Start-up India

Start-up India

Fostering Innovation, Start-ups and Entrepreneurship Ecosystem

THE Ministry of Science & Technology has played a major role in promoting the flagship programme on Startup India. There has been a major focus on building the Startup innovation ecosystem and major activities have been supported through DBT, DST and DSIR/CSIR in creating this ecosystem through supporting innovation research, technology development and product commercialisation. There have been major programmes to support the incubation facilities across the country and work with institutes and universities to link them with the Startup and industry.

ISRO's GPS 'NavIC' synced with Indian Standard Time (IST)

The Timescale of Indian GPS (NAVIC - NAVigation with Indian Constellation) developed by Indian Space Research Organisation (ISRO) is being synchronised to the Indian Standard

Time (IST) generated by the "Primary Atomic Clocks" of CSIR-NPL, New Delhi. The indigenously developed system is likely to eliminate the dependence on America backed GPS system used by many commercial taxi aggregators.

Start-ups at Venture Centre in CSIR-NCL

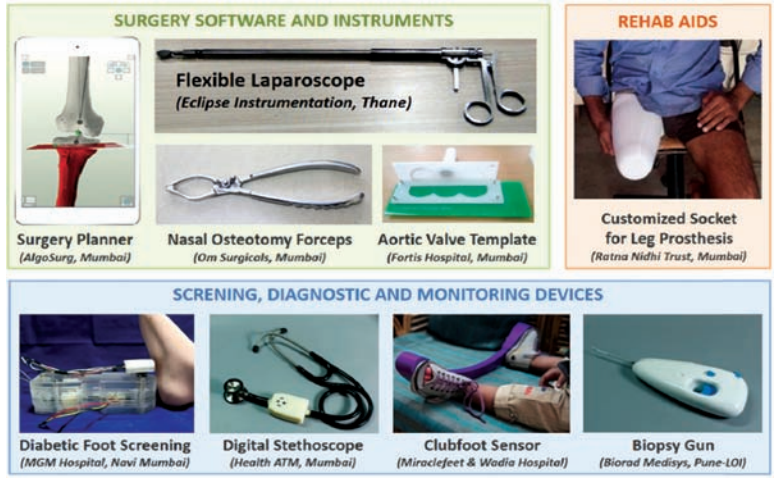
The Venture Center, which is CSIR-NCL's technology business incubator, helps in incubation of start-ups. Dr. Harsh Vardhan, Union Minister for Science & Technology and Earth Sciences visited CSIR-National Chemical Laboratory (CSIR-NCL), during February 1-3, 2016.

DST Innovation and Start-ups

- MANAK (Million Minds Augmenting National Aspiration and Knowledge) – 1 lakh top ideas from school children awarded every year.
- Speed and scale of support to Innovation and Entrepreneurship programmes increased by two to three times during the last two years; 15 new Technology Business Incubators are getting established every year.
- Number of persons trained also increased from 5000/yr to 15,000/yr.
- Over 100 innovators supported under PRAYAS and 100 start-ups per year getting enhanced seed and acceleration support.
- Budget grew from ₹ 60 cr in FY 2014-15 to ₹185 cr in FY 2017-18.
- The India Innovation Growth Programme 2.0 launched on 10th March 2017 at the Festival of Innovations at the Rashtrapati Bhavan.
- Indian Heritage in Digital Space (IHDS) - 37 generic technologies, 7 prototypes and scaled models have been developed and demonstrated. Hampi digital reconstruction demonstrated. Three start-up companies spun off.

National award winners of DST INSPIRE Award - MANAK showcased their projects at 'Festival of Innovation' at Rashtrapati Bhavan

India Innovation Growth Programme 2.0 launched on 10th March 2017 at the Festival of Innovations at the Rashtrapati Bhavan.



Products licensed to Industry, Hospitals and Institutions by the TBI at IIT Bombay – BETiC (Biomedical Engineering & Technology (Incubation) Centre)

Atal Innovation Mission (AIM)

Atal Innovation Mission (AIM) including Self-Employment and Talent Utilisation (SETU) is Government of India's endeavour to promote a culture of innovation and entrepreneurship. Its objective is to serve as a platform for promotion of world-class Innovation Hubs, Grand Challenges, Start-up businesses and other self-employment activities, particularly in technology driven areas.

The Atal Innovation Mission has two core functions:

- **Entrepreneurship promotion** through Self-Employment and talent utilisation, wherein innovators would be supported and mentored to become successful entrepreneurs.
- **Innovation promotion** to provide a platform where innovative ideas are generated.

CSIR endeavours for Atal Innovation Mission

The Council of Scientific & Industrial Research (CSIR) has been taking actions on both the core functions proposed in the Atal Innovation Mission.

Entrepreneurship Promotion: CSIR has been promoting entrepreneurship and incubation activities. DSIR/CSIR have led a national effort and have developed the desired mechanisms operational under the umbrella "Encouraging Development and Commercialization of Inventions and Innovations: A New Impetus". The mechanisms in place enable scientific establishments in the country to take up new initiatives for:

1. Permitting researchers working in Scientific Establishment to have an equity stake in scientific enterprises/spin-offs while in professional employment with their research and academic organisations;
2. Permitting the scientific establishment to invest knowledgebase as equity and/or loan in an entity;
3. Encouraging the scientific establishment to set up incubation centers; and
4. Facilitating mobility of researchers between industry and scientific establishment.

The scheme is operational in CSIR.

Innovation Promotion: Incubation Centre Scheme is operational in CSIR. National Chemical Laboratory (NCL), Pune has operationalised an incubation centre/venture centre wherein about 40 companies are being incubated. Indian Institute of Chemical Technology (IICT), Hyderabad has also set up such a centre. In CSIR, more than a dozen incubation centres are operational. It is expected that about 20 more incubation centres will be opened in CSIR laboratories. While an Incubation Centre aims to provide high quality infrastructure and environment to entrepreneurs and knowledge workers, at the same time it also helps incubate novel products, technologies, knowhow(s), process(es) and other patentable knowledge into marketable goods.

CSIR hosts Atal Incubation Centre

CSIR-CCMB has been identified as one of the ten organisations in the country to host an Atal Incubation Centre supported by NITI Aayog. The initiative is part of the Atal Innovation Mission set up by Union government to promote innovation and entrepreneurship in the country. CSIR-CCMB would offer its scientific expertise, infrastructure and business management to the start-ups.

eHealth Centre

The **eHealth** Center (eHC) is housed in a standard shipping container which can be quickly transported to remote areas of the country by air, rail or by land transport. It is a fully integrated cloud-enabled healthcare solution set up to provide affordable and preliminary healthcare in remote areas that have no immediate access to primary healthcare. The solution integrates medical instruments that collect basic patient health data with an eHC Health Cloud and enables medical diagnosis through remote consultation using built-in video-conferencing options. This initiative is pursued by CSIR-IGIB in collaboration with Hewlett Packard for the fourth paradigm of science, data-intensive discovery, while bringing affordable healthcare services to the doorstep of people. Till date, Hewlett Packard Enterprise India has installed a total of 79 eHCs and 113 Mobile eHCs spread across 18 states in India which has more than 385000 registered patients.

Nutra-Phyto Incubation Centre

A technology incubator, Nutra-Phyto Incubation Centre has been established in collaboration with the Government of Karnataka for working with/incubating industries in the domain and take them forward towards successful commercial ventures in the area of nutraceuticals and functional foods in the country. The entrepreneurs/incubatees will have access to state-of-art facilities for basic research, scale-up and efficacy studies all through a single point of access.

Setting up a Common Facility Centre (CFC) on Weaving and Textile Product Manufacturing (CSIR-NEIST, Jorhat)

A Common Facility Centre (CFC) has been established for Weaving and Textile products in Sonowal, Jorhat aimed at providing economically backward village women access to simplified plant machineries, equipment and other facilities and training along with marketing assistance for their development on a self-sustainable basis. About 435 women have benefitted. Average income per person is about ₹ 9000 per month. The products are retailed in Jorhat through NGO outlets. Products from the 49 weaving centers have been exhibited at trade fairs like ***Mahila E-haat*** organised by Rashtriya Mahila Kosh, Surajkund International Crafts Mela, Haryana, etc.

NGCMA certified GLP Test Facility @ CSIR-CDRI

CSIR-CDRI received GLP compliance certificate from National Good Laboratory Practice Compliance Monitoring Authority (NGCMA) in November 2017 for conducting safety pharmacology and acute toxicity studies. The GLP certification is a testimony to the high-quality research work that has been carried out in the Institute.

CSIR-Centre for High Altitude Biology (CSIR-CeHAB) —Reaching the Unreached

A food processing unit has been set up at CSIR-Centre for High Altitude Biology (CSIR-CeHAB) in the remote tribal region of Lahaul and Spiti. A brining unit has been designed and prototype developed for the preservation of locally and abundantly produced peas and cauliflowers. The know-how was showcased at the district level Tribal Fair at Keylong and training organised for 15 progressive farmers in making novel products from Buckwheat and also brining of the peas which is a major crop.

National Initiative for Developing and Harnessing Innovations (NIDHI)

- Umbrella programme initiated in 2016-17, aims to nurture knowledge-based and technology-driven innovative ideas into successful startups.
- NIDHI focuses on building a seamless and innovation driven entrepreneurial ecosystem. Different programmes have been designed and are being implemented to address the gaps in the ecosystem.
- Programmes range from providing fellowships to students opting for entrepreneurship, 'Proof of Concept' support for converting ideas into prototypes, business development support through accelerators, seed support to ventures and creating world class infrastructure for incubating start-ups through Technology Business Incubators and Centres of Excellence.
- Not only provides technological solutions for the pressing needs of the society but also targets creation of new avenues for wealth and job creation.
- During the last four years, 45 Technology Business Incubators (TBIs) have been established at various national institutions, apart from public and private institutions across the country. 10 TBIs supported with Prayasshalas and 30 TBIs supported with seed support to enable the start-ups to take their ventures to the next level.
- Establishment of a Research Park at IIT Gandhinagar has been supported at a cost of ₹ 90 crore.

India Innovation Initiative (I3)

Joint programme of DST, Confederation of Indian Industries (CII) and the All India Council for Technical Education (AICTE), I3 aims to promote scientific thinking and problem solving amongst the youth. It encourages them to apply theories and methods of science to carve out high impact and disruptive solutions for industry and social challenges. In I3 final event top innovators identified through intensive scrutiny at regional workshops participate and many of them win various awards & prizes sponsored by several partners & associates.
Also, an enabling mechanism has been created for commercialising the best and home-grown initiatives through support mentorship, investors and industry connect.

DBT Industrial Innovation and Startups

Fostering and Nurturing Entrepreneurs

- Biotechnology Industry Research Assistance Council (BIRAC) is a Public-Sector Undertaking set up by the Department of Biotechnology (DBT), Government of India as an interface Agency with the aim of strengthening and empowering emerging Biotech enterprises to facilitate them in undertaking strategic research and innovation that addresses nationally relevant product development needs. BIRAC along with DBT is playing an important role in the implementation and delivery of the flagship programmes of the Indian Government especially **'Make in India'** and **'Start-up India'** and has a crucial role in transformation of the Indian Bioeconomy to US $ 100 billion by 2025.
- The pioneering programmes of BIRAC such as BIG, SBIRI, PACE and BIPP have given a significant boost across the value chain of product development from ideation to commercialisation.

BIRAC Impact

- BIRAC has supported over **700** Biotech companies, Research Institutes, Small and Medium Scale Enterprises (SMEs), which includes **500 start-ups** and entrepreneurs; generated about **155** Intellectual Property Rights (IPs); supported *30* Bio-incubators across India and around 100 products/technologies developed.
- BIRAC's BIG programme has become one of the largest early stage programme and has supported more than **230** startups and entrepreneurs. Many of these BIG grantees have been able to generate follow-on funding from both public and private agencies.
- These products have exhibited positive impact on a wide range of healthcare, sanitation, food & nutrition, agriculture, industrial biotechnology challenges & renewable energy and contributing to India's action for Sustainable Development Goals (SDGs).
- ***Biotechnology Innovation Equity Fund - AcE Fund*** launched to scale-up R&D and innovation in biotechnology domains and infuse more than 350 cr in the Biotech Innovation Start-up Ecosystem.

- BIRAC is implementing National Bio-Pharma Mission, an industry-academia collaborative mission of DBT in collaboration with World Bank, with a corpus funding of 250 Mn USD for accelerating discovery research to early development of Biopharmaceuticals.
- BIRAC and DBT efforts have led to the Start-ups definition being amended by DIPP where an entity shall be considered as a Bio-technology Startup for up to 10 years from the date of its incorporation/registration. For others it is 7 years.

BIRAC Bio-innovations: Propelling the Bio-economy

Through BIRAC's support, more than 100 technologies and processes have been developed and more than 50 novel products are in the market. These affordable products impact society at large and have contributed to the healthcare, agriculture and industrial biotech sectors. Some successful examples are:

- **Pandorum Technologies – Synergy of life science and engineering competencies:** *In vitro* 3D human liver tissues were designed and are undergoing validations. This product can be used for *in vitro* medical research – hepatotoxicity & drug metabolism.
- **Bugworks Research India – Strategy for antibiotics to bypass efflux pumps:** The company is developing a first-in-class Novel Chemical Entity (NCE) that exhibits potential of killing superbugs resistant to colistin, beta-lactams, cephalosporins, carbapenems, fluoroquinolones and other pathogens difficult to treat. It is now under preclinical development and is planned to enter clinical development in 2019.
- **Aarna Biomedical Products – Affordable high-quality post mastectomy kit:** An affordable high-quality biodegradable post mastectomy kit was designed for

breast cancer patients who have lost their breast as part of surgical intervention boosting physical and mental wellbeing and preventing postural and gait issues.

- **Jeevtronics – Low-cost defibrillator that works without electricity:** The company has developed the world's first dual powered defibrillator that works in areas without electricity and will be priced at 1/4th the price of big brands, while maintaining similar or better-quality levels.

BioUrja Technology for Waste Management

The company has developed a sustainable solution for waste management. BioUrja is a modular, compact and customisable biomethanation system to handle various organic wastes..

Natural Fibers: Waste to Wealth

After harvesting banana punch, the remaining portion of the tree becomes an agricultural waste. The technology extracts valuable silk grade fibers from the waste. The shelf life of the extracted fiber will be more than 20 years. This innovation has strong market potential and has gained lots of traction.

Promoting Women Scientists & Entrepreneurs

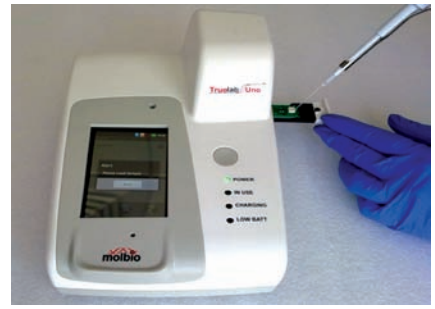
For promoting science and entrepreneurship among young women, a conclave on 'Women Scientist & Entrepreneurs' was inaugurated by the Hon'ble Union Minister Dr. Harsh Vardhan as a part of the India International Science Festival (IISF, 2017). The conclave brought together around 350 scientists, researchers and entrepreneurs from across the country.

Furthermore, the BIRAC Women Bio-Incubator was inaugurated at the Golden Jubilee Women Biotech Park, Chennai.

New Millennium Indian Technology Leadership Initiative (NMITLI)

CSIR's NMITLI Programme seeks to catalyse innovation-centred scientific and technological developments as a vehicle to attain for Indian industry a global leadership position in selected niche areas by synergising the best competencies of publicly-funded R&D institutions, academia and private industry. Through the programme, several technologies have been developed, which include:

MicroPCR: A battery-operated hand-held MicroPCR for diagnosis of diseases such as salmonella, tuberculosis, malaria, dengue, chikungunya, hepatitis B and H1N1. It has been patented in over 130 countries. The device currently costs a tenth of a conventional real-time PCR and a fifth of existing NAAT tests in the market – can be further brought down with scale and early adoption by governmental programmes. The product is available in Indian and global market and ICMR has deployed 100 devices at various health centres in the country.



Johne's Disease (JD) Vaccine: Vaccine against Johne's disease approved by the Drugs Controller General of India (DCGI), with issuance of drug manufacturing license by the State Drug Authority of Karnataka. Two formulations of vaccine i.e. JD Oil and JD Gel have been developed under the CSIR-NMITLI Scheme. The vaccine is manufactured and marketed by M/s Biovet Private Limited, Bengaluru. JD may be

the major cause of reduced productivity in Indian animals, which number over 200 million. It is endemic in the ruminant population of India and has also been reported from human beings. The vaccine will lead to increased milk and meat production and improved health of cow, buffalo, sheep and goat. The vaccine was launched by Union Minister Dr. Harsh Vardhan on CSIR Foundation Day (September 26, 2015). This is the third vaccine for JD in the world after Mycopar, US and Gudiar, Australia.

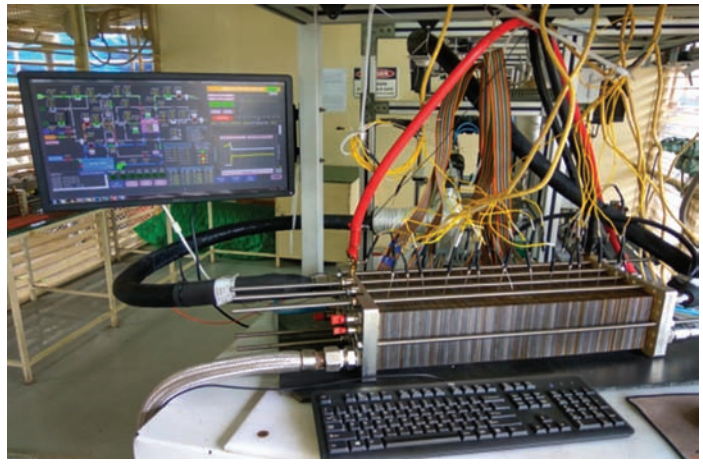
Towards Cleaner Leather Processing: The world over, leather is made employing technologies that involve using large amounts of industrial chemicals and a wide variety of specialty chemical formulations, often resulting in severe environmental pollution. Under the NMITLI programme, a paradigm shift has been brought about in beam house operations in leather manufacturing through bioprocessing as opposed to the currently used chemical processes. The salient features of the technology are:

- Enables reduction in COD, TDS and energy requirement
- Avoids lime sludge and
- Fiber opening without osmotic swelling leads to more area.

The technology developed by CSIR is the first in the world and offers substantial reduction in pollution. The cost of leather processing is slightly higher but there are environmental benefits. CSIR is demonstrating the technology to DIPP and CPCB to make the process mandatory in the country.

All-Fiber Supercontinuum Light Source: Supercontinuum Source for generating white light with wide wavelengths of 400 nm –2200 nm and the Broadband Confocal Microscope are unique with multiple applications in fluorescence spectroscopy, coherence tomography, biomedical imaging and analysis. The industrial partner, Vinvish Tech. Ltd., has become the third company in the world and the first company in India to come up with such high tech products by using specialty Photonic Crystal Fibers (PCF).

Fuel Cell: CSIR has designed and developed many prototypes of 500 W, 1.0 kW, 1.5 kW, 2.0 kW and 3.0 KW Polymer Electrolyte Membrane Fuel Cell (PEMFC) systems. It has also conducted a comprehensive testing and benchmarking process of a 3.0 kW system on a test bed in collaboration with Reliance Industries who is a major player in 4G telecommunications. It is expected to enable the development of a cost effective PEMFC system for targeted application for the first time in the country. CSIR is continuing its efforts in this green technology area by developing even vendors for critical components of the fuel cell technology in the country.



Electrical Three-Wheeler
"SoleckshawLite"

A sustainable and affordable electric three-wheeler 'Soleckshaw Lite' has been developed for urban local transport. It is designed for a top speed of 40-45 kmph and a driving range of over 100 km per charge. After rigorous testing and trials at ARAI, Pune, Central Motor Vehicle Rule (CMVR) certification for Soleckshaw Lite has been obtained. 'Soleckshaw Lite' is the country's first electric auto rickshaw which has obtained CMVR certification under L5M category with a speed of over 40 km/h. 'Soleckshaw Lite' would be an ideal product for short to medium distance transport in urban cities with a low running cost for auto rickshaw owners as well as users considering rising fuel prices, dwindling resources of fossils fuels and the threat of global warming.

Integrated Technology Solutions for Security and Operations based on UV sensor: An indigenous process technology for offset inks, UV curable screen, stamp pad, digital inks, plastic prills and new UV sensitive materials (single and bi-fluorescent) has been developed. New materials with offset ink type products developed have already been commercialised by Security Printing and Minting Corporation. (wholly owned by GoI). Various prototypes of Programmable Invisible Marker Authenticating Device (Pi-MAD) for the detection of UV tags by integrating the hardware (optics/electronics) and software were also designed and developed for providing integrated solution by detecting the fluorescence with a high signal to noise ratio.

nonClonableID Technology for Medical Product Authentication: CSIR has demonstrated the ability of a novel nonClonableID technology for medical product authentication and patient safety. The nonClonableID technology, based on novel aspects of material science and utilising the law of randomness, creates unique non-duplicable fingerprints. These fingerprints when processed, digitised and activated function as unique identification tags. These tags can be utilised for establishing product accountability through secured traceability from the point of origin to the point of dispensation, authenticity check and establishing e-pedigree.

Dental Implants: A completely indigenous dental implant system has been developed along with complete prosthetic and surgical kit to serve the treatment needs of an edentulous or partially edentulous Indian patient. In addition, various other components including surgical and prosthetic ancillaries have been developed. The implants have undergone phase II clinical trials after receiving permission from DCGI. The technology for dental implants has been licensed for commercialisation.

Antibody against NAMPT — eNAMPT: A biotherapeutic platform to generate antibody against any antigen within 30-40 days has been developed. Under the NMITLI project, the world's largest naïve human phage display libraries (2079*10 11cfu) was compared to Berkeley (2.5*10 11 cfu) and a fast panning process was developed. The project has expanded the reach of Indian scientists in this new area of R&D.


NIOT

“Make in India”

"Make in India"
for a Better India

THE "Make in India" initiative was launched by the Prime Minister in September 2014 as part of a wider set of nation-building initiatives. Devised to transform India into a global design and manufacturing hub, "Make in India" quickly became a rallying cry for India's innumerable stakeholders and partners.

It was a powerful, galvanising call to action to India's citizens and business leaders, and an invitation to potential partners and investors around the world. It represents a comprehensive and unprecedented overhaul of outdated processes and policies. Most importantly, it represents a complete change of the Government's mindset – a shift

from issuing authority to business partner, in keeping with Prime Minister's tenet of 'Minimum Government, Maximum Governance'.

The Ministry of Science and Technology and Ministry of Earth Sciences have made significant contributions to the "Make in India" initiative, some of which are illustrated here.

Wax Deoiling Technology – Will Save ₹ 500 Crore Every Year

This technology which can produce waxes from petroleum streams has won international competition for adoption by Numaligarh Refinery Ltd (NRL). A plant based on this technology has been set up with an investment of ₹ 750 crore at NRL and dedicated to the Nation by Hon'ble Prime Minister in February 2016. This newly set up plant will produce 50,000 MMTPA of high value Paraffin Wax and 4,500 MTPA of Microcrystalline Wax that will help cut down the wax import by 50% and save foreign exchange of about ₹ 500 crore/annum.

"Make in India" represents a comprehensive and unprecedented overhaul of outdated processes and policies. It represents a complete change of the Government's mindset – a shift from issuing authority to business partner, in keeping with Prime Minister's tenet of 'Minimum Government, Maximum Governance'.

Equipping Indian Railways with Ultra-modern Technologies

Technology Mission for Indian Railways (TMIR) – an initiative of the Department of Science and Technology (DST), Ministry of Railways (MoR), Ministry of Human Resource Development and Ministry of Industry – will take up research projects to develop state-of-the-art technologies for use in Indian Railways on an investment sharing model. DST has agreed to contribute ₹ 75 crore in the TMIR.

An Eye over the Oceans

Sindhu Sadhana –
India-built Vessel to Study Indian Seas

For the first time, a state-of-the-art Oceanographic Research Vessel "RV Sindhu Sadhana" has been built and commissioned. This multidisciplinary research vessel addressing R&D in the domains of food, energy, minerals, climate and environment will expand the reach of Indian oceanographers to understand the oceanographic process in the seas around India and to translate this knowledge to benefit the nation. RV Sindhu Sadhana sailed for its first oceanographic research cruise on July 19, 2014 from Visakhapatnam after sea trials.

Floating Wave Powered Navigational Buoy

National Institute of Ocean Technology (NIOT) has built an all-weather floating buoy in sea for powering a beacon lamp on top of the buoy and oceanographic related components using energy extracted from the ocean waves. The floating buoy can be used as a navigational buoy in ports and harbours. Indigenously built, the buoy has been deployed and tested off Kamarajar port in Chennai. It can be used in place of imported solar powered buoys.

Turbine Generates Electricity from Ocean Currents

NIOT has developed an ocean current turbine for harnessing kinetic energy from seawater currents. All the sub-components were indigenously designed and fabricated locally. It is to be scaled up for off-grid units for remote coastal locations. Forest outposts in Andaman require small off-grid power modules of under 5 kW capacity.

"The floating buoy can be used as a navigational buoy in ports and harbours"

Ocean Drifters

Ocean drifters have been developed for the measurement of sea surface temperature and other parameters. Trial production by Indian industries (Astra Microwave, Hyderabad and Komaline Industries, Ahmedabad) is underway.

Autonomous Underwater Profiling Drifters

Autonomous Underwater Profiling Drifters have been developed for measuring salinity and temperature up to 2000 m water depths. Trial production by Indian industry (Data Patterns, Chennai) is underway.

Remotely Operable Vehicles (ROV)

An agreement was signed for transferring the deep water Remotely Operated Vehicle (ROV) technology to the Indian industry (L&T Heavy Industries, Mumbai) through NRDC. These ROVs can be used for carrying out scientific investigations up to 6000 m water depths.

Robo Coastal Observers

Robo Coastal Observers are used for data collection in coastal waters and aiding in rescue/assisting of swimmers. An agreement has been signed for transferring the Robo Coastal Observer to CT Control Technology through NRDC.

Met-ocean buoy system

Met-ocean buoy system has been developed to collect surface meteorological and oceanographic parameters. The system is being operated and maintained in the Indian seas.

Augmenting Aviation

SARAS takes "Make in India" to New High

SARAS – the 14-seater aircraft designed and developed by CSIR-NAL – took to the skies on January 24, 2018. The maiden flight was the first of 20 flights to evaluate the system performance, the feedback from which would be used to freeze the design of the production version aircraft. The aircraft in its production version will have a capacity of 19 seats capacity and will be certified for civil and military use.

HANSA-NG — Indigenous Pilot Training Aircraft

Pilot training in India is set to get a boost with CSIR-NAL's Hansa-3 aircraft, which was handed over to M/s Mesco Aerospace. HANSA NG will be certified within 18 months and will then be taken over for production. According to a third-party market survey by CSIR-NAL, the potential requirement is about 70 to 100 aircraft by 2020.

Multi-role, Multi-mission Aircraft Developed

NM5 or C-NM5, a multi-role, multi-mission aircraft being jointly developed by CSIR-NAL and Mahindra Aerospace Ltd., is a five-seater civil aircraft and an extension of the Hansa project. The NM5 has been entirely designed and developed by CSIR-NAL and Mahindra Aerospace on a 50:50 partnership basis. The NM5 can be used as a trainer, for transporting cargo, medical evacuation, tourism, VIP travel and for training pilots.

Monitoring System Boosts Aviation Safety

CSIR-NAL jointly with India Meteorological Department (IMD) has developed and deployed the first Indigenous Aviation Automatic Integrated Weather Monitoring System. The system is functional at the Mangalore International Airport. It measures Wind Speed, Wind Direction, Pressure, Temperature and Relative Humidity along with Visibility which are critical for aviation safety. The indigenous effort has accomplished saving of foreign exchange to the country.

Dr. Harsh Vardhan, Union Minister for Science & Technology, inaugurated the Airport Instrumentation Facility

Drishti Enhances Airport Runway Visibility

Drishti, an indigenous, innovative, and cost effective visibility measuring system has been developed by CSIR-NAL. It guides pilots in times of low visibility on the runway. Drishti is suitable for all categories of airports viz., CAT I, CAT II, CAT III A& B and measures visibility down to 4 meters.

India's First Research Tunnel

A Micro Air Vehicle Aerodynamics Research Tunnel (MART) has been set up at CSIR-NAL. It's a joint development with DRDO and ISRO. The state-of-the-art tunnel would address all the aerodynamic, propulsion and aero-elastic issues related to MAVs. The tunnel will be used to test the fixed-wing, flapping-wing and rotary-wing MAVs in the 500 mm wingspan category.

Jet Fuel from Biomass: Towards **Green Aviation**

A complete process and catalyst has been developed for production of jet fuel from biomass derived non-edible oil. The process can be integrated into the current refinery structure. The biojet fuel matches all major specification for aviation fuels, helping the aviation industry reduce its carbon footprint.

Strengthening the Nation's Security

Critical Technologies for Indigenous Combat Aircraft

When India's indigenous Light Combat Aircraft (LCA) – Tejas – soared into the skies for the first time in January 2001, it was a proud and exhilarating moment for the country. LCA is 'light' largely because of CSIR-NAL's innovative development of composite airworthy parts. LCA technologies are extremely critical & sophisticated and have dramatically narrowed the gap between India and Western countries in fighter aircraft design and development. CSIR-NAL has contributed in designing and developing two parts – Fin and rudder assembly.

Helping Armed Forces Hone their Marksmanship Skills

CSIR-NAL has developed an Acoustic Based Hit Identification and Analysis System (ABHIAS) for marksmanship training of the Armed Forces – Army, Navy and Air Force, CRPF, CISF, NSG, BSF, etc. The system is currently under ruggedization with the armed forces, and an MoU is at a final stage with BEL, Bengaluru for production, marketing and after-sales service.

Head Up Display (HUD) for Fighter Pilots

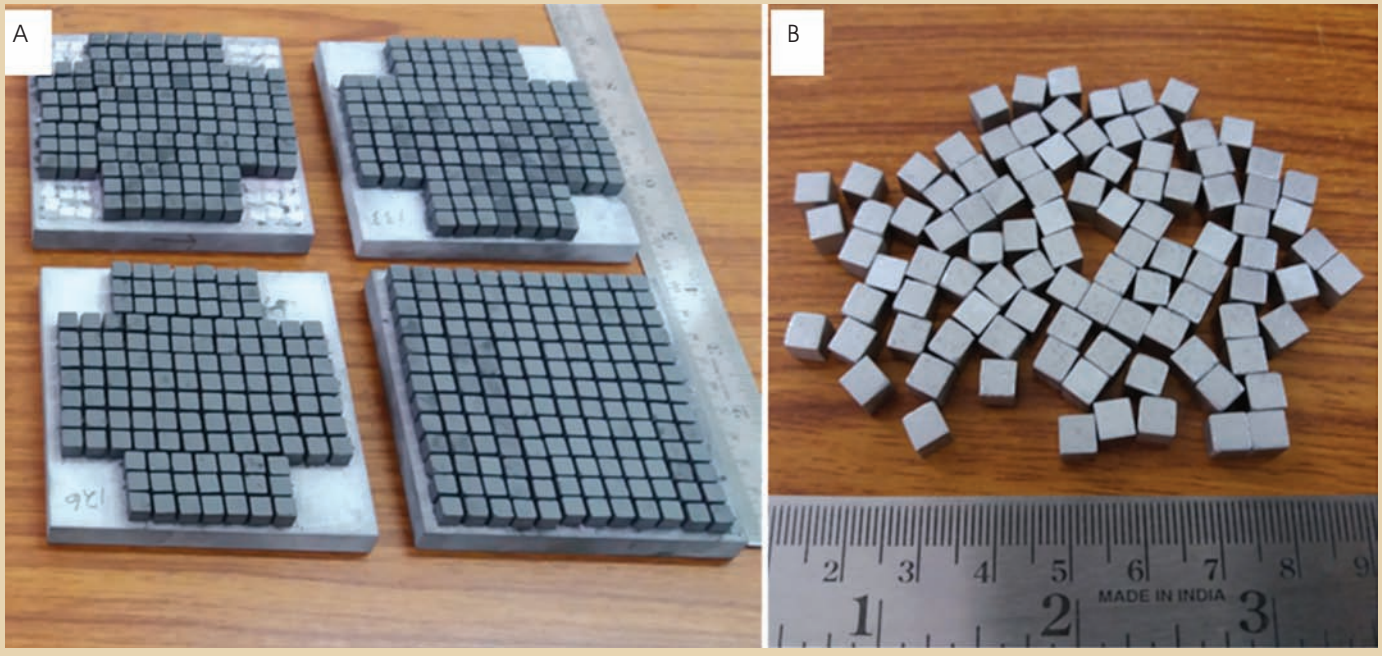
Head-Up Display (HUD) is an essential aid for aircraft pilots, especially fighter aircraft. HUD displays flight information such as altitude, airspeed, angle of attack, navigation, weapon aiming and other flight information in collimated form so that the pilot is able to view the information with his head "up" and looking forward, instead of looking down on other instruments mounted in the cockpit.

Military Aviation Head Up Display Test Platform (MAHTP)

Military Aviation Head Up Display Test Platform (MAHTP) makes automated testing & debugging less time consuming for ground staff of Air Force and Maintenance Personnel using Intermediate Level (I-Level) & Operator Level (O Level) MAHTP at Air Force Base Station.

Tungsten Alloy Cubes for Missiles

A process has been developed for manufacturing tungsten alloy cubes in 10 kg scale for DRDL for their R&D requirement in armour piercing penetrator in the missile programme. Scale up of the process at 100 kg scale is underway.



Tungsten Alloy (TA) Cubes Green (A) and Sintered (B)

Contributions to Space Programmes

CSIR-NAL has played a crucial role in the acoustic qualification of subsystems for the indigenous cryogenic stage used in GSLV–D5. These tests helped in the first successful flight of the GSLV Mark II using the indigenously developed cryogenic engine, the CE-7.5 by ISRO. CSIR is also proud to be associated with the successes of ISRO's Mars Orbiter Mission (MOM) programme.

Thyratron, Klystron, Magnetron & Gyrotron

- CSIR-CEERI developed 25kV/1kA Thyratron, later expanded to 35 kV/3 kA Thyratron, as per the requirement of BARC. It is to be used for strategic purposes.
- CSIR-CEERI has developed 6 MW S-band Klystron which would serve as Radio-Frequency power source for LINAC being developed by BARC for Cargo scanning; Food processing; Cable hardening and Gem colourization.
- Water-cooled mechanically tunable pulse magnetron, with peak power 3 MW in S-band, was successfully developed in joint collaboration with DAE. This is intended primarily for use in LINAC/ Microtron.
- A 42 GHz Gyrotron with indigenous design, development and characterisation technology as well as infrastructure has been developed by CSIR-CEERI. The Gyrotron is the first of its kind to be developed in the country.

World's Lightest Electric Car – e2o Plus

Under a CSIR supported project, M/s Mahindra has developed and launched the world's lightest and lowest cost, no-compromise 4-door, 4-seater battery operated electric car. It is the first four-door electric vehicle indigenously designed, developed and commercially produced in India and meeting global automotive quality standards. India's first indigenously developed off-board fast charger has also been developed under the project. The car is designed for a top speed of about 100 kmph and a driving range of about 150 km. The car has significant export potential.

Broad Spectrum Confocal Microscope

CSIR-CGCRI along with M/s Vinvish has designed and developed Broadband Confocal Microscopes. It will be used to obtain three dimensional features at microscopic level and play vital role in scientific understanding of nano-materials, biological objects, etc. It is a world class product based on the uniqueness of reflectance spectroscopy.

Country's First Amorphous Alloy Production Unit

CSIR-NML is setting up a pilot plant for production of amorphous electrical steel with funding from Ministry of Steel. Amorphous based electrical steels are a new class of soft magnetic materials with high electrical resistivity, low coercivity, low core loss and find extensive applications as core material (transformers, stators, motors, generators), magneto static shielding, choke coils, actuators, etc. This will be the first of its kind pilot plant in India to produce transformer-grade wide amorphous ribbons.

Catalysis for Sustainable Development

The mission endeavours to find the demand supply gaps of chemicals and processes pertinent to Indian chemical industry and develop cost effective, environmentally friendly processes for them. It will focus on alternative and renewable feedstock for chemical synthesis and intends to develop chemical products and processes utilizing renewable raw materials (in-edible biomass, carbon dioxide, water and shale/natural gas, etc.) instead of the conventional fossil fuels. It will be ensured that all the processes/technologies developed have minimum effect on the environment.

Mobile Unit Makes Bridge Repair Easy

Mobile Bridge Inspection Unit (MBIU) is an electro-mechanical device mounted on a truck that makes inspection of road bridges easy.

'PATCHFILL' Repairs Potholes

PATCHFILL is a compact machine for quick, safe and economic repair of potholes using cold mix with efficiency matching that of giant machines.

Plastics to Fuel and Petrochemicals Waste to Wealth Initiative

To address the growing menace of plastic and associated waste generation in the country, a simple process for the conversion of waste plastics (polyolefins) to value added hydrocarbons e.g. gasoline, diesel and aromatics has been developed. The liquid fuel meets Euro III specifications.

Production of US Grade Gasoline and Pure Benzene Plant Commissioned

With this technology, US grade gasoline and pure benzene can be simultaneously produced from a FCC C6 heart cut stream using extractive distillation (ED) route. The RIL has set up

600,000 MTPA unit costing ₹160.00 crore. The annual gasoline production from this unit would equal prospective export monetary value of around 682 Million USD per annum with an additional profit of around 102 Million USD per annum from the sales of the recovered high purity benzene.

Dimethyl Carbonate (DMC) from Methanol and Urea

A process for the synthesis of DMC – an important intermediate – from methanol and urea has been developed. The urea route is considered better and a green alternative for DMC synthesis. At present, India does not produce DMC and all the requirement is met through imports from China and other countries.

Recovering Cobalt from Discarded Li-ion Batteries of Mobile Phones

A cost-effective process has been developed to help in reduction of e-waste and its inefficient recycling and dissolution of metals. The process has been transferred to M/s ADV Metal Combine Ltd., New Delhi.

LPG Sweetening Catalyst

Thoxcat ES, a catalyst useful for LPG sweetening has been further modified and scaled up with M/s Lona Industries to ensure a competitive edge over competing sweetening catalysts. This fine-tuned catalyst has now been shipped to ORPIC, Oman and Saudi Aramco.

Indigenous Potash Technologies

A complete technology solution for valorisation of spent wash generated in sugarcane molasses based alcohol distillery has been developed for utilisation of spent wash for production of value-added by-products *viz.*, potash fertiliser, animal feed ingredient, etc., while achieving statutory compliance with 'zero liquid discharge' norms.

Dry Tanning (Dispersing Agent)

Game changing Tanning Technology from CSIR-CLRI, leading to cost and time savings, less quantity of tanning agent, less water requirement, fewer steps in leather processing and environmental benefits.

Facilitating "Make in India" in the Biotech Sector

- The Biotechnology Industry Research Assistance Council (BIRAC) established a "Make in India" Facilitation Cell in 2016 for disseminating information in the context of "Make in India" and attracting investments.
- BIRAC also launched the Biotechnology Innovation Equity Fund -- AcE Fund, which is a Fund of Funds to scale-up R&D and innovation in biotechnology domains. This will infuse more than 350 Crores in the Biotech Innovation Startup Ecosystem.
- BIRAC is implementing National Bio-Pharma Mission, an industry-academia collaborative mission of Department of Biotechnology (DBT) in collaboration with World Bank, with a corpus funding of 250 Mn USD for accelerating discovery research to early development of Biopharmaceuticals.
- DBT along with BIRAC has championed the cause of promoting the Start-ups Innovation ecosystem in the biotech domain. DBT endeavours to scale up the number of start-ups in the sector by nurturing approximately 300-500 new Start-ups each year to have around 2,000 start-ups by 2020.
- BIRAC has till now supported 500 start-ups and entrepreneurs. BIRAC's BIG programme has become one of the largest early stage programmes and has supported more than 250 start-ups and entrepreneurs. More than 50 BIG grantees have been able to generate follow-on funding to the tune of 125 crores from both public and private agencies.

Initiatives for Ease of Doing Business

- Exemption from the service tax on services provided by BIRAC approved biotechnology incubators to incubatees with effect from April 1, 2016.
- Mandatory requirement of export/import license for biological samples removed w.e.f. August 4, 2016. Organizations to give self-certification to customs authority that they are/will follow all applicable rules, regulations and procedures for safe transfer and disposal of the biological samples.
- Definition of start-ups amended by DIPP wherein an entity shall be considered as a Biotechnology Startup for up to 10 years from the date of its incorporation/registration. For others it is 7 years.
- 100% FDI allowed under automatic route for greenfield pharmaceuticals projects. For brownfield pharmaceuticals projects, 74% FDI is permitted under the automatic route.
- For manufacturing of medical devices, the sector was opened for 100% FDI under the automatic route on January 21, 2015.
- New Biosimilar Policy known as the Guidelines on Similar Biologics announced by the Central Drugs Standard Control Organization (CDSCO) and Department of Biotechnology in 2016 addresses the regulatory pathway regarding manufacturing process and safety, efficacy and quality aspects.

DST Programmes
Aligning with Make in India

Advanced Manufacturing Technology (AMT) Programme

In October 2015, DST initiated a programme to promote development of advance manufacturing technologies in the country – till date 45 project proposals have been supported. During the second call 256 proposals were received with focus on design tools and process innovations, modeling & simulation platforms, Digital Manufacturing, Flexible scale manufacturing, Additive manufacturing, Smart Manufacturing, Advanced Robotics (AR) & Industrial Internet of Things (IIOT), wearable low-power electronics including energy harvesting, Sensor Networks, etc.

Technical Research Centres

The Finance Minister, during his budget speech of 2014-15, announced setting-up of five Technical Research Centres (TRCs) in existing autonomous institutions of DST. Technical Research Centres (TRCs) were established in 2015-16 in five DST institutions namely, SCTIMST, Trivandrum; ARCI, Hyderabad; JNCASR, Bengaluru; IACS, Kolkata and SNBNCBS, Kolkata.

- **Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum:** 4 projects on neuro-prosthetic devices, 7 projects on cardiovascular devices, 3 projects on hard tissue devices, 6 projects on biological and combinational products and 8 projects on product/material evaluation/support were initiated during the year and they recorded good progress.
- **International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad:** Activities carried out under the project were in the areas of solar energy, energy storage, energy efficiency, energy conversion, electric/hybrid vehicle systems, etc. One Indian patent was granted in 2014 and 25 Indian patent applications are filed till date; one more is in the process of getting filed. One international patent has been granted during 2014-2018.
- **Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru:** Development of 7 technologies is in progress, 15 Indian and PCT applications were filed, one start-up 'Avinir' was incubated which would deal with DNA probes having potential for various applications, including diagnostics. Another start-up, which would deal with development of anti-bacterials for use in paints and surgical instruments is under incubation.
- **Indian Association for the Cultivation of Science (IACS), Kolkata and S.N. Bose National Centre for Basic Sciences, Kolkata:** Both the institutions took steps to establish the necessary laboratory facilities for accelerating applied research.

Partnering with MHRD for Uchchatar Avishkar Yojana (UAY)

SERB is partnering with MHRD for UAY projects and funds selected projects. It is expected to enhance industry-academia interaction and encourage industry relevant R&D by using

the best human resource and infrastructure in academic institutions. The share of SERB funding will be 25%, while MHRD will contribute 50% and industry the remaining 25%. The projects funded under this scheme will be named as "UAY SERB" projects. The first batch of 39 projects is being supported with SERB share of ₹ 30 crores.

Collaboration in Impacting Research Innovation and Technology (IMPRINT) Project

DST has joined hands with MHRD to implement IMPRINT projects, which will address major societal and developmental needs such as healthcare, information and communication technology, energy, sustainable habitat, nanotechnology, water resources and river systems, advanced materials, security and defence, and environment and climate. **Twelve projects in different domain areas particularly in nanotechnology and Advanced Materials have been funded by SERB**.

The second phase of IMPRINT-2 with a total budget of ₹ 970.5 crore was launched in March 2018. DST and MHRD will jointly steer this national initiative. SERB will be the nodal agency for implementing IMPRINT-2. IMPRINT-2 expands the catchment of implementing institutions by adopting a more demand-driven strategy of solution development and by incorporating specific externalities of the states of India so as to make end-user translation and technology adoption easier.

To simplify and streamline the process, attract wider participation of stakeholders including industry and sharpen the focus, a new and revised version of IMPRINT, IMPRINT Round II, has now been envisaged which will be steered jointly by MHRD and DST through SERB. Core mandate of IMPRINT II would be to:

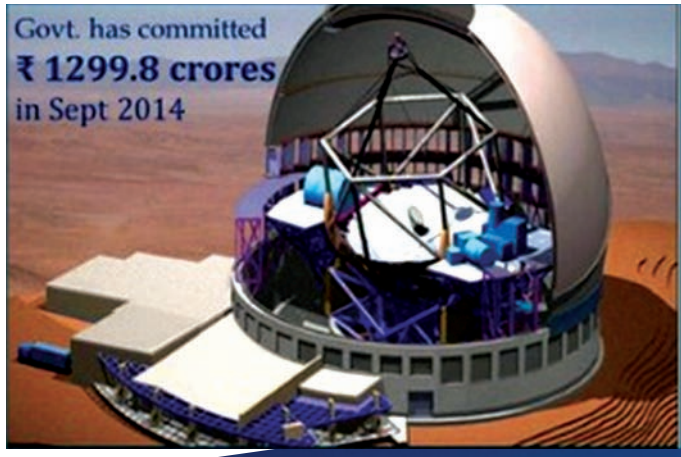
- Develop products/processes and viable technologies for addressing the identified challenges in different domains.
- Formulate and develop focused translational projects against identified technology thrust areas.

Industry-relevant R&D

Recognizing the need to facilitate increased Public Private Partnerships, the SERB has approved a scheme that provides an opportunity for collaborative research between academic institutions and industry. Upto 50% cost to be provided by DST for the project after ascertaining the usefulness and sound scientific foundations of the project. 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.

During the second call 256 proposals were received with focus on design tools and process innovations, modeling & simulation platforms, Digital Manufacturing, Flexible scale manufacturing, Additive manufacturing, Smart Manufacturing, Advanced Robotics (AR) & Industrial Internet of Things (IIOT), wearable low-power electronics including energy harvesting, Sensor Networks, etc.

- Evolve new technology transfer models for enabling technology diffusion to industry and stakeholders.
- Align the projects with the needs of various industry sectors and the States of India, in order to achieve end-user translation.
- Facilitate building capability and competence in identified technology thrust areas in the various HEIs and universities, in order to plug the demand-supply gap of human resources in specific areas of need.


Govt. has committed
₹ 1299.8 crores
in Sept 2014

Knowledge Generation and Discovery Research

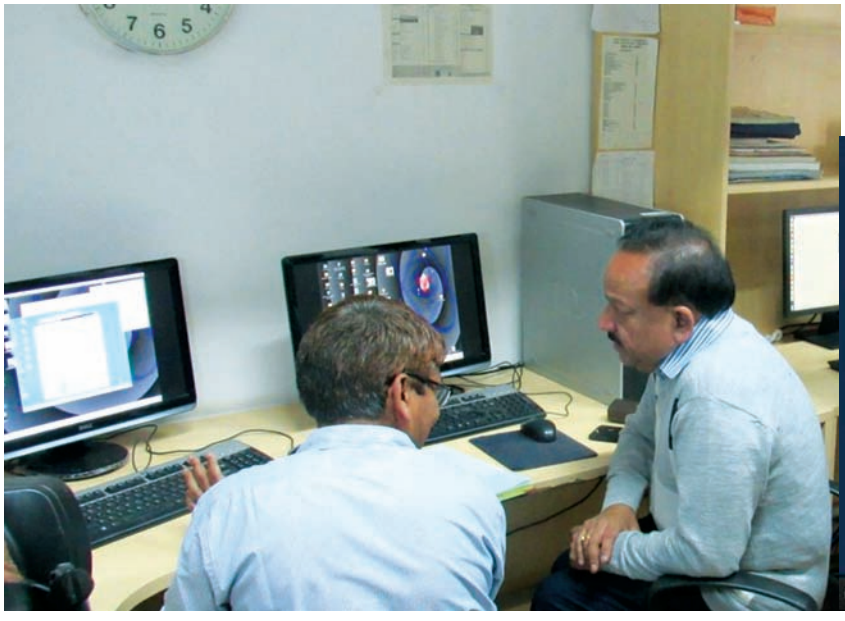
Knowledge Generation and Discovery Research

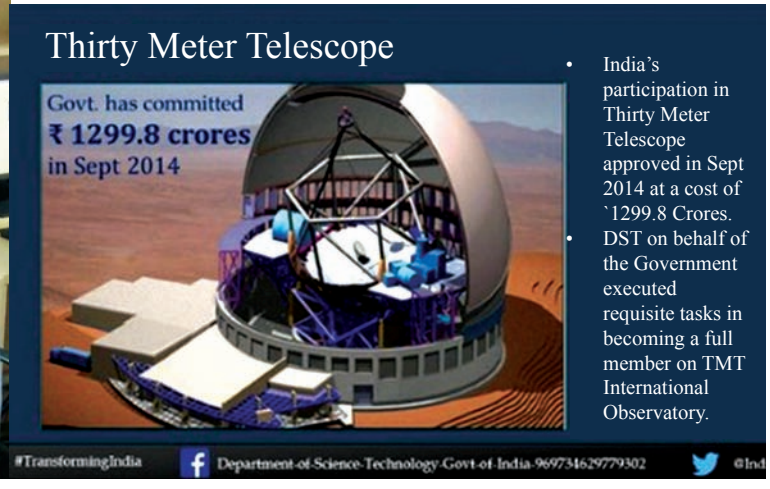
For Scientific Ideas and Innovation

THE Ministry of Science and Technology and the Ministry of Earth Sciences carry out significant research on basic science on different themes. This is aimed to improve and advance fundamental knowledge and remains as a source of new scientific ideas and innovation. Basic research is incredibly important because it lays the ground for major discoveries.

Thirty Meter Telescope

India's participation in the Thirty Meter Telescope (TMT) project was approved by the government at a total cost of ₹ 1299.8 crores in September 2014, under the joint responsibility of Department of Science & Technology and Department of Atomic Energy. The DST on behalf of the Government of India executed the TMT international observatory partnership documents becoming a full member in the project on December 2, 2014. The other countries participating in the project include the United States of America (USA), Canada, China and Japan. India will contribute in cash and kind towards the construction phase. The Indian science sector will benefit both scientifically and technologically from the participation in the project. On the technology front, design, prototyping, testing, validation and manufacturing of various in-kind items will bring in know-how for new and cutting-edge technologies. These will have long term spin-off advantages for the country.





Remote Technical Activation of Digital Optical Telescope located at Devasthal, India from Brussels on March 30, 2016 by the Prime Ministers of India and Belgium.

On the scientific front, after commissioning of TMT in 2022-23, India will get 25-30 assured observational nights on the TMT. This will enable Indian astronomers to study front-ranking scientific problems such as formation and evolution of stars, planets and galaxies.

India TMT Optics Fabrication Facility (ITOFF) at Centre for Research and Education in Science and Technology (CREST), Indian Institute of Astrophysics (IIA)

Devasthal Optical Telescope

A state-of-the-art world class 3.6-meter 'Devasthal' Optical Telescope was remotely activated jointly by the Hon'ble Prime Minister of India and the Prime Minister of Belgium on March 30, 2016. The telescope is installed at 'Devasthal' near Nainital. It is the largest steerable imaging telescope in Asia which is a result of scientific collaboration between the team of scientists from Aryabhatt Research Institute of Observational Sciences (ARIES), Nainital, an autonomous institution of DST, and Belgian scientists. The telescope will contribute to observations for frontline scientific research in astronomy and astrophysics.

The 'Devasthal' Optical Telescope was remotely activated jointly by the Hon'ble Prime Minister of India and Prime Minister of Belgium on March 30, 2016.

Experimental Stations at Trieste, Italy

As part of the India-Italy scientific and technological co-operation, two new experimental stations were set up at the Elettra Synchrotron Trieste Research Center, Trieste, Italy. Named Xpress and XRD2, the two beamlines were co-funded by the DST, Government of India, through Indian Institute of Science, Bengaluru, and Ministry of Foreign Affairs and International Collaboration (MAECI), Italy.

A delegation of DST, led by the Secretary, Ashutosh Sharma, and an MAECI delegation, led by the Plenipotentiary Minister, Fabrizio Nicoletti, Head of the Scientific and Technological Co-operation Unit, inaugurated the two beamlines in April 2017. The Xpress beamline uses X-ray diffraction technology to study the structure of materials

under extremely high pressure, including the synthesis of new compounds, such as ceramics or alloys, mineralogy, geophysics and the study of the properties of materials. The XRD2 beamline has been designed to determine the 3D structure of proteins and biological macromolecules and its applications covers the field of biology, medicine, pharmacology and biotechnology. The two new beamlines will be available to the Indian, Italian and international researchers, according to the scientific quality of the research projects and their impact, assessed by a peer-review system.

Inauguration of beam-lines 'XRD2' and 'XPRESS' at the Synchrotron Facility in Trieste, Italy

Basic Scientific Research Efforts at DBT are directed at conceiving and developing fundamental new ideas, approaches, and methods for addressing some of the most intriguing and challenging aspects of living organisms. DBT extends its support to investigator-initiated frontier research in life science, on the basis of scientific excellence.

New understanding of the developed TB bacterial

- Demonstrated new pathway for iron acquisition in M. tuberculosis
- Provided important understanding of the mechanism of bacterial survival during TB
- Demonstrated that human holo-transferrin interacts with GAPDH both *in vivo* and *in vitro* using protein chemistry, molecular biology and microscopy techniques.

Methods for making modified Morpholino-based antisense was developed and has been successfully applied in cancer cells. High-resolution X-ray crystal structures of two enzymes, *Salmonella typhimurium* 2-methylcitrate synthase (2-MCS) and acetate kinase (StAckA) has been determined. These enzymes have provided the basis for understanding the molecular basis for the specificity of the enzymes towards substrates and plausible mechanism of catalysis.

Under the SERB, a total of 2700 plus proposals would have been sanctioned till March 2018 under the Core Research Grant Scheme (EMR Scheme along with 3200 plus projects to Young Scientists/ Early Career Award Scheme. In addition, the SERB launched the National PDF Scheme in 2016 and has supported 2000 plus NPDF during the last two years.

The Ministry of Science & Technology through SERB has also supported 530 plus candidates in the Equity Scheme with almost 421 SC candidates and 108 ST candidates. This is to provide equal opportunities to candidates belonging to reserved categories. These are in addition to the candidates who have been supported under the Core Research Grant Scheme.

The tangible contributions from DST on Basic Research are given below:

- Research Papers published by DST Autonomous Institutions in refereed journals - 8755
- Scientific Books published by DST Autonomous Institutions - 128

Some details of the projects supported include the following:

Whole Genome Sequencing of Holy basil (Tulsi)

CSIR has carried out whole genome sequencing of *Ocimum sanctum*, the sacred plant of Hindu tradition which paves the way to use modern tools for scientific validation of the traditional claims in diverse medicinal usage and also opens the opportunity for *in vitro* production of the therapeutic molecules.

This is the first report of complete genome sequence of the Holy basil, using a composite next generation sequencing technology.

Ceramic Substrates for Electronics, Oxygen Sensor and Solid Oxide Fuel Cell (SOFC)

Applications

CSIR-NAL in partnership with Carborundum Universal (CUMI), has developed 100 and 250 μm thick Al_2O_3 and YSZ tapes. It has also developed tape casting grade powders and process for technologically important tape cast products like doped Al_2O_3, GDC, ScSZ, glass sealant, etc. Among these, ScSZ is considered as the futuristic electrolyte material for SOFC which has a large market potential.

Sunlight Sensitized Long Afterglow Phosphor Powder & Paint

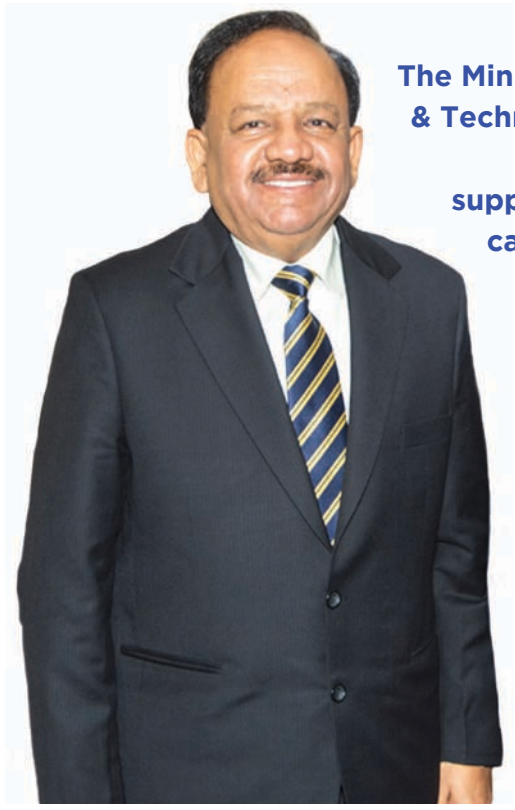
CSIR-NPL, New Delhi has developed an efficient after-glow phosphor with longer after-glow (< 6 hours) to replace existing markers like beta lights etc. Long afterglow phosphor has been of great interest globally for many strategic applications like emergency and safety marking in dark conditions. The technology has been transferred to a road marking and signage industry namely Kataline Infra Products, Nagpur.

Fatigue Life Evaluation of Welded Rail Joints

CSIR-SERC is assisting Indian Railways in assessing the quality of welded rail joints. Welded rails are being used extensively in railway tracks in India for increasing the speed of the rolling stock and better travel comfort.

Amalaki Rasayana for Management of Cognitive function in Alzheimer's disease

CSIR-CCMB has provided scientific evidence on the effect of dietary Amalaki Rasayana (AR), an Ayurvedic formulation used in Indian traditional system, in AbPP-PS1 mouse model of AD in ameliorating memory and neurometabolism which was also compared with donepezil, a standard FDA approved drug for AD. It has been shown that Indian gooseberry, Amla improves memory function in mice genetically engineered to mimic Alzheimer's disease, a neuro-degenerative disease that has no cure.



The Ministry of Science & Technology through SERB has also supported 530 plus candidates in the Equity Scheme with almost 421 SC candidates and 108 ST candidates. This is to provide equal opportunities to candidates belonging to reserved categories.

Monsoon Mission and Improved Monsoon Predictions

Accurate prediction of monsoon rainfall is crucial as it impacts many sectors including agriculture, water resources, power generation, transport and even the economy. The Monsoon Mission was launched in 2012 with an allocation of ₹ 400.00 crore to develop the capability of dynamical model prediction system for short range of seasonal forecasts and to improve the monsoon forecasts. Under the Monsoon Mission, MoES has implemented two state-of-the-art dynamical prediction systems for short range to medium, extended range and

seasonal forecasts. All these initiatives have helped to improve the monsoon forecasts over the country. For the first time, India Meteorological Department used the Monsoon Mission dynamical model to prepare operational seasonal forecast for 2017 monsoon across the country.

After the success of the Monsoon Mission Phase I, the second phase of the mission has been launched in 2017 with the objective to develop suitable applications and improve the prediction of weather and climate extremes.

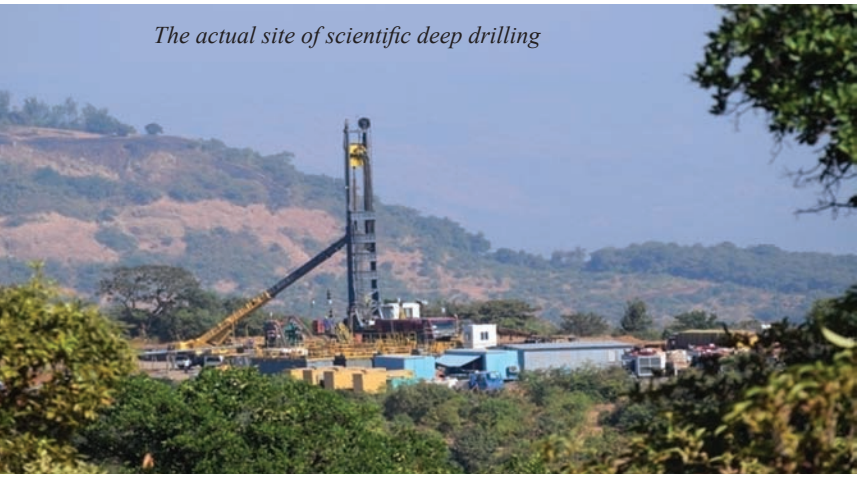
Observational Campaigns

Many observational campaigns have been undertaken in the past four years as special atmospheric observations help to understand model deficiencies and improve prediction models. To address the issues related to better measurement and understanding of small-scale processes that drive the variability, seasonality and predictability in the South Asian Monsoon, a large-scale joint India-UK observational campaign was carried out during the period June-July 2016. The campaign involved the deployment of UK's BAe-146-301 atmospheric research aircraft with sophisticated scientific instruments and India's *Sagar Nidhi* and *Sindhu Sadhna* research ships.

Scientific Deep Drilling

Scientific Deep Drilling in Koyna which started in 2016 is aimed at setting borehole observatory (s) at depth for directly measuring the in-situ physical properties of rocks, pore-fluid pressure, hydrological parameters, temperature and other parameters of an intra-plate, active fault zone near field of earthquakes—before, during and after their occurrence, leading to a better understanding of the mechanics of faulting, physics of reservoir triggered earthquakes and preparing a predictive model.

Hon'ble Minister of Science and Technology and Ministry of Earth Sciences, Dr. Harsh Vardhan, along with the UK & Indian scientists with the Research Aircraft



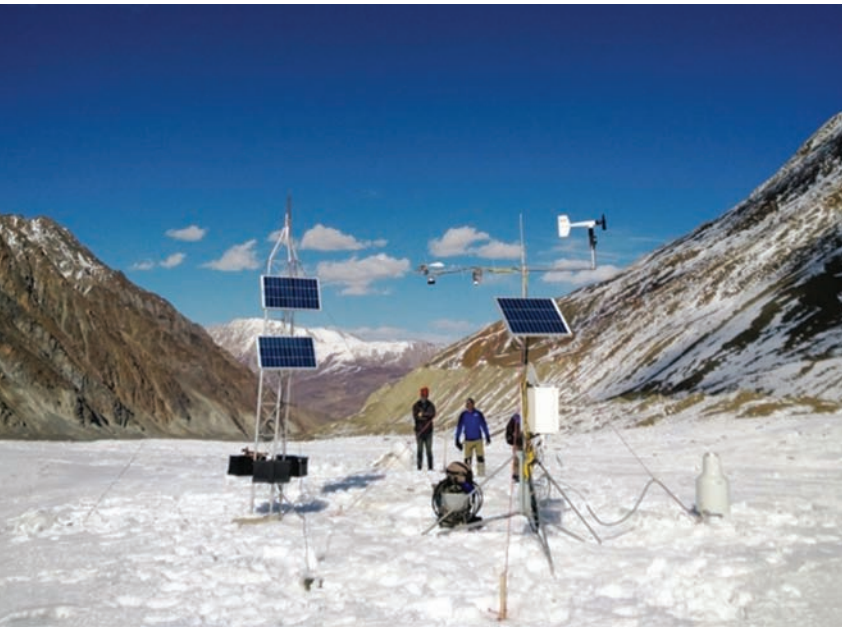
The actual site of scientific deep drilling

Borehole Geophysics Research Laboratory (BGRL), Karad has undertaken scientific deep drilling and associated investigations in the Koyna seismic zone, Maharashtra. In 2017, the pilot hole of 3 km depth was drilled with technical help from international experts. Seismological observations in the Pilot hole will now be planned for next upcoming year.

Antarctic Expedition

India is successfully co-operating two research stations, Bharati and Maitri in Antarctic to enhance the understanding of glaciology, polar atmosphere, paleo-climate and polar biology. Annual scientific expeditions to Antarctica are undertaken with scientists from different scientific institutions. The scientific expeditions included projects on upper atmosphere, astrophysics, geophysics, meteorology, glaciology, geology, biology, environmental sciences, human physiology and medicine. Yoga was recently introduced as part of a scientific programme.

Field Research Station 'HIMANSH' at Sutri Dhaka, Chandra basin, HP



Himalayan Research Station

National Centre for Antarctic and Ocean Research (NCAOR), Goa, under the Ministry of Earth Sciences established a high-altitude research station in the Himalayas called HIMANSH (literally meaning, a slice of ice), situated above 13,500 feet (> 4000 m) at a remote region in Spiti, Himachal Pradesh (HP) in 2016. This station provides the required support to researchers and is equipped with various scientific instruments. Water Level Recorders were installed at five locations along for a stretch of 130 km along the Chandra River in Western Himalayas for hydrological balance/modelling. Glaciers were monitored for mass balance, dynamics, energy balance and hydrology. Further, the researchers would use the data as a base for undertaking surveys using Terrestrial Laser Scanners (TLS) and Unmanned Aerial Vehicles (UAV) that would digitize the glacier motion and snow cover variations with exceptional precision.

Arctic Research

MoES also continued scientific activities in the Arctic at the research station in Himadri, Ny-Ålesund, Svalbard, Norway. One of the main activities included the of Indian Arctic mooring (IndARC-II). The Ambient Noise Measurement System with a single hydrophone and a data acquisition system were deployed on IndARC-II. The IndARC-II collected more than 116 parameters and worked continuously in the Arctic waters. Glaciological field studies in Arctic are conducted essentially in two glaciers (VestreBroggerbreen and Feiringbreen) in Svalbard as a part of the Indian Arctic Expeditions.

Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX)

CAIPEEX program has two main objectives:

- Advance the research on the aerosol-cloud and precipitation interactions
- Conduct cloud seeding experiments by using this background data for planning rain enhancement experiments for protocols of cloud seeding

The CAIPEEX project has resulted in 820 hours of airborne cloud, aerosol and rain microphysics observations over Indian region. From theairborne observations several key results have been published including new ice nucleation scheme for deposition ice nuclei, parameterization for ice water content, indirect effect of aerosol, dispersion effect, relationship between the surface and cloud base CCN under different sub-cloud aerosol conditions.

High-Altitude Cloud Physics Laboratory (HACPL)

The HACPL was set up at Mahabaleshwar with advanced measurement facilities for observing cloud, aerosol, precipitation and radiation parameters to understand aerosol-cloud-precipitation interactions. Using the observations, the indirect effect of atmospheric particulate pollution on cloud properties using HACPL observations and better understanding on role of aerosol physical and chemical properties on cloud activation is established. Long-term continuous measurements of cloud, precipitation and aerosol will provide test-bed for testing/improvement of physical processes relevant to orographic convection, cloud activation and effect of aerosol on precipitation in numerical weather prediction models.

Dynamics of Host-Pathogen Interactions in TB Infection

SysTB, a Network Program for Resolving the Intracellular Dynamics of Host-Pathogen Interactions in TB Infection was funded by the department. There is a lack of understanding on how Mycobacterium tuberculosis undergoes transition from actively dividing form to dormant form, and vice versa. The dormancy is believed to be induced by factors such as nutrient starvation, hypoxia, etc. The transcription factor Rv0081 of M. tuberculosis (Mtb) controls the hypoxic gene expression response and acts as a regulatory hub in the latentMtb infection. The crystal structure of Rv0081 at 3.3 Å resolution was determined revealing structural basis of hypoxic gene regulation by the Rv0081 transcription factor of Mycobacterium tuberculosis.

Science & Technology Infrastructure

Science & Technology Infrastructure for Diverse Segments

THE infrastructure created with the input of Science and Technology has acquired a significant importance in recent times. Research and development activities are being carried out in diverse segments. These include power, roads (both highways and rural roads), ports, airports, railways, telecommunication and information technology and manufacturing, among others and are areas of priority towards India's overall development. The civil engineering and infrastructure markets offer significant growth prospects, due to rapid development and urbanization. Considering the current context and future scenario, CSIR is aiming for a leadership position in the next generation infrastructure engineering. It is also pursuing development of knowledge base in accordance with the global standards in the fields of electronics and mechanical engineering, particularly in the areas of microwave tubes, sensors, medical instrumentation, aviation electronics, advanced manufacturing, mechatronics and farm machinery.

Aerospace Engineering

CSIR has been playing a pivotal role in creating an enabling ecosystem for aerospace engineering and manufacturing in the country by providing advanced-technology products and solutions with a strong foundation in science. With its growing involvement in the Indian space programme, its multidisciplinary activities and global positioning, CSIR provides necessary support to all major national aerospace programmes which include aircraft, missiles, launch vehicles, satellites, defence systems and services.

Mission on Intelligent Systems

The mission aims to develop technology for unmet needs, leveraging artificial intelligence based techniques in consonance with the advanced electronics. It would include development of technology for Intelligent Electronic Systems, Drone Applications and Brain Machine Interface, Intelligent Cyber Physical Systems, Artificial Intelligence (AI) Based Seismic Signal Analytics, AI in Healthcare, AI Techniques for Cyber Physical Security and AI Engine and Data Platform.

The research and development activities are being carried out in diverse segments. These include power, roads (both highways and rural roads), ports, airports, railways, telecommunication and information technology and manufacturing, among others and are areas of priority towards India's overall development.

Building products using Kota stone cutting and slurry waste

A technology has been developed for using Kota stone cutting and slurry waste, to make building products like paver blocks, tiles, Lightweight Cellular Foamed Concrete (CFC) blocks. It has been transferred to the Rajasthan Pollution Control Board.

Utilization of Ghazipur Site Waste to Widen NH-24 **Sustainable Environmental Solutions**

A study was carried out for possible use of Ghazipur landfill waste (12 million tonnes of waste spread across 70 acres) and methodology was suggested to use 65-75% of segregated waste for construction of embankment along NH-24 (Meerut Expressway).

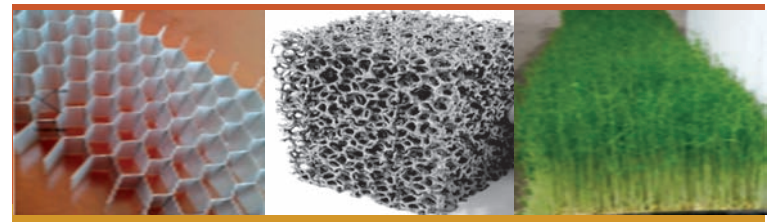
View of Ghazipur MSW landfill

Process of segregation in the plant

Technology Demonstration

Project on Laying of Geo-polymer Concrete Road Stretch at National Thermal Power Corporation (NTPC), Dadri Site

High strength fly ash based geopolymer concrete for construction of road (as per IRC specifications) at NTPC-NETRA is developed. A geopolymer concrete road stretch (50 m length and 3 m width) has been successfully laid at CSIR-CBRI using fly ash from NTPC Dadri, first of its kind in India. This road will not require water curing as required by cement concrete road and also paves the way for the utilization of bulk fly ash.



High Frequency based material | Medium Frequency based material | Low Frequency based material

Design of Noise Barrier based on different Frequencies

Frequency based noise barriers have been developed to drastically reduce noise level (about 42 decibel) and improve the quality of life in noise affected areas.

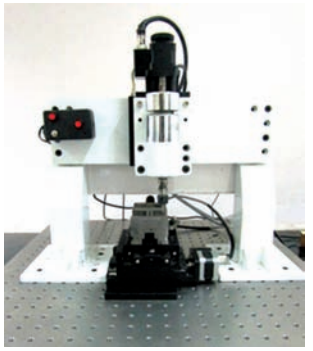
Intelligent Dry Fog Dust Suppression System

An intelligent dry fog suppression system has been developed for effective control of dust emission from crushing plants, screening plants, loading plants and mines. The technology is being implemented in NMDC's crushing and screening plants and mining areas.

Glass Textile Reinforced Concrete Crash Barrier System

To ensure the safety of road users, a pre-fabricated Glass Textile Reinforced Concrete Crash Barrier System has been developed. The crash barriers are lighter in weight, flexible and elastic with ability to absorb the energy of the vehicle upon impact. This would provide improved safety to the passengers in the vehicle and result in less damage to the impacting vehicles.

Indigenous 4-axis controller for multi-process micro machine



To avoid import of expensive micro-machines, indigenous micro-machine test bed has been developed at low cost. It is being used by small and medium scale micro-machining industries such as surgical tool industries, jewellery making industries etc. along with skill development. The machine has been supplied to New Horizons Institute of Technology (NHIT), Durgapur and Manbhum Pvt. Industrial Training Institute, Purulia.

Innovative Building Technology for **Mass Housing Using 'EPS' Panel**: Affordable Housing for Rehabilitation of Cyclone Victims

CSIR-Structural Engineering Research Centre (SERC) has conducted the analysis, designing and structural detailing of (G+1) reinforced concrete buildings using Expanded Polystyrene (EPS) Panels. The technology enables faster construction and is ideal for mass-production of affordable and disaster resistant (cyclone wind loads) houses. It has been transferred to Consortium Transmission Systems Pvt. Ltd. (CTSPL), Hyderabad for 'Hudhud' cyclone victims' rehabilitation housing programme at Srikakulam, Andhra Pradesh. About 496 dwelling units are being constructed using the technology. Development of a boring machine based on trenchless technology.

For the first time in the country, a low-cost machine for trenchless boring has been developed. The machine is affordable and requires minimal maintenance and can be used by small/middle class contractors. Techno Industrial Marketing, Uttarakhand is presently commercializing the product.

Technology for manufacturing of Austempered Ductile Iron (ADI) components for mining application

Technology for manufacturing of ADI components has been developed for mining application which would increase durability of digger tooth and reduce operational cost. The technology has been demonstrated on L&T CK -300 Excavator Machine for more than 500 hours of operation at Eastern Coal Field Limited.

MEMS Pressure Sensors

A pressure sensor for Micro Air Vehicle (MAV) application has been developed. It is fabricated for a pressure range of 0.0-1.1 bar.

Cost Effective Water Tanks using Flowable Cement Mortar

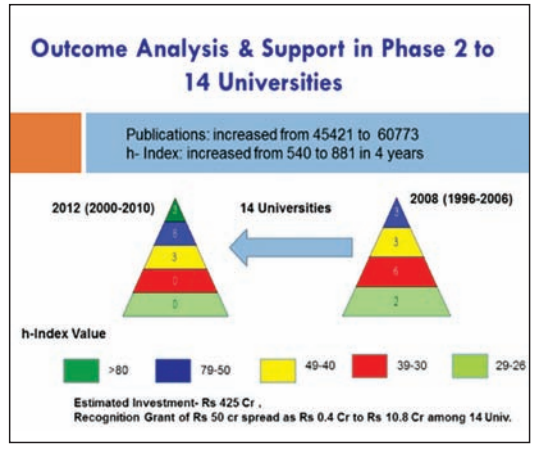
Low cost water tanks have been developed using flowable cement mortar. The water tank can be made in various sizes using the precast concrete panels and can be assembled in 30 minutes. No machinery is required for lifting the tank. Laxmi Srinivas Engineers, Hyderabad is presently commercializing the product.

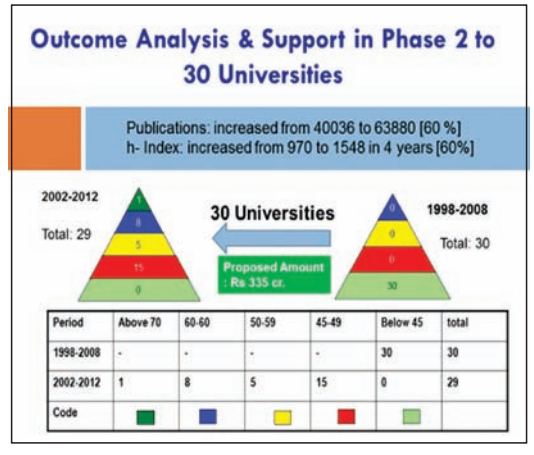
cGMP Pilot Plant for Herbal Preparations: Addressing Country's Need for Validating and Standardizing Ayurvedic Medicines

The first national state-of-the-art cGMP facility for production of herbal preparations has been established in CSIR-IIIM. The facility, based on World Health Organization (WHO) and US Food and Drug Administration (USFDA) guidelines, has production capacity of 30,000 tablets and capsules per hour and 500 litres of liquid per batch. The facility has been issued license by the State Regulatory Authority (Drug & Food Control Organization). Recently, CSIR-Indian Institute of Integrative Medicine (IIIM) also received permission to manufacture and market certain AYUSH drugs using this facility.

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

"Fund for Improvement of S&T infrastructures in Universities and Higher Educational Institutions (FIST)" program is a major infrastructure augmentation program launched by the Government in FY 2000-01. The 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. The quantum of support is limited to ₹ 1.50 Crore, ₹ 3.0 Crore and ₹ 10.0 Crore for Level 0, Level I and Level II respectively, depending upon the type of department or college and quality of research/teaching imparted. From the financial year 18-19, DST has introduced Level III, with a quantum of support limited to ₹ 20 Crores for 5 years duration.

During the last 4 years, a total of 692 proposals were identified and supported through the available mechanism of the FIST Program to consider financial support of varying quantum'sat a total budget of about ₹ 941.48 Crores for 5 years. Besides the new proposals, grants to the ongoing projects were also supported during these years. So far, nearly 2475 S&T departments spread over 650 Academic Institutions and PG colleges (Level 0-353, Level I-1892 and Level II-230) have been supported with a total investment of ₹ 2380 Crores.

Promotion of University Research and Scientific Excellence(PURSE)

"Promotion of University Research and Scientific Excellence (PURSE)" is a proactive measure of Department of Science & Technology to build the research capacity of performing Indian Universities. The main objective of the scheme is to pro-actively support for strengthening the R&D base of the performing Universities in the country with adequate financial support and associated flexibility. It is formulated on the basis 10 years aggregate publications and h-index towards creating and nurturing the research ecosystem among performing universities in the country.

Using transparent criteria forty-four (44) performing universities whose h-index ranging from 56 to 26 have been supported ranging from ₹ 30.0 Crores to ₹ 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, 2000-2010. Due to this outstanding performance of the first set of 14 Universities, another round of performance linked investment under the PURSE Scheme to these 14 Universities was decided and an amount of ₹ 425 cr including an additional incentive of ₹ 50 cr based on their growth rates both in overall publications and h-index.
Phase 2 support to a set of 14 Universities was released in the FY 14-15. PURSE Scheme has provided a triggering mechanism for promoting publication oriented research in the University sector deploying evidence based approaches. There has been significant increase in R&D outputs in PURSE supported Universities.

Sophisticated Analytical Instrument Facilities (SAIF)

The Department of Science & Technology has thus set up Sophisticated Analytical Instrument Facilities (SAIFs) in different parts of the country to provide services of the facilities of sophisticated analytical instruments to the researchers in general and specially from the institutions which do not have such instruments and enable them to pursue R&D activities requiring such facilities and keep pace with developments taking place globally. At present, there are 15 Sophisticated

Hon'ble Minster of S&T, Dr. Harsh Vardhan, visiting SAIF Facility at Central Drug Research Institute, Lucknow in 2015

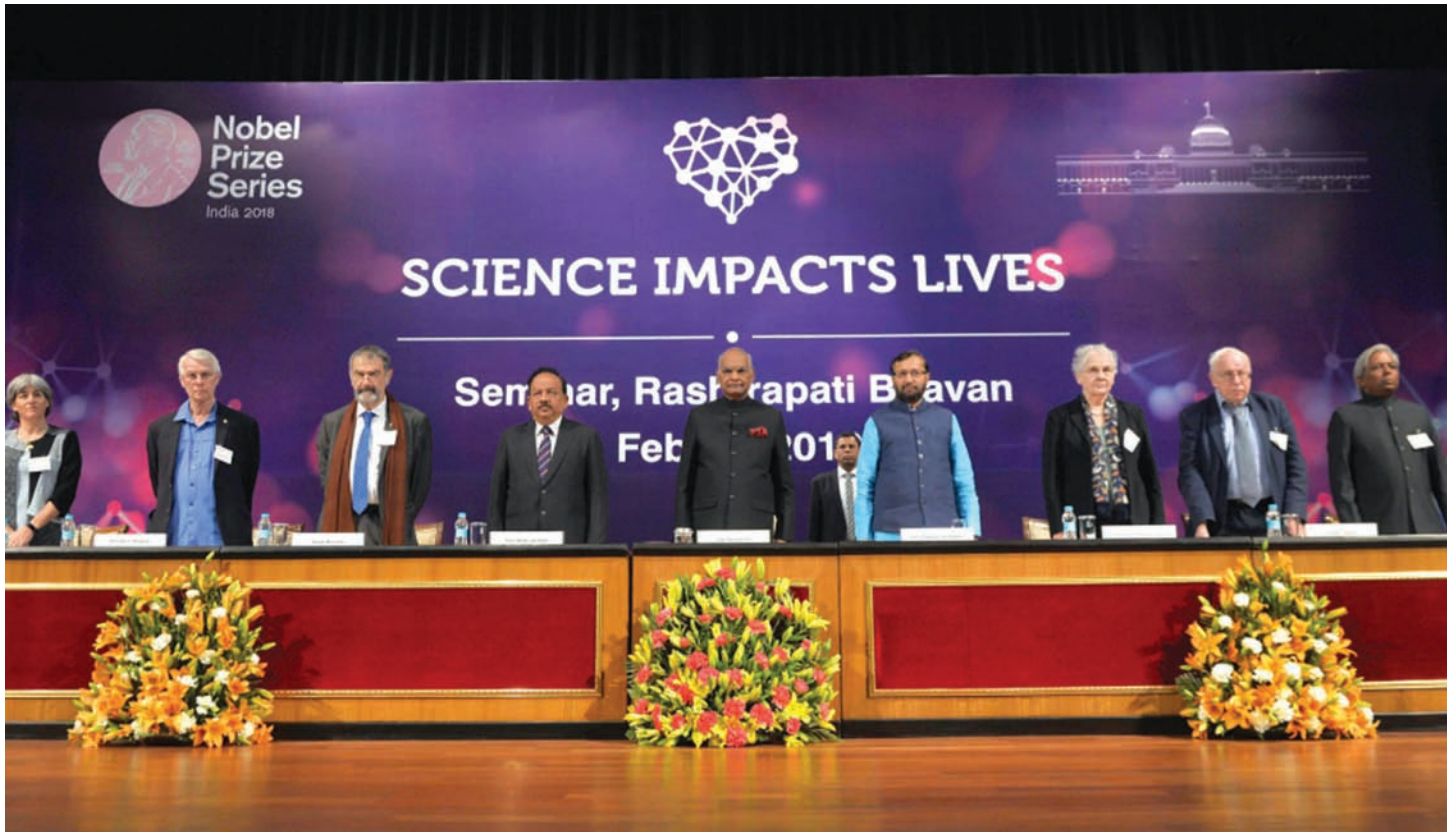
Analytical Instrument Facility (SAIF) Centres viz. at IIT, Chennai; IIT, Mumbai; CDRI, Lucknow; Panjab University, Chandigarh; NEHU, Shillong; IISc, Bangalore; AIIMS, New Delhi; Gauhati University, Guwahati; CVM, Vallabh Vidyanagar; Sophisticated Test & Instrumentation Centre (STIC), Kochi; IIT Patna; IIEST, Shibpur, Shivaji University, Kolhapur; MG University, Kottayam and Karnataka University, Dharwad, and these are being supported by the Department of Science and Technology. Five new centres have been setup in less endowed regions to facilitate the research community. A Web Portal interlinking all the Facilities for day to day transparency of the system under the SAIF program of DST has been recently developed.

Facilities by Department of Biotechnology

- DBT launched the DBT-BUILDER (Boost to University Interdisciplinary Departments of Life Sciences for Education and Research) scheme for upgradation/reengineering/ remodelling/creation of Life Science departments in central and state Universities. The scheme will boost advanced education and promotion of interdisciplinary research and technology development. Till now, 25 universities received support under this programme.
- A Beamline-14 Program Coordination Unit (DBT-BM14-PCU) at Regional Centre for Biotechnology, Faridabad has been supported by the Department for providing access to Indian scientific community to synchrotron X-ray Beam line (BM14) in Grenoble, France. An agreement has been signed between European Synchrotron Radiation Facility, Grenoble, France and Regional Centre for Biotechnology (RCB), Faridabad, India. The agreement facilitated access to six high intensity beam lines and SAXS Facility. During the year, 75 new proposals have been considered for data collection. The total number of crystals shipped is 2782 and the total number of data sets collected was 786 with deposition of 118 structures in PDB database. A total of 62 peer reviewed publications came out of this support.

- Tuberculosis Aerosol Challenge facility has been supported for maintenance at International Centre for Genetic Engineering & Biotechnology (ICGEB), New Delhi. ICGEB has also been supported for upgradation of an existing high-content screening platform as a national facility.
- A national facility for Gene Function in Health and Disease was established and operationalized at Indian Institute of Science Education and Research (IISER), Pune.

S&T Human Resource



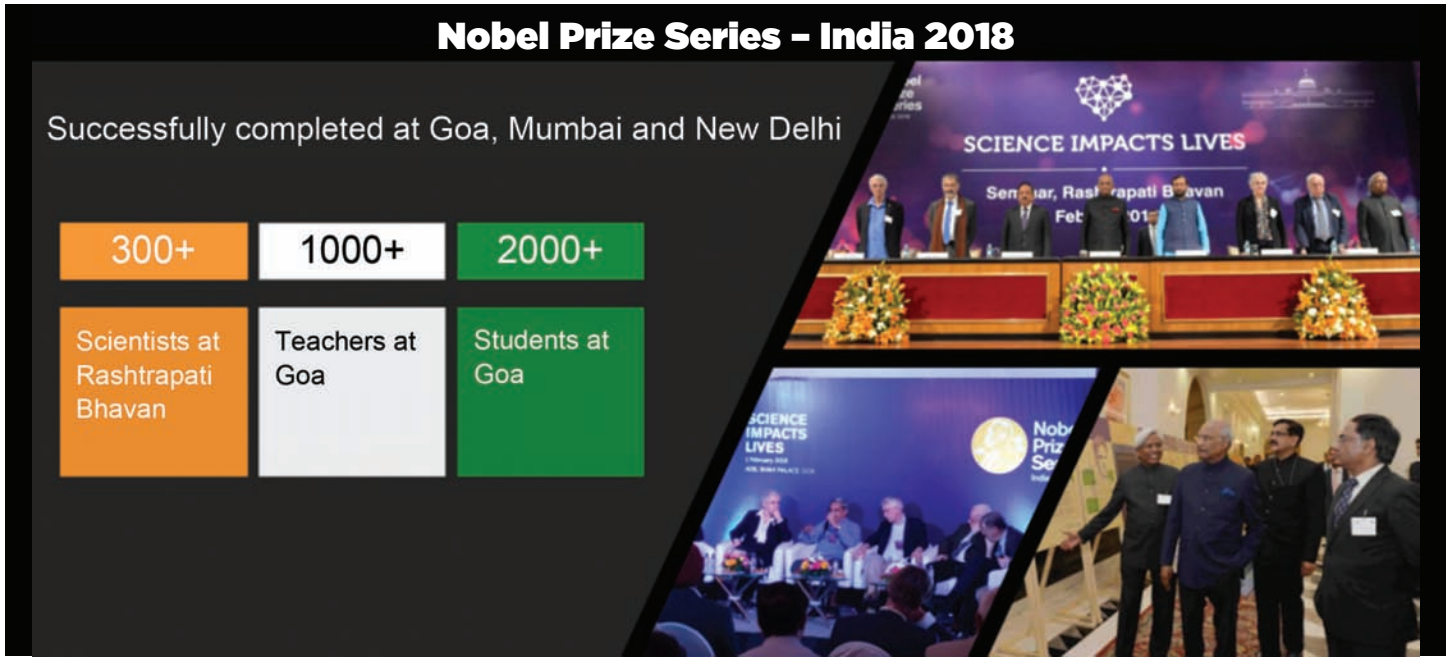
S&T Human Resource

towards a Knowledge Super Power

HUMAN resource in Science and Technology is a major driver for India's emergence as a knowledge super power. India needs to build a critical mass of well-trained scientific and technical personnel to meet the challenges of national development and international competitiveness.

Nobel Prize Series inspires students & researchers

Two editions of the Nobel Prize Series were organised by DBT in partnership with the Nobel Foundation in Ahmedabad and Goa in 2017 and 2018 respectively. Nobel Laureates from various fields of science engaged with students, researchers, teachers and industry through a vibrant dialogue on science and innovation.



The series also featured exhibitions that offered an engaging and interactive way for students to explore science. In the second edition, the department had brought together nearly 300 teachers and students from government schools across the country including Kendriya Vidyalaya (KV), Navodalya and Atal Tinkering labs. The enthusiastic participation from teachers and students representing almost all states in India revealed the eagerness for science-based learning and education in the country.

Jigyasa — Catching them Young

JIGYASA aims to inculcate the culture of inquisitiveness and scientific temper amongst the school students and their teachers. The programme aims to connect 38 laboratories with 1151 Kendriya Vidyalayas. The programme envisages to open the national scientific facilities to school children, and enable CSIR scientific knowledgebase and facilities to be utilized by school children. Nearly 24,500 students and 2000 teachers from Kendriya Vidyalayas visited CSIR Laboratories since the launch of the programme in July 2017.

The models of engagement include:

- Laboratory visit
- Select hands – on research experimentation for students and teachers
- Lectures by eminent scientists
- Visit to the state-of-art facilities
- Simple and easy scientific concepts explained with models
- Field visits
- Oral and poster presentations
- Quiz competitions
- Students as scientists programme

Signing of MoU between CSIR & KVS

Programmes implemented

- 16 CSIR laboratories participated in the Summer Camp programme implemented during June–August 2017.
- A two-day science research camp 'Jigyasa-2017' was organised during July 7-8, 2017 by CSIR-CEERI. The theme of the camp was to explore the world of electronics and allied engineering sciences to trigger and motivate young minds towards science through interaction with the scientists thereby providing an opportunity to present their ideas.
- CSIR-NPL organised Jigyasa programme on August 29, 2017. Nearly 200 students from Delhi participated in the one-day programme.
- CSIR-IITR organised "Be a Scientist" programme on Technology Day.
- CSIR-NEERI participated in the social science exhibition-cum-national integration camp organised by Kendriya Vidyalaya, Ajni. Students from seven Kendriya Vidyalayas of Vidarbha region participated.
- CSIR's Jigyasa programme will be implemented by Navodaya Vidyalaya Samiti (NVS). Based on the success of the programme, Ministry of Human Resource Development directed NVS officials to communicate with CSIR to implement Jigyasa in similar lines of KVS.
- CSIR Foundation day (September 26, 2017) was celebrated by CSIR and its laboratories by inviting students to respective laboratories. Nearly 5,000 students attended the programme from Kendriya Vidyalayas across India.

Jigyasa: CSIR Scientist's Student connect Program held at CSIR-NCL, Pune, from 30 June to 2 July 2017

CSIR's Integrated Skill Development Initiative

Following the National Skill Development Mission launched by the Hon'ble Prime Minister on July 15, 2015 on the occasion of World Youth Skills Day, CSIR launched an Integrated Skill Development Initiative on September 23, 2016 for utilization of its state-of-the-art infrastructure and human resources through specific industry oriented skill enhancement programmes.

CSIR launched 30 Skill/Training Programmes in the areas of: Leather processing; Paints and Coatings; Electroplating andMetal Finishing; Industrial Maintenance Engineering; Bioinformatics; Mechatronics; Glass Beaded Jewellery, etc. The achievements so far include:

- Skill/Training provided to more than 15000 candidates during 2016-17 and 2017-18
- Andhra Pradesh Skill Development Council, National Scheduled Castes Finance and Development Corporation (NSFDC), Punjab Skill Development Mission, Department of Industrial Policy and Promotion, NABARD have collaborated with CSIR labs for catalysing CSIR Integrated Skill Initiative.

DBT Human Resource Development: **Nurturing Excellence**

For a developing nation with limited financial resources, human capital is the most crucial asset. DBT has helped nourish some of the most brilliant minds who have been globally appreciated. The department is implementing an Integrated Human Resource Development Programme in multidisciplinary areas of Biotechnology, comprising of Post Graduate Teaching Programme, Star College Programme, Fellowships for different levels,

finishing school and industrial training for biotechnology students.

The Department has significantly augmented capacity for carrying out cutting-edge science and technology research in the country through fellowships and training programmes. It has attracted the best of talents in science and attracted as well as retained them in India to augment the scientific output of the country.

Skill development programme were initiated to provide high quality hands-on training (Postgraduate Diploma/ Certificate) in tools and techniques in Medical Biotechnology, Agricultural Biotechnology and Computational Biology for jobs in industries, hospitals, medical colleges, Research and Development laboratories, diagnostic laboratories.

DBT's Star College Scheme Transforms Undergraduate Science Education

It is vital to attract undergraduate students to pursue higher studies in science by providing them practical exposure. in this regard, DBT is focusing on boosting its star colleges scheme which aims to improve curriculum with an emphasis on practical training to students by providing access to specialised infrastructure, and scale up the skills of teachers by organising faculty training. Some of the highlights of the programme include:

- Support to 150 colleges
- Star status accorded to 26 colleges
- Training provided to >2600 personnel under UG, PG training courses
- Training provided to >3200 candidates in biotechnology industries under BITP

DBT Support at Different Education Levels Encouraging Biotech Education & Research

Partnerships Exposing Indians to International Biotech Facilities

- DBT-European Molecular Biology Organisation (EMBO) collaboration allows Indian scientists to submit proposals to the EMBO to hold prestigious meetings and workshops in India and compete for EMBO short-and long-term fellowships, thereby providing training and learning opportunities to students on an unprecedented scale in globally competitive high-end research.
- DBT's partnership with Heidelberg University, Germany on 'Big Data Research' is exposing Masters and Doctoral students from six Indian partner institutes, IIT Madras, IIT Kanpur, IIT Guwahati, Jawaharlal Nehru University, Allahabad University and Delhi University to short term training at Heidelberg University, Germany.

a) Fellowships for Students, Scientists & Researchers

DBT – JRF

The department provides fellowships to biotechnology students to pursue doctoral research in universities/research institutions across the country. The students are selected through Biotechnology Eligibility Test (BET). Presently, around 90 students have completed the PhD program.

b) DBT-Research Associateship (DBT–RA)

The department provides fellowships for post-doctoral research in frontier areas of biotechnology and life sciences at premier institutions in India. The DBT-RA programme is being implemented by the Indian Institute of Science (IISc), Bangalore. The fellowship is initially awarded for a period of two years and the support can be extended for a period of one to two years based on review of progress. 289 students were selected for the DBT-RA for Post-Doctoral Research.

c) TATA Innovation Fellowships

DBT awards Tata Innovation Fellowship to promote innovation in science, especially in Biotechnology for path-breaking solutions to major challenges in the field. The scheme recognises and rewards scientists with excellent record in biological sciences/biotechnology and commitment to find innovative solutions in healthcare, agriculture, environment, conservation of natural resources, livestock production and manufacturing process etc.

d) National Bioscience Awards for Career Development

National Bioscience Award for Career Development (NBACD) recognises outstanding contributions of 10 young bio-scientists below the age of 45 years through a grant for research projects to facilitate their career development. It provides a monetary reward of ₹1 lakh, a citation and ₹ 3 lakhs per year as a research grant for three years.

e) National Women Bio-scientist Awards

DBT recognizes the contributions of senior and young women scientists in the country who are working in biology and biotechnology and have made exemplary contributions in research, technology and product development through two separate awards.

f) Biotech Product and Process Development and Commercialisation Awards

Every year, a maximum of five awards are presented for biotechnology products and process development and commercialisation with a monetary reward of ₹ 2 lakhs along with a citation and ₹ 5 lakhs in case of commercialised and utilized product.

g) The Innovative Young Biotechnologist Award (IYBA)

The Innovative Young Biotechnologist Award (IYBA), is a career-oriented prize to identify and nurture young scientists below 35 years with innovative ideas and desire to pursue research in biotechnology.

h) Biotechnology Entrepreneurship Student Teams (BEST)

BEST-India is a programme aimed at encouraging young postgraduates and doctoral students in developing biotechnology entrepreneurship by exposing them to issues involved in commercialisation of bio-science. It has resulted in six start-ups by the winning teams.

i) Distinguished Biotechnology Research Professorship Award Scheme

DBT, Ministry of Science and Technology initiated the scheme "Distinguished Biotechnology Research Professorship Scheme" in 2008-09 to recognise eminent scientists who have made outstanding contribution in biological sciences and have superannuated.

j) Khorana Program for Scholars

This program of scholarship is an Indo-US collaborative effort to create an effective scientific communication between the biotechnology students of India and the United States

of America (USA). The scholarship allows Indian students to undertake research internship in selected universities in USA.

k) Indo-Australian Career Boosting Gold Fellowships

The scheme is a joint initiative of DBT and the Department of Innovation, Industry, Science and Research, Government of Australia. The scheme supports collaborative research activities in cutting edge areas of science and technology. It supports training of ten Indian scientists at various institutes in Australia. Four fellows have availed the fellowship.

l) Post Graduate Teaching Programme

Postgraduate teaching programmes were initiated in multidisciplinary areas of biotechnology during 1985-86 in six universities to ensure quality teaching and to fulfil the requirement of trained personnelin the country. Since then, Post Graduate teaching programmes have been expanded to over 65 universities. Students passing out of DBT-supported teaching programmes have consistently performed well at national level competitive exams conducted by CSIR, UGC, DBT, and ICMR for doctoral fellowships.

m) DBT-British Council Ph.D. Placement Programme

The programme allows Indian students to access the best resources from UK and promotes Indo-UK research collaboration 65 PhD students from India and 17 PhD students from UK have been awarded under this prestigious programme.

n) Women Agriculture Scientists Leadership Programme

- 23 female leaders in Crop and Agricultural Sciences from different parts of India attended the five-day workshop at University of Cambridge.
- The Female Leader in Science Course was organised by University of Cambridge and DBT under Newton-Bhabha fund.
- On-site visits to Farm Innovation Park at National Institute of Agriculture Botany (NIAB) and Botanical Garden and John Innes Centre, Norwich.

Biotechnology Career Advancement and Re-Orientation Programme (Bio-CARe)

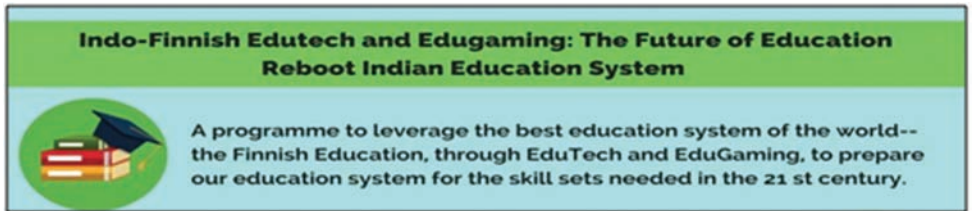
In an attempt to enhance the participation of women scientists in Biotechnology Research, DBT launched a Biotechnology Career Advancement and Re-orientation Programme (Bio-CARe) for women scientists. The programme is mainly for career development of employed/unemployed women scientists upto the age of 55 years for whom it is the first extramural research grant. The scheme is open for all areas of Life Science/Biology (including Agriculture, Veterinary Science and Medicine). The department has so far supported more than 250 young women scientists under this scheme.

Indian Biological Engineering Competition (iBEC) PRE-iGEM

The Indian Biological Engineering Competition (iBEC) was launched in 2016 to select and support best Indian student - teams to participate in the international contest iGEM (International Genetic Engineered Machine), held every year in Boston, USA. 12 teams have been selected to participate in iGEM thus far of which 10 have secured gold/silver/bronze medals.

Foldscope Access — Democratization of Science

DBT and Prakash Lab at Stanford University, USA signed an agreement in September 2015 to bring the Foldscope developed by Dr. Manu Prakash from Stanford University to India to encourage curiosity in science. Following an understanding



between DBT and Prakash Lab, Foldscopes have been distributed to several schools and college students and a series of workshops were held across India to popularise the origami paper microscope.

The team reached out to school students, teachers, scientists and citizen-scientists across India to encourage use of origami paper Foldscope to popularise curiosity based science. Low cost origami microscope was developed making the instrument accessible to colleges in remote places in India.

- 328 government colleges, 117 government schools including those in low resource areas and in the North - East were benefitted
- 445 teachers across India received training on Foldscopes in a workshop organized in Delhi
- More than 10-fold scope work shops were held across the country
- The long-term strategic objective of this project is to integrate the Finnish educational excellence and the expansive education system with Indian system of education to "Reboot education for Indian schools"
- The programme will be carried on a pilot scale and will be based on a co-creation model to reboot higher education in life sciences and conduct a pilot study for EduGaming and EduTech for life sciences. The pilot study on life science EduGaming can be a model for future education in India.

Smart India Hackathon

Department of Biotechnology organised Smart India Hackathon 2017 Grand Finale on April 1 & 2, 2017 simultaneously at 26 different nodal centers across India. The department was a 'Premier Partner' in this initiative. Smart India Hackathon 2017 harnessed creativity & expertise of students, built funnel for 'Startup India, Standup India' campaign, crowd sourced solutions for improving governance and quality of life, and provided opportunity to citizens to provide innovative solutions to India's daunting problems.

- DBT, along with 28 other departments, participated in the 'Smart India Hackathon 2017'. About 17 problems were proposed for students to provide digital solutions
- Student teams provided web-based and mobile-based apps for manpower management, detecting impersonation in exams linked to Aadhar cards, keyword-based search to avoid duplication of projects in different funding agencies, segregation of lectures by Nobel Laureates, Padma awardees, TED talks, Biotechnology history, Marine resources and utilization, etc.

- The software prototype developed by student-teams in the hackathon were evaluated by judges from the respective ministry, industry and academic experts. The best solutions were awarded ₹ 1 lakh, ₹ 75,000 and ₹ 50,000 for the top three teams respectively. DBT selected two prototypes created by student teams in digital competition for further support.

Smart India Hackathon 2018

CSIR participated in Smart India Hackathon-2018-Software Edition and successfully organised 36-hour Grand Finale at CSIR-NCL, Pune. CSIR was a 'Premier Partner' in this initiative. The Smart India Hackathon is a non-stop digital product development competition conceptualised and organised by Government of India, where the identified problems (software and hardware challenges) are posed to engineering/ technology students for developing innovative solutions.

In the grand finale organised by CSIR on March 30 and 31, 2018, 53 teams consisting of sixteam members and one-two mentors in each team participated to provide solutions to10 problem statements posed by the CSIR scientists. Finally, 318 students and 75 mentors from various engineering colleges across the country gathered to showcase their talent, while working on the problem statements.

The solutions by all the teams were rigorously reviewed by the panel of judges. After rigorous interactions with all the shortlisted teams, finally three teams received awards of Rs. one lakh), ₹ 75,000 and 2nd Runner — ₹ 50,000 respectively. Additionally, three more teams were selected for the "Persistent Inspiration Award", "KPIT Award" and "Deloitte Innovation Award".

Biotech Industrial Training Programme (BITP)

On behalf of DBT, Ministry of Science and Technology, Government of India, Biotech Consortium India Limited (BCIL) is implementing this scheme since 1993-94. The objective of this programme is to provide industry-specific training to biotechnology students for skill development and enhance their job opportunities in the biotechnology industry. This programme provides an opportunity to the biotechnology Industry for training and selecting suitable personnel. The programme is announced annually and more than 5000 students have been trained under the scheme.

CSIR was a 'Premier Partner' in the Smart India Hackathon initiative. It is a non-stop digital product development competition conceptualized and organised by Government of India, where the identified problems (software and hardware challenges) are posed to engineering/technology students for developing innovative solutions.

DST Initiatives on Human Resource development

- 2686 Research Manpower Trained (other than PhDs) by DST Autonomous Institutions
- 76 PhD awarded in DST Autonomous Institutions
- 9863 Technical Manpower Trained by DST Autonomous Institutions -
- 1,50,000 students of intermediate level were provided internship in 708 Inspire Science Camps.
- 49,293 INSPIRE scholarships offered for pursuing education in various Under-graduate /Post-graduate science courses
- 4000 INSPIRE Fellowships offered for doctoral degree
- 715 young researchers provided with INSPIRE faculty positions

International Training Centre for Operational Oceanography (ITCOocean)

ITCOocean is aimed at promoting the development and optimization of scientific base, technology and information system for operational oceanography at national, regional and global scales.The facility helps in promoting excellence in integrated multidisciplinary oceanography on a global scale. It is also expected that the legacy of the training programme will endure in to the future as it will help build a future ocean system which directly serves the needs of mankind through improved marine monitoring and enhanced stewardship of the seas.

ITCOocean established under the Indian National Centre for Ocean Information Services (INCOIS), MoES has been conducting courses since 2013. 27 courses were conducted involving students, researchers, administrators, policy makers and persons involved in operational centres thus far. In total 793 students including 116 students from 36 different countries were trained as part of the ITCOO activities. These countries include Australia, Belgium, Kenya, Nigeria, Togo, South Africa, Italy, Comoros, Madagascar, Mauritius, Bangladesh, Sri Lanka, Oman, Ghana, Tanzania, Malaysia, Romania, South Korea, Indonesia, Iran, Maldives, Morocco, Mozambique, Egypt, Saudi Arabia, Cambodia, Myanmar, Vietnam, Cameroon, Norway, France, Russia, China, Seychelles and Thailand.

The courses span from a couple of days to two weeks depending on the target audience. The courses include Ocean Data Management, Satellite Oceanography, Ocean Modeling, Fishing Zones, Ocean State Forecasting, Tsunami and Storm Surge, Remote Sensing and GIS, Ocean Colour Remote Sensing, Ocean Observation Network, Disaster Management, and Statistics for Earth Sciences.

This centre was recently conferred category two center (C2C) by UNESCO and this was approved by Government of India. The centre is now preparingfor short-term courses (spanning for four months) starting this year which leads to a certification course to students in operational oceanography.

Human Resource Development & Capacity Building at MoES

Considering the need to continuously upgrade knowledge through assimilation of new ideas and application of new knowledge in the field of Earth Sciences and to address the issue of depleting scientific manpower in the field of Earth Sciences, the Ministry has taken several steps for human resource development which include funding of M.Tech, M.Sc and PhD programmes at premiere institutions in the country, establishment of MoES Chairs at IIT's and IISER, opening of Centers of Excellence at various universities with state of the art research facilities. The human resource development programmes supported by MoES include:

- Two-year M.Sc. course in Ocean & Atmospheric Sciences in University of Hyderabad.

CSIR scheme for Promoting Knowledge Sharing through Travel and Symposia Grants Scheme

Sharing of the scientific results and interacting with leading scientists in the subject at national and international conference is an important activity in the professional growth and development of a scientist/researcher. Organising symposia and attending them allows the promotion of scientific culture and growth in the country which is considered essential. Travel and Symposia Grants awarded/sanctioned during last 4 years (2014-15 to 2017-18) include:

- Travel Grants recommended to attend international conferences abroad: **1759**
- Symposium Grants recommended to organize national/international conferences: **1104**

- M.Tech/PhD program on Atmospheric-Oceanic Sciences and Technology atCAS, IIT Delhi
- M.Tech programme in Ocean Technology at IIT Madras
- MoU on co-operation in Polar Research between NCAOR and NPI which paved the way for Norway to support Indian scientists, in the form of fellowship for carrying out research in the Arctic region. The award of the proposed fellowship to an Indian student in NPI, Norway is aimed at capacity building in the field of Cryosphere

CSIR Doctoral and Postdoctoral Fellowship Scheme

CSIR doctoral Fellowships (JRF-NET/SRF-NET, JRF-GATE/SRF-GATE, SPMFS, SRF-Direct) are very popular amongst young and upcoming scientists as they provide a platform to carry out research and development at university/ national lab of their choice. The postdoctoral fellowship schemes of RA, SRA and N-PDF groom the fresh doctorates to become mature scientists/independent researchers in the national laboratories and academic institutes. CSIR through its HR initiative has been contributing significantly to the generation of highly qualified science and technology manpower at the national level. Both these doctoral and postdoctoral programmes have generated high quality manpower for the scientific, technological and academic institutions for nation building. The fellowships/ schemes awarded/sanctioned during last 4 years (2014-15 to 2017-18) include:

- CSIR Junior Research Fellowship (JRF) National Eligibility Test (NET): 10687
- Senior Research Fellowship (SRF)-Direct: 1792
- Shyama Prasad Mukherjee Fellowship (SPMF): 158
- CSIR JRF-GATE (for Engineering & Pharmaceutical Sciences): 116

Promotion and Recognition of Excellence through CSIR Awards

The awards of CSIR have national recognition. The scientists are selected from different age groups thereby benefiting their career at each stage from the beginning to mid-career to life time achievements. These awards have served the purpose of motivating the scientist and encouraging them to contribute more. Several awardees have provided scientific leadership to the country. Awards during last 4 years (2014-15 to 2017-18) include:

- CSIR-Young Scientist Awards: **24**
- Shanti Swarup Bhatnagar Prize for Science and Technology: **42**

- CSIR Research Associateships (RA) to pursue postdoctoral research: 525
- CSIR Senior Research Associateships (SRA): 324
- CSIR Nehru Science Postdoctoral Research Fellowship Scheme: 41

CSIR Extramural Research Scheme and Emeritus Scientist Scheme

Under the Extramural Research Scheme, research proposals from the universities and research and development institutions are funded in frontier areas of science and technology which are also in line with the research programme of CSIR laboratories. The extramural research schemes are fruitful in building the research and development capabilities which in turn have benefited the country in its scientificendeavours.

CSIR Emeritus Scientist scheme provides financial assistance to superannuated outstanding scientists from laboratories/academic institutions to pursue research in their respective fields of specialisations especially in those which are of relevance to the programmes and activities of CSIR. The experience of these scientists has proven a great help to the laboratories/academic institutions in carrying out some of the ongoing projects and mentoring the younger ones. Extramural Research Grants awarded/sanctioned during last 4 years (2014-15 to 2017-18) include:

- Research Schemes: 798
- Emeritus Schemes: 99

DBT & EMBO Fellowships

The Department of Biotechnology and EMBO and its intergovernmental funding body EMBC, have signed a Co-operation Agreement to strengthen scientific interaction and collaborative research between India and Europe. As an EMBC Associate Member state, researchers working in India are now eligible to participate in all EMBO programmes and activities. In the year 2016, scientists have been selected under the EMBO Young Investigators scheme, 1 has been awarded EMBO Long-Term Fellowships, and 24 have been awarded the EMBO Short-Term Fellowships and 1 EMBO Young Investigator Lecture was organised. Recently, EMBO has established a new co-operation with the Wellcome Trust/DBT India Alliance under which 3 new interdisciplinary meetings in India per year will be organised.

Human Frontier Science Programme Organisation (HFSPO)

India is one of the member states of HFSPO. The overall objectives of the programme are to support innovative, cutting edge high risk research at the frontiers of life sciences and promoting international collaboration in the spirit of science without borders. HFSPO supports investigators under four categories – Programme Grant, Long Term Fellowship, Cross Disciplinary Fellowship, and Career Development Awards.

Department of Science & Technology

Department of Science and Technology is the largest extra-mural R&D support agency in the country. Annually more than 10,000 scientists are supported for carrying out various R&D related activities and projects. Some of major new initiatives launched during the last four years are as following:

- Early Career Research Award – The scheme launched in 2015 -16 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 scheme aims to minimise the time required for the young scientist to initiate their research. 1315 young researchers already awarded.

- National Postdoctoral Fellowship (N-PDF) Scheme – In order to attract and retain young scientists and discourage brain drain immediately after Ph.D. in academic/R&D institutions, a National Postdoctoral Fellowship (N-PDF) scheme was launched in 2015 -16. 600 -700 young scientists are supported every year.
- Overseas Visiting Doctoral Fellowship – The fellowship scheme was formulated in 2015 -16 to facilitate overseas collaborative research training for Indian Ph.D. Scholars registered in Indian institutions. 350 Fellowships will be awarded for the period 2016 -19.
- SERB Distinguished Investigator Award (SERB-DIA) – This is a one-time career award to reward good performance as well as to motivate ongoing PIs to perform exceedingly well. 35 awards to be given every year.
- Visiting Advanced Joint Research (VAJRA) Faculty Scheme – The scheme will bring the best global science and scientists to India. It is also expected to enhance global ranking of our institutions. The area of research to be undertaken by the Adjunct/Visiting Faculty should be of cutting-edge and interest to India. 43 VAJRA faculty already selected.
- Teacher Associates for Research Excellence (TARE) Mobility Scheme – This scheme, launched in 2017, aims to facilitate mobility of faculty members working in a regular capacity in state universities/colleges and in private academic institutions to carry out research work in established public funded institutions such as IITs, IISc, IISERs, NITs, CSIR, ICAR, ICMR labs and other central institutions and central universities, located preferably closer to the institution where the faculty member is working. Provision of Fellowship amount of ₹ 5,000 p.m., contingency grant of ₹ 5 lakh per annum and overhead for a period of 3 years has been made. Maximum of 500 such awards would be granted per year.
- KIRAN (Knowledge Involvement in Research Advancement through Nurturing) launched in 2014. KIRAN includes women-exclusive schemes for encouraging women to foster their career by undertaking research not only in science & engineering but also for societal benefit besides making a career through entrepreneurship and training in intellectual property management. Under the Women Scientist Scheme under KIRAN, around 1550 women scientists have been supported in the last four years.
- Augmenting Writing Skills for Articulating Research (AWSAR) schemes has been launched. 120 Doctoral/Post Doctoral scientists will be awarded for best Science popularisation articles annually under this scheme.

R&D Support by Science & Engg. Research Board (SERB)

Sl.No	Schemes	2014-18
1	**Core Research Grant (R&D Projects)**	**2704**
2	**FAST Track Young Scientist Projects**	**2170**
3	**Early Career Research Awards (ECRA)**	**1153**
4	**National Post Doctoral Fellowship (NPDF)**	**2008**
5	**Ramanujan Fellowship**	**146**
6	J C Bose Fellowship	**115**
7	Distinguished Fellowship	**7**
8	Overseas Postdoctoral Fellowship/Overseas Fellowship/Doctoral Fellowship	**99**
9	Year of Science Chair Pro-fessorship	**4**
10	ITS (International Travel Support)	**5691**
11	Seminar & Symposia	**2613**
12	WEA (Women Excellence Award)	**21**
13	Cell Tower Radiation	**19**
14	Scientists (SC)	**427**
15	Scientists (ST)	**110**


MOSQUITO
REPELLENT
MOISTURIZER
CREAM

Rural and Inclusive Technology

Rural and Inclusive Technology

DURING 2014 -18, about 240 projects were supported by the Department of Science & Technology under Long-Term Core Support for Technological Advancement for Rural Areas (TARA); Scheme for Young Scientist & Technologists (SYST); and Technology Interventions for Addressing Societal Needs (TIASN) which encompasses Technology Interventions for Disabled and Elderly (TIDE), programmes for Cold Desert Region (CODER) and Arid & Semi-Arid Region (ASAR) besides Sustainable Agriculture Rural Transformation Holistic Initiative (SARTHI) and Technology Intervention for Mountain Eco-system (TIME).

Launch of Pt. Deendayal Upadhayayal Vigyan Gram Sankalp Pariyojna

Pt. Deen Dayal Vigyan Gram Sankalp Pariyojana (PDDUVGSP), is a novel initiative for holistic & sustainable development. In four districts of Uttarakhand, S&T interventions targeting natural resources, skills, traditional crafts, etc. to enhance quality-of-life of people in clusters of adjacent villages were provided. Hon'ble Minister of S&T and ES along with Hon'ble Chief Minister of Uttarakhand launched the initiative from Dehradun in December 2017. The areas of interventions would be processing and value addition of milk, honey, mushroom, herbal tea, forest produce, native crops, medicinal & aromatic plants and strengthening traditional crafts, handloom, etc. Post-harvest processing of kiwi, strawberry, cherry, tulsi, ginger (adrak), black cardamom (badi elaichi) through solar drying technology, extraction of apricot oil using cold press technology would also be undertaken for enhancing their shelf life and for gainful benefits for the Farmer Producer Groups/Self Help Groups (SHGs).

Technology Advancement for Rural Areas (TARA)

25 S&T driven organisations are supported under TARA, which focuses on technology development/adaptation and delivery on specific challenges in the identified region. A compendium of technologies was brought out in 2017, which gives an overview of over 100 S&T interventions developed so far. Community was trained & empowered in use of such S&T packages. Also, after a gap of a decade, five new S&T driven organisations are being inducted under TARA to expand its presence in hitherto unexplored areas. Several novel and adaptive technologies were developed and deployed.

Technology Interventions for Addressing Societal Needs (TIASN)

37 projects were supported during the last four years through location-specific methodology in CODER & ASAR and Shivalik foothills under SARTHI. A few shining examples are:

- Prototype for manual load carrier-head harness developed and field trials conducted for farmers and labourers to reduce the stress induced on the spinal cord due to lifting of heavy weights
- Technological intervention and communication package developed for management and care of juvenile diabetes
- Green & Blue water harvesting techniques demonstrated in tribal districts of Panchmahal and Dahod in Gujarat
- Thornless seabuckthorn varieties introduced in Lahaul, Himachal Pradesh to reduce drudgery of farmers

Sustainable Agriculture Rural Transformation Holistic Initiative (SARTHI)

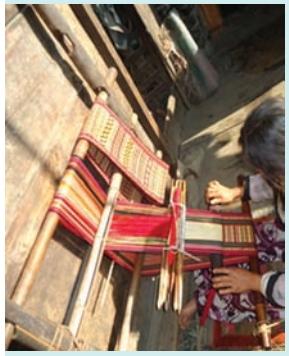
Rose sherbet: Women Self Half Group Sandhya is preparing rose sherbet using fresh rose petals of desi rose in clean, hygienic and scientific manner in Mali village of Kandi region, facilitated by Punjab Agriculture University, Ludhiana. The organic cultivation of rose and its processing was promoted as it clears toxins, prevents loss of heat, gives cooling effect and is a source of instant energy. Sandhya sold 7000 bottles of Rose sherbet in 2017-18, a 25 times enhancement since 2014. Sales of other products (Gulkand, mix vegetable pickle, black carrot kanji, tomato sauce, ketchup) by the SHG too enhanced by 10 times. Four more SHGs were registered in the area for promoting similar activities and livelihood creation.

Drying-cum-storage technology: An improvised drying-cum-storage technology for large cardamom has been successfully introduced and demonstrated in Ziro, Arunachal Pradesh. Flue pipe system dryer provides good colour to the capsules and perfect drying in short span of time. Cardamom farmers of Ziro are getting better economic returns as compared to traditional system.

Empowering SC and ST

Sizable part of allocations made under Scheduled Caste Sub Plan (SCSP) and Tribal Sub Plan (TSP) are used for societal programmes. Under both these sub plans, 85 projects were 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 SC and ST sections of society. Due emphasis has been laid on creating sustainable livelihoods through use of locally-available resources & materials.

Bamboo Sheath Cup Making (Top) and Extraction of Palmyra Fiber



Handicrafts making near Thembangbapu Community Conserved Area, Arunachal Pradesh by TBCCA

Herbal tea production near Khokhan Wildlife Sanctuary, Himachal Pradesh by Jagriti

Value addition using bees-wax around Parambilkulam Tiger Reserve, Kerala by RRC

Enhancing Quality of Life of PA Communities

The Network Programme "People and Protected Areas (PPA) Conservation and Sustainable Livelihoods in Partnership with Local Communities" is a multi-locational network programme implemented as joint initiative of SEED, DST and WWF-India. It aims to coordinate and support the efforts of local and grassroots NGOs to enhance quality-of-life of communities living in and around PAs. Under the second phase (2014-2017), 15 NGOs were involved to work around 16 PAs. The programme has covered over 4000 households of 20 tribal groups including PTGs in 75 villages with technical back-stopping from nearby S&T institutions and Core Support Groups (CSGs) of SEED. For example, in Parambikulam project area, about 45% increase in income level was reported through organised production and sale of value-added products (jack fruits, honey, manjakoova, NTFPs) by women's groups.

In Parambikulam project area, about 45% increase in income level was reported through organised production and sale of value-added products (jack fruits, honey, manjakoova, NTFPs) by women's groups.

Enhancing Livelihoods

A Network programme for North-Western Himalaya **"Technology Interventions for Mountain Ecosystem-Livelihood Enhancement through Action research & Networking (TIME-LEARN)"** was initiated in 2017. Under this programme, 19 action research projects are being supported for S&T interventions to address local issues by engaging communities in horticulture, livestock management, post-harvest technology, utilisation of local bio-resources to develop bio-pesticides, addressing human-wildlife conflict, food and nutrition, conventional ropeway, and construction technologies for multi-hazard resistant housing in mountain areas. Some novel and adaptive technologies developed and deployed are:

- Community-owned & community-operated affordable, safe water solution powered by solar energy in Bundelkhand
- Incinerator system for disposal of waste materials
- Utilising solar energy to heat water & space in high altitude dwellings to reduce dependence on fossil fuels
- Utilising solar energy to produce value-added bars/rolls from Himalayan fruits
- Vegetable powders
- Under-utilised non-timber forest produce.

Tribal Resource Centre



A **Tribal Resource Centre (TRC)** has been established for transfer of resource based rural technologies and knowledge at Rikhad Village, Chakrata, District Dehradun. This Centre will also help the villager's immediate surroundings of six villages for technological intervention in their daily needs. The whole village has been served with toilets, bathrooms, dustbins, soak pits and improved drainage bringing complete sanitation in the village. Processing and production facility centre has been developed with community participation for utilising local agri-horti produce.



CSIR has in place an ambitious, socially relevant programme named CSIR 800. This programme aims at developing and providing innovative R&D based products and processes which would be affordable by the common masses.

CSIR 800 – S&T Interventions for People at the Base of the Economic Pyramid

CSIR has in place an ambitious, socially relevant programme named CSIR 800. This programme aims at developing and providing innovative R&D based products and processes which would be affordable by the common masses. These have not only removed drudgery but also brought about economic upliftment of the Indian rural populace by successfully launching small scale enterprises.

Apple cultivation in new areas

Proof of concept has been established for the apple trees to flower and bear fruit in the Eastern Ghats region. About 3000 apple grafts of promising varieties of low chilled apple were distributed in the hilly tracks of Eastern Ghats. About 150 apple grafts were planted at Regional Agricultural Research Station (ANG Ranga Agriculture University in Andhra Pradesh). CSIR-CCMB also reduced the flowering/fruiting time of apple using the bahar treatment practice. The ripe fruit has long shelf life

and is at par with other varieties in terms of flavour and taste. Apple cultivation by tribals in Andhra Pradesh, Odisha and Telangana will lead to increased incomes (through sale of the fruit) and enhanced nutritional status (through consumption of fruit).

Water for Rural Areas

- CSIR-IICT successfully commissioned and demonstrated 12 defluoridation plants of capacity 50-150 L/h capacity in schools and village hamlets in fluoride affected villages in Nalgonda District, besides model units at CSIR-IICT hostels, Zaheer School and guest houses. So far three lakh liters of free drinking water have been served to the community, which corresponds to a population of six lakh people.
- CSIR-CMERI installed about 100 units of water filters for removing arsenic from ground water and gainful disposal of arsenic waste benefitting about 500 people with a yearly benefit of 16.06 lakhs. 100 de-fluoridation units were also deployed by CSIR-CMERI for 500 beneficiaries.
- A new cost-effective material has been developed by CSIR-CGCRI for bisphenol detection in water. Commissioned a plant at Ramchandrapur, Maldia district to produce water of 8m^3/hour. Installed about 50 improved Iron Removal Plants (IIRP) in and around Bankura district, West Bengal, approximately 3000 families benefitted.
- CSIR-IICT designed, installed and commissioned a 1000 L/h capacity RO based mineral water plant in Vattipally village located in Marriguda Mandal, Nalgonda, the worst fluoride affected region with a high fluoride content of 5.5 ppm which is reduced to < 0.5 ppm and TDS from initial 1130 ppm to final 65 ppm.
- CSIR-NCL developed Ultrafilteration-membrane based water purification units for Indian rural/tribal community. 50 such community units of 500 liter per hour water filtration units deployed in various areas of Maharashtra including tribal belt of Palghar district and in public places and government run schools in Pune.

Succor to distressed banana farmers

CSIR-CFTRI's model called FRIG (Farmers, R&D, Industry and Govt.) helps distressed banana farmers by creating a robust food value chain, which would be beneficial to the banana processing industry. The move was driven by the need to mitigate hardships of farmers in Karnataka, who were forced to sell plantains for a meagre ₹ 2 per kg in December 2015. The institute has a range of technologies for making banana-based products which include banana nectar, ready-to-serve (RTS) beverages, banana bar and so on. For demonstration of the model, around 2 tonne of fresh banana was procured from farmers of Chamarajanagar district and processed at the institute's pilot plant, packed and stored in cold storage. Buyers were brought into the loop for purchase of banana pulp. Samples were sent to pulp exporters for evaluation of products. Farmer groups, buyers and export houses along with officials from women & child development department were involved in formulating a sustainable framework. Women & child development department agreed to buy banana bars for distribution as a food supplement to Anganwadi children – 25 g/day of the bar can provide approximately 90 kcal energy along with other micronutrients for a price of ₹4.

Cultivation of Medicinal and Aromatic Plants (MAPs)

- CSIR-CIMAP organised about 60 Farmers' training-cum-demonstration/awareness programmes on cultivation and processing of medicinal and aromatic plants (MAPs) and trained about 9,500 farmers. Organised 14 entrepreneurial training programmes for women for making incense sticks using floral bio-resource and trained 515 women. It also organised Kisan Mela (Farmers' Fair) in Lucknow which was attended by about 12,000 farmers. Further 21800 farmers visited CSIR-CIMAP for gaining knowledge on cultivation and processing of MAPs.

- CSIR-CIMAP's efforts brought 3500 acre additional area under cultivation of MAPs (Menthol mint, Vetiver, Palmarosa, Lemongrass, Kalmegh and Satavar). Farmers earned in the range of ₹ 25,000- ₹ 75,000/- per ha per year through cultivation of MAPs. Employment opportunities to the tune of more than 2,75,000 man days generated.
  5 distillation units were also set up at farmers' fields. And 35 demonstration of Early Mint Technology (EMT) were organised on the farmers' fields benefitting 1565 farmers. Extension Literature/Publicity folders/Brochures have been published in English and Hindi language and distributed to farmers.
- Demonstration of lemongrass, vetiver, palmarosa, menthol mint and ashwagandha were made on farmer's field covering an area of 1140 acres in different parts of the country including Bundelkhand, Vidarbha and Kutch region. From these demonstrations crop produce worth ₹ 482.50 lakhs (essential and ashwagandha roots) was obtained. A total employment of 1.53 lakh mandays was created from the cultivation of these plants.

Processing of Agri Produce in Mizoram: CSIR-CMERI conducted training cum skill development programmes on processing and preservation of local agri-produce in association with the Women Technology Park (WTP) at Tuirial, Mizoram and worked for the creation of 2 Self Help Groups comprising 20 women each for providing sustainable income throughout the year. A production facility for value-added products from Assam Lemon (*Citrus longilimon*) was also established. Efforts are on for creation of 10 more Self Help Groups comprising 20 women each for providing them sustainable income throughout the year.

Terracotta Products: CSIR-CGCRI trained 27 artisans from Duttapukur (24 Parganas, West Bengal) on Terracotta processing with emphasis on slip casting technique.

Improving the quality and yield of solar salt: Scientific intervention for small scale salt manufacturers of Didwana/ Nawa, Sambhar Lake Area improved the salt quality helping small scale salt producers earn additional revenue in the range ₹ 0.50 to 1.0 lakh based on 10 acre area of salt production. Small scale manufacturers have been educated in value addition in solar salts. Manufacturers have been educated to recover potassium and magnesium salts from the bittern. Total estimated salt production with improved technologies is in the range of 25,000 MT per annum, creating additional profit of ₹ 100 PMT of salt, with total monetary benefit amounting to ₹ 25 lakhs per annum.

Bamboo cultivation: CSIR-IHBT has been promoting cultivation and utilisation of bamboo in rural areas. During the past year the Institute supplied 17,015 saplings of different bamboo species to Himachal Pradesh, Punjab and Jammu & Kashmir. Around 600 plants of *Bambusa bambos* and 400 plants of *Phyllostachys pubescens* were planted through the active participation of the AcSIR students and the Panchayat Pradhan at Rakh village, situated at a very high altitude. The villagers were trained in different aspects of bamboo cultivation and plantation management.

Improved Biomass Chullha: The average thermal efficiency of CSIR-IIP improved biomass Chullha is ~26% which is nearly 10% more than the conventional biomass stoves available in rural areas. Improved Chullha without chimney also lowers indoor air pollution level (Particulate matters) by 10.5%. Of simple design and low cost, material required for its construction is readily available in the rural market – overall cost of this chullha is ₹ 250-300 which is affordable for poor sections of our society.

100 improved cook stove prototypes of "NEERDHUR" were distributed to 70 households. MNRE approved NEERDHUR based on performance testing conducted by Improved Cook-

Steps like rural bio-resource complexes, skill and entrepreneurship development of rural communities led to empowerment and improvement of socio-economic condition of villagers.

stove Test Centers to meet the newly developed cook-stove emission standards by Bureau of Indian Standards (BIS 2013). NEERDHUR shows a thermal efficiency of 33.33% with emission levels as CO: 3.78 g/MJd, TPM: 340.10 mg/MJd at a power output of 1.70 KW.

Fourpan jaggery making plant: An improved four pan jaggary making plant has been installed at village Sunderpur, Distt. Saharanpur U.P. 23% extra jaggery can be prepared in the improved plant with 12% saving of fuel. The improved design has also resulted in better combustion of bagasse in the furnace as the $C0_2$% and Smoke number is comparatively better than that of conventional plants. Nearly 37 improved jaggery units have been installed in rural areas of U.P. and Uttarakhand which are running successfully while providing employment to hundreds of locals and additional income in lakhs of rupees annually.

DBT Societal Development

The Societal programme of the Department has effectively used biotechnological processes and tools for the benefit of the disadvantaged sections of the society comprising women, rural population, SC/ST and weaker section over the last four years. Steps like rural bio-resource complexes, skill and entrepreneurship development of rural communities led to empowerment and improvement of socio-economic condition of villagers. The programme seeks to create a platform for self-employment generation among the target populations and diffusion of proven and field-tested technologies through demonstration, training and extension activities.

DBT Boosting Rural Livelihood Generation and Skill Development

1240 rural women and men benefitted from dissemination of technology development of bio-agent and mycorrhiza colonised seedlings of horticultural crops by rural women, 550 benefitted from distribution of tissue culture raised plantlets along with bio-fertiliser kits and protocol details on plant production and protection techniques & 269 farmers have been benefited through cultivation of extinct banana

The Societal Development programme seeks to create a platform for self-employment generation among the target populations and diffusion of proven and field-tested technologies through demonstration, training and extension activities.

Rural Bio-resource Complexes Empowering Villagers

- Five bio-resource complexes consisting of clusters of 3-5 villages have been established in State Agriculture Universities at Bangalore, Bhubaneshwar, Hissar, Pant Nagar and Parbhani.
- Women and rural SC/ST population were economically and technologically empowered through selected biotech packages like cultivation of aromatic and medicinal plants, mushrooms, Spirulina and seaweeds, biological control of plant pests and diseases, vermicomposting, bio-fertilisers, aquaculture, floriculture, poultry farming and animal husbandry.

Health in Rural India

Awareness created about preventable causes of mental retardation, namely, congenital hypothyroidism, biotinidase deficiency and galactosemia and to establish the newborn screening program as a multi-institutional project by SGPGI, Lucknow, eleven thousand three hundred and fifty samples from newborns have been collected and all samples were tested for 3 disorders. Ten babies were diagnosed to have congenital hypothyroidism.

Rural Bio-Resources Management Uplifting Socio-economic Status of Villagers

Farmers, predominantly females and entrepreneurs, were provided hands-on training and demonstration at 3 Common Facility Centres (CFCs) established at Gayatri Suman Farm (Bulandshahr), Krishi Vigyan Kenda, Muradnagar (Ghaziabad) and Krishi Vigyan Kendra, Dadri (Gautam Budha Nagar), beneficiaries were trained on post-harvest management of fruits and vegetables, bio-control of crop diseases and pests including root-knot nematode, planting of nutritious grass spp. and cultivation of *Azolla pinnata* as green animal feed. These benefitted 4145 farmers, 580 farm women/SHGs, 770 rural youths and 275 extension functionaries visited the centre.

Women Empowered through Biotechnology Based Programmes

- Ornamental Fish Culture for empowerment of rural women
- Poultry Farming for sustainable livelihood generation for rural women
- Health and Hygiene for well-being of women: UTI, Breast Cancer screening

Pisciculture

Production in fish hatchery and rearing was taken up as a livelihood option for rural youths and farmers in three blocks of Bhagalpur District in Bihar.

Special Initiatives for North East India

THE North-East Region (NER) of India is a biological treasure trove that has not been fully explored. There are, for example, around 800 medicinal plants and herbs in remote areas of Sikkim, their properties known only to a fast vanishing population of local shamans, and their active ingredients largely uncharacterised. In fact, NER constitutes one of the richest hotspots of biodiversity of the country, and most of it remains to be characterised for its medicinal, aromatic, edibility, ecological and ornamental values.

Biotechnological research and development work in NER holds promise for yielding highly profitable patents on endemic species. The rich genetic resources spread across diverse ecosystems and nurtured by indigenous communities provide ample opportunities for promoting economic development of the region. Thus, NER offers unique potential for biotechnology-based interventions for overall development of the region.

- **North-Eastern Region-Biotechnology Programme Management Cell (NER-BPMC)** established for conceptualisation, implementation and monitoring of biotechnology programmes in NER and also to evolve and implement various new programmes in the area of biotechnology for the benefit of NER states.
- **Twinning Programme** has catalysed collaborations between institutions from NER and the rest of India, evolved NER-specific projects for implementation across all eight states of the region. More than 480 Twinning projects have been implemented, addressing issues in Healthcare (Medical biotechnology), Agriculture (Agri-biotechnology), Livestock & Fisheries (Animal and Aquaculture Biotechnology), and in the areas of Environment, Medicinal and Aromatic Plants (MAP) with specific relevance to developmental needs of the region; nearly 250 research papers have been published in peer-reviewed journals and more than 1000 young scientists of NER have been trained in advanced biotechnology.

- **Development of Molecular Diagnostic Laboratories in 11 Medical Colleges of NER.** The programme is operational in all four states of the region, namely Assam, Nagaland, Tripura and Manipur.
- The department has provided critical support to establish sophisticated infrastructure for improved diagnostic services in pathology, haematology and genetics departments at the North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences (NEIGRIHMS), Shillong (Meghalaya). The facilities will specifically help to establish viral etiology of nasopharyngeal carcinoma (EBV), and oral squamous cell carcinoma (HPV); in unravelling pattern of neoplastic renal diseases and haematolymphoid neoplasma, and

in molecular typing of minor blood group antigens in NER. Around 1000 diagnostic tests for cancer have been conducted by this lab so far.

- **Technology Business Incubation Centre** established in the campus of the Institute of Bioresources and Sustainable Development (IBSD), Imphal, Manipur to increase the income of farmers, as well as generate jobs for socio-economic development of the North-Eastern region. This initiative will help unemployed youth and farmers of the North-East region to survive and grow their businesses through the early stages of development and also would nurture new and small biotechnology-based enterprises.
- **Centre of Excellence (COE)** under the Agri-Biotechnology area established at the Assam Agriculture University, Jorhat (Assam) with focus on research in Gene Technology, Allele Mining, Molecular Breeding and Microbial Gene prospecting. It is engaged in developing skilled/trained human resource. Biofertilisers and biopesticides are also being distributed to the farmers. Nine PhD students enrolled in Agri-biotechnology at Assam Agricultural University were awarded with fellowships.
- **Value Chain Development in Citrus** programme aims at using modern technologies for mass production of

citrus plants and value-added citrus products. Under the programme, more than 2000 seedlings of rough lemon were raised, Khasi mandarin and sweet orange were successfully grafted, and processing of citrus juice has been standardised and polyhouse for multiplication of citrus root stock was constructed. The implementing partners are ICAR-RC, Nagaland, ICAR RC for NEH region, Shillong Meghalaya, NRC for Citrus (ICAR) Nagpur, IIT Kharagpur, West Bengal.

Value Addition of Agro Produce

• Nagaland State Science & Technology, Kohima has taken initiatives to improve income of farmers through value addition for their produce. The major issues faced by farmers include dehydration of the agricultural produce and its preservation. Preservation of fruits and vegetables for prolonged periods is a major problem for rural economy. But if dehydration and preservation process is done in a cost-effective manner, it increases the shelf-life and also reduces the weight for transportation. A 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.

Biomass Fired Dryer

Solar Air Heaters developed at HPL-IITB integrated with drying duct for preliminary testing

- A project on "NER-Scented Rice" was implemented during 2016 -17 to make the aromatic rice of the northeast more resilient and sustainable. Another project in consortium mode on 'NER-Banana' was also initiated during the year to address the need to conserve, characterise and expand the germplasm stock.
- A multi-centric programme on value addition in jackfruit and commercialisation of its processed products aims at identification of superior genotypes of jackfruit, their molecular characterisation, and validation and commercialisation of technologies for value added products from jackfruit. The programme has identified more than 40 elite jackfruit genotypes from Karnataka, Assam and Tripura for culinary or table purposes, organised training workshops for existing jackfruit technologies for farmers, and produced value-added products.
- Multi Utility Heat Pump to maintain a vegetable cold store between 10 to 15°C and simultaneously enabling drying of spices, fruits and vegetables was designed, developed, integrated and commissioned in Heat Pump Laboratory, Indian Institute of Technology, Mumbai (IITB) for preliminary testing before dispatch to Nagaland. Preliminary tests have been done and result indicates satisfactory operation.

Chemical Ecology of NER

A network research programme on 'Chemical Ecology of North Eastern Region' focuses on identification of the origin and composition of plants, insects and vertebrate pheromones and semio-chemicals; analysis and (re)engineering of chemical communication mechanisms; molecular and structural mechanisms; behavioural and neural mechanisms; biochemical, genetic and physiological mechanisms, governing interactions between flora and fauna of NER.

Eco-friendly Agriculture

A multi-centric network programme has been implemented for promoting eco-friendly agriculture practices in 14 districts across all 8 NE states, with emphasis upon the application of bio-inputs (biopesticides, biofertilizers) for organic farming of key high value crops (HVCs) of NER, mass multiplication of required bio-inputs and evaluation of their efficacy providing training to nearly 1400 farmers in the use of bio inputs in organic farming of 9 target crops (5 spices, 2 fruits and 2 vegetable crops).

Impact of Jhum Cultivation

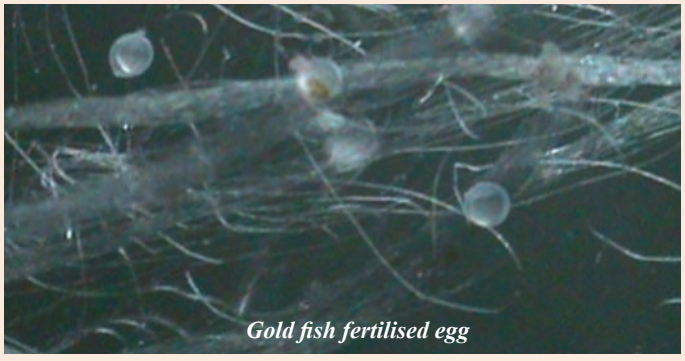
DBT has supported a multi-centric programme on assessment of impact of Jhum cultivation on soil microbiota and on restoration of diverse agro-ecosystem in NER.

Advanced Diagnostics

In the area of Animal Biotechnology, DBT has recently launched an ambitious programme on Advanced Diagnostics and Services in Animal Health and Disease for surveillance and control of trans-boundary, exotic and zoonotic pathogens.

Cultivation of Mushroom for Generating Livelihoods

CSIR-NEIST developed and introduced organised mushroom cultivation in NER. As a result, mushroom cultivation has increased in Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Tripura and Nagaland. A mushroom germplasm bank has also been established in CSIR-NEIST premises. The technology has been disseminated through awareness camps and training. Presently, there are 30,000 beneficiaries including 20 entrepreneurs/NGOs and employment to over 5000 people has been generated. The income to the beneficiaries ranged from ₹ 10,000 per month to ₹ 1,50,000 per month from cultivation of mushroom from October to March.



Gold fish fertilised egg

Training workshop

Joint Venture on Pisciculture

MASTEC-ICAR joint venture project on pisciculture and its allied activities has been established for socio-economic development in Manipur, at Manipur Science & Technology Council. The project was supported by Department of Science & Technology for rearing and production of spawn, fish brooders of Indian major carps – *Catla catla*, *Labeo rohita, Cirrhinus mrigala,* and other exotic carps such as Grass carp *(Ctenopharyngodon idella)*, Silver carp *(Hypothalmitric molistrix)*, Common carp *(Cyprinus carpio)*. To impart basic knowledge about scientific farming of food and ornamental fish, a two-day training programme on Pisciculture was organised during June 19-20, 2014 at Manipur Science Aquarium, Imphal. Altogether 30 participants including 11 beneficiaries of food fish and 4 beneficiaries of ornamental fish attended the training programme. In addition, the breeding of fan tail Gold fish *(Arassius auratus)* was tried with the available facilities at Manipur Science Aquarium. Survival rate of the fry was 50%.

Augmenting Clean Pork Production

A DBT-supported programme on Augmenting Clean Pork Production and Value Addition, being implemented at the National Research Centre for Pig, Guwahati, Assam, is designed to develop shelf stable pork products (namely nuggets and bites, sausages, patties, kebabs, samosa, momo, slices etc) and to refine and standardise the technologies for producing a wide range of value added pork products to provide variety to the pork consumers. Production of pork sausages has already been initiated.

Strengthening Fisheries

For strengthening the Fisheries and Aquaculture Biotechnology (FAB) related research and development activity in the NER region, DBT has established a FAB-Centre of Excellence (FAB-COE) at College of Fisheries, Central Agricultural University, Lembucherra, Tripura.

Capacity Building & Human Resource Development

The Department of Biotechnology has made intensive efforts in capacity building and human resource development (HRD) for the benefit of entire North-Eastern Region of India, as follows:

- Sophisticated biotechnology infrastructural facilities have been created at National Research Centre on Mithun at Jharnapani, Medziphema (Nagaland) and National Research Centre on Yak at Dirang (Arunachal Pradesh), for strengthening research dynamics for desirable gains in Mithun husbandry, Yak husbandry, improving research activities on genomics and conservation.
- In the area of Animal Biotechnology, DBT has launched an ambitious programme on Advanced Diagnostics and Services in Animal Health and Disease for surveillance and control of trans-boundary, exotic and zoonotic pathogens.

The programme envisages establishment of three core laboratories across the NER for carrying out research and training activities in trans-boundary and endemic animal diseases. It also aims to impart training to the state veterinary personnel in disease reporting, sample collection techniques and fostering public-public partnership module for effectively handling the animal-man-environment continuum chain.

The Department of Biotechnology has initiated establishment of a state-of-the-art, Regional Animal House Facility at Regional Medical Research Centre (RMRC), Dibrugarh.

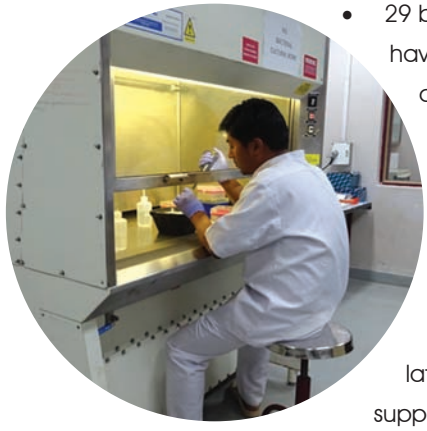
- Established a network of 126 Biotech Hubs across NER, providing necessary infrastructure in universities/colleges/ institutions and training in sophisticated technologies to support and promote biotechnology education and research. 6 State-Level and 120 national with more than 600 training programmes and supported more than 500 PG and PhD students.

Department of Biotechnology has established "X-Ray Crystallography Facility" at IIT Guwahati. This facility is fully functional and available to all NER researchers for their experimental use.

- An Overseas Associateship scheme for NER scientists aims to promote capacity building in cutting edge areas of biotechnology and life sciences. 205 scientists have been awarded the associateship thus far.
- DBT has initiated a scheme for establishing "Biotechnology Labs in Senior Secondary schools (BLiSS)" across all 8 states of NER. Around 100 such labs under BLiSS are under pipeline for establishment.
- DBT has initiated a **"Visiting Research Professorship (VRP)"** Scheme to utilise the expertise of outstanding biotechnology professionals for bringing advancement in Biotechnology and Life Science related activities in various institutions of research and higher learning in the NER States of India.

Students of school of Meghalaya being explained the functioning of different equipment

- Established a Centre for empowerment of human resources at NEHU, for conducting trainings/workshops for faculty/research students of the region in niche areas of biotechnology for undertaking research and development activities. Distinguished faculty with national/international credentials are invited to impart advanced training to the participants.

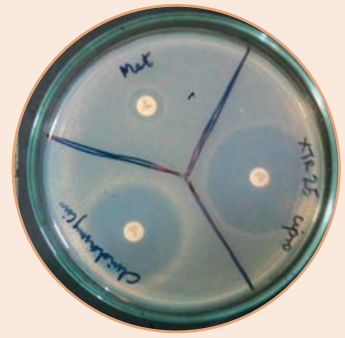


- 29 bioinformatics centers have been established in all the 8 states of the NER and are networked as the North-Eastern Bioinformatics Network (NEBINet). These Bioinformatics centres are provided with the latest IT equipment to support the research activities of the host institutions in NER. Two new bioinformatics centres were established during the last year, at College of Fisheries, Central Agricultural University, Lembucherra, Tripura and National Research Centre on Mithun (ICAR), Nagaland.
- Established a "DBT Biotechnology/Bioinformatics training centre for teachers and research scholars from the North-Eastern Region of India" at ACTREC, Mumbai. This centre will provide high-end hands-on training to NER researchers on cancer biology. Presently, 15 researchers from NER are being trained at ACTREC.
- DBT has initiated a training programme through NIBMG, Kalyani, to provide comprehensive training to scientists, research students and clinicians belonging to the NER, who are engaged in "Biomedical Research", to better equip them to undertake focused research leading to understanding the molecular basis of diseases prevalent in NER of India. So far 60 researchers from NER (2 batches) have been trained in workshops held at Assam University Silchar, and Tezpur University, Tezpur.
- Capacity Building Workshops in Grant Writing Skills and Effective Management of Intellectual Property Rights (IPR) in Biotechnology. DBT has organised a series of three-day capacity-building workshops on effective grant writing skills and basics of Intellectual Property Rights (IPR) for the research institutions and universities of the North-East Region.
- **Training of NER researchers at ICAR-NIHSAD, Bhopal**: NER has a long International border which poses problems in dealing with the inevitable inflow of transboundary pathogens which, if left uncontrolled, may be potentially lethal, zoonotic or exotic. To address this, NER researchers are trained in pathogen handling and biosafety issues. 40 researchers have been trained at ICAR- National Institute of High Security Animal Diseases (ICAR-NIHSAD earlier HSADL), Bhopal.
- DBT has established a "Technology Incubation Centre for Entrepreneurship Development in Mushroom Culture and Farming" at Department of Biotechnology, Bodoland University. A number of farmers have been trained on value added products including Mushroom soup, Mushroom Cake, Mushroom Custard and Mushroom Pakora. The unit has also produced mushroom spawn of *Pleurotus florida*, *Pleurotus flabellatus*, *Volvariella volvaceae* etc.

Characterisation of Hotspring

The project "Microbiological characterisation documentation, sociological insight, physicochemical analysis of hotsprings (Tatopani) of Sikkim" at Sikkim University, aims at microbiological characterisation documentation, sociological insight, physicochemical analysis of hot springs (Tatopani) of Sikkim. More than 200 bacterial isolates have been isolated and among these isolates, 46 isolates were found to be positive for amylase production and 6 for protease production. One isolate was found to be resistant to Clindamycin, one to Penicillin, one to Gentamycin and 38 isolates were found to be resistant to Methicillin. DNA isolation of more than 30 isolates has been done and among them 16 S rDNA sequencing of 15 isolates has been done and is still in progress. Initial sequencing results suggest that most of them belong to genus *Geobacillus anoxybacillus*, and Bacillus sp.

Newly found Hot Spring in Yumesamdung, North Sikkim



Gram Staining of Geobacillus Toebii isolated from Yumthang Hot Spring

Technology Demonstration in North East

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, Arunchal Pradesh by Arunchal Pradesh State Council for Science & Technology, Itanagar.

Traditional water mill demonstration in Arunachal Pradesh

2*100 kW Micro hydel plant at Thangu, North Sikkim

A 2*100 kW Micro hydel plant has been commissioned at a height of 13000 feet in Thangu North Sikkim based on cross flow turbine technology by Department of Science & Technology.

Department of Science & Technology

- **North Eastern Centre for Ethno Medical Research established in Manipur:** Ethno Medicinal Research Centre (EMRC) in the remote region of Manipur was established with budgetary support of approx. Rs. 6.00 crores in 2017. 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. This one-of-its-kind initiative will not only provide scientific validation of traditional herbs but also aims to improve quality of life and economic status of the local community through product development and better livelihood.

- Improvised drying-cum-storage technology for large Cardamom has been successfully introduced and demonstrated in Ziro, Arunachal Pradesh. Flue pipe system dryer provides good colour to the capsules and perfect drying in short span of time. Now, Cardamom farmers of Ziro are getting better economic returns through the introduction of this improved drying technology as compared to traditional system.

North East Centre for Technology Application and Reach (NECTAR)

NECTAR works with domain experts and with Central and State Government funded laboratories to identify techno-economic gaps and technologies to induct them in the North East. It provides last mile guidance and support to States to ensure that such technologies reach ultimate beneficiaries in the North Eastern States.

Some major accomplishments of NECTAR are:

- To promote the unique traditional art of concrete hive beekeeping, which is vanishing with time, a project was supported to revive the scientific method of beekeeping. More than 500 underground concrete hives were constructed along with water reservoirs.

- Under the beekeeping project, 170 beekeepers were supported and 1700 bee boxes were distributed among the farmers in the villages of Tuensang district of Nagaland viz. Chendang, Konya, Longtang, Chingmei, Kiding and Yangli. This intervention was aimed at empowering the local village people to the subsidiary occupation of beekeeping to generate supplementary income. Further, this intervention would increase the output of honey production in the state.

- NECTAR has extended capital support to North East Network (NEN) - Chizami Weavers – the project has engaged 300 back-strap loom weavers from 11 locations under Phek district to produce home furnishings (cushion cover, table runner), garments (shawls and mekhelas) and accessories (bags) that cater to both rural and urban consumers. NECTAR also linked the weavers with designers, thereby facilitating the weavers to enhance their skill and understand the knowhow of market trends.

Popularising and Communicating Science

Popularising and Communicating Science

THE Ministry of Science & Technology is mandated to communicate science & technology (S&T) to the masses, stimulate scientific and technological temper, and coordinate and orchestrate such efforts throughout the country. The programmes of the Ministry aim to build capacity for informed decision making at the community level and promote scientific thinking. It is devoted towards societal upliftment through the dissemination of scientific knowledge in an informed manner through the media to ensure percolation of the message to every corner.

The National Council of Science & Technology Communication (NCSTC) focuses on outreach activities; training in S&T communication; development, production & dissemination of S&T software; incentive programmes; field based science communication projects; research in S&T communication; international co-operation, motivating students and teachers; environment awareness, and gender focused programmes. Some of the important successful initiatives over the years include campaigns like 'Year of Scientific Awareness', 'Year of Physics', 'Year of Astronomy', 'Year of Mathematics', observation of the 'National Science Day' and 'National Mathematics Day', the 'National Children's Science

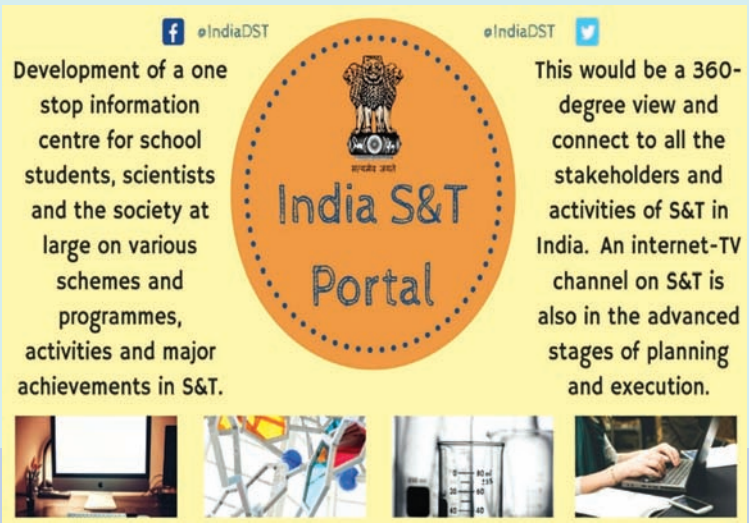
Congress', 'National Teacher's Science Congress, and 'Science Express', amongst others. A multi- pronged effort has been developed by the NCSTC including communicating science using folk media; use of mass & digital media for science communication and popularisation, and use of social media in S&T popularisation.

CSIR-National Institute of Science Communication and Information Resources (CSIR-NISCAIR), an institution belonging to the Council of Scientific & Industrial Research (CSIR), has been making a substantial contribution to the communication of scientific information in the country for the past more than sixty-two years. The Institute is the only organisation in the country that disseminates R&D information through 20 scholarly peer-reviewed journals. CSIR-NISCAIR is also taking science to the masses through its three highly-circulated popular science magazines in English (*Science Reporter)*, Hindi (*Vigyan Pragati)* and Urdu (*Science ki Duniya)*. The Institute has also made a foray into science communication through multimedia channels and social media. Besides, CSIR-NISCAIR has also been organising training workshops in science communication and science writing for scientists, researchers, students, teachers, etc.

Vigyan Prasar (VP) is an autonomous organisation under the Department of Science & Technology (DST) to serve India's science popularisation agenda. This is achieved through several strategically important two-way stakeholder specific approaches to communicate principles and practices of S&T. This also includes implications for development and quality of life. VP serves as a resource & facilitation centre for S&T communications.

India S&T Portal

- Objective to provide a one-stop information centre for school students, scientists and the common public on various schemes and programmes/activities and major achievements in S&T.
- Portal is part of the larger, National Government Services Portal (NGSP), which provides a single-window access to the various services provided by the Indian Government.
- Provides information pertaining to scientific education and scientific research & development, including details of policies, schemes, documents and programmes for scientists, researchers, scholars and students.
- Documents and reports, like e-books and citizen charters, application forms, S&T related schemes like the 'Digital Literacy Mission' and 'Multiplier Grants Scheme', as well as open data from national databases, such as the district rainfall normal, expenditure on research and development can all be accessed from a single window on the S&T Portal.



Science Express – Climate Action Special

- Most popular, mega outreach and flagship programme of NCSTC.
- Innovative mobile science exhibition mounted on a specially designed 16-coach AC train, traveling across India since October 2007.
- Completed nine tours of the country, covering 1,61,000 km and exhibiting at 529 locations spread across the length & breadth of country. Reached out to over 18.1 million visitors – the largest, the longest running and the most visited mobile science exhibition.
- Has 12 entries in the *Limca Book of Records* including six new ones in the 2017 edition.
- *Science Express* (Phase I-IV) showcased cutting-edge research in S&T being carried out worldwide in collaboration with Max Planck Society and Federal Republic of Germany.
- *Science Express Biodiversity Special (SEBS)* (Phase V-VII) displayed rich biodiversity of India and conservation measures with Ministry of Environment and Forest as partner.
- *Climate Action Special (SECAS)* (Phase VIII and IX) highlighted global challenges of climate change.
- Detailed information is available on website www.sciencexpress.in.

Science Express (SE) Milestones

(30 October 2007— 08 September 2017)

- Total Visitors ~ 1.81 crore
- Number of Schools/Colleges that visited SE ~ 45,052
- Number of Students who visited SE ~ 40.67 lakh
- Number of Teachers who visited SE ~ 2.2 lakh
- Number of General Visitors including children ~ 1.21crore
- Students participating in on-board Lab ~ 4.9 lakh and Kids Zone ~ 2.5 lakh

- Students participating in Platform Activity ~ 7.4 lakh and Outreach Activity ~ 1.7 lakh
- Number of participants in on-board Teachers Orientation Program ~ 9,500
- Distance travelled ~1.60 lakh kilometers
- Total number of Halts ~ 529
- Number of exhibition days ~ 1,812
- Entries in *Limca Book of records* ~ 12
- Over 270 trained Science Communicators
- Extensive Media Coverage

Hands-on STEM & Innovation Demonstrations

- Science, Technology, Engineering and Mathematics (STEM) and innovation demonstration activities through science fairs, expositions, mobile science exhibitions, lecture-demonstrations, visits to S&T establishments and labs, hands-on-STEM activities, and so on.
- Include hands-on activities, science based toys, games, and quizzes.
- 261 science fairs, melas, visits to S&T establishments like labs and industry organised.
- Attended by close to 10 million people.
- Participation by 1 million students during 2014-17.
- Six mobile science exhibitions and lecture-demonstrations organised attended by more than 35 lakh students.

National Awards for S&T Communication and Popularisation

NCSTC instituted National awards for 'Outstanding Efforts in Science & Technology Communication' in 1987 to stimulate, encourage and recognise efforts in science popularisation and communication. Presently, there are six categories awards:

1. General
2. Print media including books and magazines
3. For children
4. Translation of popular S&T literature in languages mentioned in the Constitution of India and in English
5. For innovative and traditional methods
6. For electronic media.

A total of 26 individual and 7 institutions were awarded during the period 2014-17.

Initiative for Research & Innovation in Science (IRIS)

- IRIS is a public-private partnership between DST (NCSTC), Intel and Indo-US Science and Technology Forum for empowering next generation of innovators.
- Aims to inspire budding scientists in India.
- IRIS enables outstanding projects to represent India at global science competitions like Intel International Science and Engineering Fair (Intel-ISEF).
- During 2014-17, team-India while competing with more than 5000 participants from 78 countries, bagged more than 40 honours including 25 Grand and 6 of them had minor planets named after them.

Mission Eco Next

(Previously, Eco Next & Eco Media Initiatives, Eco & WaSH Futures)

- The programme aims to inspire and nurture the 'Eco Intelligent Youth Young Change Makers'.
- 'Mission Eco NEXT' initiatives focus upon promoting real-time responsiveness for building regenerative ecological futures which are leveraged by eco-media, eco-design, eco-innovation for promoting integrated efforts for conservation of natural resources, specifically aimed at developing models in public guidance systems based on science communication.
- These include location-specific initiatives for actionable learning and building field capacity for adopting scientific best practices in knowledge critical domains.
- S&T communication trainings and support are provided to youth for leadership and improvement of quality-of-life of specific target groups, based on scientific approaches of 'being-on-their-own' and 'collective response' to challenges and location-specific issues.
- During 2014-17, over 50 training and capacity building programmes were conducted.

India Innovation Initiative — I^3

- Aims to promote innovation amongst citizens in age group 18 and above.
- Participants engage in creating innovative solutions to real-life societal problems and bring out a working prototype.
- Innovations in advanced stages of commercialisation are supported by linking them to the ecosystem, so that the process-to-market could be accelerated.
- Incentivises innovators with exclusive and special training on business idea development, business plan creation and financing to help them commercialise their innovations.

- Best of the innovations are provided incubation support, mentorship, investor and industry connect.
- Also aims to build capacity of innovators for launching start-up enterprises and doing business by equipping them with necessary knowledge in the areas of defining a business problem, carving a solution, conducting market research and creating a business plan so that they are better prepared to seek incubation and funding.
- Since 2014, about 40 projects are selected each year from hundreds of entries received at regional level, for recognition and rewards at the national level fair. Most of the innovative ideas/projects get incubation support, venture funding and/or seed capital.

India International Science Festival

As a new initiative, the India International Science Festival is being organised every year with the objective of sharing achievements of S&T with the public; building strategy to instil scientific temper among the masses; showcase India's contributions in the field of S&T; provide platforms to young scientists for knowledge and idea exchange; and support flagship programmes like Make in India, Digital India, Start-ups, Smart Villages and Smart Cities.

- **IISF 2015** organised in IIT, Delhi from 4th to 8th December 2015. About 10,000 delegates from all over the country participated in Young Scientists Conference, Techno-industrial Expo, Science Film Festival, Exhibition and Competition showcasing innovative models under the INSPIRE programme, Industry Academia Conclave, Largest Practical Science Laboratory Demonstration.

(From Left) Dr. Harsh Vardhan, Minister of Science & Technology and Earth Sciences; Shri Y.S. Chowdhary, Minister of State for Science & Technology and Earth Sciences; largest practical science session with 2000 students organised on 7th December 2015, which found its way into the Guinness Book of World Records.

- **IISF 2016** organised at CSIR-National Physical Laboratory (NPL) Campus, New Delhi during 7-11 December 2016. The event was inaugurated by the Honourable Home Minister, Shri Rajnath Singh. The 6th National Level Exhibition & Project Competition (NLEPC) under the INSPIRE Award Scheme was organised by Department of Science & Technology during the IISF. About 560 selected awardees from all over the country participated in the event. The top 60 innovative projects were felicitated by Dr. Harsh Vardhan, Hon'ble Minister for Science & Technology and Earth Sciences.

Honourable Home Minister, Shri Rajnath Singh inaugurating the IISF 2016 (left); Dr. Harsh Vardhan, Minister of Science & Technology and Earth Sciences giving away awards

- **IISF 2017** was held in Chennai during 13-16 October 2017 at various venues which include Anna University, Central Leather Research Institute (CLRI), Structural Engineering Research Centre (SERC), National Institute of Ocean Technology (NIOT) and IIT-Madras. Fifteen major events were held as a part of the IISF-2017.

A new Guinness World Record was created for the largest biology lesson – 1049 students participated in the record breaking session.

Dr. Harsh Vardhan, Minister of Science & Technology and Earth Sciences inaugurating the IISF 2017

S&T Communication through Community Radio

- NCSTC has launched initiatives in conceiving, designing, preparing and delivering radio programmes to ensure reach of information and messaging to all remote areas.
- In recent times, the focus has been on achieving gender equity and alignment with the national priority of Beti Bachao, Beti Padhao, well leveraged by community radios (CRs) across the India.
- NCSTC has so far supported 68 CRs under its Science for Women's Health and Nutrition (SWHN) initiative besides 'Radio Mathematics' aimed at inculcating basic math skills, amongst even the illiterate. The programmes prepared using local expertise in the subject area and in vernacular, are aired twice a day and the time of broadcast is decided by the community to ensure maximum mileage.

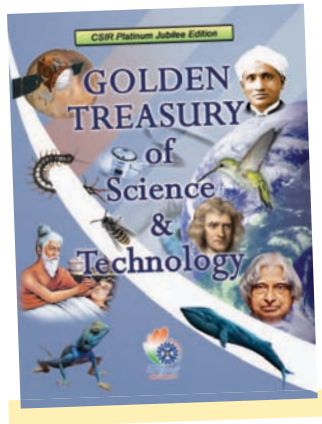
Children Science Congress (CSC)

- Flagship programme of DST to initiate young students (10-17 years) into the arena of science through hands-on, minds-on approach.
- Encourages child scientists to identify societal problems and motivates them to arrive at a possible solution through research.
- Focal themes of CSC in 2016 and 2017 were 'Science, Technology and Innovation for Sustainable Development with special emphasis on accessibility for Persons with Disabilities'. It covered almost all the districts in India, with participation of over 500,000 students annually. Promising ideas and projects were shortlisted for presentations at the state level and further scrutiny led to about 650 projects getting shortlisted for a presentation at the national level.
- Grand finale of CSC, popularly known as National Children Science Congress (NCSC) is held during 27-31 December each year.
- Child scientists with the best projects of NCSC also participated in the Rashtriya Kishore Vigayanik Sammelan organised as a part of Indian Science Congress. Over the years, children from neighbouring countries, SAARC nations and even ASEAN have participated in this.

Publications to Popularise Science and Scientists

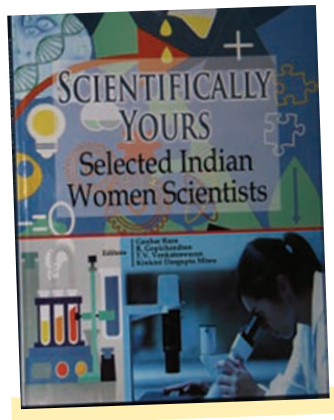
- **Popular science magazines of CSIR-NISCAIR:** CSIR-NISCAIR has been disseminating information to the masses through its three widely circulated popular science magazines. The three magazines are *Science Reporter* (English monthly), *Vigyan Pragati* (Hindi monthly) and *Science ki Duniya* (Urdu quarterly).

- ***Golden Treasury of Science & Technology:*** As part of the Diamond Jubilee celebrations of CSIR, CSIR-NISCAIR brought out the Diamond Jubilee edition of the *Golden Treasury of Science & Technology*. This extremely popular encyclopaedia contains S&T terms and terminologies that are in the public domain. Explanations to these terms have been provided in an easy-to-understand language.

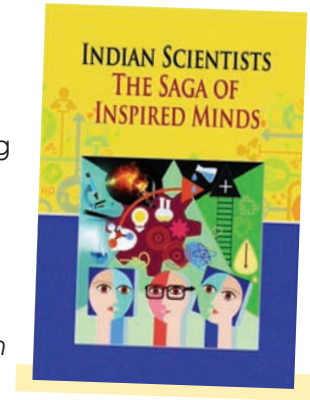


- ***Moments of Eureka:*** This book brought out by CSIR-NISCAIR in collaboration with Vigyan Prasar and RSTV is based on interviews of some of the most eminent scientists in the country – these interviews were telecast on Rajya Sabha TV (RSTV).

- ***Scientifically Yours:*** This book brought out by CSIR-NISCAIR in collaboration with Vigyan Prasar and RSTV covers the lives and times of some eminent women scientists in the country.



- ***Indian Scientists*** **– The Saga of Inspired Minds:** To develop scientific temper in the society, especially young students, interesting aspects about the inspiration that guided 54 Indian stalwarts in S&T were presented through a publication *Indian Scientists: The Saga of Inspired Minds,* published by Vigyan Prasar, and with a message from Hon'ble Prime Minister.



Science Channel

A dedicated one-hour slot "DD-Science" on Doordarshan National channel was initiated to highlight the value of science and technology in our daily life. This was also an attempt to demystify science and make it accessible to all. "Science is everywhere and for everyone" has been used as the guiding principle to ensure high quality, educative and entertaining programmes, to enable people to understand issues and to address these through a participatory process. The aim is to evolve the one hour show "DD – Science" into a 24x7 science channel.

New Multidisciplinary Digest
Science Diplomacy

Dr. Harsh Vardhan, Union Minister for Science & Technology, Earth Sciences and Forest, Environment & Climate Change,

Dr. Harsh Vardhan, Minister of Science & Technology and Earth Sciences releasing the first issue of Science Diplomacy

released the first issue of *Science Diplomacy* brought out by CSIR-NISCAIR. The publication was released during the inaugural ceremony of the India International Science Festival (IISF) 2017 at the Anna University, Chennai on 13 October 2017. *Science Diplomacy* is among the first endeavours to bring highlights of Indian scientific achievements in foreign languages. Currently the publication has been brought out in English and Japanese. More foreign languages would be added in the future.

Catalysing Debates on Science Communication

Panel Discussion on Scientific Temper: CSIR-NISCAIR in collaboration with Rajya Sabha TV and Vigyan Prasar organised a panel discussion on *Scientific Temper: A Prerequisite for Knowledge-based Society* on 10 January 2016. Inaugurating the event, Vice President of India, Shri Hamid Ansari emphasised that scientific temper is a pre-requisite for innovation and research. The panel discussion was attended by Nobel Laureate Dr. Venkataraman Ramakrishnan, Prof. Raghavendra Gadagkar, and Dr. Anil Kakodkar.

Vice President of India, Shri Hamid Ansari delivering his address

Workshop for "Training Journalists in S&T Reporting"

CSIR-NISCAIR and NCSTC organised a Workshop for "Training Journalists in S&T Reporting" during 1-3 September 2015. The Workshop, which was attended by 18 journalists, facilitated interaction of journalists with some of the most eminent scientists and scientist administrators of the country. It also exposed them to prominent scientific projects and imparted to them reporting skills which would be helpful in effective communication of scientific developments in the country. Hon'ble Minister of S&T and Earth Sciences, Dr. Harsh Vardhan, was the chief guest at the Valedictory Function, which was also attended by Dr. Girish Sahni, DG-CSIR and Mr Rajendra Prabhu, Chairman, NUJ (I) School of Journalism & Communication.

Dr. Harsh Vardhan, Minister of Science & Technology and Earth Sciences at the concluding function of the Workshop; Dr. Girish Sahni, DG-CSIR on his left and Mr Rajendra Prabhu, Chairman, NUJ (I) School of Journalism & Communication on his right

Fifth Media Chaupal: The fifth Media Chaupal was held in Haridwar, Uttarakhand during 22-23 October 2016 in which CSIR-NISCAIR collaborated with organisations such as 'Spandan', Dev Sanskriti Vishwavidyalya, Divya Prem Sewa Mission, India Water Portal, and the Atal Bihari Vajpayee Hindi University. Around 350 journalists, scholars, scientists, philosophers, academicians and students from all around the country participated in the fifth chaupal whose theme was "Science, Development & Media".

Former Chief Minister of Uttarakhand Dr. Ramesh Pokhriyal delivering the opening address

"Round Table Meet on Mass Communication":

A "Round Table Meet on Mass Communication" was organised during the Third India International Science Festival (IISF) in October 2017 at the Anna University in Chennai, Tamil Nadu by CSIR-NISCAIR in collaboration with the National Institute of Ocean Technology (NIOT), Chennai. The Round Table Meet was inaugurated by Dr. Narender K. Sehgal, Former Adviser, Govt. of India and winner of the prestigious Kalinga Prize. Dr. V.K. Saraswat, Member, NITI Ayog chaired the Valedictory Session.

(From right) Dr. V.K. Saraswat, Member, NITI Aayog, Dr. Jayant Sahasrabuddhe, ViBHA, and Dr. Manoj Kumar Patairiya, Director, CSIR-NISCAIR at the Summing-up Session of the Round Table Meet on Mass Communication at Chennai

"Regional Workshop on "Sustainable Development Goals: Communication Strategies":

CSIR-NISCAIR organised a Regional Workshop on "Sustainable Development Goals: Communication Strategies" during 16-18 November 2017 at the NASC Complex, New Delhi in collaboration with the Association of Academies and Societies of Sciences in Asia (AASSA) and the Indian National Science Academy (INSA). The Workshop brought together scientists, communicators and policy makers from South Asian countries like Japan, South Korea, Indonesia, Georgia, Iran, Afghanistan and India.

From Right: Dr. P. Goswami, Director, CSIR-NISTADS; Dr. Manoj Kumar Patairiya, Director, CSIR-NISCAIR; Prof. Yoo Hang Kim, President, AASSA; Dr. Narender K. Sehgal, Former Adviser, Govt. of India; Prof. A.K. Sood, President, INSA; Prof. Krishan Lal, former President, INSA; Mr S.P. Mishra, Deputy Executive Director, INSA

17th Indian Science Communication Congress: CSIR-NISCAIR and the Indian Institute of Mass Communication (IIMC) organised the 17th Indian Science Communication Congress during 21-22 December 2017. Scholarly societies and bodies involved in science communication including the Indian Science Writers' Association (ISWA), Society for Information Science (SIS), Indian Science Communication Society (ISCOS) and Vigyan Bharati (VIBHA) also collaborated. Some 200 delegates including science communicators, scientists, researchers, science fiction writers, science enthusiasts, science journalists and students participated in the congress held under the theme "Communicating India's Scientific Wisdom: Changing Paradigms".

From left: Prof. K.G. Suresh, Director-General, Indian Institute of Mass Communication; Prof. R.K. Bhandari, former director CSIR-CBRI; Dr. R.S. Sangwan, Director, Academy of Scientific and Innovative Research (AcSIR); Dr. Narender K. Sehgal, UNESCO Kalinga Prize Winner for Science Popularization, Mr. Kamal Kishore, Member, National Disaster Management Authority and Prof. Manoj Kumar Patairiya, Director, CSIR-NISCAIRs

"National Workshop on "Science, Technology & Innovation Policy: Optimising Communication & Information Research": In view of the need for optimising communication and encompassing information research when crafting science, technology and information policies, CSIR-NISCAIR organised a national workshop on "Science, Technology & Innovation Policy: Optimising Communication & Information Research" during 23-25 January 2018 at the NASC Complex, New Delhi in collaboration with the Department of Science & Technology, Government of India. About 100 participants including scholars, researchers, scientists, practitioners, policy makers and students from all parts of the country participated in the workshop.

Dr. Manoj Kumar Patairiya, Director, CSIR-NISCAIR addressing the gathering. On the dais (from right) Dr. H. Purushotham, Chairman and Managing Director, National Research Development Corporation (NRDC); Prof. K.K. Dwivedi, Vice Chancellor, ITM University, Gwalior; Dr. R.S. Sangwan, Director, Academy of Scientific and Innovative Research (AcSIR); Dr. Neeraj Sharma, Head and Advisor, Policy Research, DST; Dr. Akhilesh Mishra, Senior Scientist, Policy Research, DST

Global Connect
Promoting International Cooperation

International Science and Technology Cooperation and Collaborations

THE Ministry of Science and Technology has the mandated responsibility of negotiating, concluding and implementing science and technology (S&T) agreements between India and other countries; and providing interventions on S&T aspects in international forums. This responsibility is carried out by the Ministry of External Affairs (MEA), Indian missions abroad, S&T counsellors at Germany, Japan, Russia and USA, stakeholders in scientific, technological and academic institutions, concerned governmental agencies and various industry associations in India.

International Science & Technology Cooperation is realised at two levels, that of bilateral cooperation with developed and developing countries,and multilateral and regional cooperation. Presently, India has bilateral S&T cooperation agreements with 83 countries with active cooperation with 44 countries. In recent years, the cooperation has with Australia, Canada, EU, France, Germany, Israel, Japan, Russia, UK and USA has been strengthened significantly. Cooperation with African countries has also been strengthened through the India Africa S&T Initiative. The soft prowess of S&T has been leveraged to engage with several countries under India's Act East policy and with some neighbouring countries.

The DST currently supports three bi-national S&T centres which are independent entities established under inter-governmental bilateral agreements with France, USA and Germany. These are:

- Indo-French Centre for Promotion of Advanced Research (IFCPAR / CEFIPRA)
- Indo-US Science & Technology Forum (IUSSTF)
- Indo-German Science & Technology Centre (IGSTC)

The collaborations are in selected areas of mutual interest with different countries/organisations, and are materialised through various modes of cooperation such as contact building through joint workshops/seminars/frontiers symposia/exhibitions, visitation, fellowships & internships, exploratory visits providing support for joint R&D projects of mutual interest, participation in mega-science projects, joint R&D clusters, promoting commercial R&D and innovation and many such endeavours.

In order to enhance international S&T cooperation, about 500 bilateral R&D projects with nearly 44 countries and over 100 joint workshops/seminars were supported by DST. More than 2100 exchange visits took place under various bilateral programs. 27 projects were funded under the U.S.-India Endowment Fund for innovation, while 12 technologies have been commercialised in the broad areas covering healthy citizens and empowered citizens. More than 200 students were exposed to international peer interactions with Nobel Laureates and eminent scientists through the Lindau, Hope, Asian Science camp and Sakura programs to enhance professional opportunities in fundamental scientific research and to make research careers more appealing. More than 300 African researchers have availed the CV Raman Fellowship to undertake R&D work in India. Under the India Science and Research Fellowship program, more than 80 scientists from neighboring countries have availed fully paid fellowship to undertake R&D work in India.

1 India-Israel Partnership

India and Israel have agreed to significantly step up scientific and technological collaboration through the establishment of India-Israel Industrial R&D and Technological Innovation Fund (I4F) worth US $ 40 million. The joint Fund is aimed at facilitating and supporting industrial R&D projects leading to co-development and commercialisation of innovative technologies benefiting both countries in sectors covering agriculture, energy, ICT , health and water challenges.

2 BRICS Science, Technology and Innovation Cooperation

BRICS countries signed an MoU on Science, Technology and Innovation Cooperation in March 2015 to promote research and innovation with the broad objectives of addressing global and regional socio-economic challenges, utilising 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.

A. Arrangement of BRICS STI Framework Programme and the Implementation Plan

Eight funding agencies from BRICS countries signed an "Arrangement of BRICS STI Framework Programme" and the "Implementation Plan" and agreed to co-invest together US $10 million to support multidisciplinary R&D projects under BRICS STI. Pursuant to this, 26 BRICS R&D projects were supported, out of which India is a partner for 22 projects. The second call was announced in 2017 for which 291 eligible proposals were received.

B. BRICS Young Scientist Forum

Coordinated by India, the BRICS Young Scientist Forum/ Conclave is becoming an effective platform for networking of young creative talent. More than 50 young scientists from BRICS countries participated in these conclaves covering the areas of Biotechnology, Renewable Energy and Nanotechnology and Materials. India hosted the first conclave and deputed a team of 25 young Indian scientist in the second BRICS Young Scientists Conclave held at Hangzhou, China during 11-15 July 2017. These young researchers got a unique opportunity to discuss pressing problems, such as affordable energy solutions, affordable health and their solutions through scientific exploration and technological innovations. Two editions of BRICS Young Scientist Conclaves have been organised.

C. BRICS Science, Technology, Innovation and Entrepreneurship (BRICS-STIEP)

The Action Plan for BRICS Innovation Cooperation (2017-2020) was prepared in India's leadership, which was endorsed by the fifth BRICS Science and Technology Ministerial Meeting in China on 18th July 2017 and signed on 5th September 2017 at the IX BRICS Summit in Xiamen, China. The plan holds the initial focus on creation of networks of science parks, technology business incubators and SMEs, and to create talent pools for converting ideas into solutions to address societal challenges. The Department of Science and Technology, Government of India from India, and the counterpart Ministries/ Departments from other BRICS countries shall be the implementing agencies of the plan.

S&T Minister Dr. Harsh Vardhan with the Prime Minister of Portugal in Lisbon

3 India-Portugal Partnership

The R&D collaboration between India and Portugal will be significantly strengthened with the announcement of a 4 million Euro fund to support collaborative activities in marine science & technology, new materials research and tissue engineering.

4 Indo-German Bilateral Projects

Considering the relevance of digital economy and society, DST and Max Plank agreed to support the new phase of the Indo-German Centre on Computer Sciences. The new phase of the Indo German Centre for Sustainability will undertake research on impacts of climate change on the coastal infrastructure and the adaptation strategies. The funding to the bilateral Indo German Science and Technology Centre (IGSTC) was doubled from two million to four million euros from each side to further strengthen industrial R&D cooperation

Hon'ble Minister for S&T and ES inaugurating the India centric beam-line at PETRA III, DESY in Hamburg, Germany in September 2016

between academia and industry, focused on advanced manufacturing, energy technologies, bio-medical devises, ICT and others. A India centric beamline was also launched at the synchrotron facility at DESY, Hamburg, Germany.

5 Newton Bhabha Fund

The Newton Bhabha Fund aims to bring together the UK and Indian scientific research and innovation sectors to find joint solutions to the challenges India is facing in economic development and social welfare. The scheme is part of the UK's £ 375 million Newton Fund to support science and innovation partnerships between the UK and emerging powers. Under the Newton Bhabha programme between DST and the Research Council, UK, the neutron and muon source facility

MoU on Indo-UK Newton-Bhabha Program

at the Rutherford Appleton Lab in Oxfordshire, UK will be accessible to Indian researchers. This will enable Indian scientists to work in the frontier areas of nano-science and technology through access to the portfolio of high-end instruments.

6 India-Canada Technology Summit

The DST–CII India-Canada Technology Summit was held on the 14th and 15th of November 2017. It is aimed at providing a high profile and wide-ranging platform to industries, institutions and government agencies from India and Canada and to forge knowledge-business partnerships to boost investments and trade. The focus areas of the summit were smart ideas, defence and aerospace, smart machines, smart transport, smart women, smart people, clean energy and smart care.

7 Global Research Council Meeting

SERB jointly hosted the Fifth Annual Meeting of Global Research Council (GRC)-2016 from 25th to 27th of May 2016 with the Research Councils UK (RCUK). The Global Research Council (GRC) is a virtual organisation comprising the Heads of Research Councils from around the world, dedicated to promoting the sharing of data and best practice for high-quality collaboration among research funding agencies globally. Heads of Research Councils from 44 countries were among more than 100 delegates who attended the event to share the best practices and discuss policy issues in the field of Research Funding. A Statement on 'Principles of Interdisciplinarity' and 'Actions towards Equality and Status of Women in Research' was discussed and endorsed by participants representing the global research community.

8 Joint Clean Energy Research and Development Centre on Smart Grids and Energy Storage

India and the United States expanded collaboration under the Partnership to Advance Clean Energy-Research (PACE-R) to include smart grid and grid storage critical importance of expanding clean energy research, development, manufacturing, and deployment, which increases energy access and reduces greenhouse gas emissions.
A Funding Opportunity Announcement (FoA) was made in July 2016 to support multi-institutional network projects using public-private partnership model of funding. An award will be made to a consortium with the knowledge and experience to undertake high-quality collaborative research programs. Seven applications have been jointly submitted by the US and Indian researchers who would be members of the Consortia based on their mutual interests, priorities and strengths.

9 MoUs signed during the India-Africa Forum Summit

Under the India-Africa Forum Summit, DST in partnership with MEA is implementing the CV Raman Fellowships which enables researchers from African nations to undertake research in Indian R&D and academic institutions under a fully paid fellowship. This has established the S&T footprint of India across 38 African nations. From

2017, the number of fellowships was increased from 100 to 200 every year. Capacity building and training through twinning model have been extended to Benin, Ethiopia and Tunisia. Under the Africa Initiative Technology Transfer, programs with Ethiopia, Rwanda and S. Africa have been launched.

10 India-Japan Joint Research Laboratory Programme

Japan relationships with India were substantially strengthened by establishing Indo-Japan Joint laboratories in Internet-of-Things, big data analysis, and Artificial Intelligence (AI). The Phase II of the Indian Beamline at the synchrotron facility at KEK in Tsukuba, Japan was launched in November 2016 for conducting studies on nano-material characterisation for energy storage and generation.

11 IC-IMPACTS Program with Canada

An innovative model of R&D cooperation through the India-Canada Centre for Innovative Multidisciplinary Partnership to Accelerate Community Transformation and Sustainability (IC-IMPACTS) programme supported to promote research partnerships aimed at social transformation by providing solutions through application of science and technology in identified areas of safe and sustainable civil infrastructure and integrated water management.

12 India-Australia Strategic Research Fund (AISRF)

New projects in the areas covering advanced manufacturing, smart cities and infrastructure technologies, lifestyle and emerging disease control; and bio-medical technologies will be launched with Australia under the India-Australia Strategic Research Fund (AISRF). The program, which is in its tenth year, has announced ten projects selected for funding on 10 April 2017. Phase II of the Australia-India Strategic Research Fund (AISRF) was launched for providing technological solutions to grand challenges in areas of human health science and agriculture biotechnology.

13 ASEAN-Indian Science and Technology Development Fund (AISTDF)

The ASEAN-Indian Science and Technology Development Fund (AISTDF), with an equivalent amount of 5 million USD, has been created to support collaborative R&D projects, research & training fellowships and ASEAN-India Innovation Platform which includes social innovation, research innovation and product innovation. The call for proposals under R&D collaborative projects and research training fellowships have been launched. Ten R&D projects in the areas of Material Science, Biofuels, Chemical Engineering, Biotechnology and Electronics and IT have already been sanctioned for a period of 3 years. The ASEAN-India Innovation Platform concept document has also been finalised and the activities under the Innovation Platform are being launched soon.

14 India-EU Cooperation in Research and Innovation

The India-European Union (EU) Science and Technology Agreement was renewed in 2015 for another five years. In the last four years, 17 multi-countries projects were supported in the areas of new energy materials and smart grid, diagnostic for chronic non-communicable diseases, bio-economy and waste to energy.

15 India-EU Collaboration in Water

India and European Union agreed to collaborate in the water sector at the 11th India-EU Joint Steering Committee meeting held in Brussels on 6th June 2017. Pursuant to this decision, a joint India-EU Water Call was launched on November 7, 2017 seeking joint research proposals focused on wastewater treatment technology including bioremediation, drinking water purification and real time water quality monitoring. Both sides together will jointly invest € 30 million to address these water challenges faced by India.

16 DST- ICTP Cooperation for ICTP Ramanujan Prize in Mathematics

The 'Ramanujan Prize', named after the illustrious mathematician from India, for outstanding contributions by young mathematicians from 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 following 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.

17 Indo-US Fulbright-Kalam Fellowships in Climate Change

The Fulbright-Kalam Climate Fellowship has been launched in pursuance of the Joint Statement of the Government of USA and the Government of India. The United States-India Educational Foundation (USIEF) has been given the responsibility to administer the Fulbright-Kalam Climate Fellowship on behalf of both the governments. The first batch of six fellows has been selected.

18 Program with Centre National de la Recherche Scientifique (CNRS)

Initiated co-operative program with the Centre National de la Recherche Scientifique (CNRS) of France to further accelerate scientific cooperation in frontier areas of mutual interest through thematic networked Centres.

19 India-Italy Partnership

A new chapter of cooperation with Italy was enabled through the Industrial R&D program focused on industry led research which would enable development of new process or products in sectoral areas covering Advanced Materials, Smart Manufacturing, Technologies for Cultural Heritage and Water Technologies. Two new Indian beamlines were also established at the synchrotron facility at Elettra and access to more than 150 Indian researchers to this facility was also provided.

20 India-Russia Partnership

A new programme was launched with the Russian Ministry of Education and Sciences (RMES) to support joint research projects in the areas of Applied Sciences. DST and the Foundation for Assistance to Small Innovative Enterprise (FASIE) of the Russian Federation concluded a new MoU to further the objectives of supporting enterprises in both countries for technology development through industrial research and innovation.

21 India-South Africa Partnership

A novel program on grass-root innovation was launched with South Africa for sharing of open source technologies and IP protection of traditional knowledge systems. This program is designed for co-development of products, validation through deployment and market ready technology transfer to meet the unmet needs of common people.

A multi-institutional project on HIV Vaccine Research has been also initiated to develop preventive HIV vaccine that will also lead to identification of biomarkers and development of novel techniques for diagnosis and management of tuberculosis.

22 India-South Korea Partnership

The South Korea virtually-networked R&D Centres on 'Robotics' and 'Computational Materials' have been established. These Centres are aimed at leveraging complimentary R&D strengths of both countries through convergence of competencies in design, simulation and development of advanced manufacturing techniques.

23 India-US Partnership

A new priority R&D area on Smart Grids and Energy Storage was supported through joint consortia-based project to enhance the cooperation with USA under the Partnership to Advance Clean Energy Research (PACE-R). India also became a partner in the LIGO project for gravitational wave detection with agreement to set-up the detector station in India.

The call announcement of the India Science and Research Fellowship (ISRF) 2017-18 launched in the 2017 India International Science Festival, Chennai

24 Partnership with neighbouring countries

India Science and Research Fellowships were extended for seven neighbouring country scientists for undertaking research work in India. These include fellowships for Afghanistan, Bhutan, Bangladesh, Maldives, Myanmar, Nepal and Sri Lanka. S&T Ministers Conclave was also organised as a part of the 2017 India International Science Festival held in Chennai. Ministers from Afghanistan and Bangladesh participated in the event. On the occasion, Hon'ble Minister announced 200 travel slots for researchers and scientists to avail various training opportunities in India.

Activities/Achievements of CSIR International S&T in Cooperation & Collaborations

Process flow sheet for beneficiation of low grade Iron ore sample from Shire-Mentebteb, Ethiopia

CSIR-NML has developed a process flow-sheet for beneficiation of the low-grade iron ore (as saying 33.17% Fe) of Ethiopia to produce concentrate with 51% Fe. About 500 million tonnes of iron ore resources are located in Shire-Mentebteb region of Ethiopia. The deposit is a lean grade goethitic ore and it is to be concentrated to a level suitable for utilization through blending with high grade concentrate for iron and steel making.

CSIR's Twinning Programme with the Metal Industries Development Institute (MIDI), Ethiopia

CSIR is not only helping Indian industries with its knowledge base and expertise but is also foraying in developing and under developed counties to enhance their competitiveness. One such example is CSIR's agreement with the Metal Industries Development Institute (MIDI), Ethiopia. CSIR will enhance the capacity and capability of MIDI under the twinning arrangement and thereby enable it to contribute more efficiently towards the development of Metals and Engineering sectors in Ethiopia.

Working programme between CSIR and Vietnam National University

In furtherance to the MoU signed between CSIR and Vietnam National University (VNU, a "Working Programme" was initiated between the two organisations during 2014 -16 for S&T collaboration in the areas of chemical science & technology and geosciences, oceanography and climate change.

MoU signed with Stiftelsen SINTEF

CSIR and the Stiftelsen SINTEF headquartered in Norway entered into a MoU towards developing Scientific & Technical cooperation at Oslo, Norway during the visit of the Hon'ble President of India to Norway.

DBT International Collaboration

As India is emerging as a major biotechnology hub in the Asian region, there is a need for scientific capacity building to match the global standard and for facing new challenges. The Department has strategically developed strong international collaborations with numerous countries and non-governmental organisations over the last decade. DBT has also initiated the process of constant dialogue with the scientific communities across the globe for generation of new ideas and concepts in all areas of biotechnology and life sciences. More than 400 R&D projects were supported with nearly 20 countries.
Few recent developments in international collaboration are summarised below:

Australia

Agreement has been signed for collaboration in important areas of biotechnology like aquaculture and marine biotechnology, vaccines, bioenergy and biofuel, stem cell, transgenic breeding, food technology with the Australian Department of Education, Science and Training. Proposals were invited in the area of immunomodular, immunotherapeutics, biotechnological intervention for improved agricultural productivity and vaccines. The Indian and Australian Governments have set up the Australia India Strategic Research Fund where competitive funding is awarded under two components covering a range of science and research priority areas-Indo-Australian Science and Technology Fund, Indo-Australian Biotechnology Fund for providing support for collaborative research projects with an Indian and an Australian applicant

Canada

The department has ramped up its collaboration with different Canadian agencies. A major initiative was announced during the visit of Hon'ble Prime Minister of India to Canada in April 2015. In it, five health innovations in India are being funded by Department and Grand Challenges, Canada and the Government of Canada. Department in collaboration with IC IMPACTS (the India-Canada Centre for Innovative Multidisciplinary Partnerships to Accelerate Community Transformation and Sustainability), Canada under the ongoing programme "Water for Health" have funded several projects. In order to further collaboration with IC–IMPACTS, a joint call in the area of "Portable Diagnostics and Analysers" was announced. There will be increased focus on the development and evaluation of new diagnostics and analysers for infectious diseases, maternal and infant health, nutritional deficiency and interdisciplinary approaches and platform technologies.

Denmark

Department in collaboration with Innovation Fund Denmark (previously Danish Council for Strategic Research) invited proposals for Strategic Research Projects within Human Health Biotechnology. Under the call one project was jointly recommended for funding.

Finland

Department in partnership with TEKES, Finland (a funding agency for technology, innovation and industry collaboration) invited proposals in the area of "Innovative health and well-being solutions for all" through joint call.

France

Department has signed a MoU with the University Pierre ET Marie Curie (UPMC) and The Centre National de la Recherche Scientifique (CNRS) for the establishment of a National Institute of Marine Biology and Biotechnology in India. The MoU was signed by Secretary, DBT, in the presence of Hon'ble Prime Minister of India and the Hon'ble President of France during the Prime Minister's visit to France in April 2015.

Germany

In collaboration with German Federal Ministry, Science Research and Technology (BMBF), the Department has agreed to participate in inviting proposals focusing on Biotechnology for reuse of biodegradable urban solid waste and Biotechnology for reuse of biogenic raw materials in agriculture.

Netherlands

The Department and its subsidiary company the Bharat Immunologicals and Biologicals Ltd (BIBCOL) has signed a MoU with the Institute for Translational Vaccinology (Intravacc) of the Kingdom of Netherlands on "Development of Vaccines". The MoU was signed during the visit of the Prime Minister of Netherlands to India on 5th June 2015. Intravacc and BIBCOL have agreed to partner with the aim of setting up of a measles-rubella vaccine plant for BIBCOL.

Russia

Five joint proposals in area of nano-biotechnology, affordable diagnostics and devices in human health and bioenergy have

been supported under the 'Programme of Co-operation' (PoC) with the Russian Ministry of Education and Science, Russian Federation in the area of Biotechnology.

Spain

DBT has collaborated with CDTI, Spain (The Centre for Industrial Technological Development) an enterprise of Ministry of Economy and Competitiveness, Spain for technological development and innovation of Spanish companies.

Switzerland

A new collaborative network project titled "Improvement of pigeon pea for plant type, pod borer resistance and moisture stress tolerance" was initiated with Indian investigators from National Research Centre on Plant Biotechnology (NRCPB), Indian Agricultural Research Institute (IARI) and National Bureau of Plant Genetic Resources (NBPGR), New Delhi; and Swiss investigators from Swiss Federal Institute of Technology (ETH), Zurich, and School of Agricultural, Forest and Food Sciences (HAFL), Zollikofen with the objective to develop pigeon pea varieties with improved productivity and resistance to pod borer, which can be marketed, processed and priced in line with cereals and competing crops.

Sweden

Swedish Governmental Agency for Innovation Systems (VINNOVA) is partnering with the Department with three joint calls for proposals successfully accomplished. In the current year, a call for proposals partnering DBT, India and VINNOVA, Swedish Research Council was announced in the area of Biotechnology.

Tunisia

Under the Joint Programme of Cooperation, a project entitled "Assessment of the protective effect against Tuberculosis, of a new vaccine composition" has been sanctioned at ICGEB. A major focus of the project is on development of a novel method of vaccination against tuberculosis (TB), based on enhancement of BCG-mediated apoptosis through FOXO3 activation. The aim of the study is to use a novel vaccine composition made of the classical BCG mixed to FOXO3 activators (Commercially available chemicals and/or drugs capable to strongly activate FOXO3). Such composition would induce higher apoptosis of infected cells than the classical BCG alone and may confer a higher protection against TB.

U.K.

The Department in collaboration with U.K. partners (BBSRC, NERC, MRC, AMS, British council, DFID, Newton fund, INNOVATE) has launched programmes which touch upon an array of global challenges which are relevant in local Indian context. Flagship programmes initiated in partnership with U.K. are directed to address key issues of health, environment (atmospheric pollution), climate change and agriculture, antimicrobial resistance, vaccine development and tackling loss of farm produce. Programmes also address the need for improving upon quality of research through bilateral student exchange programmes.

USA

One of the major success of DBT's collaboration with USA is the low-cost rotavirus vaccine. DBT also spread access to the low-cost origami microscope in collaboration with Prakash Lab, Stanford University. The statement of intent for this initiative was signed by Secretary, DBT in the presence of Hon'ble Prime Minister of India on his visit to USA during the India-US STARTUP Konnect event. According to their agreement DBT and Prakash Lab are using Foldscope as an educational and training tool to understand physics, chemistry, biology and instrumentation. Workshops and training programmes are being run by Prakash lab in collaboration with Indian laboratories.

Japan

DAILAB (a collaborative laboratory called DBT-AIST International Laboratory for Advanced Biomedicine) at the Biomedical Research Institute (BMRI), Tsukuba campus of the National Institute of Advanced Industrial Science &Technology (AIST)

in Japan is the first international laboratory in Life Sciences & Biotechnology. It emerged as a step up from bilateral MoU and is aimed at promoting close and effective research collaboration and networking. The DAILAB-TENJI (Training for Technology Exhibit & Networking to Jump for Innovation and Industrialisation) has been participating in industrial trade fairs held in India and Japan to skill technology exhibiting and networking for innovation and industrialisation.

EU

DBT is partnering in the fourth joint transnational call in the area of 'Human infectious disease research" under Infect-EraNet. Under an ongoing initiative with geographical era-net INNO INDIGO, the Department has funded five proposals in area of "Clean Water and Health" under the project "Integrating Bio-treated Wastewater Reuse with Enhanced Water Use Efficiency to Support the Green Economy in EU and India (India side)".

MoES international cooperation

MoES extensively engages with the best institutes overseas in the field of earth system sciences to solve some of the key challenges in weather and climate related to the Indian region.

Cooperation with NOAA,USA

Under an MoU between MoES and the National Ocean and Atmospheric Administration (NOAA), ten joint research and development activities have been undertaken in the field of monsoon, ocean observations, tropical cyclone, tsunami, INSAT 3D, predictive capabilities on marine fisheries and harmful algal blooms, development of an ocean wave modeling and assimilation system for the indian ocean region to enhance the capability to generate a skillful global wave model systems especially for monsoon conditions. Significant achievements have been made in joint research between MoES and NOAA

during last four years.

India expressed readiness to enhance cooperation on Arctic science and research. This was conveyed to the first ever White House Arctic Science Ministerial meeting in Washington DC where the Minister of Science & Technology and Earth Sciences, Dr. Harsh Vardhan signed a statement for the purpose. The Minister emphasised the significance of environment and climate change in the Arctic region and its impact on Indian monsoon.

Cooperation with UK Met Office (UKMO)

In 2016,MoES signed a Consortium Agreement with the U.K. Met Office (UKMO), Korea Meteorological Administration (KMA), the Commonwealth of Australia through its Bureau of Meteorology and the Commonwealth Scientific Industrial and Research Organisation (CSIRO) and National Institute of Water and Atmospheric Research Limited, New Zealand for Core partnership on Unified Model (UM) for weather and climate forecast. This MoU enables robust collaborative partnership on joint developmental programs among all the international partners of the UM system (UK, Korea, Australia, India) under a common governance structure.

Cooperation with NERC, UK

Under this MoU, three implementing agreements (IA) have been signed with NERC UK.

1. Predicting the variability of the South Asian monsoon
2. Atmospheric pollution and human health in an Indian megacity
3. Sustaining water resources for food, energy & ecosystem services in India

India-UK Virtual Joint Centre on Water Security (IUKWC)

MoES and the NERC, UK are working together to support research in the area of "Sustaining Water Resources" and has set up a "India-UK Virtual Joint Centre on Water Security" (IUKWC) at IITM, Pune. The centre will provide a platform for joint hydrological research and greater dialogue, engagement and knowledge transfer between researchers, policymakers and business. The centre will fund and co-ordinate a diverse programme of workshops and exchange visit.

Cooperation with Belmont Forum Countries

An MoU was signed between MoES and the Belmont forum countries to support Indian scientists for international collaborative research through joint calls in societally relevant global environmental change challenges. MoES is participating in 4 Collaborative Research Areas (CRA), namely those on coastal vulnerability, food security, biodiversity and climate predictability and inter-regional linkages.

Cooperation with International Seabed Authority (ISA)

The Council of the International Seabed Authority (ISA) on 10th August 2017 approved the extension of contract between Ministry of Earth Sciences (MoES), Government of India and the ISA (an Institution set up under the Convention on Law of the Sea to which India is a Party) for exploration of Polymetallic Nodules (PMN) for a further period of 5 years (2017-22). By extending the contract, India's exclusive rights for exploration of PMN in the allotted area of 75,000 sq km in the Central Indian Ocean Basin (CIOB) will continue and open up new opportunities for resources of commercial and strategic value in area beyond national jurisdiction.

Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES)

RIMES is an international and intergovernmental institution owned and managed by its 33 member and collaborating states for building capacities in the generation and application of user-relevant early warning information. Currently, the Government of India serves as the Council Chair. The 9th RIMES Council Meeting and the 3rd RIMES Ministerial conference was held at Port Moresby, Papua New Guinea during 23-25 August 2017. It focused on discussion issues relating to enhancement of multi-hazard early warning capacities and to the broadening of the RIMES institutional development process. Afghanistan, Djibouti, Mozambique, Tonga, and Yemen joined as the new RIMES Member States. INCOIS started providing OSF (Ocean State Forecasts) services to various countries including Comoros, Mozambique and Madagascar.

Way Forward

Way Forward

DURING the last four years there has been a special focus on convergence and bringing science to society. Keeping with the call of our Prime Minister of Sankalp se Siddhi – Making of a New India 2022, the Ministry of Science & Technology and the Ministry Earth Sciences will strive to ensure that science and technology continue to impact society. We will deepen our engagement with society and continued efforts will be made towards quality education, encouraging youth and attracting them to Science.

Cutting edge new applications of science for global competitiveness; science for national missions; bringing more socio-economic benefits from Earth System Science services; encouraging startups and entrepreneurs, and promoting indigenous, affordable and accessible products under Make in India will be the endeavour of the ministries.

Our Motto is

Vigyan Se Vikas – Science Impacting Society.

The future road map of the Ministries is given below.

Department of Science and Technology (DST)

DST will focus on bringing together the science of the future and the social scientific needs of this huge country. Capacity building of scientists, teachers, researchers and students will continue to be high on priority and given added impetus.

- **Securing our Future:** DST to launch a comprehensive Rs 3600 Crore National Mission on Cyber-Physical-Systems (mentioned in the Budget Speech of the FM 2018), which includes Artificial Intelligence, Machine Learning, Deep Learning, etc. and the synthesis of these elements for applications in Agriculture, Health, Manufacturing, Robotics, Sensor Networks, Education, etc. The Missions will cover the entire value chain from R&D to technology development to innovation/startups to commercialization of technology.

- **Impacting Research Innovation and Technology (IMPRINT-2):** The second phase of IMPRINT-2 with a total budget of ₹ 970.5 crore has been launched in March 2018. DST and MHRD will jointly steer this national initiative. SERB will be the nodal agency for implementing IMPRINT-2. IMPRINT-2 is proposed to be undertaken in a more inclusive manner by expanding the catchment of implementing institutions, by adopting a more demand-driven strategy of solution development and by incorporating the specific externalities of the states of India so as to make end-user translation and technology adoption easier.

- **Teacher Associates for Research Excellence (TARE)** will continue to facilitate mobility of faculty members working in regular capacity in state universities/colleges and in private academic institutions to carry out research work in an established public funded institution such as IITs, IISc, IISERs, NITs, CSIR, ICAR, ICMR labs and other central institutions and central universities, located preferably closer to the institution where the faculty

member is working. Provision of fellowship amount of ₹ 5,000 p.m., contingency grant of ₹ 5 lakh per annum and overhead for a period of 3 years has been made. Maximum of 500 such awards would be granted per year.

- **Augmenting Writing Skills for Articulating Research (AWSAR):** DST has been in the forefront in devising and implementing several initiatives to communicate Science and Technology (S&T) to the society and to inculcate scientific temper among all as enshrined in the Constitution of India. In order to encourage science communication as an alternate career choice and to tap latent talent to popularize & communicate science and inculcate scientific temperament in the society, each year 100 best entries from PhD Scholars and 20 from Post-Doctoral Fellows will be awarded ₹ 10,000/- each with a Certificate of Appreciation. In addition, Cash prizes of ₹1,00,000/-, ₹50,000/- and ₹ 25,000/- respectively would be given to 3 leading stories.

Department of Biotechnology (DBT)

India's biotechnology industry has been built on four core beliefs – entrepreneurship, innovation, developing local talent, and demonstrating high quality value based care. The country is amongst the top 12 biotech destinations in the world and ranks third in the Asia-Pacific region. The industry includes 500 companies, records the second highest number of USFDA-approved plants (only after the United States). Continued support to the biotech industry to reach the target USD 100 Billion by 2025 will be the endeavour.

- Development of a translational ecosystem connecting Industry-Academia-Research to take advanced leads from our research labs to commercialization especially in the health, agriculture and energy sector.
- Mission on application of big data and computational biology and biotechnology.
- Building and strengthening partnerships with national and international stakeholders. Will collaborate across ministries, state governments and build robust biotech capacity across the country
- International Bioconnect offices will be established to leverage International strengths for national impact. Vibrant translational ecosystems for cutting edge science for maximum social development.

Council of Scientific and Industrial Research (CSIR)

CSIR is repositioning itself towards technology and intellectual property development, translation and commercialization with a major focus on enhancing industrial competitiveness and entrepreneurship. CSIR today is focused in a major way on "Technology Innovation and Translational Research and Commercialization" to achieve the national goal of socio economic development. To achieve results, CSIR will focus on outcomes through a thematic approach to harness multidisciplinary talent and infrastructure.

- CSIR has forged close ties with stakeholders across government and private sectors around specific missions of relevance to economy including MSME, and the strategic sector.
- CSIR is focusing on solving the problems faced by the common people, through desired scientific and technological interventions such as affordable health care, malnutrition, enhancing potability of water, hygiene and sanitation, affordable housing, to name a few.
- On the societal front, other mandates include large-scale skill development and employment generation.

- Eight Thematic Directorates have been formed in CSIR and these cover specific sectors: (i) Aerospace, Electronics, and Instrumentation & Strategic Sectors; (ii) Civil Infrastructure & Engineering; (iii) Ecology, Environment, Earth & Ocean Sciences and Water; (iv) Mining, Minerals, Metals and Materials; (v) Chemicals (including Leather) and Petrochemicals; (vi) Energy (conventional and non-conventional) and Energy devices; (vii) Agri, Nutrition & Biotech; and (viii) Healthcare.
- The Theme Directorates are envisaged to provide for greater alignment to and for enhancing industrial/ stakeholder focus of CSIR R&D activities. The roadmap and activities of each theme would focus on substantial contributions towards each of the parameters – public good, private good, strategic good and societal good.

Ministry of Earth Sciences (MoES)

MoES provides weather, climate, ocean, coasts and seismology. MoES will spread its impact from land to deep oceans. The development of Multi-hazard Early Warning Systems for Disaster Risk Management will continue to be on a high priority.

- MoES will augment the Agromet Advisory Service (AAS) network to sub-district level by setting up of District Agro-Met Units (DAMUs) in 530 districts, thus creating a network of 660 units by the end of March 2020 for providing sub-district (block) level agromet services to farmers in the country. Currently, about 24 million farmers are receiving crop specific agro-meteorological advisories in vernacular languages. It is planned to reach about 40 million farmers by the end of July 2018. This initiative will help farmers to reduce crop losses due to weather vagaries.
- MOES will be installing six more desalination plants in Lakshadweep islands, each with a capacity to produce 1.5 lakh litres of water per day, with the help of Lakshadweep administration. Two plants will be commissioned by December 2018. These six plants are in addition to the three plants already installed by MoES. This will ease drinking water problems in the islands.
- MoES will further strengthen the weather and climate services and establish a state of the art multi-hazard early warning system for severe weather like tropical cyclones, floods, droughts, thunderstorms/dust storms, etc. The ultimate goal will be to make India "Weather Ready and Climate Smart".
- MoES will further strengthen the ocean and coastal services by improving Tsunami warning system for predicting inundation due to Tsunamis, establishing Marine Coastal Pollution Monitoring and Prediction system, and assessment of Marine Litter around the Indian seas.
- Oceans cover 72% of the Earth and provide a substantial portion of the global population with food and livelihood. The blue economy encompasses sustainable use of ocean resources for economic growth, improved livelihoods and job and health of ocean ecosystem. MoES is in the process of formulating multiagency programmes on the Deep Ocean Mission encompassing various aspects of oceans in an integrated framework with involvement of other national departments, viz. CSIR, DBT, ICAR, Department of Space, etc. It consists of appropriate programmes for sustainable harnessing of ocean resources (water, minerals and energy) and development of suitable technology like manned submersibles, deep sea mining system, autonomous underwater vehicles (AUV), etc.