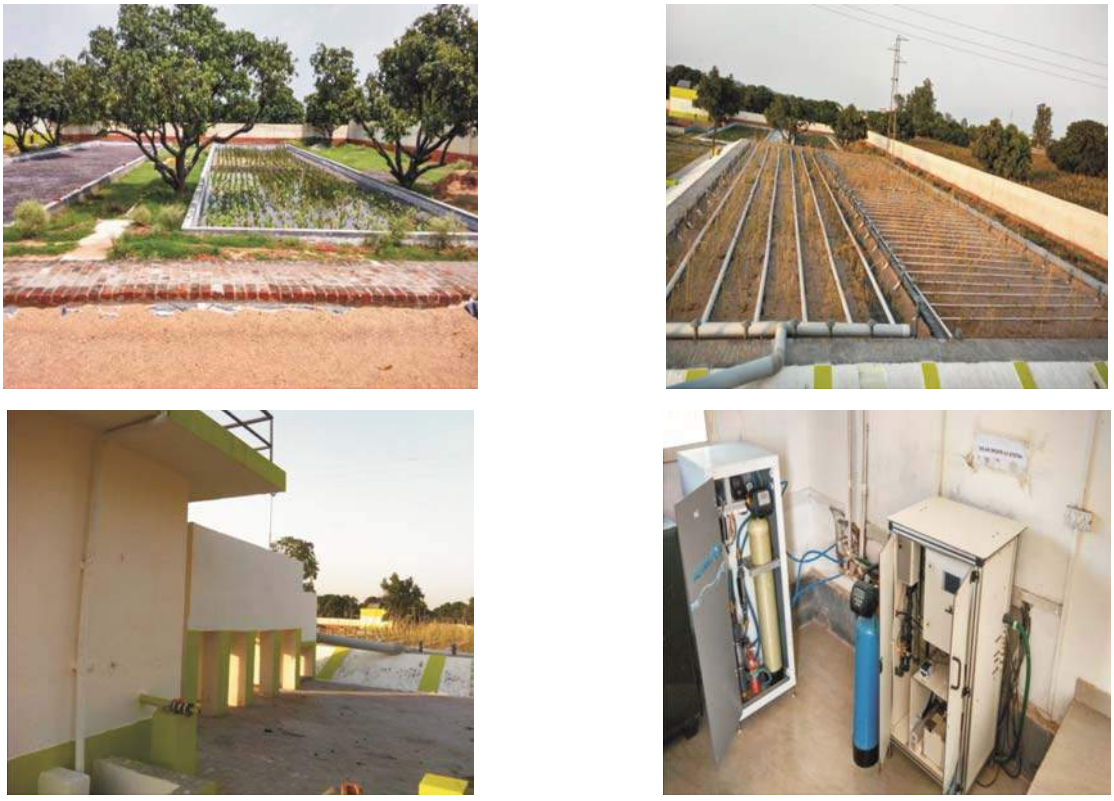
The National Scientific Expert Committee Meeting (at NIT Patna 20-22 August, 2015), while taking stock of scientific progress made under 4 India-EU projects, foresaw positive spin-offs that can form the basis for building new India-European Union/Member States joint opportunities as given below:

- Next level of engagement with European Union; Germany, France, Netherlands & Spain et al., can be co-investors with India for R&D projects in the domain of Water Use and Water Treatment

and Reuse Technologies in Agriculture, Online Monitoring of Water Quality and Transmission Systems; Treatment of Emerging Pollutants;

- Coupling of European SMEs with Indian research and local civic bodies/municipal authorities rendered to be a realistic and effective approach to solve location specific problems in India in water sector;
- Identifying suitable and efficient European technologies and their design improvements/ modifications proposed by Indian partners proved to result in optimization and improved performance;
- Hosting an International Meeting/Workshop in Indian during February 2016 with the aim of (a) showcasing outcomes from India-European Union water research projects (b) identifying gaps to be addressed for future collaboration as well as in determining possible up scaling /replication/ wider scale deployment of proven technologies during multi stakeholders consultations

Demonstration of performance efficiency and possible combination of technologies in identified locations are presented below:



UASB Reactor and view of Pilot Constructed Wetlands at Aligarh Muslim University

100 m^3/day HYSAF system in Rishikesh

Influent and Effluent Water Quality

Amanora Park Town, Pune :(Treatment Capacity: 40 m^3/day)

College of Engineering Pune (COEP) hostel: (Treatment Capacity: 180m^3/day)

Ordnance Factory Ambajhari (OFAJ), Nagpur(Treatment Capacity: 100m^3/day).The treatment system is under the commissioning phase.

Surface and Ground water treatment especially arsenic removal for drinking purpose Murshidabad District, West Bengal

India supported 6 new India-EU joint projects in Diagnostics and Interventions in Chronic Non-Communicable Diseases"

Under India-EU/MS INNO INDIGO partnership framework, six multi-countries research and technology development (RTD) projects in the area of "Diagnostics and Interventions in Chronic Non-Communicable Diseases" involving Belgium, Estonia, Germany, Portugal, Norway and India have been agreed for co-funding with an investment of Euros 1 M from Indian side. The thrust of these joint RTD projects include non-invasive rapid diagnostics for cancer and neurodegenerative disorders; understanding the processes of calcification in chronic kidney disease; Nanoplatform-based drug delivery system and combinational therapy against breast and colorectal cancer; Multiple biomarker detection of Rheumatoid Arthritis etc.,

India desired to take leadership role in ESDM under India-EU ICT cooperation

9thIndia-EU ICT working Group meeting held at in New Delhi on January 14, 2015. During the

meeting DST requested DeiTY to constitute India-EU/MS GSO-Thematic Group: Electronic System Design & Manufacture (ESDM) including ICT as agreed in the 1st India-EU/MS GSO- cum- 9th India-EU S&T Steering Committee Meeting during 8-9 Oct, 2013. DeiTY has agreed in principle to take leadership role in this regard. This will help our national efforts on Digital India and Make in India.

India-ASEAN Cooperation

Shared Vision and pathways through STI cooperation framework for better collaborative index around inclusive development

India has enhanced the ASEAN-India Science & Technology Development Fund to US$ 5 million to deepen its research and innovation collaboration with ASEAN.

Hon'ble Prime Minister of India announced the enhancement of scope, scale of ASEAN-India Science and Technology Development Fund (AISTDF) from 1 Million USD to 5 Million USD during the 13th ASEAN-India Summit held in Kuala Lumpur,Malaysia on Nov.21, 2015. The scope of AISTDF has been enhanced by way of inclusion of "Innovation Platform" which includes development of affordable technologies and commercialization. Accordingly, in consultation with ASEAN Secretariat, the Terms of References (ToR) and other modes and mechanisms of enhanced AISTDF are being revised.

The support to on-going activities under ASEAN-India S&T Development Fund was continued. Some of these regional collaborative activities / projects are- ASEAN-India Technology Commercialization web-portal, ASEAN-India IPR portal, Training Pogram on quality systems for manufacturing (laboratory accreditation) etc. Three new Indo-ASEAN projects viz Food R&D; Combating malaria -a public health challenge; and Marine Biotechnology have been conceptualized and are under various stages of formulation/ approval/ implementation.

India hosted ASEAN- India Workshops on Combating Malaria: A Public Health Challenge

Under ASEAN-India Science and Technology Development Fund (AISTDF) coordinated by DST (IMRCD), a workshop on ASEAN-India flagship program on Combating Malaria: A Public Health Challenge was hosted by National Institute of Malaria Research (NIMR-India lead technical coordinator), at New Delhi during May11-15, 2015 with the aim to exchange information on national strategies for elimination malaria, major challenges, and to identify R&D areas that merit ASEAN-India project based collaboration to be funded under AISTDF, ASEAN-India Fund (AIF), CLMV Fund, IAI Fund tracks.

The Indian participants included scientist/officials from MEA, DST, ICMR and various institutes under NIMR, Industries (Sun/Pharma, Bio tech International); official from SEARO-WHO Office New Delhi. The 8 country presentations (7 ASEAN and 1 India) provided basis for identifying 14 themes for collaboration which were regrouped into the following 5 major areas with the help of Regional Advisor, Malaria –WHO (South East Asia Regional office-SEARO), MoH&FW (DGHS-National Vector Borne Diseases Control Program:NVBDCP) and DHR (ICMR):

i. Anti malarial Drugs and Diagnostics (Lead from ASEAN-Thailand)

ii. Malaria Epidemiology and Malaria Vector Control (Lead from ASEAN-Malaysia and Indonesia)

iii. Malaria Surveillance using ICT (Lead from ASEAN-Cambodia)

iv. Malaria Health care social delivery systems and best practices (Lead from ASEAN-Indonesia)

v. Capacity building,training and networking (Lead from ASEAN-Philippines)

India's engagements with UN, its Specialized Bodies & International Organizations

DST continued to contribute on science and technology aspects of UN and its specialized bodies and agencies during the year. These included the following:

DST-TWAS Program of Cooperation in S&T:

DST has awarded a grant of US$ 740,000 for five years starting from 2016 onward to The World Academy of Sciences (TWAS) for implementation of DST-TWAS Program of Cooperation (POC) in Science and Technology. TWAS outreach and professional linkages would be gainfully utilized for

(i) engaging TWAS in implementing DST's Pan Africa Doctoral Fellowship program for about 100 fellowships over five years with total funding from DST; (ii) TWAS would facilitate the placement of about 200 INSPIRE fellows from India by TWAS at the world class research institutions across developing countries for initiating them into research, part of pursuing doctoral work abroad and for advancement of skills and research experience abroad. This would allow affiliation and research internship of Indian students at world class R&D lab in the developing countries in the interest of their career and exposure to multidisciplinary research environment.**(iii)** TWAS will organize Science Diplomacy capacity building program both in India and Italy with provision of participation of 10 participants from India in each batch. The participants would be those engaged in promoting international S&T cooperation, national STI policy related responsibilities in Government, scientific and foreign relations through diplomatic Indian missions abroad, R&D professionals and officials from science and engineering academies.

India's engagements with NAM S&T Centre

DST continued with the payment of India's annual membership subscription of US$20,000 to the NAM S&T Centre ,an inter-governmental international organization hosted and functioning from India with currently 47 member countries..

Research Training Fellowship for Developing Countries Scientists (RTF-DCS) program The NAM S&T Centre is implementing the 2nd Phase of the Research Training Fellowship for Developing Countries Scientists (RTF-DCS) program from the year 2012 onwards for five years (2012-2017) on behalf of the Department of Science and Technology (DST), Government of India. The program 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 the 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. In the fourth year (2015-16) of implementation of RTF-DCS, 481 applications were received from 41 developing countries. 50 fellows have finally been selected. The placement of the selected fellows in Indian institutions is now going on and will be completed by March 2016.

The 2nd Bureau Meeting of 13th Governing Council of NAM S&T Centre was hosted in Kampala, Uganda on the 7 -8 September 2015 by the Uganda National Council for Science & Technology (UNCST).

DST- ICTP Cooperation for ICTP Ramanujan Prize in Mathematics

The 'Ramanujan Prize' named after the illustrious mathematician from India, for outstanding contributions by young mathematician from the developing countries is being awarded annually since 2005. As per the MoU between ICTP and IMU, DST agreed to fund the annual 'Ramanujan Prize for Young Mathematicians from Developing Countries' for a period of five years, from the year 2014. Dr. Amalendu Krishna**,** mathematician from the Tata Institute of Fundamental Research (TIFR), Mumbai, India, was awarded the '2015 Ramanujan Prize' in recognition of 'his outstanding contributions in the

area of algebraic K-theory, algebraic cycles and the theory of motives.' The award carries a Citation and a Prize money of USD 15,000/-.

Indian National Commission for Cooperation with UNESCO (INCCU) and its Sub-Commission Meetings:

Preparatory to 38th UNESCO General Conference at Paris during Nov 3-18, 2015 Ministry of Human Resource Development convened a meeting of INC and its constituent Sub-Commissions on 7th Oct 2015 under the Chairpersonship of HRD Minister and President INCCU at New Delhi. Natural Sciences Sub-Commission upon election was chaired by Secretary, DST and was attended by eight institutional and three individual members of reconstituted Natural Sciences Sub Commission. Recommendations proposed during the meeting on India's interest vis-à-vis UNESCO Draft Program for 2018-2021 were as follows:

- Development of keyboards for computers in local Indian languages will tremendously increase the access of millions of people to the new technology and enable them to use it for various social, educational and cultural domains of life.
- INC to flag the theme of Heritage Science and Technology with a focus on integrating science and technology to our cultural traditions.
- India to flag a proposal at UNESCO to create some such prizes for inclusive science and technology, promotion of public understanding of science etc.

43rd Meeting of the 'Carnegie Group' of Science Ministers and the Chief Science Advisors to the Heads of the State and Government hosted by India

India hosted the 43rd Meeting of the 'Carnegie Group' (comprising of Science Ministers and the Chief Science Advisors to the Heads of the State and Government of the G8; European Commission and BRICS countries) during November 20-22, 2015 at the Gateway Resort, Gurgaon. The Science and Technology Minister from South Africa; Science & Technology and Earth Sciences Minister from India; Science & Technology and Earth Sciences Minister of State from India; and Chief Science Advisors from Canada, European Commission, France, Germany, India, Japan, the UK and USA attended the meeting. The Ministerial delegates shared S&T Updates from their countries and brain-stormed on the following three thematic topics:

(1) **'Harnessing Research and Innovation for Food Security, Nutrition and Sustainable Agriculture':** The discussion on the topic was led by South Africa. The Group desired international efforts to address global health challenges and food security challenges to be synergized. It suggested improved coherence and coordination of various international agreements and frameworks. The meeting favored international collaboration to develop tools and indicators for measurement and analysis of food security challenges.

(2) **'Future of Seas and Oceans: Joint research for the preservation and sustainable use of**

the marine environment': The discussion on the topic was led by Germany. The Group emphasized on a comprehensive strategy for an integrated view on future of earth and future of oceans besides protection of the marine environment. The meeting suggested international collaborations on development of biodegradable material and plastics that degrade in salt water, ocean observation, sharing and utilization of research facilities such as sea vessels.

Participants of 43rd Meeting of the 'Carnegie Group' of Science Ministers and Sherpa. Indian delegation led by Hon'ble Minister Dr. Harsh Vardhan

(3) '**Innovation for Inclusive development':** The discussion on the topic was led by India. The Group emphasized on crowd sourcing ideas which translate into innovative, affordable solutions, products and services. The Group also desired funds to support research and innovation under Official Development Assistance (ODA). The meeting suggested international partnerships on (i) Global Mentoring of Start Ups; and (ii) 'Global Forum of Innovators and Innovative Solutions, which India offered to lead.

Spin off from the Carnegie Group Meeting : India contributions towards development of Global Research Infrastructures

An international Group of Senior officials on Global Research Infrastructures (GSO-GRI) comprising of G8 Countries, European commission, Brazil, India, China, Mexico, South Africa and Australia has been deliberating the issue pertaining to development, operation and management of big Research Infrastructures (RIs). The GSO has finalized a framework for world-wide development of RIs and has identified about 40 Research Infrastructures (RIs) including the India Neutrino Observatory' (INO) and 'Laser Interferometric Gravity-wave Observatory' (LIGO) Station in India with specific offers & roles for new collaborating partners.

DST(IMRC) participated in the 6th meeting of the Group of Senior officials on Global Research Infrastructures (GSO-GRI) during April 20-21, 2015 in Hamburg, Germany. India shared its interest in four RIs offered for international participation viz. International Mouse Phenotyping Consortium (IMPC) proposed by Italy; The Wind Engineering Energy and Environment Dome (Windtee) proposed by Canada; Brazilian Bioethanol S&T Laboratory (CTBE) offered by Brazil and, Nuclotron-based Ion Collider fascility(NICA) offered by (Russia). Italy and Russia expressed interest in collaboration in the INO and 'LIGO Station, the RIs proposed by India. The Group shortlisted 5 proposed RIs as case studies for future collaborations (i) Underground labs (Gran Sasso) (Italy) (ii) International Mouse Phenotyping Consortium (IMPC) (iii) High Altitude Water Cherenkov Observatory(HAWC) Mexico (iv) Canadian High Arctic Research Station(CHARS) Canada, (v) European Spellation Source (ESS).

STRENGTHENING S&T IN STATES/UTs

Department of Science & Technology (DST) has established Councils for S&T in the States and Union Territories (UT's) in the country. This programme was initiated by the Department for the promotion of Science & Technology and building strong base for providing S&T intervention in country. Department has played a catalytic role by facilitating the State Governments in establishing and developing the State Councils on S&T and by providing support for their technical secretariats. Concurrently, DST, in collaboration with respective State Councils, is organizing all India thematic seminars/workshops whose recommendations helped to identify some activity-areas for promotion by the State Councils. DST also organized periodic review meetings to discuss the status of various S&T programmes and to plan the strategy for future. Regional meetings organized by DST facilitated review of state S&T structures and identification of areas of mutual cooperation between States for implementation of project and programme to address the location specific issues through Science & Technology interventions.

The support provided under SSTP can be classified as:

- Core support to S&T Councils
- Location Specific Research and Technology Development (LSR&TD)
- Pilot scale technology demonstration and replication of successful models
- S&T studies, surveys, information exchange and joint programming

New Projects supported

During the year 2015-16 following activities were carried out under the programme:

- **Core Support:** 28 State Councils for S&T were supported for their technical secretariats to implement S&T activities in the country.
- **Location Specific Research and Technology Development (LSR &TD) programme :** 5 new projects were supported for specific S&T intervention in the following areas**:**

Some of the new project initiated for providing S&T intervention in the the following areas:

1. Heath and sanitation :

"Promotion of Environmental Sanitation and overall health awareness among the rural tribals of Arunachal Pradesh" at Arunchal Pradesh State Council for Science & Technology, Itanagar.

'Effect of Malnutrition on Cognitive Development of Tribal Children of Eastern Uttar Pradesh with Special Reference to Psychosomatic Constitution' at Banaras Hindu University, Varanasi in collaboration of Genome Foundation, Hyderabad.

"Health survey of tribal population in Kashmir valley with special reference to magnitude and risk factors of non-communicable diseases: A collaborative cross sectional study" at All India Institute of Medical Sciences (AIIMS), New Delhi & Sheri-Kashmir Institute of Medical Sciences (SKIMS), Soura, Srinagar.

"A pilot study on Chickenpox and Herpes Zoster/Shingles among different age groups and vulnerable sections of Chennai population" at Presidency College, Chennai, Tamilnadu.

"Evaluation of Pharmacological interventions Targeting Retinal Renin Angiotensin System in Retinopathy of Prematurity" at All India Institute of Medical Sciences (AIIMS), New Delhi.

2. Agriculture:

"Identification of local strains from Kuttanadu suited for mushroom production and agro-waste composting" at Rice Research Station, Moncompu (Kerala Agricultural University), Kerala.

"Development and evaluation of nanocarrier for enhanced anti-microbial activity of anacardic acid against human and plant pathogensat Indian Institute of Technology, BHU, Varanasi, Uttar Pradesh.

"Dietary Supplementation for Restoring Health and Growth of Fish during Chronic Exposure to Water Borne Iron and Acidity in Tripura at College of Fisheries, Central Agricultural University, Tripura.

"Agro waste utilization: Separation of nutraceutic β-cryptoxanthin from Kinnow peels and its conversion to aqueous dispersible nano-emulsion for value addition of foods" at Punjabi University, Patiala, Punjab.

"Generation of Pony Based Animal Energy for Utilization in Agricultural Development of Manipur State" Agricultural University, Manipur, etc.

3. Location specific issues of the States

"Microbiological Characterization Documentation, Sociological Insight, Physicochemical Analysis of Hot Spring's (Tatopani) of Sikkim" at Sikkim University, Gangotk, Sikkim.

"Inventory, characterization and conservation of medicinal plants used by ethnic groups of

Mizoram, through traditional knowledge system up to pharmaceutical level" at Mizoram University, Mizoram.

"Ultrasonic technology for brightening and tarnish removal of Gold and Silver Jewelleries" at Entrepreneurship Development Institute of India, Ahmadabad , Gujarat.

"Molecular and digital documentation of ethno-traditional knowledge of Sikkim with special focus on folk healing for protection of Intellectual Property Rights (IPR)" at Sikkim State Council of Science and Technology.

4. Entrepreneurship development :

"Rural women empowerment and sustainable growth through training on sanitation etc" at Malviya National Institute of Technology, Jaipur.

"Enhancement of crop productivity and employment generation through disseminating latest technology of agriculture/beekeeping at Kumar Gramin Seva Shanthan, Allahabad.

5. Technology demonstration :

Some of the projects implemented in various part of the country have generated promising outcome and have potential for applications in the other parts of the country.

An indigenous technology on improving Traditional Water Mills for Income Generation to enhance the livelihood of Tribals in Arunachal Pradesh" was demonstrated at two places Rikpu Ronya and mukyom-Kojak village, West Siang District, Arunachal Pradesh by Arunchal Pradesh State Council for Science & Technology, Itanagar.

Traditional water mill demonstration in the State of Arunachal Pradesh

An indigenously Developed table-top Surface Plasma Resonance (SPR) set up developed at University of Delhi has been demonstrated at various places in the country for collection of field data.

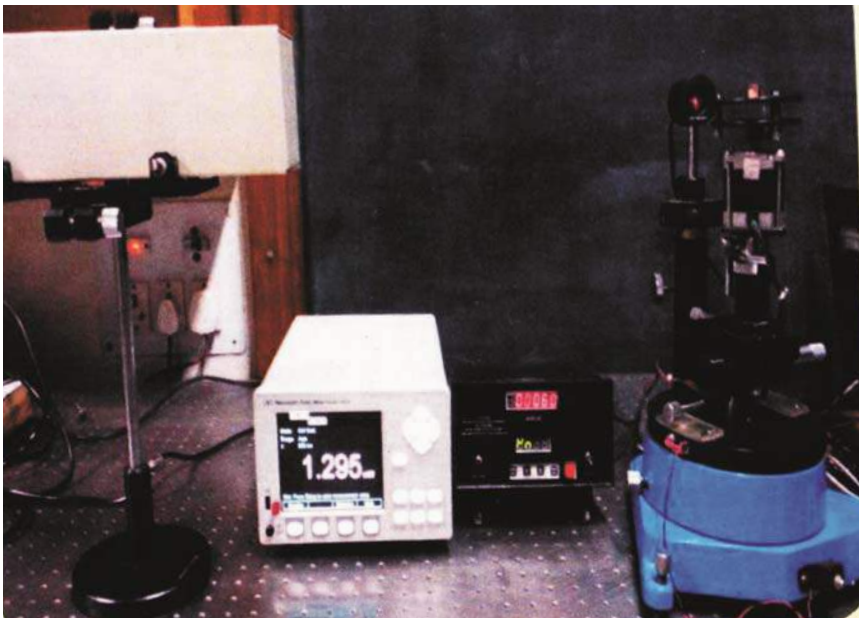


Table Top surface plasma resonance system developed at Delhi University

A robust, high performance and field ready rural lighting salutation using Rapidly Rechargable Hybrid Ultra Capacitors (RRHUC)" by Indian Institute of Science (IISC), Bangloare

The project has led to development of hybrid ultracapacitor based lighting technology which has been deployed at various places for collecting field data and user feedback. The lighting system was developed by IISc, Bangalore and the technology had been transferred to the industry (Mesha Energy Solutions, Bangalore). It has specialties like High Power Density (can deliver higher discharge currents with lower capacity), Quick charging (can charge at much higher currents), Longer life (> 100,000 cycles), Consistent (or improving) performance across life cycle, can charge with lower currents (useful while charging with solar under cloudy conditions) and eco-friendly (highly reduced use of Lead and Acid) and cost-effective (cheapest super-capacitor). It can be utilized in uninhabited areas for signaling and telecommunication services for railways, defense, etc., and also along the coastal line for light beacons and other navigational aids in desert areas, mountainous terrains and interior forests etc., for communication links and lighting as well as during disaster management/relief. A patent has been also applied.


Illuminating class rooms/School children utilizing the light

"Establishment of electronic cordless jacquard loom weaving centre for the socio economic development of marginalized handloom weavers" implemented at Vivekha Charitable trust, Kanchipuram, Tamilnadu

The project was implemented with an aim to establish embedded system based electronic cord less jacquard loom weaving centres in three different places; Kanchipuram (512 hooks), Ammayyappan (384 hooks), Thirupanangadu (384 hooks). This will lead to revival of manufacturing of ornamental designer silk sarees through science and technology intervention for the socio-economic development of marginal weavers and developing new livelihood opportunities in the field of weaving to the youth and women. The project had been already successfully implemented at two places such as Kanchipuram (512 hooks) and Ammayyappan (384 hooks) and work is progressing for the implementation at the third place Thirupanangadu (384 hooks). The system is unique as this is an indigenous development which will nullify the occupational stress of the weaver and will help to develop design conversion tool using visual basic on windows operating platform. This will also help in the creation of new business opportunities for the handloom weavers group.


Electronic Cordless Jacquard system demonstration in Tamilnadu

"Value addition of agro produce through Multi-Disciplinary science & technology inputs in Nagaland" implemented at Nagaland State Science & Technology

The project was implemented with an aim to improve the income of farmers through application of Science & Technology inputs by means of value addition for their produce. The major issues faced by the farmers are to dehydrate the agro produce and preserve it.

- A reasonably low cost biomass fired dryer which is efficient and based on fuel wood has been developed and tested by NASTEC, Kohima, which has found very good response in the remote villages where there is no electricity particularly during the rainy season. It could be used in conjunction with the solar air heater based dryers.
- Members of NASTEC had visited the proposed locations and have installed the biomass fired dryer at Kohima under Kohima district, Khelma and Nkialwa village, Peren district and at Sakraba village under Phek district.
- A slicer machine to slice fruits and vegetables is also being developed, tested and installed at Kohima
- The NASTEC team has identified and determined location in Kohima for setting up the cold storage cum dehydration unit. Also the cold room with the insulation has been set up and is ready for the cooling unit to be installed. The technology of heat pumps which is to be used for cold storage and dehydration have been developed by IIT Bombay.

Biomass Fired Dryer

Slicer Machine

Multi Utility Heat Pump to enable maintaining a vegetable cold store between 10 to 15°C and simultaneously enabling drying of spices, fruits and vegetables is designed, developed, integrated and commissioned in Heat pump Laboratory, Indian Institute of Technology, Mumbai (IITB) for preliminary testing before dispatch to Nagaland. Various components like Evaporator-cum-Ice-Bank-Tank and Condensing Unit with Provision for Drying are already developed. One MUHP capable of delivering about 2.5 TR with evaporator operating at -5°C is integrated at IITB. Preliminary tests have been done and result indicates satisfactory operation.

Various Solar Air Heaters Developed at HPL_IITB Integrated with Drying Duct for Preliminary Testing

The other important meetings and activities organized:

State Science & Technology Conclave-2015 was organized at Jaipur in collaboration with Rajasthan State Council for Science and Technology, Department of Science and Technology, Government of Rajasthan, Jaipur during 27th -28th August 2015. The conclave was inaugurated by Hon'ble Union Minister of Science & Technology and Earth Sciences and well attended by participants from various states of the country. Compendium on Specific S&T interventions by State S&T Councils was also released.

BUILDING NANO S&T CAPACITY

The Mission on Nano Science and Technology (Nano Mission) — an umbrella programme - was launched in the year 2007 to promote R&D in this emerging area of research in a comprehensive fashion. The main objectives of the Nano Mission are — basic research promotion, research infrastructure development, nano applications and technology development, human resource development, international collaborations and orchestrating national dialogues. During the year 2015-16, Nano Mission actively continued its activities which are summarized in brief below.

Basic Research Promotion

Forty six (46) new individual scientist-centric R&D projects were funded this year which focused on fundamental scientific studies of nano-scale systems and applications in the area of drug delivery, biomedical, agricultural, energy and solar. Some of these projects dealth with: two dimensional infrared (2D-IR) spectroscopic studies of molecular relaxation of nano-confined water and aqueous binary mixtures: role of ions, composition fluctuations and dynamic heterogeneity; development of multi-modal nonlinear plasma optical microscopy workstation to probe metallic nanoarchitectures; development of nano-particle based directed delivery systems for peptide therapeutics; synthesis and characterization of 2-D carbon backbone based hybrid magnetic nano composities for selective tumor theranostics; nanoformulation of siRNA: a strategy for effective treatment of drug resistant breast cancer; multiscale modeling of pharmaceutically releveant drug-dendrimer nanoscale complexes biometric, tissue adaptive nanofibre membrane for guided tissue regeneration; target-specific nanomaterials as contrast agents for high precision multimodal bioimaging applications; design of

controlled and targeted agricultural pesticide delivery nano-carrier with copper- graphene oxide composite; targeting pain neurons topically: a nanotechnology approach to treat chronic neuropathic pain; peptide-generated metal naoparticles and their potential biomedical applications; development of nanocomposite scaffolds with high wet strength for bone tissue engineering; uptake and effects of control and target directed carbon nanoparticles by differentiating and matured subpopulations of leukocytes in resting and activated states; nano-catalyst embedded hierarchically porous carbon AIR carbon for Li/Air rechargeable batteries; application of emerging nanomaterials in health, energy and water; formulation and fabrication of composite titania matrix with surface plasmon and quantum dots for use in dye sensitized solar cell and sensor system; architecting visible-NIR light absorbing hetero-nanostructures for harvesting solar light.

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:

- **Lanthanide-doped nanomaterials: Applications in solid state lightings**

  Colloidal synthesis method was used to prepare lanthanide-doped core-shell nanoparticles and core nanoparticles and have been characterized. The synthesis of lanthanide-doped nanoparticles has been optimized to achieve the monodispersity and high crystallanity by careful control of the process variables (concentration, temperature, order of addition, etc.). Various nanoparticle matrices such as lanthanum vanadate, tungstate, NaYF4, and MgO have been prepared with Eu3+, Tb3+, Dy3+, and Tm3+ have been done.

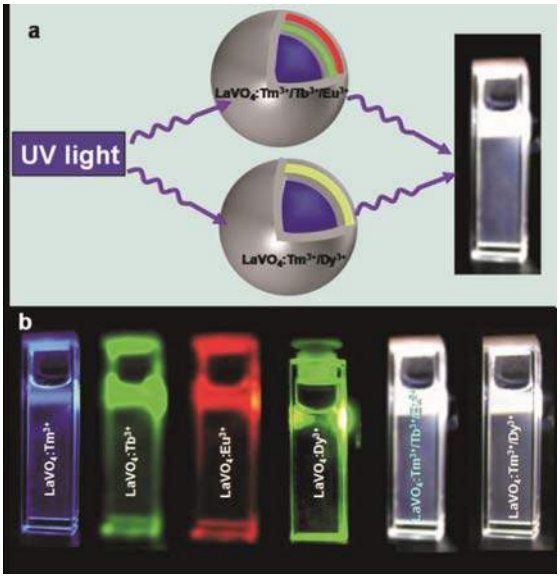


Fig. 1 a) Schematic representation of the generation of white light from LaVO4:Tm3+/Tb3+/Eu3+ (Type 1) and LaVO4:Tm3+/Dy3+ (Type 2) core-shell nanoparticles and b) digital photographs of blue, green, red, yellow and white light emissions from colloidal dispersions of LaVO4:Tm3+, LaVO4:Tb3+, LaVO4:Eu3+, LaVO4:Dy3+ core nanoparticles and LaVO4:Tm3+/Tb3+/Eu3+ (Type 1) and LaVO4:Tm3+/Dy3+ (Type 2) core-shell nanoparticles in dichloromethane solvent (1mg/mL). The Samples were excited with 280 nm Xe lamp light.

- **Organic solar cells**

  MoOx buffer layers, MoOx films were deposited on PEDOT/PSS coated ITO plate followed spin coating with P3HT/PCBM (1:1 w/w), dissolved in chlorobenzene and characterized.

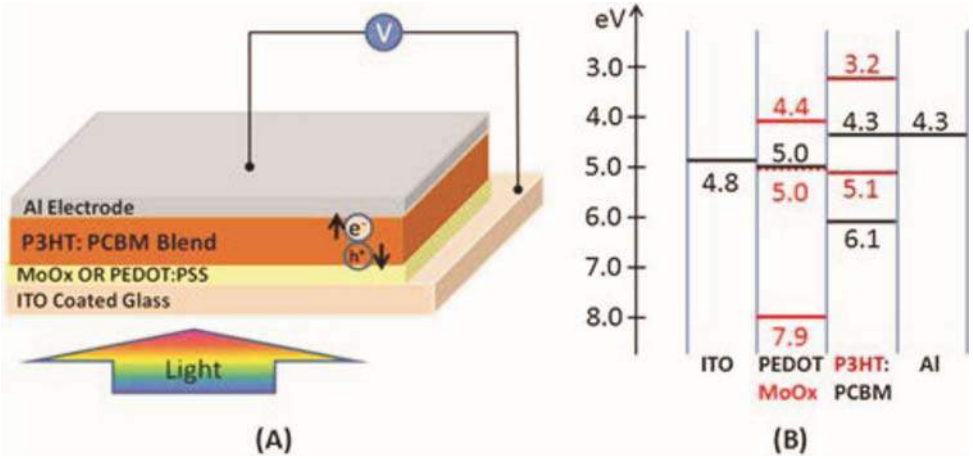
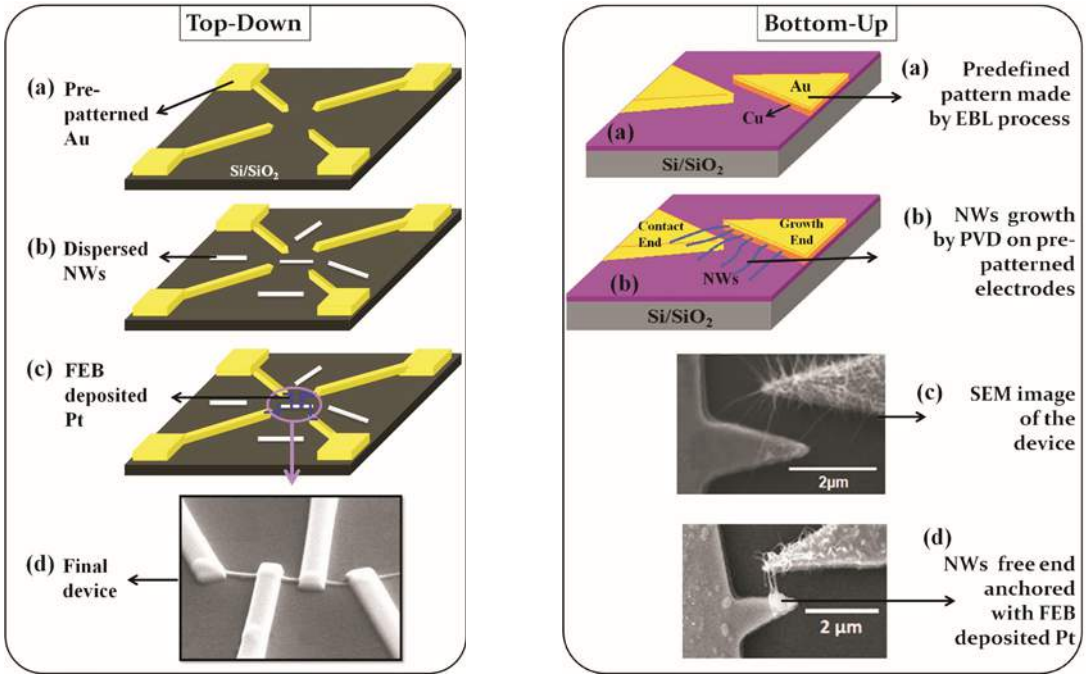


Fig. 2. (A) P3HT/PCBM organic solar cell device structure using PEDOT/PSS or sMoOx hole transport layers and (B) the corresponding band diagram.

- Development of the complete fabrication process for making single nanowire devices and nanobridge device arrays. The schematic diagram below shows the details of process.



- New class of polymeric photonic switches having oligophenylenevinylene (OPVs) were developed and their nano-gel alignment produced thermo-responsive photonic swithches for optical communications.
- Polysaccharide nano vesicles were developed for loading and delivering anticancer drugs through intravenous administration. Block copolymers based on nano-assemblies were utilized for delivering drugs through GI track.
- Studies on nanomedicine approach using ORMOSIL nanoparticles provided a promising direction for non viral gene delivery.
- Development of novel methods which are green, simple and economic for the synthesis of Cu/Cu_2O, Ag@AgCl, iron oxide, Au nanoflowers, Pd, Cu_2O, MgO NiO, Fe_2O_3, Co_3O_4, Fe@Pd/C, Ag and AgS nanoparticles.
- Silver nano particles synthesized using T.procumbens plant extract was found to possess nematicidal activity against root knot nematode M.incognita.It caused mortality of infective juveniles and inhibited hatching.
- The concept of nanotechnology has been envisaged in TB research for the development of safe, potent and efficacious antibiotics/drug delivery systems. In a study 5 secretory antigens have been successfully identified in the culture supernatant (Rv1738, Rv0569, Rv2626c, Rv2623, Rv3131c) based on moelcular size, antigenic index, and number of T and B cell epitope. In addition, FDA approved PLGA nanoparticle [Fig.4 & 5.] has been successfully cloned, expressed, purified and encapsulated.

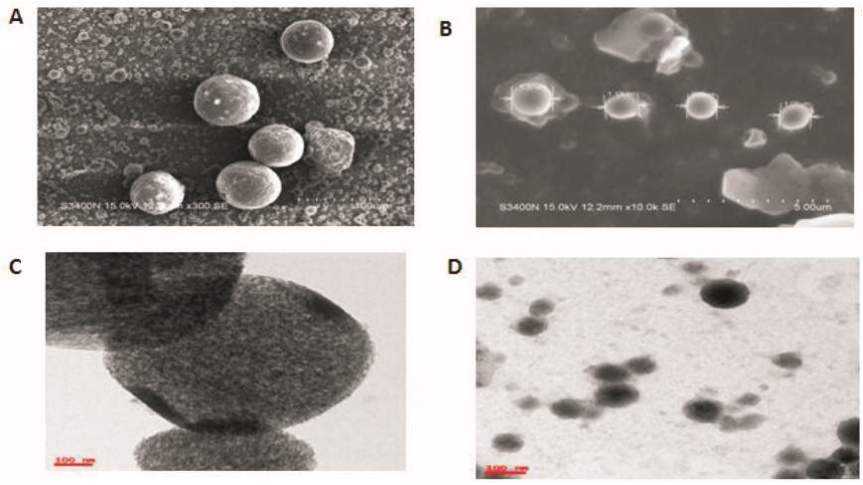


Fig. 4: **Surface morphology of Ova loaded PLGA nanoparticles.** A&B- SEM image and corresponding size distribution of PLGA micro and nanoparticles with Ova produced by an Emulsion-solvent evaporation method. C&D- TEM images of Ova coated PLGA nanoparticles with different magnification.

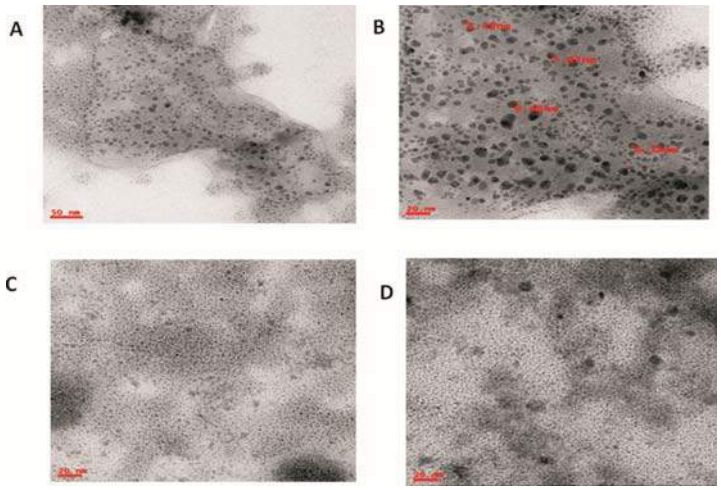


Figure 5: Surface morphology of PLGA nanoparticles loaded with MPL (TLR4 ligand) - A&B; and R837 (TLR7 ligand)- C&D observed using TEM.

- In a study, it was shown that ZnO-NPs can be used as antibacterial agent against human pathogens, including drug resistant clinical isolates and also reduced bacterial skin infection induced by S. *aureus* in in-vivo model, indicating that topical application of ZnO-NPs can be used as anti-infective agent for the treatment of skin infections.

Research Facilities

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 completed during the year. Excellent research work has been carried out using these facilities, which have resulted in about 130 research publications in international journals, preformed collaborative research with about 25 institutions and provided sample analysis service totally to about 7,500 sample in 5 years.

Support to accelerator-based facilities at Kurukshetra University and University of Allahabad continued during the year. The progress of these projects was also reviewed during the year.

Human Resource Development

Support to 3 ongoing Post-Graduate programmes (M.Tech/ M.Sc. in Nano Science & Technology) continued during the year. 5 new M.Tech programme specialized in area of Nanoelectronics and Nanophotonics, Nano Medical Sciences, Medical Nanotechnology and Nano Science & Technology were also sanctioned during the year.

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.

International Conference on Nano Science and Technology-2016 (ICONSAT-2016), a flagship event of the Nano Mission, is scheduled to be organized at Indian Institute of Science Education Research (IISER), Pune during the year under report. About 700 participants from India and abroad are expected to attend this mega event. Partial support to 4 other International /National Conferences was also provided. One National Research Award in Nano Science and Technology for the year 2016 and two Young Career Awards in Nano Science and Technology for the year 2016 would to be awarded to nominees during ICONSAT-2016.

Nano Applications and Technology Development Programme

One Joint Industry-Institute Project (JIIP) entitled "Novel nano silver polymer composites for bioactive technical textiles and plastics" was supported

International Collaborations

Support for using the India-Japan beamline established at the Photon Factory, KEK, Tsukuba, Japan continued during the year. Indian scientists from all over the country carried out their experiments using this facility. Also, support to the PETRA III project continued during the year. Several important and novel experiments were carried out by Indian scientists using this facility.

The next phase of India-Japan beamline project was sanctioned during the year. MoU for the same was also signed during the year. The project for Indo-UK Collaboration with Rutherford Appleton Lab, U.K. also got sanctioned 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.

The project for development of Standards for Nanotechnology implemented by National Physical Laboratory, New Delhi completed its duration this year.

Review of Ongoing Projects

A Special Review Meeting of Thematic Units of Excellence and some other major projects funded by Nano Mission was organized at JNCASR, Bengaluru on September 10, 2015 to assess the cumulative expertise acquired by various groups and to discuss the way forward for promoting breakthrough basic research and/or applications and technology development by competent groups in the country.

CLIMATE CHANGE PROGRAMME

Two national missions on climate change i.e. National Mission for Sustaining the Himalayan Ecosystem [NMSHE] and National Mission for Strategic Knowledge on Climate Change [NMSKCC] launched under National Action Plan for Climate Change [NAPCC] are being implemented under Climate Change Programme of the Department.

Highlights of activities of the scheme during 2015-16:

- A Major climate change research programme on 'Building Human and Institutional Capacities for Sustaining Himalayan Ecosystem'
- Strengthening of existing Knowledge Centres of Excellence and institutions working on climate change issues
- Capacity building programmes/Training of research professionals in climate change related areas.
- International bi-lateral and Regional cooperation

(a) Major Activities

As part of deliverables of these national missions, the programme division has initiated and supported 4 major research programmes during the period 2015-16. Brief scientific summaries of these programmes are given below

(i) Task force programme on "Himalayan Agriculture"

The main aim of this task force programme is to study the climate variability and the growing capriciousness in precipitation and rising temperatures, the traditional farming systems and cropping patterns are increasingly under threat in Indian Himalayan Region. Since the resource-poor rural farming communities are most vulnerable to the risks of climate change due to poor adaptation capacity, this programme 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, agro-forestry, farming systems, horticulture and fisheries. Further, it also 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 & K).

ii) Task force programme on "Integrated Hydrological Studies for Upper Ganga Basin up to Rishikesh"

This Task force programme has been supported by DST to focus on addressing the issue of comprehensive integrated hydrological studies for upper Ganga basin up to Rishikesh. 11 different sub-projects have been formulated under this programme with different study teams. The broad objectives of these sub-projects include the development of hydrological database in Upper Ganga basin, real-time snow cover information system, assessment of downstream impact and future runoff variations under climate change scenarios, hydrological modeling, study of river - aquifer interactions and groundwater potential in the upper Ganga basin. The project intends coherent sharing of the knowledge among the institutions engaged in research on water, snow and ice aspects in Himalayan eco-system through an interactive website for the Himalayan region of India.

iii) Task force on "Status of Geo-resources and Impact Assessment of Geological Processes in NW Himalayan Ecosystem"

Under this Task force programme, studies will be carried out to monitor the exogenic geological processes which includes landslides and related mass movement activities and GLOF are common in the mountainous terrain, and may interfere with geologic, geomorphic, anthropogenic and geotechnical characteristics of the slopes. Since, these may pose serious threat to the lives and property in the region and pose serious problem of erosion. This study is having an aim to identify potential zones of landslides and to understand the affect of the short- and long- term climate change on these activities. Overall, this proposed work would deal with the problems for the sustainability of geological resources and ecosystem of the NW Himalaya.

iv) Strengthening of "State Climate Change Centre/Cell in the State of Meghalaya"

This programme has been supported with an attempt to bring closer coordination with all stakeholders and apply climate change lens to scrutinise all activities to ensure proper response by way of adaptation or mitigation to climate change impact in the state of Meghalaya. To achieve its deliverables, this centre will include provisions for information generation and knowledge sharing on multiple dimensions.

(b) R&D manpower trained

CCP has already initiated a number of R&D programmes on some key areas of climate change science, adaptation and mitigation. Several institutes working in these areas have been engaged in providing capacity building programmes along with involving research students leading to generate trained manpower in the area of climate change sciences and technologies. Few institutions such as IITs, Bombay and Delhi; International Crops Research Institute for Semi-Arid Tropics (ICRISAT), Hyderabad have in-built capacity to engage PhD scholars during the course of there programmes.

(c) Study reports produced/generated and their brief findings

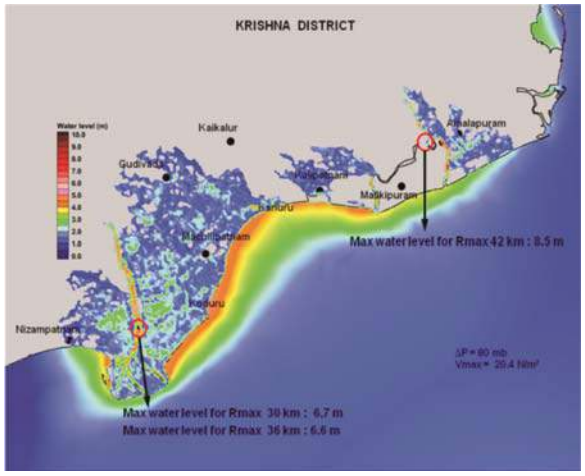
A gist of important findings/outcomes/achievements of some of the programmes supported by Climate Change programme of DST is given below:

Various research programmes have been supported under NMSKCC. The creation of strategic knowledge for climate change is being attempted through mapping of the knowledge resources relevant to climate change, networking of institutions for gathering knowledge, creation of new dedicated centres and promotion of international cooperation on S&T for climate change are some of the major activities. A gist of few findings is as given below:

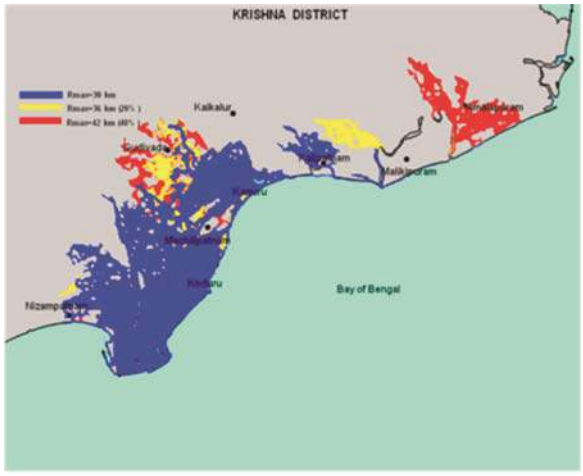
(i) Future projection of storm surges and inundation along the east coast of India using numerical simulations, Centre for Atmospheric Sciences, IIT, Delhi

India is frequently affected by coastal flooding due to storm surges which has a significant impact on human life. This project involves computation of storm surge and hence water levels

and associated inundation for any event of cyclone crossing the coast. The computations are also made in the climate change scenario by considering wind enhancement and increase of size of the cyclone.



Total depiction of maximum water level with peak surge locations for all possible Cyclones crossing Krishna district due to enhancement of R_{max} by 20% & 40% in no wind enhancement due to climate change



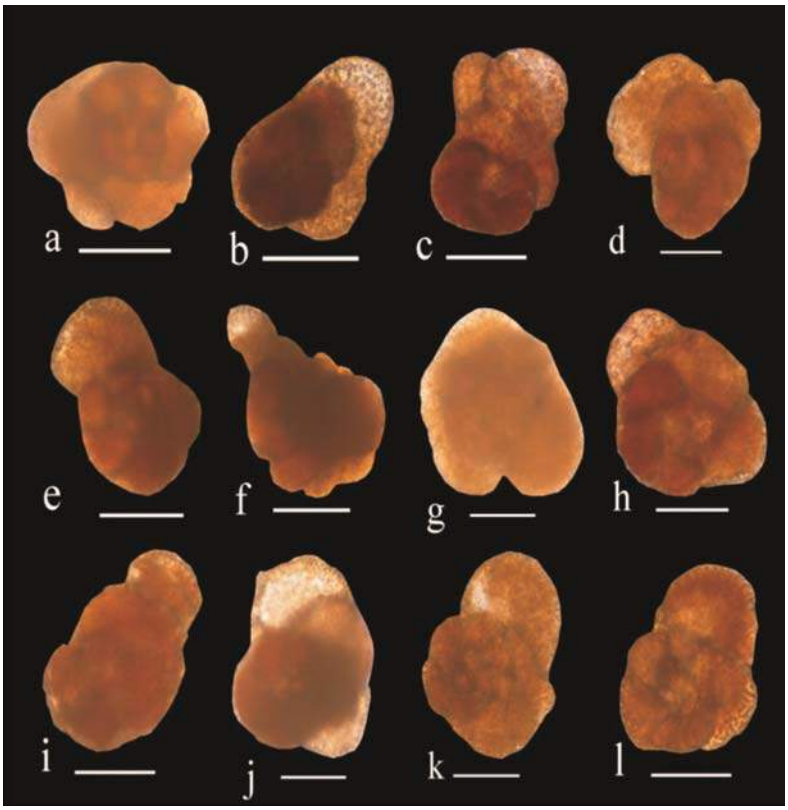
Total depiction of extent of coastal inundation for all possible Cyclones crossing Krishna district due to enhancement of Rmax by 20% & 40% in no wind enhancement due to climate change

Using ADCIRC model, the computations of total water elevations and associated coastal inundation at district level suggest that the most vulnerable regions among all the districts are Krishna and East Godavari due to the presence of large river basins. The maximum water levels are noticed in these regions vary from 6m-9.4m along the river due to extreme winds enhancement as a response of climate change. As per model computations, Vishakhapatnam is the safest district among all these coastal districts. The risk analysis is very useful for coastal authorities, concerned stakeholders and policy makers.

(ii) Laboratory experiments to study Ocean acidification using foraminifera CSIR-National Institute of Oceanography, Goa

The project is aimed to monitor changes in seawater pH in the shallow water regions off Goa and to study the response of living shallow water benthic foraminifera to different pH. Foraminifera are unicellular marine microorganisms which mostly secrete a hard calcareous exoskeleton. The calcareous exoskeleton is vulnerable to increasing ocean acidification. Based on the laboratory experiment wherein shallow water benthic foraminifera collected from the marginal marine areas, were subjected to a range of salinity and pH, it is found that the lower pH tolerance range of benthic foraminifera is 7.5, which is significantly different than the earlier report. Recently, is was reported that due to the adverse effect of anthropogenic green-house gas induced ocean acidification, benthic foraminifera will become extinct by the end of this century. In order to test the validity of this report, entire shallow water benthic foraminiferal

community was subjected to CO2 concentrations varying from ambient to as high as 4000 ppmv. It is found that the shallow water benthic foraminifera can tolerate CO2 concentration as high as 4000 ppmv. However, the population at high CO2 concentration decreases significantly. Therefore, it is highly unlikely that the projected atmospheric CO2 induced ocean acidification will significantly affect shallow water benthic foraminifera.

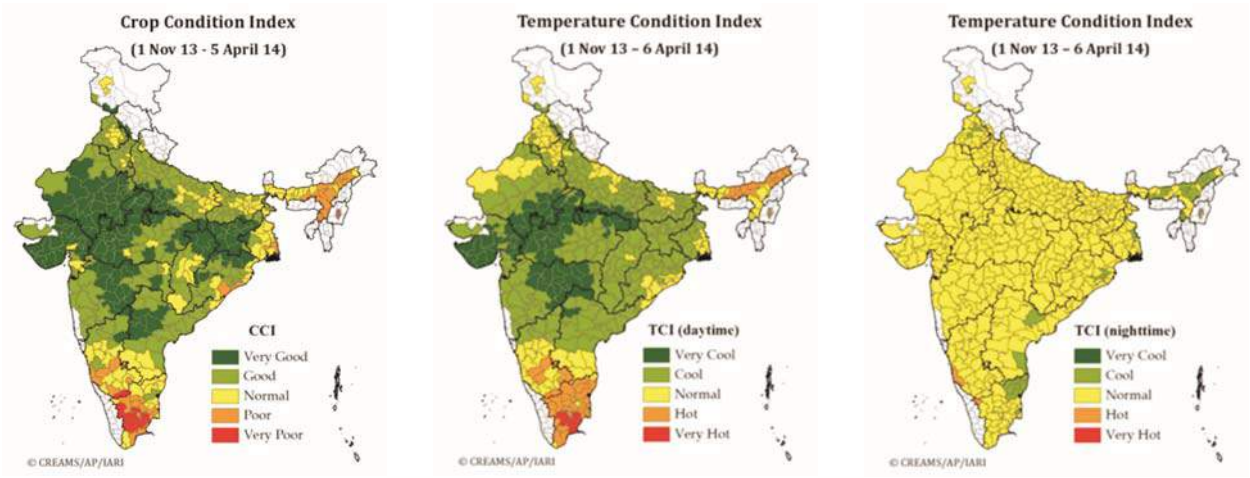


Abnormalities observed in *Rosalina Globularis* specimens

(iii)Adaptation of Indian agriculture to climate change, Center for Environment Science and Climate Resilient Agriculture, Indian Agricultural Research Institute, New Delhi

The main objectives of the study are to develop adaptation technologies to enhance the resilience of agriculture to the current and future climatic risks and to update simulation models for assessing impact of climate change and adaptation strategies.

Genotypes of rice, wheat and maize for tolerance to temperature and resistance to pests and diseases were identified and evaluated. Few differentially expressed proteins in wheat under the heat stress were identified. The magnitude of accumulation/activity of these proteins can be used as one of the criteria's to identify lines with high tolerance to the abiotic stresses; can be extended to other crops as well. Based on the biochemical traits, one can easily predict the tolerance nature of the cultivar under the climatic variations.



Crop condition index and temperature condition index for day and night maps for rabi 2013-14

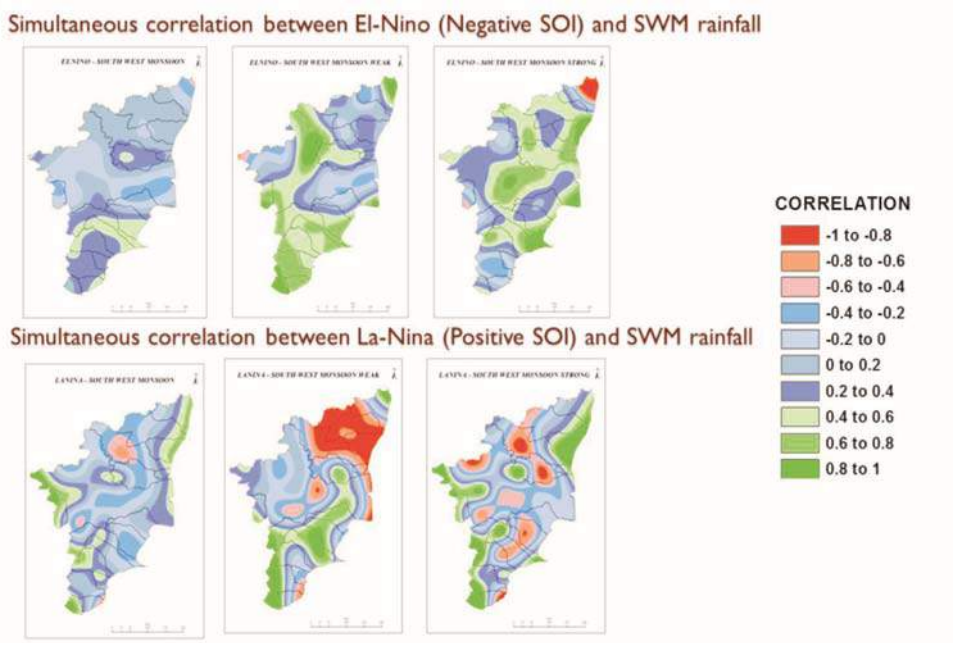
InfoCrop model was updated for assessing the effect of climate change on crop yields and development of adaptation strategies. Conservation agriculture practices have been evaluated for adaptation to climate change. Greenhouse gas emissions from Indian agriculture were assessed and the trends in emission were analysed. Various adaptation technologies for climate change and their co-benefits in terms of GHGs mitigation were identified and assessed. Existing knowledge on climate change adaptation available in various institutes and universities in the country was collated and analysed. This will help in developing strategic knowledge for climate change adaptation and can be implemented by the farmers.

(iv) Climate change impact assessment and developing adaptation strategies for rice crop using CERES-Rice model,Tamil Nadu Agricultural University, Tamil Nadu

Assessment of the impact of climate change as well as for developing adaptation strategies to manage the negative effect of climate change on rice was conducted. For precise assessment of direct and indirect impacts of climate change on rice, crop weather models could be one among the cost effective and time saving tools. In the current study, crop modeling tool was employed for assessing the impact of climate change as well as for developing adaptation strategies to manage the negative effect of climate change on rice.Rice crop would be greatly affected due to changing climate and the yield is expected to go down under future warmer climatic conditions. Some of the adaptation technologies like timely planting and practicing system of rice intensification (SRI) would help in sustaining the rice yields under changing climatic conditions. During *Kharif* (*Rabi*) season, SRI produced higher yield by 33.1 % (25.1 %) with water saving of 16 % (7.8 %) over traditional flooded rice cultivation.

(v) Impact of El Niño/Southern Oscillation on Hydrology and Rice Productivity in Cauvery basin: Application of Soil and Water Assessment Tool, Tamil Nadu Agricultural University, Tamil Nadu

Testing the impact of ENSO events on the water availability in the Cauvery river basin and its subsequent influence on the rice production was also carried out. Cauvery river basin is one of the important river basins in terms of agriculture and ensuring food security as it contributes 40% of the food grain production of Tamil Nadu. Rice is the major crop irrigated mostly by water from the Cauvery River. During kharif (June-September) season, the beginning of the cropping activity depends upon the release of water from the Mettur reservoir. Due to large variation in rainfall in the catchment as well as in the delta area of the basin, the water availability on time for cultivating paddy is becoming highly uncertain.



El Niño episode had a good linkage with rainfall, hydrology and rice productivity in the Cauvery river basin, India. El Niño years received more rainfall which resulted in high soil water recharge including percolation and soil water availability in the surface layers. The mean rice productivity was shifted up in El Niño over normal and la Niña years.

(vi) Devise a Grassroots' level Geospatial System for Climate-Stress Management in Bhilangana Basin of Garhwal Himalayas, Delhi University, New Delhi.

The objective of the study was to devise a Grassroots' level Geospatial System for Climate-Stress Management in Bhilangana Basin of Garhwal Himalayas.

The research has offered three recommendations for negotiating strategies by domestic climate policy makers to take forward in international forums as following:

- Creation of holistic adaptability mechanism at grassroots levels with multiple measures of external support (economic, government, social etc.), spearheaded by Philosphic, Operational and empowerment motive.
- To give more importance to indirect consequence of climate change related to livelihoods; and
- Creating stand-alone global schemes focusing on high magnitude borderless climate event in Himalayas, though with low probability. Ethical concerns should always be a part of moral binding while formulating the policy framework.

(vii) DST- Climate Change Studies Centre (CCSC) at Indian Institute of Technology, Bombay, Maharashtra

The research focus of the centre is related to the regional climate change, vulnerability assessment and adaptation and technology assessment & mitigation aspects.

The study is the first to attempt statistical downscaling for the entire country at a resolution of 0.5°. The downscaling model seems to capture the orographic effect on rainfall in mountainous areas of the Western Ghats and northeast India. The model also reveals spatially non uniform changes in rainfall, with a possible increase for the western coastline and north eastern India (rainfall surplus areas) and a decrease in northern India, western India (rainfall deficit areas), and on the south eastern coastline, highlighting the need for a detailed hydrologic study that includes future projections regarding water availability which may be useful for water resource policy decisions.

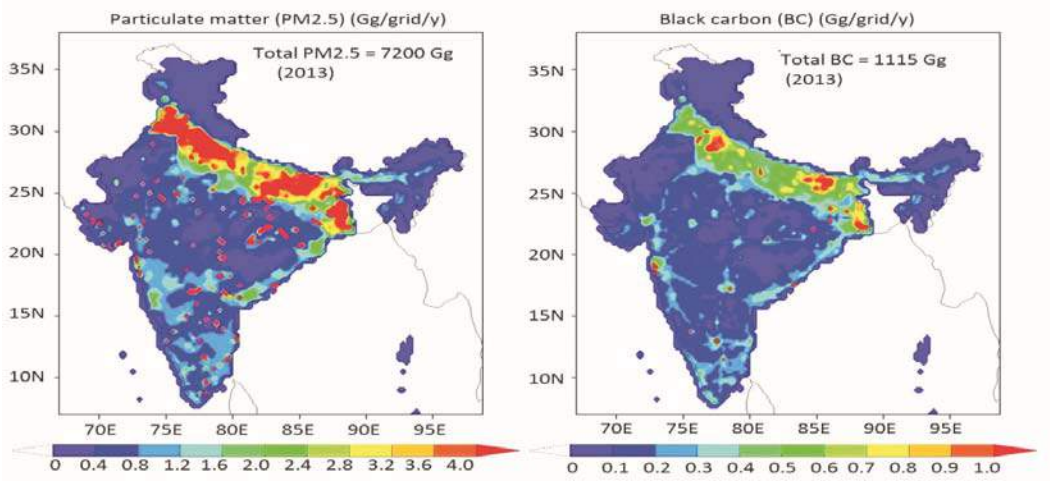


Figure National multi-pollutant emissions inventory, showing spatial distributions of annual emissions of particulate matter ($PM_{2.5}$) and black carbon (BC) from Indian industrial, transport, agriculture and residential sectors.

A City-Level Index based Approach indicates that the cities of Jaisalmer and Jodhpur are the most vulnerable among all the cities. 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 values of the contributing major sub-component indices are different for the different cities.

At present 28 PhD students are perusing under the above mentioned three board themes of research, covering different topics.

(viii) DST-Indo-German Centre for Sustainability (IGCS) at Indian Institute of Technology, Chennai

The Indo-German Centre for Sustainability seeks to build an International Research Network on Sustainability to Enhance Strategic Knowledge for Climate Change.

Few of the ongoing studies are as follows:

- Development of local air quality management system and formulation of action plans for air pollution control in Chennai city by identifying and analyzing pollutant hotspots and offer climate change mitigation and adaptation solutions.
- The need for wastewater treatment is a challenge particularly to mitigate climate changes due to emissions of methane, N2O and CO2 during the treatment process. The project attempts an alternate way by going green by utilizing renewable energy for treating waste water. Dewatering studies indicated that about 300 litres of septage would yield 10 kg of biosolids. Methane emission reductions from composting could exceed 99 percent compared to raw septage.
- A large database of publicly available information on Sripermbudur including but not limited to water access, levels and quality, land use and land prices, environmental indicators, industries categorized by small/medium/high impact on environment, socio-demographic information, and labour and employment have been collected. An inter-disciplinary team of anthropologists, civil engineers, economists, geographers, hydrologists, and urban experts has been closely involved with the project so far. The project is also developing a set of protocols for replicable datasets and methodologies for analysis.

(ix) State Climate Change Cell of J&K

The Receding Glaciers are dynamic and fragile ice bodies on the landscape and are products of the climate and climatic changes. Change in climate is clearly reflected in mass and temperature changes of glaciers. Hence the perennial land ice bodies are considered the key for climate system studies. Many significant studies on the recession of the Himalayan glaciers have been made are and are considered one of the prominent indicators of global climate change. Analysis of the areal extent of glaciers in Kashmir Valley from 1911 -2014 revealed that the extent of glaciers has reduced from 112 km2 in 1911 to only 94.44 km2 in 2014, showing a

glacial retreat of 17.89 km2. The observations made in this study suggest that small glaciers in Shepidddalau, Anantnag District, have been reduced from 0.5 to 0.3 km2. In addition, larger glaciers in Bodapather, Toshamaidan, Anantnag District are being fragmented into smaller glaciers. Some of the glaciers have been completely lost. Small glaciers are significantly affected due to global warming from the middle of the last century.If global warming is not checked now, glacial fragmentation and retreat is likely to increase in future, which might have a profound effect on availability of water resources in this region.

International Programme

Under NMSKCC, an Indo-US bilateral programme has been developed with the objective to launch a specialized Climate Fellowship Programme for the researchers with the joint support from both the countries. The vision of the fellowship is to build long term capacity in India and United States of America (US) by providing thepost-doctoral/ doctoral fellowships to the research scholars to pursue innovative research on climate issues.

Under NMSHE the Indo-Swiss Capacity Building Programme on Himalayan Glaciology has been successfully conducted during 2014-15. The programme was jointly organized by DST with the Swiss Agency for Development and Cooperation (SDC) as part of its ongoing collaboration focusing on climate change adaptation in the Himalayas. The programme comprises of advanced study of Himalayan glaciers and three-week field work at an identified glacier in Himalayas. The training is jointly conducted by experts from India and Switzerland and aims to strengthen capacities of Indian researchers and institutions in the field of glaciology. The phase I of this collaboration is over (2012-15) and Under NMSHE, DST intends to further enhance its collaboration with SDC including that in collaborative research with an aim of conducting studies which respond to the needs and concerns of the communities dependent on the Himalayas. Possibilities of collaborating with the International Center for Mountain Development, Kathmandu (ICIMOD) for unlocking synergies across the South Asia region are also being explored.

Himalayan Sustainable Development Forum (HSDF)

DST is also working towards establishment of the Himalaya Sustainable Development Forum (HSDF) as a platform for multi stakeholder dialogues and experience and knowledge sharing with GBPIHED as its secretariat. HSDF is based on recommendation of 'Shimla Declaration on Sustainable Himalayan Development' (Shimla, October 30, 2009).

(d) ***Mega events***

Himalayan Sustainable Development Forum (HSDF) As part of the HSDF two regional consultations for western and eastern Himalayan states in Dehradun Uttarakhand (4 August 2015), and Guwahati, Assam (5 October 2015) and one national level consultation in New Delhi (29-30 December) has been conducted.

Meet of Himalayan Peoples' Representatives: So far, two meeting have been organized by

GBPIHED, Almora. A group of Members of Parliament of India from the Himalayan region came together to share and discuss issues related to climate change adaptation in the Indian Himalayan Region. First People's Representatives meet was held in Almora (10 September 2015) while second (15 December 2015) meeting were organized in New Delhi.

Scientific Exchange Workshop: Scientific Exchange Workshop on Vulnerability, Risks and Hazards & Adaptation:Indian Himalayan Region has been organized on 2-3 July 2015, in New Delhi.

Supported the International Workshop on Climate Change Impact and Adaptation in Himalaya: Science and Policy Interface was organized by Kumaun University from 2-3 November 2015 in Nainital, Uttarakhand.

(e) ***Stakeholder responses***

Some of the State governments of the Indian Himalayan Region i.e. Sikkim, Uttarakhand, Meghalaya, Himachal Pradesh, Tripura, Mizoram, Nagaland have submitted their inputs regarding their proposed plans related to sustaining the Himalayan ecosystem issues of concerned states.

NATIONAL SUPERCOMPUTING MISSION (NSM): Building Capacity and Capability

The NSM was approved by the Government on 25th March, 2015 at a total cost of Rs. 4500 crore over a 7 year period of implementation. The Mission is being jointly steered by the Department of Science and Technology (DST) and the Department of Electronics and Information Technology (DeitY) along with the Implementing Agencies namely Indian Institute of Science (IISc), Bangalore and Centre for Development of Advanced Computing (C-DAC), Pune.

The NSM intends to set up a grid of 73 supercomputing facilities on a buy-and-build approach at academic and research institutions across the country. Three of these facilities would have petascale computers which will be in the range of 3-10 petascale and will be set up in the first 40 months. The next level would be of 20 supercomputers in the 500 to 800 teraflops range and the remaining 50 supercomputer will be with 100 to 400 teraflop capacity. Peta-scale computing refers to the capability to add at least a quadrillion (1,000 trillion) real numbers in a second.

The Executive Board under the Co-Chairmanship of Secretary, DST and Secretary, DeitY met on 09.07.2015 along with nominated representatives from Scientific Ministries, Departments and Agencies. Subsequently the constitution of Technical Advisory Committee (earlier nomenclatured as Think Tank) to NSM has taken place and a first meeting was held to chalk out the Implementation Strategies for NSM. The four Expert Groups namely on Infrastructure, Research & Development, Applications, and Human Resources are in the process of being constituted.

The mission aims to enhance the research capacities and capabilities in the country by connecting them to the Supercomputer grid. This will be the first step in the direction to have a supercomputer machine in the top 20 list by the end of 6 years.

The Mission is going to be transformative since high-end training is being planned as a part of HR efforts apart from understanding and developing indigenous applications to cater to our needs in basic science & engineering and in applications in medicine, agriculture, and technology. Applications areas in Engineering and Climate Modelling include typical complex problems such as in aerospace and automobile engineering; weather and climate modelling; computational fluid dynamics; computational structural mechanisms; computational physics, computational biology, computational chemistry and their interfaces etc. are few other areas that will be ventured into by Indian researchers in due course.

The mission supports the government's vision of "Digital India" and "Make in India" and would also generate highly skilled manpower for multi-disciplinary application development and also for meeting requirements of the scientific community.

CHAPTER 5

SOCIETAL CONTRACT OF S&T

SCIENCE FOR EQUITY, EMPOWERMENT & DEVELOPMENT

Science for Equity, Empowerment and Development (SEED) Division supports S&T based initiatives for societal benefits involving S&T based voluntary organizations, academic institutions, research labs, and so on across the country. It supports action research projects to address location-specific problems with S&T interventions and evolve field-based technology packages for improved livelihoods and quality of life at grassroots level. Adequate focus has also been given on providing technological solutions to well-identified challenges through technology appropriation, its demonstration in the field and delivery for meaningful adoption at the community level to ensure absorption as well as sustainability. Over the years, the schemes/programmes of SEED Division have achieved significant breakthroughs in developing and demonstrating technology packages in several sectors with the involvement of S&T based field groups and institutions for improving the quality of life, particularly those from the economically weaker sections of society in urban/semi-urban and rural areas. Major initiatives/achievements during the year under review are listed below:

1. SCIENCE AND SOCIETY PROGRAMME (SSP): This programme aims at development and nurturing of promising S&T based field institutions as well as development and delivery of appropriate and/or innovative technologies for addressing societal needs. Achievements made under various schemes/programmes are as follows:

1.1 Long Term Core Support-Technological Advancement for Rural Areas (TARA)

Under this innovative scheme of societal relevance of DST, long term core support is provided to S&T based voluntary organizations/field level institutions to develop and deliver need-based S&T solutions at the grassroots level. Currently, 25 organizations are being provided core support across the country. These groups, usually comprising of core team of at least 3-4 S&T manpower, work in their respective area of strength to innovate and deliver need-based technological solutions to well-identified local problems through adaptive research involving community as well as S&T knowledge hubs. For instance, Centre for Technology & Development working in Uttarakhand has been able to evolve a specific range of packaged, FSSAI-compliant products of millets and other high-nutrition grains along with an appropriate technology package for a community-based Rural Enterprise. Such need based intervention is to promote consumer demand and improve nutrition, create local jobs and new skills, and provide fresh stimulus for millet cultivation which would have important dividends for sustainable, climate-resilient agriculture in Uttarakhand.

Specific field based technological interventions made by these core groups are shown in a **Table**

given below relate to micro-enterprise creation, clean energy services, livelihood enhancement with improved quality-of-life for communities living in and around rural and difficult areas of the country.

Table : Technology Development and Up-scaling by Core Supported Organizations under TARA

S. No	Core groups	Interventions, Innovations and Packages Developed
1.	**Himalayan Research Group (HRG), Shimla, HP**	• Designing and development of cost effective solar panels for domestic needs of water and space heating in mountain areas. 20 units have been installed at households level in Mandi area, HP.
2.	**Development Alternatives, Jhansi, Bundelkhand**	• Development of innovative "Community-Owned and Community-Operated" affordable Safe Water Solution packages powered by solar energy for supplying safe drinking water in Bundelkhand. It is now being piloted in three villages' i.e. Pipra, Govindnagar and Chandraban.  **Women drawing Water from a Solar Powered Supply System at Govindnagar** • Setting up of production resource center to revive Kalapuram artisan cluster at Datia with skill development to create fibre based enterprises by introducing TARA Loom technology and hand made paper technology.
3.	**Vigyan Ashram, Pune**	• Development of low cost prosthetic hand by using open sourced digital fabrication tools like 3D printer, mio-sensor technology. • Business models around new technologies- Rice De-husking (Brown rice production at domestic level), Low cost terrace dryer, Hydroponics and fodder cultivation. 

		• Introduction to basic technology (IBT) program to provide technology based services to community through schools in more than 150+ schools of six states like Maharashtra, Chhattisgarh, Karnataka, Goa, Andhra-Pradesh, Odessa with 10000 + students.
4	**M S Swaminathan Research foundation, Wayanad, Kerala**	Technology based farming intervention packages evolved & replicated successfully in terms of conservation, food & nutritional security and livelihoods gain for tribal of Waynad region: • Traditional Pepper vine production through orthotropic (terminal) shoots. • Pot cultivation of traditional Ginger varieties for increased production with decreased pest/disease incidence. • Mass production of agricultural bio-inputs (*Trichoderma harzianum, Pseudomonas fluorescence, Beauveria bassiana* – pesticides; Bio Potash and Vermicompost – fertilizers • Community home gardens of traditional varieties of Tubers, Yams, Taors and Legumes (total 40 varieties).
5.	**Appropriate Rural Technology Institute (ARTI), Pune, Maharashtra**	• Village level Incinerator System for disposal of waste materials based on principles of natural draft, with chimney pipe and heat exchanger. Substitute to open burning / disposal and pollution free. 25 units installed at village Panchayat, rural hospitals and corporate sector on pilot scale.
6.	**Society for Energy, Environment & Development (SEED), Hyderabad**	• Innovative solar food processing technology: Development of value added fruit bars/rolls from Himalayan fruits, vegetable powders & under-utilized Non-Timber Forest Produce. Technology package has been delivered to establish 24 micro-enterprises with NGOs, Foundations, and Private entrepreneurs. 
7.	**Mitraniketan, Trivandrum, Kerala.**	• Vertical column method for rapid multiplication of pepper involving farming community. 

8.	**BAIF Development Research Foundation, Warje, Pune**	• Improvised Tanka with Agor (Cemented Catchment around Tanka) System in Desert region of Barmer and well recharge measures and roof top rain water harvesting in Kutch, Gujarat to address the issues drinking as well as for irrigation.  • Agri+ Horti + Forestry + Fodder Development: Establishment of wadi model (Ber, Pomegranate and Lasora) with inter crop of grain and vegetable (Cluster beans, Mung, Moth bean, Sesame, Cucurbits (Vegetables/ watermelon – kachri /Beans) with forestry trees (Ex: Trees such as Subabul /Khejri/Ardu/Neem/Sesbania), on farmer fields in Barmer Rajasthan.
9.	**HESCO, Dehradun, Uttarakhand**	• Standardization of technology based gravitational irrigation system to serve immediate needs of water for livestock and for spring recharging in rainfed hilly region.
10.	**N.B. Institute of Rural Development, Tripura**	• Development of Day Light Capture Device: Micro Solar Dome (MSD) for remote non-grid areas for lighting in slum and village habitat.

1.2. Technology Interventions for Addressing Societal Needs (TIASN): The scheme is aimed at development and adaptation of new and/or appropriate technologies to outreach beneficiaries. The scheme mainly focuses upon Agriculture, Health, Nutrition and other activities related to Non-Farm sector. Some of the achievements made under the individual projects funded under TIASN scheme are:

- A project funded to National Agro Foundation, Chennai to popularize integrated pest management and soil health management technologies for sustainable crop productivity among small and medium farmers in Chitamur, Acharapakkam and Madurantakam blocks of Kancheepuram District, Tamilnadu, has resulted in considerable improvement in crop yield and profit to farmers as given below:

S. No.	Crop	Percentage increase in yield (ICM *vs.* FP)*	Percentage increase in profit (ICM *vs.* FP)*
1	Paddy (Cereal)	26.8	54.0
2	Groundnut (Oilseed)	28.4	49.88
3	Vegetables (horticulture)	39.9	127.8

(*ICM – Integrated Crop Management, FP – Farmers Practice)

In order to sustain the benefits of ICM promoted under the project, ICM adopted groups were mobilized to form Farmers Clubs with support from NABARD which will be upgraded to Farmers Producer Organizations (FPOs).

- In another project being implemented by SGPGIMS, Lucknow, awareness and preventive impact of insulin and glucose monitoring devices, on glycemic control in children with underprivileged background having Type-1 diabetes were analyzed. An interim analysis of 75 patients' baseline data revealed average HbA1c of 8.5 $\pm$ 1.4% with no association with socio-economic status or gender, but, a strong association with education status of the head of household (education > class 10 *vs* $\leq$ class 10: HbA1c 7.9 $\pm$ 1.4% *vs* 9.0 $\pm$ 1.6%, $p < 0.005$).

A patient education booklet in Hindi has been prepared and is distributed free of cost to patients, and is also available for free reading on the website www.ispae.org.in (http://www.ispae.org.in/html_pages/diabetes_childhood.php).

Network Programmes: Department has undertaken special initiative to address various issues related to Livelihood, Health, Nutrition, Drudgery and Local Resource Management in the difficult terrains of Hot and Cold deserts of the country through its programme "ASAR (Arid and Semi-Arid Regions)" and "CODER (Cold Desert Regions)." Specific achievements are:

***ASAR Programme*:**

- Blue and green water harvesting techniques for enhancing the land & water productivity of semi-arid districts (Panchmahal & Dahod) of Gujarat were demonstrated in participatory manner. The experiments, conducted in farmers' fields, used green water harvesting techniques (Fig.1) for rainfed crops, indicated that conservation furrow system produced maximum green water harvesting (up to 80%) and minimum runoff and soil loss. It has also enhanced the crop yields of maize (22%), cotton (28%), and pigeon pea (25%). During the study, it was observed that under limited water supply situations in Rabi season, among the various irrigation techniques, alternate furrow with surge flow irrigation is better option and this method saved irrigation water up to 50 per cent. The cost effective and innovative check dams with plastic materials for different flow regimes and recharge filters were also developed. These low cost check dams and filters were evaluated in the farmers' fields of Panchmahal district of Gujarat and check dams with PP sheets were found to be more effective and durable.

Fig. Green water harvesting and irrigation techniques for water saving in farmer fields

- In order to bridge the gap and ensure food security at household and regional level, popularization of traditional food plants *Prosopis cineraria* (Khejri) and *Capparis deciduas (Kair)* was undertaken as both plants have great potential to serve as models for diversifying income and improving livelihoods of local people. In a project being implemented by AFRI, Jodhpur, Khejri fruit (sangri) collection was carried out from trees ranging in height and girth from 5.5m to 6.4m and 56cm to 67.5cm respectively, during April-May 2014 and 2015 within the intervals of 2-3 days from the fifth day of appearance of pods till their ripening. The average pod length varied from 12.8cm to 29.6cm, width from 1.7mm to 5.7mm, weight (10 pods) from 2.4g to 37.8g and moisture content from 50%-70%. Preservation of green pods was carried out in refrigerator, deep freezer (-22°C), brine and vinegar.

  Fruit collection of *Kair* was carried out in April-May, July-August and November-December of 2014 & 2015 and periodic phenological observations were recorded. Average fruit diameter varied from 5.8mm to 14.4mm, weight varied from 1.0g to 14.6g and moisture content from 70% to 75%. Sieves of different sizes were fabricated and gradation of fruits was done using these custom fabricated sieves. Different methods were adopted for processing of Kair fruits viz. soaking in different media like plain water, saline solution, lime solution and buttermilk for varied time intervals, boiling and steaming. Sugar evaluation in processed fruits showed that there was only very slight change in sugar content after 10 days of soaking in buttermilk (9-11%) as compared to other solutions. Farmers' entrepreneur model will be developed using the data collected through these experiments.

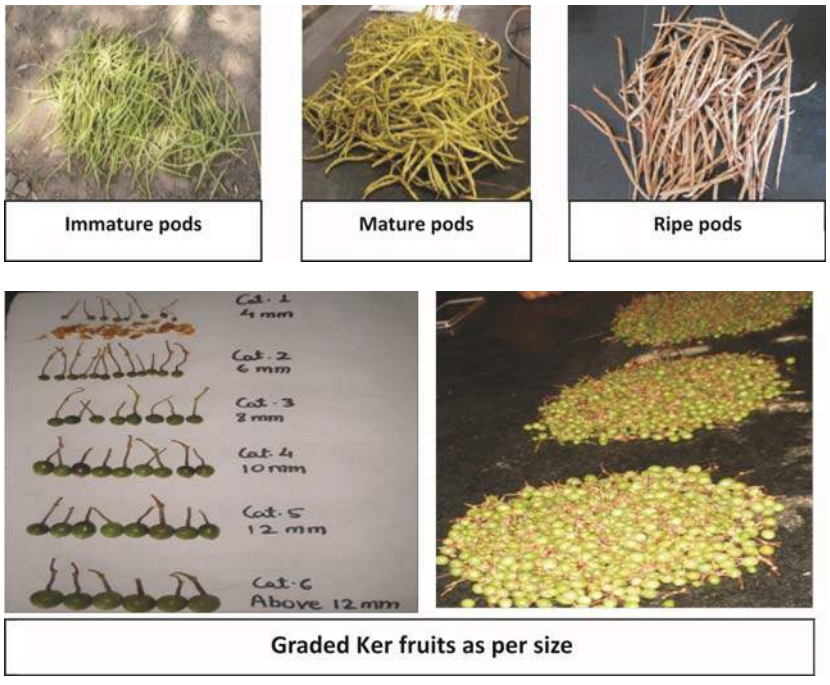


Fig. Different stages of *Sangri* pods and *Ker* fruits based on maturity and size

- Rajasthan is third largest salt producing State of India and contributes 10-12% of salt production. The State does not have sea coast and therefore solar salt production is exclusively dependent on sub-soil brine. Salt & brine samples of Didwana region of Rajasthan have been thoroughly characterized and problems of impurities in solar salt have been diagnosed by CSIR-CSMCRI, Bhavnagar. Based on brine characterization, novel methods of high purity salt production have been developed by CSMCRI (involving Samagra Vikas Sansthan, Jhunjhunu), and one of the running salt work sites has been redesigned and converted as demonstration site. High quality salt production technology has been demonstrated to salt producers with quality control laboratory facility established in Didwana. Local salt producers are also being trained regularly for quality parameters of salt and brine and they have been provided with training manuals. Salt iodizing facility has also been created to fetch better income.

CODER Programme:

- There are several indigenous food items of the cold desert and natives of Ladakh have been preparing and consuming these breads (khambir) and cheeses (Chhurpi) for years. The main ingredient of Ladakhi Chhurpi is Yak or Dzomo (crossbreed of cow & yak) milk. Primary microbial analysis of Chhurpi revealed that it contains yeast, mould, Lactic Acid Bacteria (LAB), and *Bifidobacterium sp.* The fermented material also contains *E. coli* and *Vibrio* sp., which raises a concern about its quality. Biochemical analysis reveals that it contains protein (60-64%), carbohydrate (23-24%) and fat (7-9%) along with organic acids such as lactic acid (0.1-0.23mg/g) and acetic acid (0.06-0.16 mg/g). The fermented material also contains different hydro soluble vitamins such as riboflavin (102-162µg/g), thiamine (35-64µg/g), and ascorbic acid (9-23 µg/g). Minute amount of ethanol and methanol were detected in both types of Chhurpi. The water extract of this material showed significant antioxidant activity (DPPH, ABTS, Catalase, and SOD) and antimicrobial activity against several diseases/disorders like *Salmonella typhi, Shigella dysenteriae, Staphylococcus aureus* and *Micrococcus luteus*).

Fig. Chhurpi processing steps in Ladakh: (A) Formation of Dahi (curd); (B) Separation of cream; (C) Boiling of buttermilk; (D) Mixing of coagulated portion; (E) Shaping and matting; (F) Sun dried Hard chhurpi

Khambir, is prepared mainly from wheat flour and yeast/lassi (milk). Microbial analysis of Khambir (yeast added) revealed that yeast and mould were major participating microbes while yeast, mould, and LAB play the major role in lassi added to khambir. Both these bread contain *E. coli* and *Vibrio* sp. Khambir contains a riboflavin (0.5µg/g in yeast added, 0.64µg/g in lassi added) and thiamine (1.1µg/g in yeast added, 0.88µg/g in lassi added). Lactic and acetic acid were present in lassi added Khambir but no acetic acid was detected in yeast added Khambir. A little amount of methanol and propan-2-ol were detected in yeast added Khambir but the lassi added one did not contain any alcohol. The water extract of the yeast added Khambir exerted significant antioxidant activity (DPPH, ABTS, catalase, and SOD) and antimicrobial activity (against *Salmonella typhi, Shigella dysenteriae, Staphylococcus aureus, Streptococcus faecalis, Vibrio harveyi* and *Micrococcus luteus*).

The results confirm that Chhurpi and Khambir are nutritious food items of the cold desert. However, further efforts are being made to standardize traditional practices through scientific interventions, free from microbial contamination. Upgradation of traditional methods along with manageable techniques of bio- preservation and packaging will increase the productivity and quality product preparation with extended shelf-life, and create marketing opportunities for socio-economic development of rural people.

- In order to create year-round employment opportunities in the cold desert region of Spiti district of Himachal Pradesh involving the villages of Kaza, Kibber, and Dhankar, sustainable value-added agro-processing technologies using crops and fruits grown in the areas are being developed under a project jointly being implemented by KIIT, Bhubneshwar and MUSE, Spiti. Technology for development of two value-added symbiotic fruit matrices - apple and Seabukthorn (*Hippophae rhamnoides*)- have been developed with a brand name Frutics as a fruit based probiotic beverage drink. For example, in the apple based drink, probiotic bacteria (*L. plantarum* and *L. rhamnosus*) could maintain its viability in only apple juice. Therefore juice matrix was fortified with two other ingredients. A probiotic count of 10^8 CFU/mL of each probiotic culture was inoculated in fortified apple juice and stored at 4°C for 4 weeks. Shelf life studies confirmed the viability of added probiotic bacteria in the fortified apple juice matrix. The probiotic fortified apple beverage product was found to be stable during cold storage. The conditions for pasteurization of fortified apple juice were also standardized. Subsequently, entrepreneurs will be trained in the developed technology through the process of technology transfer.

- Seabuckthorn fruit, mainly found in the cold desert region of Ladakh in J&K, Lahaul-Spiti and Kinnaur in Himachal Pradesh, is a rich source of Omega fatty acid, vitamins C (300-2750mg/100g), E, flavonoids and sterols. Harvesting of fruit is a tedious and laborious process due to dense arrangement of thorns and small size of berries. In order to ease the process of berry collection seeds, 11 Russian seabuckthorn varieties, having very large fruits (40-120g/100), high fruit yield (8-15kg/plant), nearly thornless and rich in oil (4-7%) were sown in the nursery at a farm of CSK Himachal Pradesh Agricultural University, at Kukumseri in Lahaul. After 2 years of growth, most of the varieties showed promising results, whereas few have failed in nursery conditions. At the end of growth season, observations for the height, girth and leaf size and occurrence of

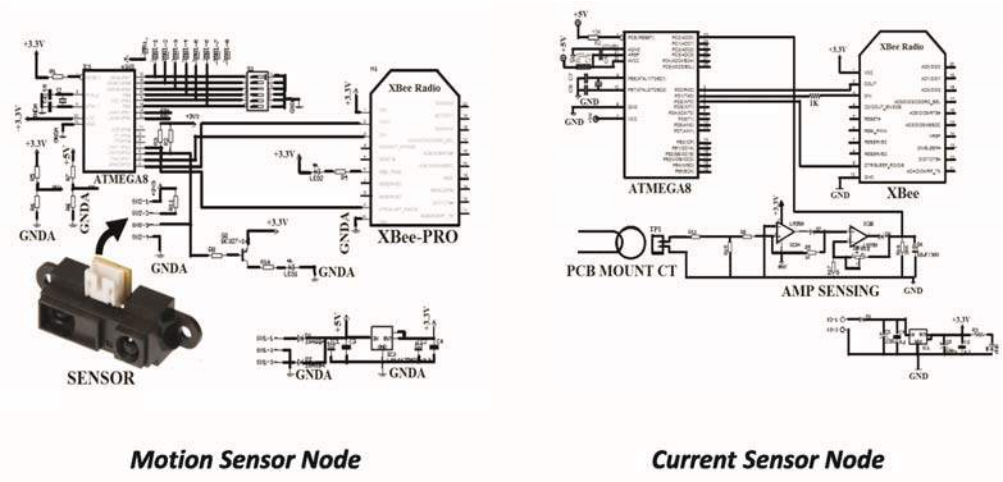
diseases and pests were recorded for 10 plants with 3 replicates for each variety. Introduction of improved Russian varieties show promise for socio-economic upliftment for farmers involved with seabuckthorn harvesting.

Programme for Disabled & Elderly (TIDE):

SEED also has a unique & focused initiative on S&T interventions for the benefit of elderly population and differently-abled persons - Technology Interventions for Disabled and Elderly (TIDE). In addition to providing technological solutions with multidisciplinary approach to address challenges, resolve problems and improve quality-of-life of the elderly and differently-abled population, TIDE also aims at providing such an individual the autonomy and independence through holistic development by creating enabling environment for their empowerment through application of S&T.

A wide array of projects like developing interactive teaching aids for autistic children, Mobile Phone Assisted Remote Speech Therapy Platform for treating speech disorder in children, prototypes of Clinical Spirometer and Multiple Wireless Sensor System for Monitoring Health Status of Elderly people, coherent communication system for comatose and patients with multiple disabilities, and so on were taken up for improving the quality of life of elderly population and accessibility of the disabled persons.

1. In order to provide more independence and autonomy to elderly, rather than getting neglected by the family or being forced to live in an old age home, a project "*Multiple wireless sensor system for monitoring health status of elderly people – prototype development and field testing*" has been implemented by Bengal Engineering and Science University, Kolkata for monitoring the vital health parameters and movement of elderly. An existing lab level prototype has been modified by incorporating a wristband like heart rate sensor and an algorithm in the central receiver to alert the person for wearing the heart rate sensor and also to stop scanning the irrelevant sensor nodes for power saving besides predicting the abnormal signals, if any in the vital health parameters. The schematic diagram of the sensor nodes and central controller unit are given here:



Motion Sensor Node ***Current Sensor Node***

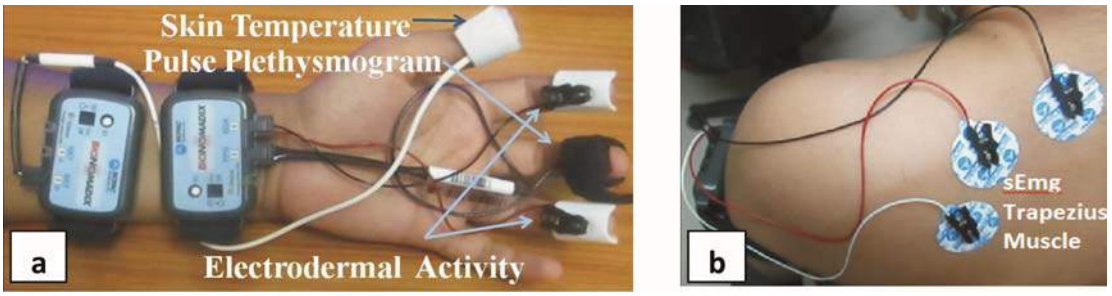
Following are some of the innovations attempted in the project:

- The motion sensor node has been developed with a reflective type proximity sensor which detects motion by measuring changes in the return signal from the object.
- The photoelectric sensor has a high response speed about 20 μs and is interfaced with ATMEGA8 microcontroller which is connected to a ZigBee transceiver.
- The interfacing circuit works with the microcontroller and uses Bluetooth protocol for receiving the ECG data from the monitor.

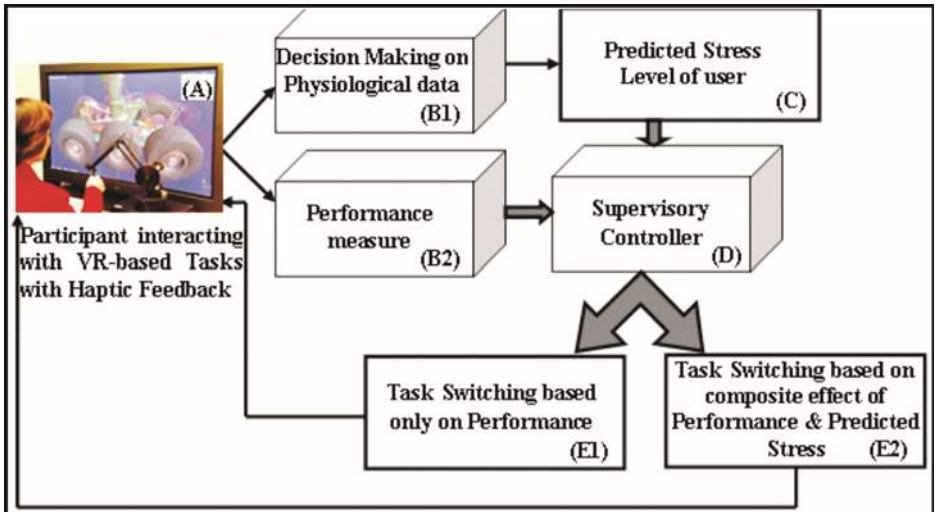
Multiple prototypes (20 in number) of the wireless sensor nodes and the central receiver have been developed and field tested. The prototype (50 in number) will be fine-tuned by installing in the houses of elderly people and it is proposed to transfer the technology to Industry through DST-CSIR Sensor Hub, CGCRI, Kolkata.

2. Standard digital spirometer that provides information about human lung vital capacity and related diseases such as asthma, pulmonary fibrosis, cystic fibrosis and chronic obstructive pulmonary disease (COPD) costs US$500-700. Under a project "*Design and Development of Clinical Prototype of Electronic Spirometer*" implemented by Disha Institute of Management and Technology, Raipur, an easy to use, compact & cost effective spirometer using MEMS (Micro-Electro-Mechanical Systems) technology using a differential pressure sensor which also has an inbuilt temperature compensation mechanism has been developed. Digisys labs, Hyderabad, was involved for embedded programming and PCB design whereas the clinical testing is being carried out at AIIMS, New Delhi and AIIMS, Raipur. The PCB assembly and display units developed under the project are shown here. It is expected that manufacturing cost could be brought down to around $120, about one-fifth of the existing spirometer.

3. Stroke is a global health problem. Organized care for stroke is limited and inadequate in middle income countries like India where resources for rehabilitation are scarce and movement impairments after stroke are typically treated with intensive hands-on physical and occupational therapy for several weeks after the initial injury. Recent research in the field of Virtual Reality (VR) being used for stroke rehabilitation is mostly based on one's performance, thereby lacking individualization of services. Intelligent Adaptive Virtual Reality (VR) based Stroke Rehabilitation tool has been developed under a project "*Intelligent Adaptive Virtual Reality based Stroke Rehabilitation Platform for Elderly*" by IIT, Gandhinagar, which has shown the feasibility of designing platforms that are not only sensitive to one's performance, but also to stress level predicted from one's physiological indices while interacting with VR environment. In the instant model, VR-based task platform was interfaced with real-time physiological data acquisition device (Biopac MP150). Thus, while the participants interacted with various VR-based tasks, the system acquired real time physiological signals, e.g., electromyogram, electrodermal, etc. (Figs. a and b) in a time-synchronized manner along with task progression. Subsequently, these physiological signals were used to predict the participant's stress level.



Subsequently, based on one's predicted stress level and task performance, a rule-based supervisory controller (Supervisor) was used to switch VR-based interactive tasks to develop individualized adaptive reinforcement strategy which was as a Stress Sensitive (SS) System. Simultaneously, a task switching rationale that could switch tasks based on one's task performance alone, named as a Performance Sensitive (PS) system has also been designed. Integrating these two, studies to systematically explore the potential of the new technology with respect to stroke rehabilitation had been developed (Fig c)



Thus, rehabilitation platforms can be individualized. This lends its novelty to VR-based rehabilitation platform. Preliminary results concluded that VR-based adaptive intelligent stroke rehabilitation platform has the potential to contribute to the improvement in certain aspects of upper limb movement, such as, coordination skill of shoulder and elbow joints, etc. of patients with upper limb movement disorders. The VR-based platform being individualized can alleviate the necessity of an always-present physiotherapist.

1.3. Scheme for Young Scientists & Technologists: The scheme encourages young professionals to take up scientific projects of social relevance with lab-to-field approach. DST supported 21 projects under the scheme in 2015-16. Some noteworthy achievements are:

- Resistant Starch (RS) resists digestion in stomach and intestine thus controlling the level of blood glucose or insulin after having a meal. Resistant Starch Rich Powder (RSRP) was prepared from

the isolated sweet potato starch. Chemical, functional, and structural properties of sweet potato starch were examined and it was revealed during the study that it contains high amount of rapidly digestible starch (73.49%) and low amount of resistant starch (13.52%). RSRP contained higher amount of resistant starch (63.07%) but, lower amount of rapidly digestible starch (33.57%). Experimental breads (EB) with different levels of RS {0% in control bread (CB); 10% (EB1) and 15% (EB2)} were formulated by using appropriate amount of RSRP. RS could be incorporated up to 10% in bread with a minimum change in the sensory scores and the bread could be stored up to 4 days. Glycemic response of the breads (Control and Experimental) is being studied in the elderly volunteers.

Fig. Resistant starch was isolated from sweet potato that used to prepare bread and a comparative study was performed with control and experimental bread.

- Promotion of AM fungi was done for the cultivation of betlevine in Sunderbans, by Vivekananda Institute of Biotechnology, West Bengal. Field trials were carried out at 12 farmers' betelvine yard of Namkhana, Kakdwip, Sagar and Patharpratima block. Trials were conducted in 3 Gram panchayat in each 4 blocks to study the effect of different microbial inoculation levels on plant height, leaf area, chlorophyll content and quality of betel vine leaves. The experiment comprised of 4 treatments. i) AMF (T_1), ii) AMF + Liq. *Azotobacter* (T_2), iii) Liq. *Azotobacter* (T_3) and (iv) Control (T_4). Application of AMF + Liquid *Azotobacter* had shown significantly higher plant height, leaf area, no. of adventitious root**,** chlorophyll content, shelf life of betel leaves in comparison to other treatments. Bio-safety assessment of the foliar spray was also observed as *Azotobacter* sp. belongs to Risk Group I microorganisms, which is unlikely to cause human/animal disease. Usage of AMF and liquid *Azotobacter* in betelvine yard resulted in increased shelf life of the betel leaves and 30 per cent reduction in usage of chemical fertilizer.

2. TECHNOLOGICAL INTERVENTION FOR TRIBAL EMPOWERMENT (TITE): Under this scheme, diverse projects have been implemented in different parts of the country focusing on appropriate and cost effective technology modulation and transfer, based on location specific needs/conditions leading to technological empowerment in related occupations of tribal sections of the society. Major emphasis has been on creating sustainable livelihood base through use of locally available resources and materials. 27 new projects have been sanctioned during the year. Specific outcomes are as under:

- Under a project *'Forest Resource Centric Interventions for Diversified Sustainable Livelihood Opportunities in Tribal Regions of Central India',* being implemented by BAIF, Pune, field based technology packages for Lac Cultivation, Inland Fishery, Non-destructive Gum Harvesting were introduced/demonstrated to build the capacity of 202 tribal households covering Etapalli block, Gadchiroli district, Maharashtra and Ghodadongari & Shahapur blocks, Betul district, Madhya Pradesh. These interventions have helped in sustainable management of the forest resources as well as enhancing livelihood opportunities at the local level.

- In another livelihood related project on 'Development of Composite Sericulture' being implemented in Imphal District, Manipur, seven Seri-Self Help Groups have been formed which are engaged in Mulberry plantation in 12000 m2 of wasteland and subsequently in silkworm rearing and post-cocoon technologies (reeling, spinning, gicha yarn production and dying of the silk fibre) by establishing common facility centers. Likewise, in a project on *'Value addition of Non Timber Forest Produces to enhance the Economic Status of Rural Community in Bastar, Chhattisgarh'*, 200 tribal households have been skilled in value addition of tamarind and production & value addition of lac by adopting scientific practices and use of appropriate technology. Trained tribal are now able to make value-added products as Seed Tamarind, Tamarind Candy and Seed Lac thus enabling them to enhance their income and quality of life.

- To augment livelihood opportunities in eco-fragile mountainous Tribal Areas, a project is being implemented by HIFEED, Dehradun, which has helped to introduce 'Improved Agricultural Package of Practices' for production of organic crops of pulses & spices in Rain-fed and Irrigated Pockets of 10 Villages in Chakrata and Kalsi Blocks of Uttarakhand. About 90 trained tribal farmers have been able to adopt and set up poly houses, poly tunnels and seed banks with common agro service centre as a facility for quality pulse and spice crop production.

- 260 farmers from 32 villages have been chosen by CSIR-CIMAP, Hyderabad in *'Cultivation and Processing of High Value Aromatic grasses'* like citronella and vetiver in hilly tribal areas of Visakhapatnam district, Andhra Pradesh. Such initiatives with introduction of scientifically validated varieties, distillation units and formulations at the farmers' level have enabled them to double their average annual income utilizing the same unit area.

- Further, a project is being implemented by SKUAST, Jammu, for providing entrepreneurship opportunities for socio-economic up-liftment of rural farmers through Quality Protein Maize (QPM) hybrid seed production techniques. Under this innovative project to address the problem of protein malnutrition and better income, farmers of ST community around Rajouri are involved in scientific production and management of QPM and seed production technique of Single Cross hybrid QPM seed in place of the traditional cultivars. 40 Front Line Demonstration (FLD) of two QPMQ cultivars i.e., Vivek QPM-9 and HQPM-4 have been conducted in 5 different blocks of Rajouri.

Building Capacities in Production of Single Cross Hybrid Quality Protein Maize at Rajouri, Jammu

- DST has sanctioned a one-of-its-kind "Ethno Medicinal Research Centre" at Foundation for Environment and Economic Development Services, Hengbung, District Senapati, Manipur with an outlay of Rs 6.92 crores. This Centre is being established with an aim to undertake ethno phyto-chemical research of the wild herbs available in the North-Eastern region of India that has unique, rich and diverse medicinal and aromatic plants and also study properties in traditional system. The Centre will not only give scientific validation of traditional herbs and facilitate product development but also strive to improve economic status as well as quality of life of local community by providing better livelihood opportunities.

People and Protected Areas Network Programme-Conservation and Sustainable Livelihoods in Partnership with Local Communities: This multi-locational network programme is being implemented at 16 locations in collaboration with WWF-India by engaging tribal communities from buffer zones of different PAs across the country in adoption of alternative livelihoods activities as well as to make use of energy efficient devices for cooking, lighting, etc. Such technology driven initiatives for NTFP processing, nursery raising, farm and off-farm based activities with interface from technology knowledge hubs have helped to establish local institutional network, to be owned and managed by communities from 75 villages for ecological as well as livelihood gains and to reduce dependency on forest resources.

LEISA demonstration near Valmiki Wildlife Sanctuary, West Champaran, Bihar

Cultivation of tubers near Dandeli-Anshi Tiger Reserve, Uttar Kannada, Karnataka

Herbal tea production near Khokhan Wildlife Sanctuary, HP

Introduction of Fuel Efficient Chullha near Nargu Wildlife Sanctuary, Kullu, HP

Building Capacities for Alternative Livelihoods around Protected Areas: Technological Interventions to address Conservation *vis-à-vis* Livelihoods Issues

3. SCHEDULED CASTE SUB-PLAN FOR THE DEVELOPMENT OF SHEDULED CASTE POPULATION (SCSP): Social Equity principles demand special attention and careful intervention to facilitate the overall development of Scheduled Caste community in their developmental aspirations. DST has been implementing Scheduled Castes Sub-Plan (SCSP) since 1992 with a view to empower SC population through S&T inputs. During the year, 23 projects were sanctioned in farm as well as non-farm sector. Specific achievements made during the year are as follows:

Technology Application for Livelihood Improvement of Scheduled Caste Population: DST has initiated a network programme with the aim to provide S&T solutions to address issues/problems of the SC community thereby enhancing the quality-of-life in the top seven SC-populated States in the

country - Andhra Pradesh, Bihar, Madhya Pradesh, Odisha, Rajasthan, Tamil Nadu and Uttar Pradesh. The technological interventions are:

- Climate resilient systems for sustainable farming and livelihood enhancement of SC population: In a cluster of 6 villages, 100 farmers were imparted training for Rice + Fish + Poultry in wetland holdings for quality rice seed production and for integrated management of water hyacinth. An innovative model of integrating fish culture and poultry rearing in rice fields have been evolved by Annamalai University, wherein the component enterprises would remain as separate entities. This technological intervention resulted in the additional or supplementary production of poultry and fish meat, and rice productivity increased by 14 per cent. Besides, pest incidence in rice reduced by 4 per cent per year in the absence of inorganic pest control.

- Moringa Cultivation & Processing- Established 6 Moringa Cultivation Plots and imparted training to the beneficiaries on organic cultivation methods for income generation and drying the leaves for better price by utilizing Solar Dryer in the village. Farmers have well adopted organic cultivation techniques for optimum yield and reported approximately 1000 to 1250 kgs yield in an acre of land. Forward linkages for marketing were also established.

- Cattle Feed Formulation and Organic Liquid Fertilizer (Humus): 15 household Humus organic liquid manure production units were established. Humus liquid manure is also used as pesticides by the farmers and applied to Paddy, Groundnut, Sugarcane, Banana, Gingili, Manila and reported significant increase in plant growth. Beneficiaries have reported that it prevents water loss and increase in microorganism in the soil (NPK nitrogen fixation). Beneficiaries are presently selling Humus organic liquid fertilizer @ Rs. 85-100/liter.

- Azolla Cultivation- 15 Azolla pits (6'x4') were established in the backyards of farmer's lands and they are engaged in production of Azolla and administering it to their cattle as feed supplement. Beneficiaries were provided with lactometers to test the milk quality to enable them to sell milk at higher prices. Each beneficiary harvesting 200 gms/day. This project is predominantly focused to encourage biotech based village enterprises for effective utilization of bio-resources in an integrated & judicious manner for sustained socio-economic development of the community.

- Bio-pesticides technology interventions for livelihood improvement of SC population in Vellore district in Tamil Nadu by Indian Institute of Horticultural Research, Bangalore has helped in managing Wilt disease complex in crops like capsicum, tomato, banana, tuberose, crossandra and gerbera which was reducing the productivity. Application of microbial (neem based) consortia containing bio-nematicide, bio-fungicide and bio-bactericide helps in reducing the disease. The technologies for enrichment of organic mixture containing FYM/ Vermi-compost and neem / pongamia cake with bio-pesticides and methodology of application as seed, substrate and soil application were popularized for production of disease-free nursery seedlings and pesticide-free high quality produce. Around 200 small and marginal farmers are adopting the technology. Increase in productivity was also reported by the farmers.

- 'Improvement of Livelihood and Socio-Economic Status of SC– Exploitation of wetland resources for the nutritional security of rural SC population': A project on Bivalve Hatchery Technology (BHT) and Farming of Green mussel, *Perna viridis* and Edible oyster, *Crassostrea madrasensis* for livelihood improvement of SC population in & around Parangipettai coastal town, Cuddalore District was undertaken by Centre of Advanced Study in Marine Biology, Tamil Nadu. The natural stocks of edible bivalves are identified for sustainable utilization as well as continuous supply of bivalve seed ensured through Hatchery Technique. The SC community is being trained to become entrepreneurs on sea farming practices for bivalve species.

- Another project on shell fishery was undertaken to conserve and propagate the Molluscs in the region of North Bihar by RLSY College, West Champaran, for providing food to the poor and raw materials to the pearl button industries. The technology has been standardized to conserve the shell fishery to supplement income and nutrition for better livelihoods using local resources.

S&T LED ENTREPRENEURSHIP AND INNOVATION PROMOTION

The National Science & Technology Entrepreneurship Development Board (NSTEDB) of the Department of Science and Technology (DST), Government of India has taken several measures to foster and nurture innovation and entrepreneurship by scouting and supporting innovative ideas, implementing various institutional programmes and organizing capacity building programmes across the country. In addition, the Department has also played an active role in formulating and enforcing few policy interventions for strengthening incubators and its start-ups. To fuel the Start up India movement, NSTEDB would further strengthen its ongoing programmes and also initiate new programmes by partnering with likeminded Government as well as private organisations. Brief details of the major activities of the division undertaken during F.Y. 2015-16 are reported below.

A. Institutional Programmes on Entrepreneurship – The division supports four different types of institutional programmes on promotion of technology based entrepreneurship. The details of

programmes supported and being implemented by various institutions and organisations during 2015-16 are highlighted below.

A1. Technology Business Incubators (TBIs)

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. TBI programme initiated during 2000-2001 aims to catalyse growth of technology driven, knowledge based new ventures/startups and is usually hosted at academic institutes of higher learning. DST has established around 90 Technology Business Incubators (TBI) and Science and Technology Entrepreneurs Parks (STEP) and several among them have matured and developed competence to become state-of-the-art Incubators. Incubators have become key mechanism for spurring entrepreneurial culture in institutions, employment generation, introduction of innovative technologies in Society and contribution to economic growth.

During 2015-16, four new TBIs based on collaborative models with international partner/ state partner /industry partner have been sanctioned and are being hosted at the following locations:

1. Biomedical Engineering & Technology (Incubation) Centre' at IIT Bombay with Rajiv Gandhi S&T Mission, Govt. of Maharashtra , a multi-disciplinary biomedical engineering and technology centre to facilitate rapid translation of innovative ideas from clinicians and engineers into high quality low-cost indigenous medical devices.

2. Jain University, Bangalore with ALSTOM, France and Karnataka State Council for Science and Technology (KSCST)

3. Startup Oasis , Jaipur with Rajasthan State Industrial Development & Investment Corporation Limited (RIICO) Jaipur

4. Zone Startups India a subsidiary of Ryerson University, Canada hosted at Bombay Stock Exchange (BSE) Institute Ltd., Mumbai

In addition, new TBIs are being established at Gujarat Foundation for Entrepreneurial Excellence, iCreate , Ahmedabad; Sree Chitra Tirunal Institute for Medical Sciences & Technology, Tiruvanthapuram; Ahmadabad University, Ahmedabad; Shri Mata Vaishno Devi University Katra; Amal-Jyothi Rural College of Engineering, Kerala; National Innovation Foundation, Ahmedabad; and Indian Institute of Technology ,Gandhinagar.

A1.1. Seed Support System to Incubators- The Seed Support provided by the Department equips the STEP/TBI with the much needed early stage financial assistance to be provided timely to deserving start-ups under incubation in a relatively hassle free manner. During F.Y 2015-16, six new TBIs namely, IITM Incubation Cell-IIT Madras, IIM Calcutta Innovation Park, Kolkata, JSSATE-STEP, Noida, Society for Innovation & Entrepreneurship, IIT Bombay (SINE, IIT-B), Vel Tech Technology

Incubator, Chennai, Association for Innovation Development of Entrepreneurship in Agriculture (a-*IDEA*) at National Academy of Agricultural Research Management (NAARM), Hyderabad were sanctioned seed support. Grant-in aid of Rs.200.00 lakh has been sanctioned to these TBI which will be disbursed in phases. Subsequent installments of Seed support was also extended in case of 7 TBIs where seed support system is already under implementation.

A 1.2 National Award for Technology Business Incubators for the year 2014 – In order to recognize and reward the remarkable work done in the area of techno-entrepreneurship development through value added business support by specialized facilities such as Technology Business Incubators and Technology Parks, Department has established a National Award for Technology Business Incubators. The National Award for Technology Business Incubators for the year 2014 was presented to the "Technology Business Incubator-Startup Village, Kochi "on the Technology Day, 11th May 2015.

Startup Village, Kochi receiving National Award for Technology Business Incubators for the year 2014 from Dr. Harsh Vardhan, Hon'ble Minister of Science & Technology and Earth Sciences

A 1.3 Select Startup Success Stories / New Initiatives of TBI

1. Incubatee company (The Bridgedots Techservices P. Ltd.) of **TBI-MCIIE at IIT-BHU, Varanasi** won the *DST – Lockheed Martin IIGP Award for 2015*. Bridgedots has been placed among the top 10 most innovative companies to be mentored by IC2 institute of Texas, Austin. The award has been given for developing a technology to use **Rice Husk Ash** and **Extract Highly Dispersible Silica** from it. This silica can be used in tyres and can improve the fuel mileage of vehicle by 5-7%.

2. Incubatee company- L &A Tech Pvt Ltd of **TBI-CIBA at Assagao, Goa** was **acquired by a German IT company for a sum of 1 million Euros**. L & A Tech Pvt Ltd had a portfolio of

11 mobile apps with a major thrust area in human spiritual wellness using the latest technical, functional and user experience standards, followed the world over.

3. The **Technology Business Incubator-IIM Calcutta Innovation Park (IIMCIP)** at IIM Calcutta established in 2014, has initiated a joint venture between West Bengal Government, SIDBI and launched for the **1st time a TV Reality show "*EGIYE Bangla*" to Boost Entrepreneurship in West Bengal**. The Programme is being aired on Channel Zee Bangla, every Sunday with 9 episodes. Prof. Ashok Banerjee from **IIMCIP-TBI** as a **Knowledge Partner** will be responsible for sourcing, screening, selection, grooming and mentoring of the participants. The show will focus on innovative ideas covering multiple domains - Education, Healthcare, Manufacturing, Agriculture & Food, Handicrafts, Technology, Clean Energy for the Competition with an award for Rs.1.0 crore. The anchor of the Reality show is former Indian Cricketer Mr. Sourav Ganguly.

A2. Innovation and Entrepreneurship Development Centres (IEDCs)

Innovation and Entrepreneurship Development Centres (IEDCs) have been promoted in educational 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 being encouraged to take up innovative projects as a part of their curriculum and are supported to developed a working prototype. 50 IEDCs have been supported so far across the country including 6 IEDCs established during the year.

A3. i-STED (Innovation, Science and Technology led Entrepreneurship Development)

i-STED programme was initiated in 2013-14 with an aim of inculcating strong entrepreneurial orientation in people to translate already developed innovative /S&T solutions in the market. Five new projects to Rural Development Foundation (RDF), Gujarat; Centre of Technology and Entrepreneurship (CTED), U.P; R.K.Santhan, Rajasthan; Kerala Forest Research Institute (KFRI), Kerala; and Foundation of MSME Clusters (FMSME), New Delhi, focussing on location specific potential technologies i.e bamboo processing, foundry waste management, food and agro processing, solar energy, dairy technology, engineering farm machinery, metal brassware, leather and footwear etc. have been recommended for financial support out of which 2 (RDF, Gujarat and FMSME, Delhi) have been sanctioned during 2015-16. Support to all four ongoing i-STED projects was continued during 2015-16.

A4. Science & Technology Entrepreneurship Development (STED) Programme

A total of 30 ongoing STED projects were supported in 2015-16 which have helped in nurturing 1500 micro-enterprises across the country. In view of a new and improved variant of STED i.e.

i-STED already under implementation from last two years, the programme on Science & Technology Entrepreneurship Development (STED) is now being phased out gradually and no new proposals are being considered. However, support to the existing STED projects under implementation would be continued till the stipulated project period of four years.

B. NSTEDB Training Programmes on Entrepreneurship

During 2015-16, a total of 1,540 programmes covering various modules of training on entrepreneurship i.e EAC, EDP, WEDP, TEDP and FDP were conducted by 325 organizations benefitting 92,420 participants.

C. Collaborative Programmes based on Public Private Partnership for scouting innovations and start ups

NSTEDB collaborates with leading industries, industry bodies, international organisations and other relevant stakeholders with an objective of strengthening the innovation ecosystem in the country. Following programmes of collaborative nature were undertaken successfully during 2015-16.

C1. DST-Lockheed Martin India Innovation Growth Programme (IIGP) 2015

DST-Lockheed Martin Program India Innovation Growth Program(IIGP) is a Public-Private partnership programme supported by the National Science & Technology Entrepreneurship Development Board (NSTEDB), Department of Science and Technology, Govt of India and Lockheed Martin Corporation, USA with an aim of accelerating Indian innovations in the global market place. The program leverages the competencies of each of the partners i.e Federation of Indian Chambers of Commerce and Industry(FICCI); Stanford Graduate School of Business; the IC2 Institute at the University of Texas at Austin and TiE Silicon Valley. A total of 1015 applications were received under IIGP-2015. A Technology Commercialization and Entrepreneurship Workshop was organized during April 12-17, 2015 in Goa to provide mentoring to the top 44 innovators for business plan pitching, patenting and scaling up innovations in market place. The workshop was led by experts from Stanford Graduate School of Business. Final Competition was held on May 11-13, 2015 in New Delhi. Top 10 Innovators were selected for all paid Austin and Silicon Valley Visit and 20 Innovators were selected for Rs.1 lakh Cash award. The Award Ceremony presided by Dr. Harsh Vardhan, Hon'ble Minister of Science & Technology and Earth Sciences, Government of India was held at DRDO Bhawan, New Delhi on 13.05.2015.

A compendium of Technologies nurtured and supported under IIGP from 2007-2015 has also been brought out by Ernst and Young.

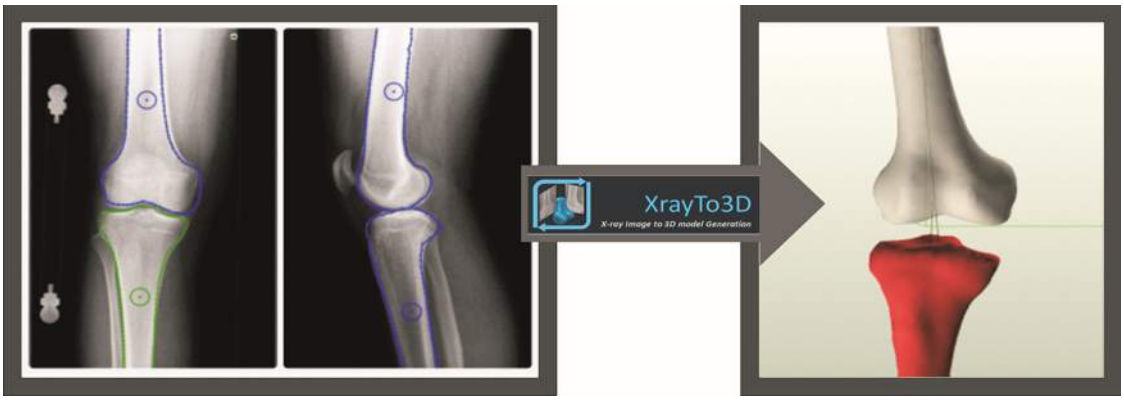


Fig. IIGP 2015 awarded product by Vikas Karade , IIT-Bombay student, which converts two dimensional X-Ray image into a 3D bone model as a safer and low cost alternative to CT Scan

C1.1 Visit of IIGP Innovators Delegation to U.S

Under IIGP, a visit to U.S was undertaken by a delegation of top 10 innovators, 5 incubation managers and DST Official during 25th September to 3rd October, 2015. The prime aim of the visit was to learn best global practices on innovation, entrepreneurship and technology commercialization from the Silicon Valley ecosystem. During the Silicon Valley visit, IIGP innovators also had an opportunity to showcase their innovative solutions at the India-U.S. Startup Konnect Event at San Jose on 27.09.2015 which was presided by Hon'ble Prime Minister, Shri Narendra Modi. The start-up enterprises also networked and interacted with more than 200 investors and business community members at the event.

Fig. Top 10 IIGP 2015 Innovators at India-U.S. Startup Konnect Event at San Jose on 27th September 2015 with the Hon'ble Prime Minister, Shri Narendra Modi

C2. The Power of Ideas (POI) 2015

The Economic Times Power of Ideas (ETPOI) is India's largest entrepreneurship development initiatives, jointly organized by The Economic Times in association with Jio, Department of Science and Technology (Government of India) and the Centre for Innovation Incubation and Entrepreneurship (CIIE) at the Indian Institute of Management Ahmedabad (IIMA). ETPOI is aimed at providing a launch pad for entrepreneurs to convert their ideas and start ups into real, viable business. The time linked process of selection of innovative ideas for POI 2015 is placed below.

POI WORKSHOP @ IIMA during 4th Jan to 14th Jan 2016

An intensive 10-day capacity building workshop was organized for the top 75 teams, culminating in pitching for funding and grants. The 75 teams were shortlisted from over 18,500+ applicants through a rigorous 3-month-long multi-stage evaluation and selection process. At the workshop, the teams were taken through a week-long crash course packed with intensive, interactive and inspiring sessions covering diverse topics dealing with setting up, scaling up & managing a successful business. The sessions were addressed by leading entrepreneurs, experts, mentors and IIMA faculty. The workshop ended with three days of pitching sessions, where the teams pitched to a jury panel for grants and seed funding to the tune of Rs. 6.2 crores.

C3. Partnership with Anita Borg Institute for Women Entrepreneurs Quest (WEQ) Program

NSTEDB of the Department of Science and Technology (DST), Government of India along with the bi-national body, Indo-US Science and Technology Forum (IUSSTF) has partnered with the Anita Borg Institute (ABI), a non-profit organization based in US to create an entrepreneurial ecosystem for technology led women entrepreneurs in India through **Women Entrepreneurship Quest (WEQ) Program**. As a part of the partnership, top 6 women entrepreneurs from WEQ 2014 were awarded with an all paid experiential visit to Silicon Valley from April 13-17, 2015 and were provided with extensive mentoring, networking opportunities and access to top VCs and NRI entrepreneurs through TiE Silicon Valley.

Delegation of ABI-DST–IUSSTF led WEQ Women Entrepreneurs at the TiE Silicon Valley Event on April 15, 2015 at Santa Clara

Support has also been provided for organization of WEQ 2015 and the final selection of the top 6 women entrepreneurs was done through an event organized on 4the December 2015 in Bangalore.

C4. DST-Intel "Innovate for Digital India"

The Intel & DST - Innovate for Digital India Challenge was launched with an objective to seek easy and effective innovative technology solutions in the hands of citizens to help them enhance the quality of their lives. The application platform was integrated with the MyGov website. A total of 1913 applications were received out of which Top- 50 were selected and through further evaluation, Top-20 were selected. These twenty teams were given intensive mentoring and prototype development support in a three months residential accelerator programme at College of Engineering, Pune. Various activities i.e session with UC Berkeley via WebEx, one-on-one sessions between teams, mentors and adjuncts, identifying the Top-10 teams for the Go-To-Market phase were organized under the programme. The teams also met the Hon'ble President of India

Launch of Innovate for Digital India Challenge by Program Partners: DST, Intel, CIIE-IIMA and MyGov.in during April, 2015 in New Delhi.

D. Policy Interventions for TBIs and Start-ups related to Service Tax Concessions

NSTEDB recognizes Technology Business Incubators (TBIs) and Science & Technology Entrepreneurship Parks (STEPs) for availing exemption of taxable services, to or to be provided by TBI/STEP. 46 STEPs/TBIs have been accorded recognition for availing Service Tax exemption.

E. Support to Knowledge Sharing and Dissemination Events- Seminars, Workshops and Conferences

NSTEDB supports various events on knowledge sharing and information dissemination related to Innovation, Entrepreneurship and Incubation. Few major events supported during 2015-16 are listed below.

- Two day Residential Workshop on **CSR Initiatives for Incubators** organized by Indian Institute of Corporate Affairs in IICA Manesar Campus on 15-16 September 2015
- Largest Annual Entrepreneurship Conference, **TiEcon 2015** organised by The Indus Entrepreneurs (TiE), Delhi during 16-17 October, 2015, New Delhi
- 6 Week International Programme on Promoting Innovation & Entrepreneurship through Incubation under ITEC by APIN, PSG-STEP, Coimbatore during January 4- February 12, 2016 in EDII Ahmedabad
- Business Plan Competition **Eureka 2015-16** by IIT Bombay
- Business Plan Competition **Techkriti,** 2016 by IIT Kanpur
- Two day Workshop on Exploring Pathways to Promote Entrepreneurship Through Innovation & Incubation by TBI-KIET, Ghaziabad at Lucknow during January 24-25, 2016

F. New Initiatives

A Joint initiative of DST with MHRD to promote Innovation and Incubation at National Institutes of Importance

Department of Science & Technology (DST) and Ministry of Human Resource Development (MHRD) have launched a joint initiative of promoting Start-up Ecosystem in National institutes of repute. DST has been promoting establishment of Technology Business Incubators and MHRD has been establishing Research Parks in the country. Under this joint initiative, it is proposed to establish a 'Start-up Centre', a 'Technology Business Incubator' or a 'Research Park' depending on the preparedness of the institution in commercialization of technologies, supporting industrial research and nurturing and mentoring start-ups. It is proposed that the Research Parks shall be funded by MHRD, TBIs by DST and Startup Centres shall be jointly funded by DST & MHRD. IIT Hyderabad and IIT Gandhinagar have been recommended for establishing Research Parks, 11 IIT/NITs have

been recommended for establishing Technology Business Incubators and 10 IIT/NIT/ IIITs have been recommended for initiating Start-up Centres.

DEVELOPING SCENTIFIC TEMPER IN SOCIETY

The National Council for Science and Technology Communication (NCSTC) is mandated to communicate science and technology to masses, stimulate scientific and technological temper and coordinate and orchestrate such efforts throughout the country. The programmes of NCSTC aim at building capacity for informed decision making in the community. It is devoted towards societal upliftment through dissemination of scientific knowledge.

The NCSTC focuses on outreach activities, training in science and technology communication, development, production & dissemination of S& T resource materials, incentive programmes, field based projects, research in S&T communication, international co-operation, motivating students, environment awareness & programme with a special component exclusively for women.

1. Initiatives & Programmes for Mass Awareness

1.1 Science Express – Climate Action Special (SECAS)

This unique mobile exhibition mounted on a specially designed 16 coach AC train was first launched in October 2007 by DST and since then it has completed 7 phases across India of 6-7 months duration each and currently it is on its 8th phase journey. Till date *(till 5 Jan 2016*), Science Express has travelled over 1, 30,000 km, halting at 418 stations and in 1,488 exhibition days, more than 1.42 crore (14.2 million) people, primarily students & teachers, have visited it. Science Express has thus become the largest, the longest running and the most visited mobile science exhibition. Science Express is currently running as 'Science Express Climate Action Special (SECAS)'. It is a unique collaborative initiative of Department of Science & Technology (DST), Ministry of Environment, Forest & Climate Change (MoEFCC), Department of Biotechnology (DBT) and Ministry of Railways, Government of India.

SECAS was flagged off on October 15, 2015 from Delhi Safdarjung Railway Station by Dr. Harsh Vardhan, Hon'ble Minister of Science & Technology and Earth Sciences; Shri Suresh Prabhakar Prabhu, Hon'ble Minister of Railways; Shri Prakash Javadekar, Hon'ble Minister of Environment, Forest and Climate Change and Shri Y. S. Chowdary, Hon'ble Minister of State for Science & Technology and Earth Sciences in the presence of several other dignitaries and guests. SECAS in its current phase is scheduled to travel across the country for about seven months, from October 15, 2015 to May 7, 2016, halting at 64 locations in 20 States, covering 19,800 km. The exhibition will convey a strong message about Climate Change and will also be a good opportunity to generate dialogue and discussion. Expert volunteers in S&T will be travelling along the train to create awareness among the visitors about various aspects of climate, sustainable development and conservational measurements. There is a kids zone on the train where children would be able to do 'Do it yourself activities' like making simple science toys, science craft, science magic and puzzles, etc. Many major scientific

institutions are knowledge partners in this mega endeavor of Deptt. of Science & Technology. A virtual tour has been developed for this exhibition which is available on www.scienceexpress.in. So far, around 10 lakh people have visited the SECAS. Schools and scientific organizations have been roped in for extending support to outreach platform activities.

At each halt of SECAS, activities are planned to engage visitors across different age groups to reinforce its message. An exciting and much sought-after Outreach Programme is also conducted in local schools/institutions along with activities on the railway platforms. In addition, informative take-away material is made available for wider distribution amongst schools and visitors.

For the first time, solar panels have been installed on the rooftop of Science Express coaches 11-13, as a collaborative effort of DST and CEL, for harnessing solar energy.

Hon'ble Ministers of Science & Technology and Earth Sciences and Environment, Forest & Climate Change; and Railways flagging off SECAS

1.2 National Children's Science Congress (NCSC)

All the 35 States and Union Territories together with Kendriya Vidyalaya and Jawahar Navodaya Vidyalaya organized State level Congresses during November-December 2015. Selected students from district level congress took part and competed for the State level. The team leader of each selected project participated in the National Children Science Congress (NCSC) along with the guide/escort teachers.

The National event of 23rd NCSC was organized at Chandigarh University, Gharuan during 27-31 December, 2015. Around 1200 delegates comprising students & teachers from UAE, Kuwait and Qatar and escort/guide teachers, State coordinators, State academic coordinators participated. It started

with a vibrant and dazzling procession of children dressed in their colorful attire led by Army band followed by flag hoisting by Shri K A P Sinha, Principal Secretary, Education, Govt of Punjab. Dr Y S Choudary, Minister of State for S&T and Earth Sciences, GOI sent a video message congratulating the child scientists. The event was inaugurated by Dr Daljeet Singh Cheema, Hon'ble Education Minister, Punjab. Amidst great enthusiasm and high spirits, Souvenir of NCSC-2015 was released along with 'Glimpses of Outstanding Projects of NCSC-2014' and a book titled 'The Spelling of Science – Why' authored by Lakshya, an eleventh grade student from Faridabad.

An exhibition corner was also inaugurated by the Hon'ble Minister of Education, Punjab. Number of exhibits were displayed and demonstrated by the experts including low cost science teaching aids, origami, explaining science behind miracles, creative thinking, Bi-box, Science on wheels by Kapurthala Science City, Mobile science exhibition on a van, etc. A special display of various arms & weapons, vehicles, tanks used in wars by Indian Army was also displayed.

Evaluation of the projects were based on the uniqueness of the project, critical thinking of the child and how effectively the project finds solution to the local problems. 32 projects were selected for second round evaluation, which was conducted on 29th December. In the final round 16 projects were selected as the best projects of NCSC-2015.

On 30th December, all of them thronged at Sukhna Lake and took part in the 'Young India Walkathon – Walk to raise concern on Changing Climate & Weather', flagged off by Dr B Purushartha, Principal Commissioner of Chandigarh.

Each participant was awarded with a participating certificate and a medal. The top 16 projects were selected from Maharashtra, Bihar, Jharkhand, A&N Islands, West Bengal, Arunachal Prasad, Assam, Punjab, Puducherry, Karnataka, Kerala, Tripura, Andhra Pradesh, Odisha, and Haryana. They will be given opportunity of the internship scheduled during summer vacations.

The theme for next two year i.e. 2016 & 2017 titled "Science, Technology and Innovation for Sustainable Development" was also declared and launched. A brochure and poster was given to each state to carry forward the activity.

Rashtriya Kishore Vaigyanik Sammelan

To provide a unique opportunity to children to use their scientific temperament and knowledge and

to quench their thirst for creativity by conducting scientific experiments, two best projects selected from each State under NCSC and 16 best exhibits of Jawaharlal Nehru Science & Mathematics exhibition participated in the *Rashtriya Kishore Vaigyanik Sammelan*, held at University of Mysore, Mysuru as part on 103rd Indian Science Congress. The programme was inaugurated by the Nobel Laureate, Prof John B Gurdon, Cambridge University, UK on 4th January 2016 at the Amphitheatre, Manasagangothri, Mysuru. Prof K S Rangarappa released a tabloid titled 'Billion Beats'. The exhibition was displayed at the lawns of Senate Bhavan, University of Mysuru where number of students, teachers, Scientists visited the exhibition and interacted with the students.

1.3 National Science Day (NSD)

National Science day 2016 would be celebrated by NCSTC. On this occasion, the awards for 2015 on outstanding contribution in communication of science and technology and promoting scientific temper would be presented.

National Science Day (NSD) is celebrated every year on February 28 to commemorate the discovery of the 'Raman Effect'. The theme of NSD-2016 is 'Make in India: S&T driven innovations'. Dr. R.A. Mashelkar, National Research Professor, will deliver the NSD lecture at IIT, Delhi. Many institutions organize open house for their laboratories and appraise students about career opportunities available in a particular research laboratory/institution.

1.4 8th National Teacher's Science Congress (NTSC)

The National Teachers' science congress was started by the National Council for Science & technology Communication (NCSTC) in 2003. Since then it has become a biennial activity, which provides a platform to the science teachers to communicate their innovative ideas, share their newer experiments in teaching methodology and science education.

The 8th National Teachers Science Congress was held during December 17 – 19, 2015 at the Indian Institute of Science Education & Research (IISER), Pune. More than 250 science teachers, science communication experts, researchers, academicians & faculty of IISER Pune participated in this programme. More than 200 papers and 50 posters were presented. Besides IISER, IBM, was also partner in the congress. The sub themes of the National Teachers Science Congress were- Innovative use of low cost/no cost teaching learning materials; Challenges of Science, Technology, Engineering and Mathematics (STEM) Education – from schools to society; Science for self-reliance; Innovative assessment techniques; Inclusive STEM education; and Innovative vocational science education.

Regional Orientation Workshops: Before the national event, in order to motivate and orient the teachers to submit papers on the main theme of the congress i.e. "Learning Science by Doing".

Five regional orientation workshops were organized at the Regional Institute of Education located at Bhopal, Ajmer, Mysore, Bhubneshwar and Shillong. Teachers from various regions of the country participated in the regional orientation workshops and presented their papers. There were experts from the regional institutes, award winners from S&T Communication as faculty, etc.

1.5 National Science Fair of The Initiative for Research & Innovation in Science (IRIS) - 2015

IRIS is a research based innovative initiative that offers a unique platform for the budding young innovators (classes 5-12) to showcase their talent at the national level since 2006. It is a joint venture of Department of Science & Technology (DST), the Indo US Science and Technology Forum (IUSSTF) and Intel corporation. IRIS finalists will be mentored by the Indian Institute of Science Education and Research (IISER), Pune for a week as the Partner for fostering Research.

IRIS 2015 was a grand event held at IIT Delhi from December 4-7 along India International Science Festival (IISF). Out of the 2958 synopses, a total of 142 projects were selected after evaluation by the IRIS Scientific Review Committee. Out of these, 12 best projects were selected for representation at the Intel International Science and Engineering Fair (ISEF) which is the world's largest international pre-college science competition. After their participation in the ISEF, the students will be given an opportunity for visit of S&T establishments in USA.

Winners with Dr. Harsh Vardhan, Hon'ble Minister of S&T and Earth Sciences

IRIS has been offering a platform to young innovators to showcase their talent at the National level and also an opportunity for representing the country at Intel International Science & Engineering Fair (ISEF). This year, 29 school children including 17 ISEF participants and 12 observers (selected from partner fair of NCERT, NCSM, NCSC and CBSE) represented India at ISEF held at Pittsburgh, USA during 10 -15 May, 2015. India bagged seven prizes on Plant Sciences, Embedded systems, system software, Materials science and Mathematics. Onkar Singh from Kolkata won first award of US $ 1000 from the Association for computer Machinery and an Intel ISEF second grand award of US $ 1,500 for his project Image Processing Algorithms towards Optical Detection of 2D Nanomaterials. Team India also got an opportunity to meet late Dr. APJ Abdul Kalam, former president of India before take off for ISEF. They also visited famous Smithsonian Museums in Washington DC in their exposure visit.

1.6 India Innovation Initiative – I3

It is a platform to encourage young enthusiasts who have the potential of becoming science and technology based entrepreneurs. The initiative has the major objective to strengthen the entrepreneurial eco system in the country by sensitizing, encouraging and promoting student innovators and facilitating incubation /mentoring of their innovations. NCSTC in collaboration, with Confederation of Indian Industry (CII) and All India Council for Technical Education (AICTE) showcased, the finalists of India Innovation Initiative (I^3) 2015 at the India International Science Fair, Indian Institute of Technology (IIT), Delhi, during 4th to 7th December, 2015. There were more than 700 applicants from various areas like agriculture, education, energy and environment, etc. Out of the applicants some 70 applicants were shortlisted through a systematic and planned method of evaluation for showcasing their innovations. Top nine were given cash awards and trophies. Some of the award winning projects were – Rightbiotic-fastest antibiotic provider, power-loom warping machine, injection mouldable polymeric composite based passive polycentric knee joint, etc.

1.7 Health Communication Programme

1.7.1 Women's Health & Nutrition

The target group of this project is mainly women and girls. A need assessment done in two blocks of Lohardaga district namely Kudu and Kairo reflected that the community suffers from problems of superstitions, malnutrition, female trafficking, water pollution, diseases etc. Taking this background in picture, Manthan Yuva Sansthan is working in the field of awareness and communication of scientific knowledge. Apart from need assessment, focus group discussions were also held and a 'girls club' was formed comprising of 40 girl children. They were made aware of health issues including their physical and mental changes.

From the primary activities of this project, the hesitation among the women and girls related to their health had lessened. The scientific curiosity was increased that will be quintessential in the success of the project. Later on through narrowcasting, awareness will be done in larger community.

1.7.2 Personal Hygiene and Obesity Prevention

Scientific awareness on personal hygiene and obesity prevention in Delhi and NCR is underway. The main attraction of the programme is screening of video films and puppet shows on hygiene and obesity. After each show, an expert interacts with the students and answers their queries. Till date about 65 schools have been covered and around 15,000 students have participated in the programme.

1.7.3 Awareness about Cancer

Malwa region of Punjab is increasingly under focus for the increasing incidence of cancer. The indiscriminate use of pesticides has led to a number of health problems in the region especially in women. Breast and Cervix Cancer are more prevalent. With the objective of raising awareness about general health problems prevalent in the Malwa region of Punjab with special emphasis on women

health, Punjab State Council for Science & Technology is running an awareness campaign aimed at educating women on early detection of breast and cervix cancers through breast self-examination and Pap smear tests. The program focuses on educating the women about treatment methods available by active involvement of hospitals. Awareness material is being developed including CDs, Pamphlets, Posters etc. on early detection and treatment. It is also planned to take up the program in high-risk districts of Muktsar, Faridkot, Bathinda and Mansa and Low risk districts of Sangrur, Barnala, Moga and Ferozepur.

1.7.4 Orientation Workshop

An orientation workshop on Science for Women's Health & Nutrition (SFWHN) was organized by Commonwealth Educational Media Centre for Asia (CEMCA), New Delhi. Around 27 Community Radio Stations (CRS) from all over the country participated. The CRS were briefed about the SFWHN programme, its guidelines, methodology, baseline survey, monitoring, content developed and Advisory Committee to guide the same.

All the participants shared their experience of making radio programmes. Experts like Dr Sreedher, Ms Shirley Deepak, Ms Rukmini Vemaraju, Ms Jayalaxmi Chittoor interacted with the participants. Ms. Shanta Koshti from Ahmedabad and Ms. Lalita Panwar from Solan shared their experience, challenges and their solution for running the 365 episode radio programme.

1.7.5 Need Assessment of Women's Health & Nutrition

Media 4 Community Foundation with its expertise in research, community participation and capacity building undertook the project for nine different community radio stations (CRS) across the country – some located in remote part of India. The nine community radio stations (CRS) are: (i) Vayalagam Vanoli, Kottampatti Village, Madurai District, Tamil Nadu, (ii) Radio Vishnu, Shri Vishnu Engineering College for Women, Bhimavaram, Andhra Pradesh, (iii) Radio Deccan, Abid Ali Khan Educational Trust, Hyderabad, Telangana, (iv) Radio Snehi, Snehi Lokottan Sansthan, Siwan, Bihar, (v) Yeralavani, Yerala Projects Society, Jalihal Budruk Village, Sangli District, Maharashtra, (vi) Alfaz-e-Mewat, SM Sehgal Foundation, Mewat, Haryana (vii) Kumaon Vani, The Energy and Resources Institute (TERI), Mukteshwar, Uttarakhand, (viii) JanVani, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand and (ix) Voice of Azamgarh, Mirza Ahsanullah Beg Institute, Azamgarh, Uttar Pradesh.

This project was scheduled as seven days for Baseline Studies and seven days for capacity building and content creation in each CRS. This project aims to reach out to the women of the marginalized sections of the society- both in semi-urban and rural, across the country. The uniqueness of the participatory programme is the creation and broadcast of radio programmes to laymen in their own native languages and mother tongue to influence behavioural change.

The baseline study was conducted by female students from the educational institution/ community radio staff as well as women from the communities. Through this study, profile of the community was mapped including current practices & knowledge, various issues, assessment of the needs and shortcomings among the women. This feed-forward study gave an insight into the socio-economic and demographic profile of the community, media practices with special references to radio, and women's and children's health concerns including other issues. A detailed questionnaire comprising more than 60 questions was used to collect, record and compile data for the baseline study. It was translated in the local language and modified to suit the local profile. Random sampling technique was used to identify 1000 households in the above mentioned CRS' catchment areas and one member over the age of 16 from each household was interviewed for the survey, making a total of 9000 sample size.

In the capacity building and content generation, the inputs for the making of relevant radio programmes were identified by the community women who also participated in the survey. They were trained to handle all aspects of radio production, various formats of radio presentation, participatory and interactive radio programmes. The capacity building workshops familiarized the community women participants with programme planning, need analysis, and the baseline studies. Programme scheduling, repeat broadcasts, presentation aspects, radio counseling, and value added services were additional aspects in the training

1.8 Mathematics Awareness

1.8.1 National Mathematics Day: In recognition of Ramanujan's contribution to mathematics, his birthday, December 22, has been declared as the National Mathematics Day. Main objective of observing the National Mathematics Day is to popularize mathematics and its applications among various segments of the society, remove fear of mathematics from students by giving popular mathematics lectures, hands on sessions, etc. The programme was celebrated in a few states through the state S&T councils. There were initiatives like quiz programmes, debates, radio, television shows, exhibitions, etc. in several states. In Maharashtra SNDT Women's University, Mumbai; North Maharashtra University, Jalgaon; Dr. Babasaheb Ambedkar Marathwada University, Aurangabad; Solapur Science Centre; Nehru Science Centre and several others organized inter college competitions, popular lectures, workshops, etc.

In Mizoram, National Mathematics Day was celebrated in collaboration with the Mizoram

Mathematics Society, and lectures were organized on importance of mathematics in Mizo Society. State level Mathematics Competitions were held in district headquarters of Aizwawl, Lunglei, Serchhip and Champhai. A Mathematics Congress was also organized on the occasion.

Manipur Science & Technology Council, Imphal organized lecture on the topic, "Mathematics in our day today life" at the S.D.J.M. Higher Secondary School, Imphal. In addition to this, mathematics model making, quiz competitions, mathematics competitions, science film shows were organized in various schools.

1.8.2 Radio Mathematics through Community Radio

To help overcome the fear of Maths, to generate the interest in the subject in the young learners and to develop analytical mind and problem-solving approach among general public, NCSTC conceived and called for the proposals from Community Radio Stations (CRS). Ten community radio stations from six states were selected to launch and run the programme titled 'Radio Mathematics'. Each of them produced 182 episodes on basic Mathematics in their regional languages and broadcast on every alternate days, four times a day of 30 minutes each. The radio magazine format included song, interview, quiz, puzzle, stalk character and phone-in.

1.9 S&T Exhibitions & Demonstration

Science exhibition is one of the most important activities to create and enhance scientific awareness of children; teachers, parents, peoples representative and common man. The 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. Starting with thematic exhibitions & demonstrations, stress was also shifted to Mobile Science Communication for rural areas.

Networking is fostered on priority for students, teachers, farmers & professionals. Initiatives are taken for static and mobile Science Exhibitions, Science & Technology Fairs, Basic Science experiment workshops, Technology and innovative work conferences, seminars, workshop etc. lectures and hands-on activities and demonstration of workman ship on different engineering process, technological development and innovative methods. As a result on various themes of S&T communication media/

formats have been prioritized as Environmental quality, Clean & Green Technologies, S&T solutions for rural sector, Home grown technologies, Low cost Innovation. Several static and mobile exhibitions were organized in several states. Almost 53 Science fair/Science exhibitions were held at various places in several states, like Uttar Pradesh, Madhya Pradesh, Jammu & Kashmir, Uttarakhand, Haryana, Bihar, Punjab, Delhi, Andhra Pradesh, Arunanchal Pradesh, Chattisgarh, West Bengal, Orissa, Rajasthan, Tripura, Kerala, Maharashtra, Andman & Nicobar Island and Assam etc.

1.9.1 Perfect Health Mela: 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. Hands on Training on Hands only CPR 10 were given with an objective to train common population to saving people from sudden death through this technique. More than 2315 students and staff visited the DST pavilion and of these 1938 students representing 31 school of Delhi NCR participated in the Inter School Competition & CPR-10 Training Program that were held under this project. This year's theme was "Scientific Awareness campaign on Food Safety in children". The competitions included: Painting, Slogan cum Poster Making, Collage Making and Health Model cum Demonstration on Food Safety. Besides large number of general public visited DST stalls where scientific activity corners like NCSTC exhibition, NCSTC Network, Hydroponics Nature Study, Detection of food adulteration, Vermicomposting, Water Testing, Low-cost Teaching AIDS, ORIGAMI, Fun with Science, Explaining Science behind miracles, Vigyan Prasar, etc. were put up.

1.9.2 India International Trade Fair (IITF)-2015 at Pragati Maidan: NCSTC Div. in association with Millennium India Education Foundation (MIEF) organized Science popularization outreach activities recently in Department of Science & Technology Pavillion during 35th India International Trade Fair 2015 held at Pragati Maidan, New Delhi from 14th-27th November 2015. IITF was inaugurated by Hon'ble President of republic of India Sh Pranab Mukherjee. However the DST pavilion was inaugurated by Dr Harsh Vardhan, Hon'ble Union Minister of Science & Technology and Earth Sciences.

Dr Harsh Vardhan, Hon'ble Minister of S&T and ES at NCSTC Pavillion

General public at NCSTC Pavillion

1.9.3 India International Science Festival (IISF)-2015 at IIT, Delhi: The IISF was organized in very different from annual session of Indian Science Congress Association which is highly technical and focused while IISF aimed to engage people with science and technology and bring people, Science, Technology, entrepreneurship, and innovation etc. together. NCSTC Div. DST in collaboration with Millennium India Education Foundation (MIEF) organized Science popularization outreach activities at recently concluded First India International Science Festival 2015 held in Indian Institute of Technology premises New Delhi from 4th-8th December 20215. The exhibition was inaugurated by Dr Harsh Vardhan, Hon'ble Union Minister, Ministry of Science & technology and Ministry of Earth Sciences.

Some dignitaries and large number of general public including school and college students visited the festival and interacted with scientists at the activity corners set up by various organizations under the banner of NCSTC DST. The pavilion attracted most of the school children and youth who evinced interest in science behind miracles, how to detect food adulterations at home using simple kits, simple scientific experiments, hands on activities etc. Scientist from various organisation from Punjab, Uttar Pradesh and Delhi conducted following science activity corners: Explaining Science Behind Miracles; Fun with Science (low Cost no cost teaching aids); Detection of Food adulteration and Water Quality Testing; Vermicomposting; Origami; Mobile science exhibition and Mobile Planetarium shows by Puspa Gujral Mobile Science Bus, Pushpa Gujral Foundation.

Hon'ble Minister of S&T and ES having a look at low cost/no cost teaching modules

***1.9.4 Science Exhibition on Wheels*:** Mobile science exhibition is to take science to the doorsteps of rural population and spread the message of science and expose them to some of the emerging and challenging issues. The activities include science model exhibition, regular sky gazing camps through telescope and scientific explanation to miracles etc. The target group for these activities includes general

public, school & college students, youths, women, teachers, gram panchayat members, voluntary organization and policy makers etc. The mobile science exhibition bus was commissioned on 19th August 2015 at Pushpa Gujral Science City, Jallandhar.

Beside this, third phase of mobile science exhibition in Madhya Pradesh has been completed (30 Oct 2014 to 29 Oct 2015) which covered extensively all 51 district of M P including 12 district in this Phase. 40,000 school students up to Panchayat level schools have participated in the exhibition. The target group for these activities were the general masses, particularly the school and college students, youth, women, teachers, gram panchayat members, voluntary organizations and policy makers etc.

1.9.5 Visit to Establishments Where S&T are at work:

The main objective of the programme is to expose young minds to S&T, create their interest in new S&T subjects, and develop their curiosity, as well as creativity. State S & T councils/ Non Government Organizations/ Science Clubs /Individual Schools together can organize such activity. 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 can be important activity for students. Students are taken to establishments like, research organizations, factories, telephone exchanges, steel plants, power stations, milk plant, railway control rooms, TV Kendra's, dams, hospitals, petroleum refineries, weather forecasting centres, automatic bakeries, printing presses, automobile repair workshops, modern agriculture and poultry farms etc. The industrial tours were organized at several places such as Bihar, Uttar Pradesh, Jammu & Kashmir and Andhra Pradesh.

1.10 Ecological & WaSH (Water, Sanitation & Hygiene) Futures

The current phase is dedicated to fostering skills, capacity and understanding of youth and grass root institutions to handle actionable S&T ideas and growing the base of popular support for scientific solutions. *Training & research driven capacity building & outreach* are orchestrated for communication of community science of natural water heritage, including preserving and maintaining river basin ecosystems, archaeological installations, insecure and water challenged sites is the upcoming initiative. A series of latest initiatives include – *Eco Eureka Workshops, Building WaSH Educators especially Women WaSH Educators, and WaSH Creatives with post-trainings engagements, Water Clinics, WaSH Smart/Magnet School Modules.* Improvement of quality of life of target groups is

attained with an approach of *'Being- on- their -Own'*/ 'Do-it-Yourself' and 'C*ollective response'* to challenges and location specific developmental/socio-scientific problems.

A Research and Advisory Group of Experts (GoE) on *"Eco & WaSH Media & Eco-Cultural Interpretations"* has been constituted to guide the training & research driven capacity building and outreach for Youth and Community, IEC resource development and research, Public understanding of community science of Natural Water Heritage, models in eco-innovation & eco-design, eco-cultural mapping skills, communities of ecological best practices, including development of representative site specific models for specifically promoting - water security, ecological adaptation and indigenous sustainable development, preserving and maintaining cultural & heritage sites & ecologically challenged water regimes. The GoE shall also guide the organization of *Eco-Media labs*. **1ST Eco-Media Lab** of the Country was organized on 30th Dec, 2015 at School of Journalism & Mass Communication, Manipal University, Jaipur.

Stress has been placed on model interventions for remote, inaccessible, marginalized, and challenging areas and populations. A few notable activities are:

1.10.1 Brainstorming Meet on Jaisamand Water Ecosystem, Udaipur was held on 1st October 2015 at Maharana Pratap University of Agriculture & Technology, Udaipur. Catchments of water bodies like Jaisamand offer a challenge of skilling of our young hands and inspiring lead actions for other similar sites in the country. Experts were invited from organizations specializing in issues like surface water, ground water, ecological resources, cultural and environmental geography, eco-media, folk media & community mobilization. The blueprint was developed for building organizational and community capacity in scientific interpretation, understanding river basins and promoting ecologically adaptive best/next practices for positive WaSH Outcomes. It emphasizes initiatives like - eco-media resource centres near prominent water resources i.e. Jaisamand, Haridwar, Varanasi etc, use of Eco informatics & Eco-WaSH geospatial studies for evidence based planning and awareness generation activities, building eco-media design and competence of youth, EcoWaSH information portal for multi stakeholder involvement, use of visual arts - revival of folk art and crafts and linking trainings to the job markets.

***1.10.2 Jalshala: an Action Research for Institutional Capapcity Building and Community Empowerment through Workshop Series**:* Jalshala, an action research project was themed around increasing the knowledge, affirmative attitudes and skills related to WaSH issues of primary and secondary stakeholders in the six villages of Ajmer


अनूठा जल प्रबंधन| बांदरसिंदरी के निकटवर्ती गांव सिरोही के हर घर इस्तेमाल कर रहा पानी बचाने की तकनीक

एक गांव ऐसा जहां नहीं सूखता तालाब

अतुल सिंह| अजमेर

बांदरसिंदरी के निकटवर्ती गांव सिरोही का कोना-कोना हरा-भरा है। कभी गांव में पानी की कमी नहीं होती। ग्रामीणों का दावा है कि भीषण गर्मी और अकाल के समय में भी तालाब में पानी रहता है, कुएं सूखते नहीं और हैंडपंप पानी देते हैं। इसकी गवाही दे रहा है तालाब किनारे लगा करीब डेढ़ सौ साल पुराना वट का घना हरा-भरा वृक्ष और मन को छू लेने वाली हरियाली।

गांव में तरह-तरह के पक्षियों की चहचहाहट और पशुओं की चहलकदमी। इस गवाही को साकार कर रही है गांव के घर-घर में जल प्रबंधन की वर्षों पुरानी व परंपरागत तकनीक।

सिरोही गांव की दूरी सेंट्रल यूनिवर्सिटी से 8 किलोमीटर है। आबादी है करीब 2000। गांव में 250 मकान हैं। आसपास के सभी गांवों में मिलाकर जितने मोर और बगुले नहीं होंगे, वे अकेले इस गांव में बसेरा करते हैं। इसका कारण तालाब और आसपास की हरियाली है। तोते, कोयल, कबूतर, कमेड़ी, किंगफिशर, स्पैरो, टटहरी सहित अन्य कई तरह-तरह के पक्षी यहां बहुलता में देखे जा सकते हैं। गांव के भूमिगत जल का स्तर बढ़ाने के लिए युवा और वृद्धजन जुटे हुए हैं।

हर घर 1 साल में बचाता है 50 हजार लीटर पानी

गांव के ज्यादातर मकानों के बाहर 10 फीट गहरा और 6 फीट चौड़ा खड्डा (सोकपिट) बनाया गया है। इस खड्डे में घर में इस्तेमाल होने वाला पानी पहुंचता है। यह पानी जिस पाइप के जरिए खड्डे तक आता है, उसमें पानी को साफ करने के लिए जालियां लगाई जाती हैं। इस तरह से एक घर से हर वर्ष करीब 50 हजार लीटर पानी बचाया जाता है। सरपंच समरूपा का कहना है कि पानी बचाने की यह तकनीक वर्षों से गांव में इस्तेमाल की जा रही है।

मिलजुलकर बचा रहे हैं जल

डिपार्टमेंट ऑफ साइंस एंड टेक्नोलॉजी और सेंट्रल यूनिवर्सिटी का समाज कार्य विभाग इस गांव की पानी बचाने की तकनीक से खासा प्रभावित है। इन दोनों विभागों ने ग्रामीणों के साथ मिलकर गांव में जलशाला परियोजना के तहत सोकपिट बनाने के लिए प्रेरित करने का जिम्मा उठाया है। परियोजना के प्रोजेक्ट फैलो सतीश मीणा बताते हैं कि श्रीनगर पंचायत समिति के मकदुनी, अराई पंचायत समिति से चौसला, किशनगढ़ से सोढ़ा, रूपनगढ़ से मोरड़ी और दूदू जिला से सिरोही कलां गांव को जलशाला परियोजना में शामिल किया गया है। इन गांवों में जल की बूंद-बूंद बचाई जा रही है।

District of Rajasthan State. The project adopted water stressed villages (each from six different blocks) having different characteristics such as scarcity, availability, accessibility, quality (potable), water conflict, water management and development issues. Two thematic workshops "Know Your Watershed" and "Integrated Water Resource Management" have taken place with regular followed up activities emphasizing on sanitation and gender issues. Soak pits construction in three villages, high momentum of individual toilets constructions in four villages, plantation of 1500 trees in three villages, establishment of community library in four villages are the visible changes.

1.10.3 Jalshala" Workshop Series, Creating Community Leadership from Cross Learning and Exposure to Innovations in Water, Hygiene and Sanitation Issues with Special Emphasis on their Ecological Underpinnings***:*** "Jalshala" Workshop Series, two Jalshalas, of 5 day duration each , were organized by Aravali Foundation for Education in the NCR region, to create a cadre of ECO-WaSH torchbearers who can engage the attention and imagination of community members in their respective geographic contexts on ECO-WASH issues that confront the society.

Jalshalas brought together community leaders from diverse localities together and took them through the entire gamut of ECO-WASH issues so as to equip them for a) increasing effectiveness in their ongoing initiatives focused on water and sanitation issues and b) conducting similar workshops, as Master Trainers, for their peers in order to play the role of force multiplier. Attended by 40 participants each, the 1st Jalshala was conducted at Integrated Training Centre Village Ghagas, Nuh, Mewat District, Haryana from 18-22 May, 2015. The 2nd Jalshala was held at New Delhi from 07-11 October 2015. The workshop involved about 95 school teachers, leading ECO Clubs in schools across the NCR region and also selected RWA representatives. A selection of college students having demonstrated interest in water & sanitation issues also participated.

1.10.4 Eco Literacy on "Water, Health & Hygiene" *:* Eco Literacy on Water, Health & Hygiene was spread through Inba Seva Sangam, Karur, Tamil Nadu to more than 2000 rural school children from 5 schools in Kadavur block of Karur district. Awareness campaigns, Functional models and Do-it-Yourself (DIY) trainings have been imparted not only to the school students but also to the teachers from the member schools. The prominent concepts are clean drinking water, knowledge of traditional Indian medicines, bio dynamic agriculture methodologies, recycling the solid wastes generated within the school campus (Vermi Compost and Handmade paper) and the knowledge of menstrual cycles. The students from member schools are now able to build their own Waste water treatment units and the girl students make their own hygienic, cost effective and user friendly sanitary napkins for their own consumption and their family members.

Eco & WaSH activities in a village of Sundarban, West Bengal

1.10.5 Eco & WaSH activities in two forest fringe villages of Sundarban, West Bengal : Lokamata Rani Rashmoni Mission has undertaken Eco & WaSH activities in two forest fringe villages of Sundarban, viz., Purba Gururia and Madhya Gurguria of South 24 Parganas, West Bengal. Student Parliament of all primary schools and Sishu Siksha Kendras of target area are very actively following personal health and hygiene in schools and maintaining good practices in schools as well as in houses. Women are also aware now about water related problems and bad effects of wasting drinking water, ignoring hand washing before taking food and after using toilet, not washing vegetables properly before cooking. Everyone of the area knows the necessity and is interested to construct of household latrines. Farmers of the villages came to know about water saving System of Rice Intensification (SRI), water saving irrigation systems and vermi composting for waste management and organic farming, to generate resources from domestic ponds, and to protect and reintroduce indigenous fish varieties. Electronic and traditional IEC materials prepared for common people is being encapsulated as eco regional tool also for enriching media capabilities of youth.

1.10.6 Promoting EcoWaSH Literacy through Community Informatics and Participatory S&T Communication: The model project activities in E. Pallaguttapalli gram panchayat, Distt Chitoor, Andhra Pradesh, using Quantum GIS, a FoSS (Free and Open Source Software) have been effectively employed in demonstrating co-learning with farmers in a drought stricken village to explore causes and solutions to their problems. Through exposure visits to other model sites of eco-resurgence and use of visualization tools such as GIS maps, the farmers assessed their relation with natural resources, such as forests, water, soil health and cropping systems. They explore and try to understand their eco-maladjustment, its significance for ecology & society, and pathways to correct it.

1.10.7 "Eco Wash- Innovations & Excellence in Water Credits & Water Budgeting Skills of Girl Students & Teachers – Neer Naari Vigyan": A country wide programme, involving School Children and Teachers focusing on the role of Women in Water Conservation, is being implemented with Eco Roots Foundation, New Delhi. Workshops in 100 schools in 10 selected cities for school teachers and

students are being undertaken. The teachers will mentor students (6th- 9th std.) to prepare a theatrical skit, musical play on the role of women in water conservation.

1.10.8 Health risk awareness with special reference to water hygiene and environmental conservation by development of webportal and awareness campaigns in Uttarakhand: The intervention through Gurukul Kangri Vishwavidyalaya, Haridwar, aims to develop awareness among the community *viz*. industrial labourers, people from nearby villages and children from the schools of industrial estate in Haridwar District. The awareness campaign had major focus on effects of water pollution, diseases caused and their symptoms. Along with community awareness, public demonstrations have been organized to understand the importance of conservation of environment and water bodies with banners and holdings at community places with major focus on River Ganga and plastic waste.

1.11 Motivating Students

To encourage bright students to select careers in science, NCSTC collaborates with research laboratories, universities, state S&T Councils and science based agencies for hosting Motivational Programmes of one week duration. These programmes aim to sensitize students about the science & technology related work going on in various laboratories, universities and scientific institutions in the country and give them an exposure of various sophisticated instruments, facilities and work going on in S&T laboratories. As an outcome students develop an appreciation about various research and applied aspects of S&T. Punjab State Council for Science & Technology (PSCST), Chandigarh organized more than ten such programmes for nearly 500 students and a few teachers at the premier institutions of Punjab. Panjab University, Institute of Nano-Science & Technology, Mohali, Central Scientific Instruments Organisation, Chandigarh, etc are a few of the institutions which hosted these programmes with the help of PSCST.

Students at Chandigarh Group of Colleges, Chandigarh

1.12 Ignited Minds

Uttarakhand State Council for Science & Technology (UCOST), Dehradun organized two camps of more than 100 students titled, “Ignited Minds”, Students from remote districts of Uttrakhand

participated in these camps. They got exposure at rock museum, bio-fuel laboratory, Mechatronics laboratory, Oil & Natural Gas Commission (ONGC), mobile planetarium, etc. They visited science based factories and Himalyan Drug Institute, Dehradun. Students were explained models of satellites at the campus of Indian Institute of Remote Sensing (IIRS). They were given hands on experiments exposure, civil defence and awareness about disaster preparedness, etc.

1.13 Grameen Vigyan Jagriti Karyakram

Society of Pollution & Environment Conservation Scientists (SPECS) of Dehradun organized a series of "Grameen Vigyan Jagriti Karyakaram- A Science & Technology Orientation and exposure programme" in three districts of Uttarakhand. The participants were from the farming community like farmers, Self Help Group members, volunteer activists, rural women, village level workers etc.. They were sensitized about latest technologies in agriculture, rational use of pesticides and fertilizers, eradication of superstitions, Gender sensitization, conservation of Bio –Diversity and disaster pre-preparedness etc.

Ten workshops were organized in three districts namely Almora, Rudraprayag and Haridwar. During the workshops the participants were taken to GB Pant University, Kumoun Gramodyog, food processing units and Krishi Vigyan Kendras to see latest technologies in agriculture. The issues like agricultural crop insurance, weather monitoring, food adulteration issues, soil testing, etc were discussed in detail and experiments were demonstrated. Two folders on disaster preparedness and alternate sources of energy were also developed as the outcome of the programme. Farmers were also given scientific explanations of so called miracles. Workshops created a platform for interaction of rural community and local technology resources institutions.

2. Manpower Development

2.1 Training Programmes in Mathematics

2.1.1 Learn and Enjoy Mathematics for Teachers and Children: To popularize Mathematics and remove its phobia, NCSTC catalyzed and supported two training camps organized by the Bharat Jan Gyan Vigyan Samity, Bhubneshwar for batches of 20 teachers and 40 students, each. Teachers and students from various blocks of Kendrapada and Khurda districts participated in these camps. The main objectives of the camps were to introduce action based learning activities for the students and teachers to convert their theoretical knowledge in to experimentation in mathematics and to impart knowledge about the role of different factors in mathematics, their interdependence on hands on activities and instill a spirit of enquiry among students.

2.1.2 Mathematics Popularization Workshops: The Association of Mathematics Teachers of India (AMTI), Chennai, Tamil Naidu, had organized three workshops of four days, each at Bengaluru, Puducherry and Kozhikode for teachers and students to motivate them to take interest in mathematics in a simpler way and to make it more interesting for students. The workshop covered the basics of Arithmetic's, Geometry and Algebra in detail and make concepts easily comprehendible. Nearly 120 teachers participated in these workshops.

During the workshop at Bengaluru the different aspects of Mathematics such as Data classification, tabulations, Analysis & interpretation etc were discussed. In the workshops mathematical theorems were also discussed, using paper models. Pythagoras theorem was shown using a paper boat which children may never forgot. Exponentially form of 2 by paper folding, bisection of angles and new methods of teaching were explained in workshops.

2.1.3 Thinkfinity & Others: A Mathematics Popularisation and Communication programme was organized by the Kings College of Engineering, Pudukkottai, Tamil Naidu, titled "Thinkfinity". It was NCSTC sponsored programme for Teachers & Students, it included Math drama, Sudoku, Math confound, quiz, cube games, etc. Besides these, there were talks on Cryptography, Data Security, application of mathematics, etc. The objective of the programme were to apprise students about application of Mathematics in day to day life, introduction to the process of mathematics modeling and to present Mathematics in an interesting way, etc.

2.1.4 Development of Resource Material for Teachers Training in Experiment- Based Physics Teaching in Rural Areas

Department of Physics IIT Kanpur, aimed at developing resource material for teachers in rural areas of Hindi belt. With the help from *Shiksha Sopan*, Talent Development Council and *Anveshika*, a number of sessions were conducted with the teachers in different districts in Kanpur to understand their academic needs and capabilities and relate science topics with their lives. Interactive sessions were held in various schools and colleges under the 'PICTURE' plan i.e. **P**ick-up, **I**nteraction, **C**amp, **T**utorials, **U**pdate **R**eading Material and **E**xperiments. A Teachers' Trainer's Manual was developed consisting of modules for Hindi Medium schools of class 8-9 level. It was developed as TEAM i.e. **T**est, **E**xperiments, **A**ctivities and **M**anthan.

2.1.5 Making Mathematics Education Interesting

Aravali Foundation for Education, New Delhi, organized a series of six training workshops for school level mathematics teachers to equip them to use Origami in teaching of mathematics. The five training workshops conducted thus far have engaged 180 teachers from a wide variety of schools NCR region in association with Salwan Education Trust, Kendriya Vidyalaya Sangathan and New Delhi Municipal Council. Each 5-day workshop focused on enabling the participants to use Origami concepts to explain related mathematical concepts of Trigonometry, Algebra and Geometry to students of up to high school levels and help lighten the teaching atmosphere in the class. The 6th workshop was a Master Trainers Workshop to create a group of mathematics teaching professionals who can serve as a faculty for future such training programs in various parts of the northern Indian region.

2.2 **Development of Resource Material for Teachers Training in Experiment-Based Physics Teaching in Rural Areas:** Department of Physics IIT Kanpur, aimed at developing resource material for teachers in rural areas of Hindi belt. With the help from *Shiksha Sopan*, Talent Development Council and *Anveshika*, a number of sessions were conducted with the teachers in different districts in Kanpur to understand their academic needs and capabilities and relate science topics with their lives.

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2.3 Training Programmes on Nature Study and Biodiversity Conservation Activities: Bharat Jan Gyan Vigyan Samity, Bhubneshwar organized four training programmes in Jajpur, Subarnapur, Kendrapada and Dhenkanal districts of Orissa. Around 200 teachers were trained on various aspects of conservation of bio-diversity in these programmes. Participants collected samples of flora and fauna during their field visits, resource persons helped them in identification and preservation of samples. Water and soil samples were also collected and tested during the field visits.

2.4 Water, Sanitation & Hygiene (WaSH) Trainings

2.4.1 A school in *"Eco-media and WaSH Science Communication"* has been established in Thiruvananathapuram, Kerala, and initiative taken for two more -one each in Madurai, Tamil Nadu, & New Delhi.

2.4.2 Youth leaders in WaSH Science Communication *i.e. WaSH Educators & Eco/WaSH Creatives* are trained and support extended to select ones by way of 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 completed by Association for Rural Advancement through Voluntary Action and Local Involvement (ARAVALI), Jaipur for 30 trainees (rural village 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, in the rural areas of central and eastern region of Rajasthan. The 22 Water Educator trainees have been placed in 22 NGOs are working in 2 Gram Panchayat each covering 44 villages engaging with the rural communities to work on Eco-WaSH issues in their region**.** An interactive Face book page have also been developed under the project for disseminating project learnings with larger stakeholders on social platform visit https://www.facebook.com/watereducator

WaSH Educators trained at Association for Rural Advancement through Voluntary Action and Local Involvement (ARAVALI), Jaipur

2.4.3 *Water Educators Trainings (WET*) is being implemented as a series by Vikram Sarabhai Centre for Development Interaction, Ahmedabad. This year, two more batches are being trained by VIKSAT, Ahmedabad, one completed exclusively for training of women Water Educators at national level and another for western eco-regions in 18 states. 2 training programme for WaSH Educators (WET) were planned. The first batch of WET programme, WET-2015 as a Women special batch conducted during 18th – 27th August 2015 and had 30 participants and another programme is scheduled from 26th February - 04th March 2016 focusing on the Western Eco-regions of India. Under the WET-2015, 30 number of water educators from Gujarat, Rajasthan, Delhi, Tamil Nadu, Maharashtra, Uttarakhand and Madhya Pradesh participated. The programme helped to develop a cadre of water educators equipped with the understanding of sustainable management of WaSH issues which act as a rich resource for the society and benefit the people through innovative, need specific, sustainable and replication interventions. The water educators were able to engage community with the issues, to observe methods of science in investigations and to find scope for more dialogue, debate, consensus and dissent.

2.4.4 *Training and Orientation of college NSS Volunteers as Women Water Educators for conserving Fresh water Reservoirs along the coastal Belt of Gulf of Mannar:* The aim of the proposed project is to train the women NSS volunteers of colleges as Water Educator Fellows and use their services for creating awareness among the community on water management, sanitation and hygiene. Women WaSH Educator's Training Programme has been conducted during Oct 19 – 27, 2015 for 90 NSS volunteers from 25 colleges of Tuticorin, Tirunelveli and Ramad Districts, and 2 days Orientation Programme was conducted for 45 NSS volunteers for 2 days in Kamraj College, Thoothukudi, Tamil Nadu. Support to more of such initiatives is on in 12 states. The sessions were conducted in Two Batches as parallel. Water Educator Fellows selected from these batches are going for Field visits in the Fresh Water reservoir/ Ponds/ River areas of these three Districts for Educating the people regarding 1) Water Management & Storage 2) Rain Water Harvesting 3) Maintaining Sanitation & Hygiene in those areas. This work is being executed as a Joint venture of local Panchayat President, village youth clubs and with the assistance of PWD & Health officials of that area for creating Effective Awareness.

2.4.5 *Water, Sanitation and Hygiene- Capacity and Awareness Building in Usilampatti :* The Eco-WaSH project has been implemented by Arul Anandar College. A workshop on Water, Sanitation and Hygiene was organized during 10th -11th December 2014. Scientists from TNSTC, Chennai and Experts from all over Tamil Nadu participated. The number of teachers who participated was 100 from 100 schools in Usilampatti Educational District. 10 December being International Human Rights Day, the teacher participants and the students of Arul Anandar College participated in the human chain programme and also took oath to conserve water. A three day WaSH Exhibition was also organized. Water and Soil from nearly 60 villages were tested and the reports were given to the beneficiaries. The exhibition arose interest in school children and they keep on coming to college to ask many doubts regarding Eco-WaSH details. Thus the project became a bridge between the school students, their teachers and me in the college. A film festival was also organized on this theme and the album is getting ready to be released soon.

2.4.6 *Training programme by Sathyabhama University, Chennai, 'To Conserve Water, A Natural Resource - Know Your Watershed':* The training programme to school teachers & school children created awareness about water resources, map reading, watershed, basic aspects of water quality & environment through Power point presentation, short audio visual documentary, Physical watershed model demonstration, Display boards & Field visits. It also involved delineation of a watershed in the map and on the ground. The teachers and students participated in the programme gained understanding on the concept of watershed and the need for preserving water resources for a better living.

2.5 Science Behind Miracles

Miracles, such as the Incarnation and the Resurrection, are by their very nature unprecedented events. Science simply cannot be the judge and jury as to whether or not these events occurred. In the society, miracles is a phenomenon or an activity which seem unexplainable by the law of nature and that is why it is supposed to be supernatural in origin or described to be an act of God. Old faiths and believes, based on non-scientific prejudice and habits still persist and dominates scientific thinking in a large part of our society. Miracles are performed by so called God men who want to mislead the gullible, but fact is that all miracles are based on various principles of science.

Expert demonstrating and explaining science behind miracle

God men are always intended to talk about paranormal phenomena like extra-sensory perception, healing of diseases by supernatural powers etc. The ultimate aim is to create local activists who can go to the field & expose the prevalent blind beliefs and generate scientific temper among the masses. The training has been organized aiming at providing basic skill in performing & investigating such miracles. The activities performed are - hands on activities; use of mechanical apparatus; scientific laws, properties and illusions of body; chemical reactions; and learning by doing through discussion and explanation by Experts.

Twelve workshops, three were held in Maharashtra at Nagpur, Nasik and Mumbai, two in Chhattisgarh at Raipur and Jagdalpur, four in Madhya Pradesh at Chhindwada, Bhopal, Jabalpur and Ratlam, two in Gujarat at Ahmadabad and Rajkot, one each in Goa and Odisha. Various topics were dealt with in the workshops such as the process of blind belief, need of scientific temper, psychology behind ghost, process behind *tona totka*, black magic and miracles and their effects on the society, vastu shastra and myth, scientific laws as a weapon against superstitions, combating superstitions through media, psychology behind a body being possessed by so-called gods and goddesses, psychiatric problems and so on.

2.6 Vermin Composting

To manage domestic solid waste using vermin composting & doing simple experiments by way

of understanding the life cycle of earthworms, composting different kinds of waste, effect of different manures on yields etc. Modules for developing experimental skills equipping the teachers & students with better knowledge and understanding about various facts of vermin-composting in one hand and inculcating scientific temperament by conducting experimentation in waste management. Number of programme were held in Rajasthan, West Bengal, J&K etc.

2.7 The 9th Science Communicators' Meet

The 9th Science Communicators' Meet was organized at 103rd Indian Science Congress. during 5-6 January 2016 at University of Mysore. The scientists, researchers, teachers, policy makers and students participated to promote and popularize scientific learning. Prof Dan Shechtman, Nobel Laureate, Israel Institute of technology, Haifa, inaugurated the meet. The science communicators discussed and deliberated the innovative learning tools, developing existing and novel methodologies for creating scientific awareness and scientific temper among students, teachers and common people for understanding the scientific and natural phenomena with the view of indigenous research and development. The two day's of the meet emphasized the role of science communication in popularizing science education, skills development, technology transfer, sharing and access to information for strong indigenous research and development programmes in the country. The participants presented 21 technical papers and 16 posters.

3. National Awards for Science & Technology Communication

National Council for Science & Technology Communication (NCSTC) instituted national awards in 1987 to stimulate, encourage and recognize outstanding efforts in the area of science popularization and communication. Following awards for 2015 were presented:-

A. *National Award for Outstanding Efforts in Science & Technology Communication in general* for 2015 was given to Pushpa Gujral Science City, Kapurthala, Punjab, and Dr. Kuldeep Chander Sharma, Udhampur, J&K.

B. National Award for Outstanding Efforts in Science & Technology Communication through Print Media including Books and Magazines for 2015 was given to Prof. Shashanka Mohan Bose, Chandigarh; Dr. G. Ganesan, Rajapallyam, Tamil Nadu; Shri R. Sivaraman, Chennai, Tamil Nadu; and Dr. Anil Kumar Chaturvedi, Delhi.

C. National Award for Outstanding Efforts in Science & Technology Popularization among Children for 2015 was given to Dr. V. Rajendran, Tiruchengode, Namakkal, Tamil Nadu; Vasundhara Public Charitable Trust, Nerurpar, Maharashtra; and Shri Gurmeet Singh, Kapurthala, Punjab.

D. National Award for Outstanding Efforts in Science & Technology Communication through Innovative and Traditional Methods for 2015 was given to "Science & Tech. Voluntary Organisation, Peddavangara, Telengana".

E. National Award for Outstanding Efforts in Science & Technology Communication in the Electronic Media for 2015 was given to Shri Pallava Bagla, Delhi.

CHAPTER 6

SCIENCE, TECHNOLOGY AND INNOVATION (STI) POLICY

STRENGTHENING STI INFORMATION SYSTEM

Centre for Human and Organisational Resource Development (CHORD) division has two main functional activities: NSTMIS and ASPIRE. The details of activities and significant achievements under each of them during 2015-16 are given below:

National Science & Technology Management Information System (NSTMIS)

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 national survey 2015-16 on resources devoted to research and development activities was launched in electronic mode to facilitate quick and timely response. The national S&T survey 2015-16 aims at capturing the current R&D landscape by collecting information from around 5000 R&D organizations viz., public sector, private sector, MNCs, higher education, SIROs and NGOs spread across the country. A structured questionnaire based on international standardization of S&T resources has been designed seeking information on various aspects such as General Information, Expenditure on S&T (R&D) activities, R&D Manpower and R&D Output to generate S&T indicators for assessment and benchmarking of S&T potential of the country. This paves the way for next issue of national publication "Research and Development Statistics".

Bibliometric studies Commissioned by the Department of Science and Technology (DST) on India's research output, collaboration and comparative performance were brought out spanning a ten years period: 2005-2014 by Thomson Reuters based on SCI database and Elsevier based on SCOPUS database respectively. The purpose of these reports is to provide an understanding of India's volume of research activity, research quality and international collaboration across different research areas in an internationally comparative context through various bibliometric indicators. These reports would serve as an evidence base for the policy formulation in the S&T sector.

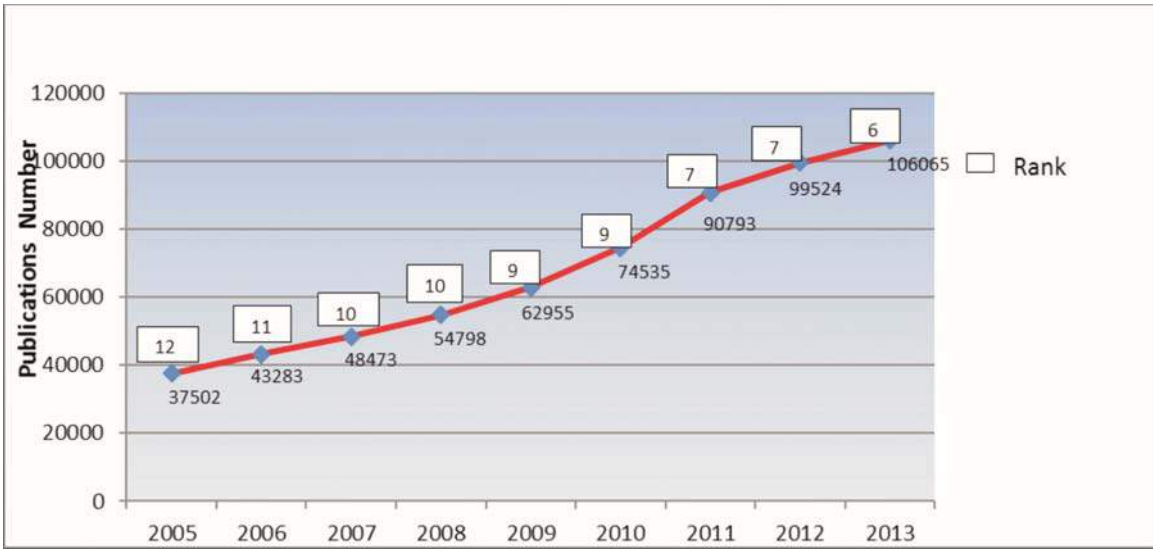

Fig-1 : India's Trend in Scientific Publications, 2005-2013

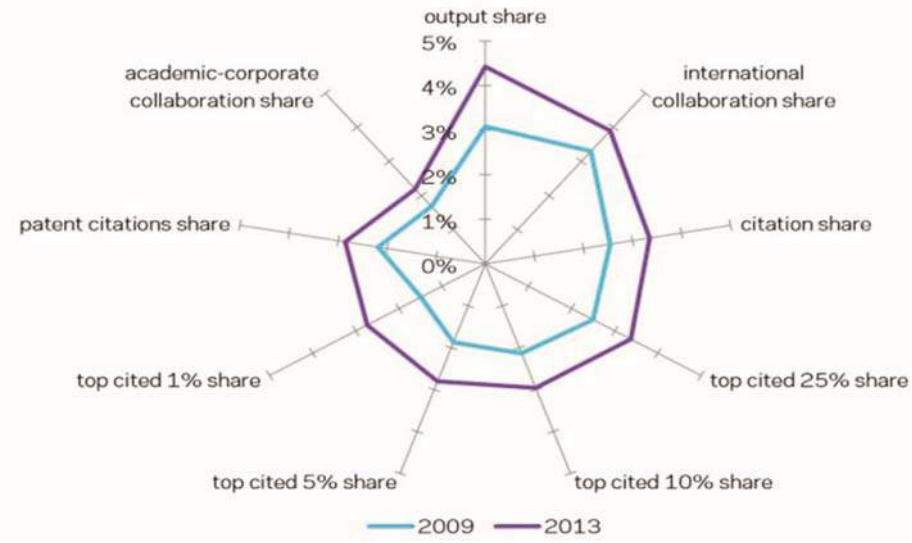

Fig-2: India's output, impact and knowledge transfer, 2009-13

(ii) Information System/Database Activities

With a view to disseminate information on sponsored research and development (R&D) projects for the benefit of different stakeholders, NSTMIS since 1990-91, has been continuously engaged in compiling information on extramural R&D projects funded by various central S&T agencies and publishing an annual ***Directory of Extramural R&D Projects***. The latest directory 2012-13, twenty-third in the series was brought out by the Department. To bridge the time gap, the work for simultaneous

preparation of **Directory of Extramural R&D projects** for the years **2013-14 and 2014-15** has been started and data collection is under progress.

Preparation of outcome of extramural R&D report, third in the series, entitled **"Analysis of Outcome of Extramural R&D (EMR) Projects 2005-10"** is under finalisation. The report would help policy planners in understanding the R&D funding approach and nuances.

Further, a **web based digital repository,** of all the NSTMIS research publications brought out till now, has been successfully developed. It includes *in-house research publications as well* as project completion reports generated under NSTMIS scheme. The repository is available in public domain through NSTMIS website (http://www.nstmis-dst.org/NSTDRepository.aspx) and updated regularly.

(iii) NSTMIS Sponsored Studies

As a part of its sponsored research programme, NSTMIS has sponsored over 200 projects in the last three decades. The sponsored research studies have imparted backward and forward linkages with the in-house research activities of NSTMIS by providing the much needed evidence base for policy actions in the S&T sector. NSTMIS research sponsorship has been availed by over 100 organizations including research institutions, universities, colleges, NGOs and consultancy organizations spread across the country.

A compendium/ report of the studies completed under NSTMIS Scheme entitled **"Three Decades of NSTMIS Scheme (1985-2015): Research Summaries"** was published this year. This compilation gives a panoramic view of the work done so far including brief annotations of the 175 project completion research reports done under NSTMIS scheme. This forms a part of the web based digital repository.

Project Advisory Committee (PAC) of experts involving experts from various inter-disciplinary and S&T areas such as natural sciences, engineering, agriculture, management, economics, statistics, information science, Public policy etc. was reconstituted to advise in the approval of the project proposals received under NSTMIS scheme, new initiatives, enlarging the scope and value addition to NSTMIS activities in view of changing STI landscape.

Some of the select sponsored studies completed during the year are:

(i) Mapping Innovation: An Analysis of the Patents obtained by Foreign Entities in India.

(ii) Appropriability of Innovations in Indian Manufacturing

(iii) Analysis of selected fellowships awarded during 2005-2013 in the field of S&T.

(iv) Measuring scientific value of Indian journals: A pilot study on Physics-Chemistry-Biology journals

(v) Assessing industrial innovation process and suggesting Policy support framework in India

(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 being incubated in project mode at the Administrative Staff College of India (ASCI), Hyderabad 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.

During the year, two workshops under the title "STI for Make in India" in response to the new initiative announced by the PM were held at IIC, New Delhi and at ASCI, Hyderabad during April and November 2015 respectively. There are plans to hold many more thematic workshops engaging various stakeholders in succession across the country to discuss the various aspects for a consolidated critical inputs resulting in a brief compendium on STI for making 'make in India' work. Apart from this, the policy studies such as *Innovation in Large Firms including Public Sector Enterprises*, *Study on Identification of Constraints to Growth of Technology based Start-ups in Technology Business Incubators and Technology Parks of India* etc would be completed. 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. Major objectives of the Policy Research include preparation of study reports on Science, Technology and Innovation. The Department is engaging itself with stakeholders, national and international experts and others to develop policy related papers. It is also expected policies will result in increased participation in R&D by the private sector. Apart from the above, the policy environment will also give a major push for the country to gain global leadership in S&T.

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 stakeholders 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 Technology Bhawan, New Delhi (May, 2015) as well as IISc Bangalore (January 2016). During the meeting, all the Centres had presented their progresses as well as future plans before the Expert Advisory Committee. All the Centres have published their annual reports for 2014-15.

The Policy Research Centre at EDII has published two research studies namely; (i) 'A Study on Problems and Issues Faced by Hi-Tech Entrepreneurs in Launching, Managing and Growth of their Ventures: Some Policy Options' and (ii) 'The Innovators - Stories of Hi-Tech Entrepreneurs'. The documents were released on the occasion of National Technology Day by Hon'ble Union Minister for S&T, Dr. Harsh Vardhan.

Policy Research Centre at Babasaheb Bhimrao Ambedkar (Central) University (BBAU), Lucknow, has prepared draft level policy briefs/ research papers based on field survey in following different thematic areas;

i. **Agriculture:** Factors Affecting Agriculture Sustainability: Role of Science Technology and Innovation for Sustainable Agriculture Policy

ii. **Climate:** Climate Change Adaptation Strategies in Agriculture: Factors Affecting the Reponses of the Farming Households

iii. **Energy:** Assessment of Rural Energy Consumption and Scenario Analysis of Alternative Energy for Village Energy Consumption: A Case Study in rural villages in selected districts of Uttar Pradesh, India

iv. **Health**: Factors affecting rural and urban healthcare system using probit model

v. **Water**: Technological Intervention in Water Sector for Human and Ecological Demands: Role of Science, Technology and Innovation

Apart from the above, the Centre has prepared a draft edited book "**Bridging the Science Policy Gap"** which will be published with an International Standard Book Number (ISBN) very soon.

The Centre at Panjab University, Chandigarh has completed preliminary level **Case Studies on Successful Industry-Academia Research Projects** that have been completed by various academic institutions. A draft comparison study report on S&T indicators of Asian Countries such as India, China, Singapore and South Korea has been prepared and it was suggested to come out with Policy Documents.

Centre at IISc Bangalore has developed Data sets for their ongoing activities *viz*. (i) Metrics used in global ranking exercises (ii) Bibliometric study of scientific research in India (iii) Financial assessment of top ranking universities and (iv) Research performance of top Indian institutions. Analysis of the above is in progress and working papers are being drafted.

Policy Research Centre at IIT Delhi is preparing draft report on India's Innovation mapping as well as status of technologis transferred. The report focusing on Innovation Assessment in the field of Agriculture Technology is being drafted.

One day conference on 'Inclusive Innovation' was organised by the Centre at IIT Delhi. Prof. Ashutosh Sharma, Secretary DST chaired the panel discussion on "Future of Inclusive Innovation and delivered the concluding remarks. A meeting of Advisory Council of Centre for Policy Research at Panjab University was held to discuss Industry-Academia linkage issues. Dr Girish Sahni, Director General, Council of Scientific and Industrial Research (CSIR) had attended the meeting.

To increase the effectiveness and integrated promotion of STI, a plenary session on STI Policy was organised on 3rd January, 2016 during the 103rd Indian Science Congress at University of Mysore. The session was chaired by Dr. M. K. Bhan, Former Secretary, Department of Biotechnology, Govt. of India.

CHAPTER 7

ADMINISTRATION AND FINANCE

The administration and finance divisions of the Department continued to provide support and of necessary administrative decisions for smooth functioning of the Department as well as its subordinate offices.

STAFF POSITION

Department has a total number of 205 Group 'A' and Group 'B' (Gazetted) officers as per the break-up given below:-

Group 'A'	General	SC	ST	OBC	PH	Total
Scientific	86	07	02	-	04	99
Non-Scientific	32	-	01	-	-	33
Group 'B'						
Scientific	11	02	01	01	-	15
Non-Scientific	44	14	-	-	-	58
Grand Total	**173**	**23**	**4**	**1**	**4**	**205**

Department has a total number of 260 non-gazetted staff on its rolls as per the break-up given below:-

Group	General	SC	ST	OBC	PH	Total
Group 'B' (Non-Gazetted)	74	06	03	04	04	91
Group 'C'	74	64	13	15	03	169
Grand Total						**260**

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 one Subordinate office and 5 Autonomous Institutions under the Department regarding progressive use of Hindi during the year.
- 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 14 to 28 September, 2015 in the Ministry of Science and

Technology. Various competitions with Hindi as medium of communication e.g. Essay, noting drafting, debate and translation etc. were organized and the successful participants were given cash awards and certificates.

RIGHT TO INFORMATION (RTI)

A total of 1503 applications and 142 Appeals were received by the Department during the year 2015-16. 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 2916 public grievances were dealt with by different Sections/Divisions during 2015-16. Out of these, 1704 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 science exhibitions at national and international level. In addition, it has also been assigned responsibility of coordinating the work related to participation of Department of Science & Technology along with its subordinate offices/aided institutes in various science exhibitions.

The Exhibition Cell has coordinated participation of DST by setting up DST pavilion in IITF-2015 in which many aided institutes and subordinate offices of DST showcased key Government of India initiatives and their major achievements in S&T sector. The cell is facilitating participation of DST in 103rd session of Indian Science Congress 2016 being held during 3-7 January, 2016 by setting up DST's Pavilion in the Pride of India Expo. The Cell has also played an active role in 5th National Level Exhibition and Project Competition held under INSPIRE Award Scheme during 06-07 Dec., 2015. The Cell also participates in a number of other exhibitions in various States.

AUDIT OBSERVATIONS

Detailed position of Action Taken Notes (ATNs) for the year 2015-16 is as following:

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 Audit),Union Government Scientific and Environmental Ministries/Departments			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)	
15	30 of 2015 (Compliance Audit), Union Government Scientific and Environmental Ministries/Departments		1 (3.1)		
16	30 of 2015 (Compliance Audit), Union Government Scientific and Environmental Ministries/Departments		1 (3.2)		

(*)ATNs have been delivered to O/o PDA (SD) on 14.08.2015 (Sl. No.4), 16.11.2015 (Sl. No. 5), 09.02.2016 (Sl. No. 10), 12.01.2016 (Sl. No. 11) respectively for vetting.

Significant audit points printed in Audit Reports of 2015

Audit Report no. 30 of 2015-Union Government, Scientific Ministries/ Departments

Department of Science and Technology

1) Para No. 3.1 of 30 of 2015 - Implementation of Drugs and Pharmaceutical Research Programme

Deficiencies in selection, financial management and monitoring of projects sanctioned by Department of Science and Technology under Drugs and Pharmaceutical Research Programme led to non-realization of outstanding loans and interest of Rs.73.68 crore, non-receipt of final project completion reports and consequent lack of information on outcome generated from the projects. The objectives of enhancing capabilities of Indian Pharmaceutical industry and promoting them to develop new drugs at lower costs were not achieved.

(Paragraph 3.1)

2) Para No. 3.2 of 30 of 2015 -Avoidable expenditure due to poor management of land and delayed construction of office complex

Department of Science and Technology delayed executing lease deed in respect of land acquired from Noida for 21 years and failed to complete construction of office complex within permissible time period. Consequently, it incurred avoidable expenditure of Rs.1.81 crore besides recurring liabilities towards penalties till completion of the construction.

(Paragraph 3.2)

FINANCIAL SUMMARY

DEPARTMENT OF SCIENCE AND TECHNOLOGY SUMMARY OF FINANCIAL REQUIREMENTS													
Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2014-2015			BE 2015-2016			RE 2015-2016			BE 2016-2017		
		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	57.95	57.95	0.00	69.91	69.91	0.00	64.41	64.41	0.00	79.82	79.82
	TOTAL - SECRETARIAT ECONOMIC SERVICES	0.00	57.95	57.95	0.00	69.91	69.91	0.00	64.41	64.41	0.00	79.82	79.82
2	R&D SUPPORT												
2.1	RESEARCH AND DEVELOPMENT SUPPORT	259.54	0.67	260.21	330.00	0.75	330.75	330.00	0.75	330.75	360.00	1.00	361.00
2.2	DRUGS AND PHARMACEUTICALS RESEARCH	18.97	0.00	18.97	25.00	0.00	25.00	23.00	0.00	23.00	20.00	0.00	20.00
2.3	NATIONAL MISSION ON NANO-SCIENCE & NANO-TECHNOLOGY	64.92	0.00	64.92	85.00	0.00	85.00	85.00	0.00	85.00	95.00	0.00	95.00
2.4	SWARAN JAYANTI SCHOLARSHIP FOR OUTSTANDING SCIENTISTS	0.00	11.99	11.99	0.00	15.00	15.00	0.00	15.00	15.00	0.00	15.00	15.00
	TOTAL - R&D SUPPORT	343.43	12.66	356.09	440.00	15.75	455.75	438.00	15.75	453.75	475.00	16.00	491.00
	TOTAL - R&D PROMOTION PROGRAMMES	343.43	12.66	356.09	440.00	15.75	455.75	438.00	15.75	453.75	475.00	16.00	491.00
3	TECHNOLOGY DEVELOPMENT PROGRAMME	130.59	0.00	130.59	154.00	0.00	154.00	152.16	0.00	152.16	200.00	0.00	200.00
	TOTAL - TECHNOLOGY DEVELOPMENT PROGRAMME	130.59	0.00	130.59	154.00	0.00	154.00	152.16	0.00	152.16	200.00	0.00	200.00
4	S&T PROGRAMMES FOR SOCIO-ECONOMIC DEVELOPMENT												
4.1	SCIENCE AND SOCIETY PROGRAMME	9.80	0.00	9.80	13.93	0.00	13.93	13.93	0.00	13.93	17.00	0.00	17.00

DEPARTMENT OF SCIENCE AND TECHNOLOGY
SUMMARY OF FINANCIAL REQUIREMENTS

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2014-2015			BE 2015-2016			RE 2015-2016			BE 2016-2017		
		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
4.2	SCIENCE AND TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT												
	AND EMPLOYMENT GENERATION	44.00	0.00	44.00	40.00	0.00	40.00	60.00	0.00	60.00	180.00	0.00	180.00
4.3	SCIENCE AND TECHNOLOGY COMMUNICATION AND POPULARISATION	19.88	0.00	19.88	20.00	0.00	20.00	24.00	0.00	24.00	25.00	0.00	25.00
	TOTAL - S&T PROGRAMMES FOR SOCIO ECONOMIC DEVELOPMENT	73.68	0.00	73.68	73.93	0.00	73.93	97.93	0.00	97.93	222.00	0.00	222.00
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	9.99	0.00	9.99	18.04	0.00	18.04	18.04	0.00	18.04	19.00	0.00	19.00
5.4	AUTONOMOUS SCIENTIFIC INSTITUTIONS	16.00	0.00	16.00	18.00	0.00	18.00	18.00	0.00	18.00	20.00	0.00	20.00
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	5.00	0.00	5.00	25.00	0.00	25.00	25.00	0.00	25.00	37.50	0.00	37.50
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	24.00	0.00	24.00	24.00	0.00	24.00	23.50	0.00	23.50
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.12	TECHNICAL RESEARCH CENTRES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL - SCSP	45.99	0.00	45.99	85.04	0.00	85.04	85.04	0.00	85.04	100.00	0.00	100.00
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	16.90	0.00	16.90	62.04	0.00	62.04	62.04	0.00	62.04	59.00	0.00	59.00
6.4	AUTONOMOUS SCIENTIFIC INSTITUTIONS	9.30	0.00	9.30	15.00	0.00	15.00	15.00	0.00	15.00	33.00	0.00	33.00
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.8	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	10.00	0.00	10.00	8.00	0.00	8.00	8.00	0.00	8.00	8.00	0.00	8.00

DEPARTMENT OF SCIENCE AND TECHNOLOGY
SUMMARY OF FINANCIAL REQUIREMENTS

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2014-2015			BE 2015-2016			RE 2015-2016			BE 2016-2017		
		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
6.10	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.12	TECHNICAL RESEARCH CENTRES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL - TSP	36.20	0.00	36.20	85.04	0.00	85.04	85.04	0.00	85.04	100.00	0.00	100.00
7.	INTERNATIONAL COOPERATION PROGRAMMES												
7.1	INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH	12.50	0.00	12.50	14.50	0.00	14.50	14.50	0.00	14.50	12.50	0.00	12.50
7.2	SCIENCE COUNSELLORS ABROAD	0.00	7.74	7.74	0.00	9.95	9.95	0.00	8.95	8.95	0.00	13.40	13.40
7.3	INDO-US SCIENCE AND TECHNOLOGY FORUM	9.50	0.00	9.50	10.50	0.00	10.50	10.50	0.00	10.50	10.00	0.00	10.00
7.4	INDO-GERMAN SCIENCE & TECHNOLOGY CENTRE	6.00	0.00	6.00	10.00	0.00	10.00	10.00	0.00	10.00	13.00	0.00	13.00
7.5	S&T COOPERATION WITH OTHER COUNTRIES	50.68	0.00	50.68	64.00	0.00	64.00	64.00	0.00	64.00	114.50	0.00	114.50
	TOTAL - INTERNATIONAL COOPERATION PROGRAMMES	78.68	7.74	86.42	99.00	9.95	108.95	99.00	8.95	107.95	150.00	13.40	163.40
8	STATE SCIENCE AND TECHNOLOGY PROGRAMME	32.32	0.00	32.32	35.00	0.00	35.00	45.00	0.00	45.00	60.00	0.00	60.00
9	TECHNOLOGY DEVELOPMENT BOARD	0.00	6.75	6.75	0.00	10.00	10.00	0.00	30.00	30.00	0.00	10.30	10.30
	TOTAL- OTHER SCIENTIFIC RESEARCH	740.89	27.15	768.04	972.00	35.70	1007.70	1002.16	54.70	1056.86	1307.00	39.70	1346.70
10.	SCIENTIFIC SURVEYS (MODERNISATION OF MAPPING ORGANIZATIONS (SoI & NATMO)												
10.01	SURVEY OF INDIA	17.80	305.75	323.55	27.16	331.01	358.17	27.00	311.48	338.48	4.93	350.54	355.47
10.02	NATIONAL ATLAS AND THEMATIC MAPPING ORGANISATION	1.53	10.54	12.07	2.84	14.70	17.54	2.84	13.70	16.54	25.07	16.62	41.69
	TOTAL - SCIENTIFIC SURVEYS	19.33	316.29	335.62	30.00	345.71	375.71	29.84	325.19	355.02	30.00	367.16	397.16
11	AUTONOMOUS SCIENTIFIC INSTITUTIONS	675.70	8.10	683.80	830.50	9.00	839.50	857.50	9.00	866.50	1007.00	9.64	1016.64
	TOTAL - SCIENTIFIC INSTITUTIONS	675.70	8.10	683.80	830.50	9.00	839.50	857.50	9.00	866.50	1007.00	9.64	1016.64
12	SYNERGY PROJECTS (O/o the PRINCIPAL SCIENTIFIC ADVISER) (including CHAIN)	23.23	0.00	23.23	26.00	0.00	26.00	26.00	0.00	26.00	26.00	0.00	26.00
	TOTAL	23.23	0.00	23.23	26.00	0.00	26.00	26.00	0.00	26.00	26.00	0.00	26.00
13	INFORMATION TECHNOLOGY	0.36	0.00	0.36	5.00	0.00	5.00	5.00	0.00	5.00	3.00	0.00	3.00
	TOTAL	0.36	0.00	0.36	5.00	0.00	5.00	5.00	0.00	5.00	3.00	0.00	3.00

DEPARTMENT OF SCIENCE AND TECHNOLOGY
SUMMARY OF FINANCIAL REQUIREMENTS

Sl. No.	HEAD OF DEVELOPMENT PROJECTS / PROGRAMMES / SCHEMES	ACTUALS 2014-2015			BE 2015-2016			RE 2015-2016			BE 2016-2017		
		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
	NEW SCHEMES (Eleventh Five Year Plan)												
14	SCIENCE & ENGINEERING RESEARCH BOARD	530.00	0.00	530.00	635.00	0.00	635.00	635.00	0.00	635.00	712.50	0.00	712.50
15	MEGA FACILITIES FOR BASIC RESEARCH	61.93	0.00	61.93	99.00	0.00	99.00	69.00	0.00	69.00	120.00	0.00	120.00
	TOTAL	591.93	0.00	591.93	734.00	0.00	734.00	704.00	0.00	704.00	832.50	0.00	832.50
	NEW SCHEMES (Twelfth Five Year Plan)												
16	POLICY RESEARCH CELL	7.94	0.00	7.94	17.00	0.00	17.00	7.00	0.00	7.00	16.00	0.00	16.00
17	DISHA PROGRAMME FOR WOMEN IN SCIENCE	43.85	0.00	43.85	53.00	0.00	53.00	58.00	0.00	58.00	60.00	0.00	60.00
18	ALLIANCE AND R&D MISSION	392.46	0.00	392.46	512.50	0.00	512.50	528.00	0.00	528.00	518.50	0.00	518.50
19	SUPER COMPUTING FACILITY & CAPACITY BUILDING	0.00	0.00	0.00	84.00	0.00	84.00	84.00	0.00	84.00	120.00	0.00	120.00
20	NATIONAL GEOGRAPHIC INFORMATION SYSTEM	0.00	0.00	0.00	0.00	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	TECHNICAL RESEARCH CENTRES	1.00	0.00	1.00	137.50	0.00	137.50	100.00	0.00	100.00	80.00	0.00	80.00
	TOTAL	445.25	0.00	445.25	804.00	0.00	804.00	777.00	0.00	777.00	794.50	0.00	794.50
	GRAND TOTAL	2496.69	409.49	2906.18	3401.50	460.32	3861.82	3401.50	453.30	3854.80	4000.00	496.32	4496.32

ABBREVIATIONS

AMRIT	-Affordable Medicines & Reliable Implants for Treatment
APIN	-Asia Pacific Incubation Network
ARI	-Agharkar Research Institute
AZO	-Aluminum Doped Zinc Oxide
BARC	-Bhabha Atomic Research Centre
CAETS	-International Council of Academies of Engineering and Technological Sciences
CAT	-Centre for Advanced Technology
CCD	-Charged Couple Device
CERES	-Crop Environment Resource Synthesis
CIGS	-Copper Indium Gallium Selenide
CII	-Confederation of Indian Industry
CIIE	-Centre for Innovation, Incubation and Entrepreneurship
CMPDI	-Central Mine Planning and Design Institute
CRNS	-Centre National de la Recherche Scientifique (French National Centre for Scientific Research
CS	-Chemical Science
CSIR	-Council of Scientific and Industrial Research
CURIE	-Consolidation of University Research for Innovation & Excellence
DAE	-Department of Atomic Energy
DBT	-Department of Biotechnology
DIPP	-Department of Industrial Policy and Promotion
DNA	-Deoxyribonucleic Acid
DOPT	-Department of Personnel and Training
DPMS	-District Planning Map Series
DST	-Department of Science and Technology
EAC	-Entrepreneurship Awareness Camp
EAS	-Earth and Atmospheric Science
EDII	-Entrepreneurship Development Institute of India
EDP	-Entrepreneurship Development Programme
EEG	-Electroencephalogram
EFS	-Encrypting File System
EPR	-Electron Paramagnetic Resonance

ES	-Earth Science/Engineering Science
FAIR	-Facility for Antiproton Ion Research
FDP	-Faculty Development Programme
FIST	-Fund for Improvement of S&T Infrastructures in Universities and Higher Educational Institutions
FSSAI	-Food Safety and Standards Authority of India
GBPIHED	-GB Pant Institute of Himalayan Environment and Development
GHG	-Green House Gas
GIS	-Geographical Information System
GISTDA	-Geoinformatics and Space Technology Development Agency
GITA	-Global Innovation and Technology Alliance
GLP	-Good Laboratory Practices
GMS	-Golden Map Service
GOI	-Government of India
GPS	-Geographical Positioning System
HCT	-Himalayan Chandra Telescope
HESP	-Hanle Echelle Spectrograph
HYSAF	-Hybrid Submerged Aerated Filter
ICAR	-Indian Council of Agricultural Research
IC-IMPACTS	-India-Canada Centre for Innovative Multidisciplinary Partnerships to Accelerate Community Transformation and Sustainability
ICMR	-Indian Council of Medical Research
ICPMS	-Inductively Coupled Plasma Mass Spectrometry
ICT	-Information and Communication Technology
ICTP	-International Centre for Theoretical Physics
ICZM	-Integrated Coastal Zone Management
IDC	-Infiltrative/Invasive Ductal Carcinoma
IGSTC	-Indo-German Science and Technology Centre
IHC	-Immunohistochemistry
IIGP	-India Innovation Growth Programme
IISER	-Indian Institute of Science Education and Research
IIT	-Indian Institute of Technology
IITF	-India International Trade Fair
IMPRINT	-Impacting Research Innovation and Technology

IMU	-International Mathematical Union
INSPIRE	-Innovation in Science Pursuit for Inspired Research
IPR	-Intellectual Property Rights
ISRO	-Indian Space Research Organisation
IRHM	-Intelligent Remote Health Monitoring
JRF	-Junior Research Fellow
MEA	-Ministry of External Affairs
MEMS	-Micro-Electro-Mechanical Systems
MFP	-Mercury Free Plasma
MNRE	-Ministry of New and Renewable Energy
MSBR	-Multi-spouted Bed Roaster
MSME	-Ministry of Micro, Small and Medium Enterprises
NABL	-National Accreditation Board for Testing and Calibration Laboratories
NASA	-National Aeronautics and Space Administration
NEHU	-North Eastern Hill University
NET	-National Eligibility Test
NCSTC	-National Council for Science & Technology Communication
NGCMA	-National GLP Compliance Monitoring Authority
NIF	-National Innovation Foundation
NIMHANS	-National Institute of Mental Health and Neurosciences
NIMR	-National Institute of Malaria Research
NLST	-National Large Solar Telescope
NMR	-Nuclear Magnetic Resonance
NSDI	-National Spatial Data Infrastructure
NSTEDB	-National Science & Technology Entrepreneurship Development Board
NUIS	-National Urban Information System
OECD	-Organisation for Economic Cooperation and Development
OSM	-Open Series maps
PAC	-Programme Advisory Committee
PFC	-Patent Facilitation Centre
PLGA	-Poly Lactic-co-Glycolic Acid
PMS	-Physical and Mathematical Science
PURSE	-Promotion of University Research and Scientific Excellence

QCD	-Quantum Chromo Dynamics
RC-UK	-Research Council-United Kingdom
R&D	-Research and Development
SERB	-Science and Engineering Research Board
SHG	-Self Help Group
SIRO	-Scientific and Industrial Research Organisation
SRF	-Senior Research Fellow
S&T	-Science and Technology
SSTP	-State Science and Technology Programme
STI	-Science, Technology and Innovation
ST-Radar	-Stratosphere Troposphere Radar
TDB	-Technology Development Board
TEDP	-Technology Entrepreneurship Development Programme
TIFR	-Tata Institute of Fundamental Research
UASB	-Upflow Anaerobic Sludge Blanket
UG	-Under Graduate
UGC	-University Grants Commission
UKIERI	-United Kingdom India Education and Research Initiative
UT	-Union Territory
UV	-Ultra Violet
UVIT	-Ultra Violet Imaging Telescope
WEDP	-Women Entrepreneurship Development Programme
WFA	-Web Feature Service
WMS	-Web Map Service
WSN	-Wireless Sensor Network

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