Annual Report

2020-21

Council of Scientific and Industrial Research, New Delhi

Annual Report

2020-2021

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

NEW DELHI

Prepared by
Science Communication and Dissemination Directorate, CSIR

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Staff Strength

10724	3507	4390	2827
Permanent Staff (as on 01.04.2021)	**Scientists Gr. IV**	**Technical and Support Staff**	**Administrative Staff**

Budget (Rs. in Crore)

GIA General	1858.400
GIA for Capital Assets	300.000
GIA General (Research Scheme, Scholarship & Fellowship)	400.000
GIA Salary	1650.000
Total	**4208.400**

Performance Indicators

Intellectual Property

- More than **5000** Research Publications during 2020
- **208** Patents Filed in India
- **318** Patents Granted in India
- **174** Patents Filed Abroad
- **206** Patents Granted Abroad

National S&T Human Resource Development

- Junior Research Fellows Supported: **2247**
- Senior Research Associates (SRAs) in position: **176**
- Research Schemes supported: **676**
- Emeritus Scientists in position: **82**

EXECUTIVE SUMMARY

Preamble

- The Council of Scientific & Industrial Research, established in 1942 is an autonomous body known for its excellence in R&D and S&T innovations. CSIR has pan India presence through its network of 37 national Laboratories which undertake well focused basic and applied research in diverse fields of science and technology. CSIR has also established 39 outreach centers, one innovation complex and three units. CSIR's R&D expertise and experience is embodied in about 3507 active scientists supported by about 4390 scientific and technical personnel.

- CSIR has been playing a significant role in mentoring the scientific and technological advancement of the country. Through its technological interventions, CSIR has not only provided solutions and innovations for the industry but has also proved to be a catalyst in improving the quality of life of millions of people across the country. CSIR covers a wide spectrum of science and technology - oceanography, earth sciences, geophysics, chemicals, drugs, genomics, biotechnology and nanotechnology to mining, aeronautics, instrumentation, environmental engineering and information technology. It provides significant technological intervention in many areas with regard to societal efforts which include environment, health, drinking water, food, housing, energy, leather, farm and non-farm sectors.

- CSIR is the Nation's custodian for Measurement Standards of Mass, Distance, Time, Temperature, Current etc. CSIR has created and is the custodian of Traditional Knowledge Digital Library (TKDL) which is a powerful weapon against unethical commercial exploitation of Indian Traditional Knowledge. CSIR maintains Microbial Type Culture Collection (MTCC) and Gene Bank.

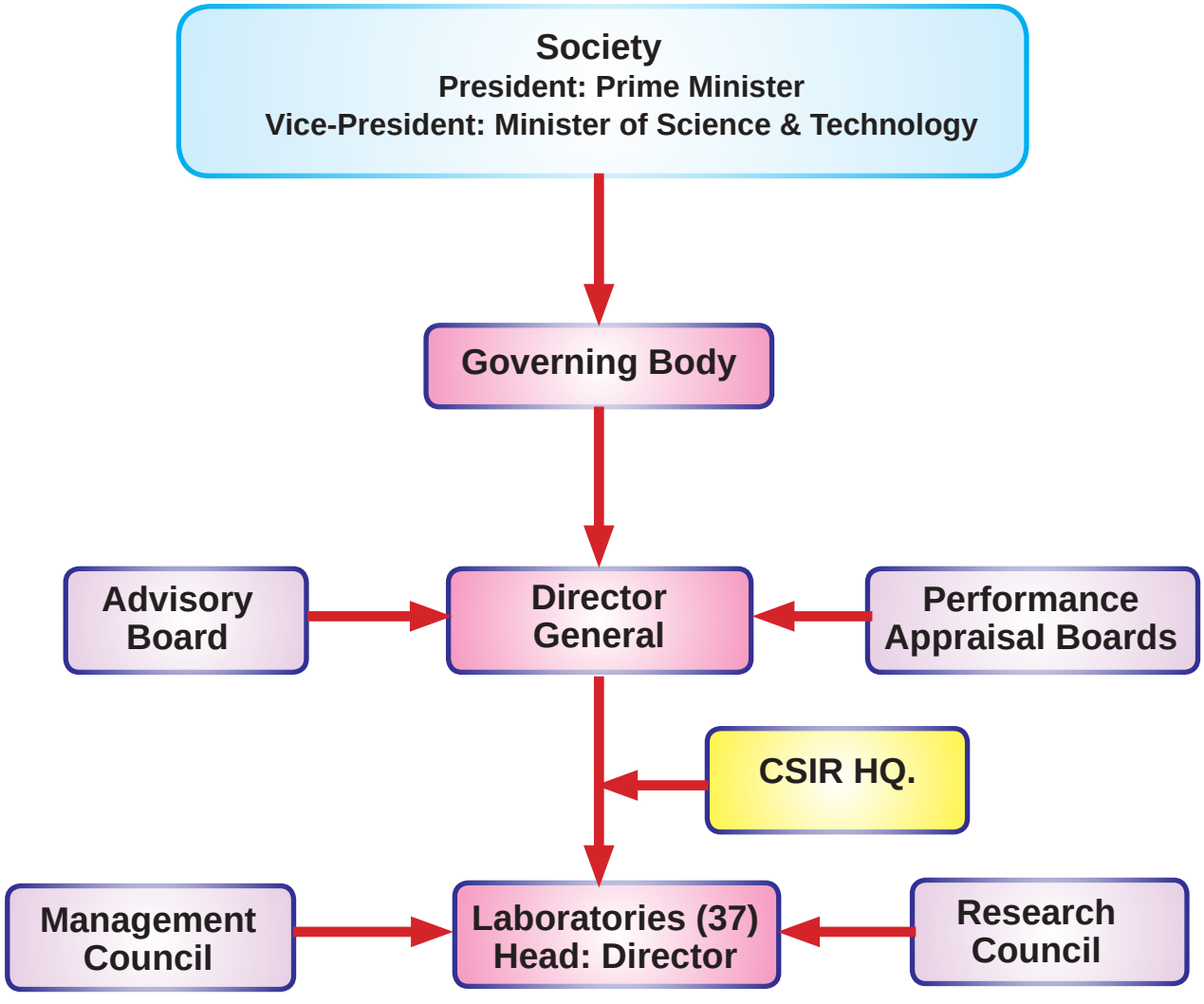
- Pioneer of India's intellectual property movement, CSIR today is strengthening its patent portfolio to carve out global niches for the country in select technology domains. CSIR has pursued cutting edge science and advanced knowledge frontiers. It has published around 5043 papers in SCI Journals during 2020 with an average impact factor of 4.481.

- CSIR through its various constituent Laboratories is also placing major focus upon creating incubation facilities for spin off and startups. CSIR hand holds these companies so as to create a new segment of knowledge enterprises.

- CSIR has been focusing in a significant manner on the development of S&T Human Resource and has been providing yeoman service through various fellowships. It has been imparting skills in diverse S&T areas so as to empower youth for better career and employment opportunities. CSIR has forged linkage with Ministry of Skill Development and Entrepreneurship to enhance and widen its contributions for Skill Development in the country.

- The year 2020-21 has been challenging with the emergence and spread of the highly infectious coronavirus disease SARS-CoV-2. Despite the extraordinary challenge posed by the nationwide lockdown, CSIR laboratories comprising its scientists, students and staff, exhibiting great dedication came in the forefront and worked tirelessly on multiple fronts ranging from development & distribution of hand sanitizers and protective masks, which saw a sudden increase in demand as compared to its availability. They also strived to generate general awareness to the public about the preventive measures to combat the spread of the virus through social communications, media, posters etc. and generating awareness about the lockdown guidelines. Identifying the need of the hour, various CSIR labs also started working on setting up facilities for testing of patient samples, development of novel diagnostics, hospital assistive devices, PPEs, make-shift hospitals and other initiatives. CSIR devised a strategy to address the Covid-19 comprehensively and identified five verticals namely; Digital and Molecular Surveillance; Rapid and Economical Diagnostics; Repurposed/New Drugs and Vaccines; Hospital Assistive Devices and PPEs, Supply Chain and Logistics. All CSIR labs initiated contributing to these verticals along with identifying suitable Industry and PSU partnerships in order to produce and deploy the proposed/targeted products and technologies in the country.

CSIR Organizational Structure



CSIR Vision

"Pursue science which strives for global impact, technology that enables innovation-driven industry and nurture transdisciplinary leadership thereby catalysing inclusive economic development for the people of India"

The people and nation-centric thrust to science, technology and societal pursuits remains the cornerstone of CSIR's mission. In view of rising dreams and aspirations of the nation, its expectation from CSIR and the other public funded institutions is ever increasing. Not only are the pace of scientific and technological growth and the aspirations of higher living standards evident today but also many age old myths of economy and economy and growth have been broken; e.g., the shift from manufacturing to services; capital resources to knowledge resources; population as a burden to human resource as an asset; national needs to international opportunities and so on. The changed scenario has inspired CSIR towards:

- Science & engineering leadership;
- Innovative technology solutions;
- Open innovation and crowd sourcing;
- Nurturing talent in transdisciplinary areas;
- Science based entrepreneurship; and
- Socio-economic transformation through S&T intervention.

Director General's Message

The year 2020-2021 was unprecedented in the world history of about a hundred years gone by. There have been natural and manmade catastrophes and disasters, but perhaps not of the scale and spread seen during the Covid-19 pandemic. Just about every country in the world was affected by the pandemic.

The situation was no different in India. Almost every citizen of the country was affected by the pandemic, one way or the other, severely or marginally. The pandemic exposed our systems' vulnerabilities when faced with a catastrophe like the Covid-19.

However, India rose to the challenges posed by the pandemic. It was emergent to control the spread, attend to the infected and develop vaccines to pre-empt the virus. Naturally, the spotlight was on the medical and scientific fraternity of the country, including the CSIR.

CSIR was quick to respond to the unfolding Covid-19 crisis. CSIR initiated a strategy to handle the situation even before the contagion was declared a pandemic. For effective planning and strategizing, CSIR swiftly set up five Covid-19 verticals, including disease surveillance, drugs & vaccines, testing & diagnostics, PPEs and supply chain management. This anticipatory approach enabled the CSIR laboratories to develop over a hundred Covid-19 specific technologies in just 3-4 months.

From building makeshift hospitals to developing a formulation for the Favipiravir drug, from designing ventilators to contributing to vaccine development, from conducting clinical trials and serosurveys to developing CRISPR based diagnostic kits, CSIR was right at the forefront of India's Covid-19 battle. This annual report has an entire section on CSIR's Covid-19 contributions.

Although the focus of CSIR during the year was largely on Covid-19 research and development, we also made significant contributions in other areas. CSIR introduced, for the first time, asafoetida cultivation in India, launched indigenous footwear sizing system, consolidated the floriculture mission, rolled out *Hansa NG*—the new generation two-seater trainer aircraft, trialled India's first hydrogen fuel cell car, installed aviation weather monitoring system, carried out the heliborne geophysical survey and so on. Details of these and many more achievements of CSIR during the year are also given in this report.

CSIR was the lead organization to host the India International Science Festival 2020. Despite being in the throes of a pandemic, CSIR-NISTADS and CSIR-NISCAIR, with the active involvement of all other ministries, organized one of the biggest ever science festivals in the online format with 41events and over 1.3 lakh participants.

Five Guinness Records were also set during the festival. To harness the synergy of CSIR-NISCAIR and CSIR-NISTADS, and to strengthen science communication and policy research, the two institutes were merged to form the new CSIR-National Institute of Science Communication and Policy Research (CSIR-NIScPR).

Since its inception, CSIR's scientific research has focused on technological development for the industry. That notwithstanding, CSIR scientists have always contributed to basic and blue-sky research in several frontiers. Many R&D efforts of CSIR also have been keeping the country's rural sector in mind.

During the pandemic year, too, we continued to focus on the rural sector. CSIR-CCMB distributed the improved Samba Mahsuri Rice to over 3000 farmers of several states. CSIR-CLRI has taken up the development of the leather value chain in Ladakh. CSIR-IIIM distributed quality planting material of lavender to many farmers of different locations in the Doda district of Jammu and Kashmir.

I am pleased to report that CSIR's External Cash Flow stood healthy at approx ₹ 1600 crore even during the unprecedented year. Significantly, the earning from the private sector registered a growth of 48% over the previous year and is the highest in the last five years.

As the nation is set to celebrate the 75 years of independence as *Azadi Ka Amrit Mahotsav*, CSIR enters into its 80th year. The coming year is thus that of twin celebrations for CSIR, of its 80th year and, of course, of India's 75th year of independence. We have begun the celebrations by initiating a series, *80 Years, 80 Success Stories*, wherein we shall showcase 80 of CSIR's most impact making science to society.

CSIR entering the 80th year means that many of our laboratories are also touching their own milestone years. The CSIR-National Physical Laboratory celebrated its 75th Foundation Day. It was indeed a privilege for us to have Hon'ble Prime Minister Shri Narendra Modi, also the President CSIR, join us in the celebrations.

We also had the proud privilege of Shri Venkaiah Naidu, Hon'ble Vice President of India, inaugurating the Platinum Jubilee Foundation Day Celebrations of CSIR-Central Building Research Institute (CSIR-CBRI), Roorkee.

The year 2021-2022 will be a celebration of science, reflecting on the scientific and technological contributions of CSIR in the last 80 years and rededicating ourselves to the nation; and to science, technology and innovation for the next many decades to come.

Shekhar C Mande
Director-General, CSIR

1.0
Significant Events

1.0
Significant Events

PM delivered inaugural address at National Metrology Conclave organized to mark the 75th Foundation Day celebration of CSIR-NPL

Hon'ble Prime Minister of India and President, CSIR, Shri Narendra Modi delivered the inaugural address at the National Metrology Conclave 2021 organised by CSIR-NPL on its 75th year of inception on 4th January 2021. The theme of the conclave was 'Metrology for the Inclusive Growth of the Nation'. Vice-President, CSIR and Union Minister of Science & Technology, Earth Sciences, and Health & Family Welfare, Dr Harsh Vardhan and Principal Scientific Advisor to the Govt of India, Dr K. Vijay Raghvan also graced the occasion. Addressing at the inauguration, the Prime Minister lauded the Indian scientists for successfully developing two Indian Covid vaccines. He lauded the scientific institutions in the country including CSIR for coming together to find solutions for every challenge faced by the country. Shri Narendra Modi also dedicated National Atomic Timescale and Bhartiya Nirdeshak Dravya Pranali to the Nation and laid the Foundation Stone of National Environmental Standards Laboratory through a video conference on the occasion.

Shri Venkaiah Naidu inaugurated Covid-19 makeshift hospital at Nalagarh during the Platinum Jubilee Foundation Day Celebration of CSIR-CBRI

The Hon'ble Vice President of India Shri M. Venkaiah Naidu virtually inaugurated the Platinum Jubilee Foundation Day celebration of CSIR-CBRI on 10th February 2021 and stressed the need for providing affordable, safe and durable housing to the growing middle classes without compromising on quality. The Vice President also virtually inaugurated makeshift hospitals at Nalagarh and Tanda, Himachal Pradesh, the Platinum Jubilee Pseudo Dynamic Laboratory and the Centre for Excellence in Cultural Heritage at CSIR-CBRI.

Shri Jai Ram Thakur, Hon'ble Chief Minister of Himachal Pradesh, Dr. Shekhar C Mande, Director General, CSIR & Secretary, DSIR and Dr N. Gopalakrishnan, Director, CSIR-CBRI, Roorkee were among the dignitaries present during the virtual event.

Drug Discovery Hackathon (DDH2020) jointly launched by Union Ministers Dr Harsh Vardhan and Shri Ramesh Pokhriyal

Union Minister for Science and Technology Dr. Harsh Vardhan and Union Minister for Human Resource Development Shri Ramesh Pokhriyal 'Nishank' jointly launched the Drug Discovery Hackathon 2020 (DDH2020) - an online competition.

The Hackathon is a joint initiative of CSIR, AICTE and MHRD with the guidance of Principal Scientific Advisor to GoI. Speaking on the occasion, Mr Pokhriyal said, Drug Discovery Hackathon is the first of its kind national initiative for supporting the drug discovery process. He said, to attract international talent, the hackathon will be open to participation from across the globe from professionals, faculty, researchers and students.

Addressing the participants, Dr Harsh Vardhan emphasised the need to establish the culture of computational drug discovery in the country. In this initiative, HRD Innovation cell

and AICTE will focus on identifying potential drug molecules through the Hackathon while CSIR will take these identified molecules forward for synthesis and laboratory testing.

Dr Harsh Vardhan said the objective of this Hackathon is to identify drug candidates against SARS-CoV-2 by in-silico drug discovery through the hackathon and follow up by chemical synthesis and biological testing.

Inauguration of Makeshift hospitals

A modern, durable, portable, fast installable, safe and varying weather compatible 10-Bedded Make-Shift Hospital was inaugurated by Dr. Harsh Vardhan, Minister (S&T, ES and H&FW) at NDRF 8th Battalion Centre, Ghaziabad. The make-shift hospital has been set up by CSIR-Central Building Research Institute, Roorkee in collaboration with National Disaster Response Force (NDRF), Ministry of Home Affairs for demonstration purpose as well as the use of NDRF. It would serve the purpose for disaster recovery stage including for use in a long pandemic or emergency situation. Dr Shekhar Mande, DG, CSIR; Shri S.N. Pradhan, DG, NDRF; Dr Gopalakrishnan, Director CSIR-CBRI were among the dignitaries present on the occasion. The structure has been named as 'Karuna Bhawan'.

Hon'ble Minister of Science & Technology, Earth Sciences and Health & Family Welfare, Dr. Harsh Vardhan inaugurated a 10-Bedded Make Shift Hospital and isolation centre set up by CSIR at 4th Battalion Centre, Chennai, through video-conference. The new facility at Chennai has been designed as a makeshift hospital solution for the patient to provide primary health facility with safety, security and a comfortable living environment. It is a foldable and framed steel structure, such that a single person can carry a couple of frames on his shoulder and assemble these at any site without much loss of time. Speaking at the occasion, Dr. Harsh Vardhan congratulated CSIR-SERC (Structural Engineering Research Centre) and its scientists as well as National Disaster Response Force (NDRF) for finding innovative solutions to meet new challenges like the one presented by Covid-19.

CSIR Compendium of Covid-19 mitigation technologies released

Dr Harsh Vardhan, Hon'ble Union Minister released a compendium of Covid-19 technologies and products developed by CSIR. The compendium covers a wide range of technologies and products spanning from diagnostics to drugs to ventilators and PPEs with more than 100 technologies, 93 industry partners listed and with over 60 of these technologies have been transferred to industry. Dr Harsh Vardhan observed that the portfolio of technologies and products developed in a short time are a testament to the capabilities of CSIR scientists and that they can deliver in most difficult of the circumstances. He complimented the efforts of the scientists, students and staff of CSIR for developing these technologies and products at such short notice in these challenging conditions.

Guidelines for Public Transport Formulated by CSIR

CSIR-CRRI formulated Guidelines for Public Transport and Feeder Modes considering Social Distancing Norms detailing safety measures for every mode of public transport. The guidelines were released by Hon'ble Minister Dr. Harsh Vardhan, the cabinet minister, Department of Science and Technology & MoHFW along with Dr. Shekhar C Mande, DG, CSIR and Prof. Satish Chandra, Director, CSIR-CRRI on May 04, 2020. The document mentions a systematic and strategic approach to be adopted to move ahead during the Covid-19 pandemic.

CSIR partnered clinical trials on Covid-19 (CuRED) portal launched

Hon'ble Union Minister, Dr Harsh Vardhan launched an online portal CuRED (CSIR Ushered Repurposed Drugs), a website developed by CSIR that gives comprehensive information about the numerous Covid-19 clinical trials that CSIR is engaged in partnership with industry, other government departments and ministries. The website provides information about the drugs, diagnostics and devices including the current stage of the trials, partnering institutions and their role in the trials and other details. The Minister lauded the efforts of CSIR for being at the forefront of the ongoing fight against Covid-19 and prioritising clinical trials, generating data for their regulatory approval and helping launch drugs and diagnostics in the market. CSIR is exploring multiple combination clinical trials of anti-virals with host-directed therapies for

the potential treatment of Covid-19. CSIR is also working with the Ministry of AYUSH for clinical trials of AYUSH drugs. The sites can be accessed at

https://www.iiim.res.in/cured/ or *http://db.iiim.res.in/ct/index.php*.

Scientific Social Responsibility of CSIR-IITR on Covid-19 Prevention

CSIR-IITR produced 4500 Litres of WHO formulated hand sanitiser. The sanitisers were provided to Chief Minister, Yogi Adityanath and Chief Secretary for distribution to various agencies. It was distributed to over 30000 personnel involved in essential services to provide them with the first line of protection for their safety that includes Ration Shop, Public Distribution System, LPG bottling plant, Central Government Health Scheme (CSHS), Electricity Supply Administration & Electricity Substations, State Mission for Clean Ganga (SMCG), Lucknow Nagar Nigam, Police department, CPRF, Helping Hands - Organisation helping Cancer Children, District hospital, Raibarely through the district

administration and King George's Medical University (KGMU). This initiative was part of the Scientific Social Responsibility of CSIR-IITR and was accomplished through the Corporate Social Responsibility contributions of various organisations as part of CSIR Vertical 4: Hospital Assistive Devices and PPEs. Further, M/s ASPL Green Ventures (P) Ltd, a startup of Lucknow has been incubated at CSIR-IITR BIRAC Bio-NEST centre for the preparation of hand sanitiser and developing disinfection solutions. Microwave based disinfection machine for disinfection of PPE and N-95 mask was developed by SSMaser Technology Pvt Ltd, former incubatee of the institute. The sterilisation cycles for disinfection were co-developed with the help of CSIR-IITR.

Eco-friendly, efficient and DME fired "Aditi Urja Sanch" Unit launched

CSIR-NCL developed the nation's first pilot plant operated with clean and cost-efficient fuel 'DME' with 20-24Kg/day capacity. Dimethyl ether (DME) is an ultra-clean fuel. The conventional LPG burner is not suitable for DME combustion as DME density is different from LPG. To address this issue, CSIR- NCL's "ADITI URJA SANCH" has come up with a helpful, innovative setup. The Union

Minister of Science and Technology and Earth Sciences, Dr. Harsh Vardhan inaugurated the DME fired "Aditi Urja Sanch" unit along with the DME-LPG blended fuel cylinders and handed them over for common public and CSIR-NCL canteen use on a trial basis at CSIR-NCL premises virtually through video-conferencing.

CSIR Celebrated its 79th Foundation Day and Prestigious Bhatnagar Awardees for 2020 were announced on 26th Sept 2020

CSIR celebrated its 79th Foundation Day at the S S Bhatnagar Sabhaghar in CSIR Headquarters at New Delhi on 26th Sept 2020. Dr Harsh Vardhan, Union Minister of Science and Technology, Earth Sciences, Health and Family Welfare and Vice President, CSIR presided over the event. In view of the Covid-19 pandemic while the physical event was a small gathering with appropriate social distancing, Dr. Shekhar C. Mande, DG, CSIR & Secretary, DSIR (Department for Scientific & Industrial Research), Mr. A. Chakraborty, Head, HRDG, and all CSIR labs and several others joined the event through various social media platforms. The Minister appreciated the work done by the entire CSIR during the Covid-19 crisis. He said under the times of needs CSIR labs have risen to the occasion and delivered diagnostics, drugs and ventilators among many others. Dr Harsh Vardhan also released a digital book and a short film on the CSIR's Covid-19 efforts, which highlighted the people behind the various initiatives of CSIR in its fight against Covid-19.

At the occasion, various CSIR Awards were announced virtually, including CSIR Innovation Awards for School Children-2020, CSIR Young Scientist Awards-2020, CSIR Technology Awards-2020, CSIR Award for S&T Innovation for Rural Development (CAIRD) - 2017, 2018, 2019, CSIR Diamond Jubilee Technology Award -2019 and G N Ramachandran Gold Medal for Excellence in Biological S&T-2020. Finally, DG-CSIR Dr. Shekhar Mande announced the winners of the prestigious Shanti Swarup Bhatnagar Awards 2020.

Phytorid Technology Sewage Treatment Plant (STP) set up at NCL-Pune

Union Minister of Science & Technology, Earth Sciences and Health & Family Welfare Dr. Harsh Vardhan inaugurated the eco-friendly and efficient Phytorid Technology Sewage Treatment Plant (STP) at CSIR-NCL-Pune. The Hon'ble Minister called upon CSIR scientists to scale up their sewage treatment technology and install it in all their campuses across the Country. Phytorid is a subsurface mixed flow constructed wetland system developed

and internationally patented by CSIR-NEERI, Nagpur with successful demonstration in the field for more than 10 years of continuous

operation as a stand-alone sewage treatment system. Phytorid is a self-sustainable technology for wastewater treatment that works on the principle of natural wetland. It uses certain specific plants which can absorb nutrients directly from wastewater but do not require soil. Using Phytorid Technology for the treatment of sewage, it is possible to recover and reuse the treated water for gardening purposes.

Inauguration of Platinum Jubilee Foundation Day celebration of CSIR-CIMFR

Union Minister of Science & Technology, Dr. Harsh Vardhan inaugurated the Platinum Jubilee Foundation Day celebration of CSIR-CIMFR, Dhanbad, through video-conferencing in Delhi. On the occasion, Dr. Harsh Vardhan also dedicated to the nation the three indigenously developed technologies and facilities, first of its kind, as a step towards AtmaNirbhar Bharat Abhiyan.

1. The Centre of Excellence for Coal Gasification- Coal to Syngas Plant;
2. Centre of Excellence for Strategic and Infrastructure Sectors;
3. Indigenously developed innovative technologies for import substitution of coking coal.

Memorandum of Agreement signed between CGWB and CSIR-NGRI for High-Resolution Aquifer Mapping & Management in Arid Region of North-Western India

A Memorandum of Agreement (MoA) was signed between Central Ground Water Board (CGWB), Ministry of Jal Shakti and CSIR-NGRI, Hyderabad for use of advanced heliborne geophysical survey and other scientific studies in parts of the States of Rajasthan, Gujarat and Haryana under the Aquifer Mapping Programme. The MoA was signed by Chairman, CGWB and Director, CSIR-NGRI in the august presence of the Union Minister of Jal Shakti, Shri Gajendra Singh Sekhawat, and Union Minister of Science and Technology, Health and Family Welfare and Earth Sciences, Dr. Harsh Vardhan in New Delhi. Under phase- I of the project, an area of nearly 1 lakh sq km spreading over nearly 65,500 sq km of western arid Rajasthan (covering parts of Bikaner, Churu, Ganaga Nagar, Jalor, Pali, Jaisalmer, Jodhpur and Sikar districts), 32,000 Sq. Km arid parts of Gujarat (covering Rajkot, Jamnagar, Morbi, Surendranagar and Devbhumi Dwarka districts) and nearly 2500 sq km of Haryana (covering Kurukshetra and Yamuna Nagar districts) would be covered at an estimated cost of 54 Crores.

Diagnostic Testing of Coronavirus Samples

CSIR is deeply involved in the testing of human samples for the presence of coronavirus infection using the RT-PCR test. Several of its laboratories are engaged in the work, and 13 CSIR labs across the country are testing, more than 7.0 lakh samples have been tested with CSIR-IITR and CSIR-CDRI having tested more than 1.5 and 1.0 lakh respectively. CSIR labs have also engaged in training of Human Resources for testing and have helped many hospitals and research institutes in carrying out RT-PCR. CSIR-CCMB is the only non-ICMR but ICMR-approved validation centre that is approved to test the different kits that are being used in Covid-19 testing.

MoU between CSIR and FSSAI for Collaborative Research and Information Dissemination regarding Food and Nutrition

Dr Harsh Vardhan, Union Minister for Health and Family Welfare presided the signing of an MoU between Food Safety and Standards Authority of India (FSSAI) under the Ministry of Health & Family Welfare and Council of Scientific & Industrial Research (CSIR) in the presence of Shri Ashwini K. Choubey, Minister of State (HFW) on 7 August 2020. The MoU seeks to promote collaborative research and information dissemination in the area of food and nutrition. Congratulating both FSSAI and CSIR for this innovative step that will merge the potential and faculties of both the premier organisations, Dr Harsh Vardhan said that the MoU will enable identification of technologies and programmes to be developed in the area of food safety and nutrition research, along with recognition of innovative technologies available with CSIR for deployment by the Indian businesses and/or for regulating compliances. It will also seek collection of data regarding food consumption, incidence and prevalence of biological risk, contaminants in food, identification of emerging risks, their mitigation strategies and introduction of rapid alert system.

Introduction of Asafoetida (Heeng) cultivation in the Indian Himalayan region

A historical shift in farming practices is in the offing with farmers of the remote Lahaul valley in Himachal Pradesh taking up cultivation of asafoetida (Heeng) to utilise vast expanses of wasteland in the cold desert conditions of the region. In their efforts, the farmers are being supported by scientists of the CSIR-IHBT, Palampur, who brought in seeds of asafoetida and developed its agrotechnology. Since asafoetida is a major condiment in Indian cuisines, team CSIR-IHBT made relentless efforts for introduction of this important crop in the country through proper channel and finally, the institute introduced six accessions of seeds from Iran through ICAR-National Bureau of Plant Genetic Resources (ICAR-NBPGR), New Delhi.

The first seedling of asafoetida was planted by Dr. Sanjay Kumar, Director, CSIR-IHBT on 15th October 2020 at farmer's field in village Kwaring of Lahaul valley to mark the initiation of cultivation of asafoetida in India.

Dr Harsh Vardhan Launched Footwear Sizing system at CSIR-CLRI, Chennai

Hon'ble Union Minister, Dr Harsh Vardhan, on 9th January 2021 launched the Footwear Sizing System, Fashion Forecasting Card and CLRI Comfort Shoes for Women — TOESPRING at CSIR-CLRI. Dr Vardhan addressed the staff of CSIR-CLRI at Tagore Ashram and promoted "Vocal for Local" initiative for Self-reliant India.

Dr Harsh Vardhan inaugurated the new entity CSIR-National Institute of Science Communication and Policy Research (CSIR-NIScPR) with a new Vision

Hon'ble Union Minister Dr. Harsh Vardhan inaugurated a new institute of CSIR i.e. CSIR National Institute of Science Communication and Policy Research (CSIR-NIScPR), in New Delhi. The new institute has been established consequent to the merger of two prestigious institutes of CSIR namely, CSIR-National Institute of Science Communication and

Information Resources (CSIR-NISCAIR) and CSIR National Institute of Science, Technology and Development Studies (CSIR-NISTADS) which work at the interface of S&T and Society; and Science Communication and Policy Research. Dr. Harsh Vardhan unveiled the plaque of the new Institute, followed by plantation of saplings in the central lawn of CSIR-NIScPR campus on this occasion. He highlighted that the purpose of this merger is to combine the strength of the two institutes in a synergistic way with a vision to become a globally respected Think Tank and Resource Centre for understanding Science, Technology & Innovation (STI) Policy Research and Communication.

CSIR celebrated 20 years of India's Traditional Knowledge Digital Library, the first of its kind globally

CSIR launched a new campaign of highlighting 80 success stories from the organization as it is set to turn 80 years old in 2022. The campaign was launched with CSIR's Traditional Knowledge Digital Library (TKDL) completing two decades of safeguarding India's Traditional Knowledge. To commemorate the two decades' journey, a webinar "Two Decades of TKDL - Connecting to the Future" was organized. Distinguished dignitaries graced the program were Dr. Raghunath A. Mashelkar, Former DG, CSIR & Secretary, DSIR; Vd. Rajesh Kotecha, Secretary, Min of AYUSH; Shri Guruprasad Mohapatra, Secretary, DPIIT and Ms. Begona Venero, Sr. Counsellor, Traditional Knowledge Division, WIPO, Geneva, and Dr. Shekhar C. Mande, DG, CSIR and Secretary, DSIR.

CSIR-CDRI celebrated its 70th Annual Day

Addressing the 70th Annual Day celebrations of CSIR-CDRI, Lucknow through video-conferencing in New Delhi, Hon'ble Union Minister Dr. Harsh Vardhan applauded CSIR- CDRI for its championship in bringing in affordable drugs that has given the world breakthrough molecules like Centchroman (first nonsteroidal oral contraceptive) and Arteether (lifesaving drug for cerebral malaria) amongst others. Dr Harsh Vardhan inaugurated 'Atal National Colloquium on Healthcare and Innovation', a series of

lectures from highly eminent persons, to commemorate Late Shri Atal Bihari Vajpayee's vision and support for 'Vigyan' and CSIR-CDRI. He also inaugurated 'Common Research and Technology Development Hub (CRTDH)' supported jointly by DSIR and CSIR online.

Bill & Melinda Gates Foundation and CSIR, India signed MoU to promote health research

Bill & Melinda Gates Foundation and CSIR, India signed a MoU to support the development, conduct and promotion of health research in India. Gates Foundation and CSIR will work together to identify opportunities to initiate scientific and technological collaborations. These will focus on developing and testing new preventions, therapies and interventions that can help to solve major health concerns that affect India and other developing countries. As per the MoU, areas of research collaboration would include genetic diseases that impact infant and neonatal mortality; new diagnostics and devices for infectious disease and environmental surveillance; development of cost-effective processes for drug, vaccines, biologics, and diagnostics manufacturing; novel microbiome-directed foods; socio-economic impact of science and technological tools; and other areas of health and development.

Dr. Harsh Vardhan inaugurated four pyres of the Green Crematoria, 'Air Pollution Control System for Crematoria', developed by CSIR-NEERI at Delhi's Nigam Bodh Ghat Crematorium

Dr. Harsh Vardhan called for a comprehensive plan for institutionalised 'Green Good Deed' at the venue. He said with such green initiatives, a lot can be achieved in improving the air pollution index in the National Capital and scientists from CSIR-NEERI can play a major role in that. He informed that the Central Government has already been working for improving the air quality index in 120 cities across the country.

CSIR joined the India@75: Bharat ki Azadi ki Amirt Varsh celebrations

CSIR joined the India@75 or Bharat ki Azadi ki Amirt Varsh celebrations with two events on 22 March 2021. Along with Vijnana Bharati (VIBHA), the CSIR and its Delhi-based CSIR-NPL organized an event, "From Many to One: The Saga of the Indian Calendar". The event was held at the CSIR-NPL auditorium and was also livestreamed on digital platforms. The 22

March 2021 is also commemorated as World Water Day. CSIR also organized a webinar on "TERAFIL: Water Purification System" technology of CSIR-IMMT. TERAFIL is a low-cost water purification system that has been licensed to over 120 MSMEs and industries. Today there are over 2,50,000 installations of the TERAFIL based water filters all over the country. The TERAFIL water purification system is among the 80 technologies that CSIR showcased as part of its 80 years celebration.

CSIR observed World TB Day: Holds a panel discussion on "Lessons from Covid-19 Pandemic for TB"

On the occasion of World TB Day on 24th March 2021, the Minister of S&T, ES and MoHFW, Dr Harsh Vardhan delivered a key note lecture at the World TB Day Event organized by MoHFW and at the panel discussion on "Lessons from Covid-19 Pandemic for TB". Every year world TB day is observed to commemorate the day in 1882 when Dr Robert Koch discovered the bacterium that causes TB. Dr T. Balganesh a leading TB expert and President Gangagen Biotechnologies, in his remarks emphasized on the need for non-invasive diagnostics for TB as a game changer in surveillance and rapid control of infection. Other TB experts from the country who participated in the panel discussion included Dr Anurag Agrawal, Director, CSIR-IGIB, Dr Rajesh Gokhale, Staff Scientist VII, NII, Prof Jaya Tyagi, Dept. of Biotechnology, AIIMS, New Delhi, Dr Chandra Shekhar S, Director, CSIR-IICT, Dr Anil Koul: Vice President, Research, J&J. Dr Geetha Vani Rayasam, Sr. Pr. Scientist and Head-SCDD at CSIR and Dr Anshu Bhardwaj, Senior Scientist at CSIR-IMTECH moderated the discussion towards identification of disruptive ideas as well as identification of critical gaps in our current strategies and how they can be addressed from the recent experience with Covid-19.

Dr. Harsh Vardhan inaugurated the Centre for Advanced Radiation Shielding and Geopolymeric Materials and an Analytical High Resolution Transmission Electron Microscope Laboratory at CSIR-AMPRI, Bhopal

Dr Harsh Vardhan inaugurated the Centre for Advanced Radiation Shielding and Geopolymeric Materials and Analytical High-Resolution Transmission Electron Microscope Laboratory, during his visit to CSIR constituent lab AMPRI based in Bhopal on March 13, 2021. He also laid the foundation stone of CSIR-AMPRI Bamboo Composite Structure. After the inauguration and laying of foundation stone, the Minister visited the Technology Exhibits of CSIR-AMPRI, Bhopal. He addressed the scientists & staff of the institute. Speaking about the Covid -19 pandemic, Dr Harsh Vardhan lauded the efforts of the entire CSIR community who came together and developed a gamut of technologies and products.

Dr. Harsh Vardhan launched "CSIR Floriculture Mission"

Hon'ble Union Minister, Dr Harsh Vardhan exhorted scientists of CSIR laboratories across the country to develop the land available at each laboratory to be set up as a model under the CSIR Floriculture Mission. CSIR Floriculture Mission has been approved for implementation in 21 States and Union Territories of India wherein available

knowledgebase in CSIR Institutes will be utilized and leveraged to help Indian farmers and industry re-position itself to meet the import requirements. The Minister addressed the launch ceremony of CSIR Floriculture Mission through virtual mode in New Delhi. Dr. Harsh Vardhan also launched CSIR's Societal Portal along with the Android App. This portal has been developed by CSIR Team with the help of MyGov Team. The Portal is to facilitate the public to submit the societal problems that can be resolved using S&T interventions. This is the first step in terms of seeking inputs on challenges and problems being faced by different stake holders in society.

Formulation of Guidelines for Evaluation of Nano-based agri-input and food products in India

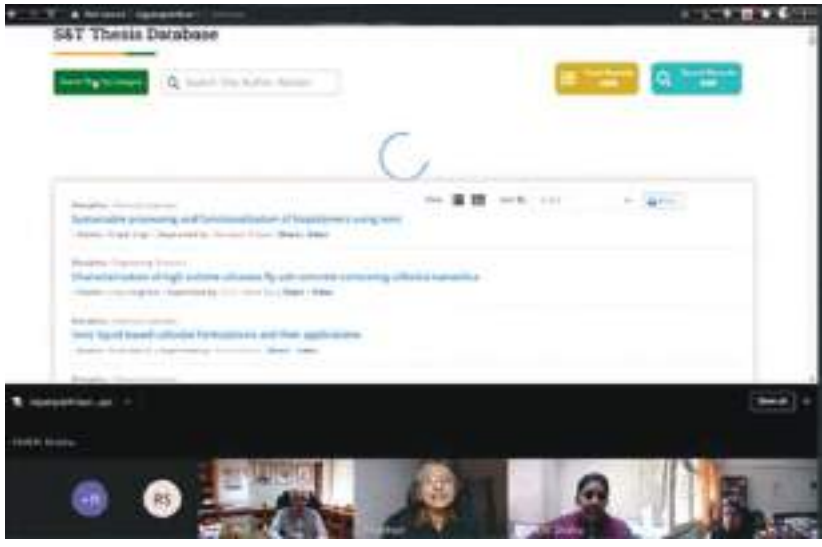
CSIR-IITR contributed to the Guidelines for Evaluation of Nano-based agri-input and food products in India released on 7th July 2020 by Dr Harsh Vardhan, Hon'ble Union Minister for Science & Technology, Earth Sciences, Government of India. CSIR- IITR, has contributed significantly in the area of nanotoxicology as well as food safety.

AcSIR and CSIR launched Vigyangranth- the PhD Thesis Repository portal, aimed at giving a holistic view of R&D initiated and carried out by Indian research scholars

Vigyangranth- the PhD Thesis Repository which is a joint initiative of Academy of Scientific and Innovative Research, India (AcSIR) and CSIR was launched on 12 Feb 2021 through an online event by the Chief Guest Lt. General (Dr.) Madhuri Kanitkar, Deputy Chief of Integrated Defence Staff (Medical). The portal is aimed to give a holistic view of R&D initiated and carried out by Indian research scholars in the areas of Science, Technology, Engineering and Mathematics (STEM) with

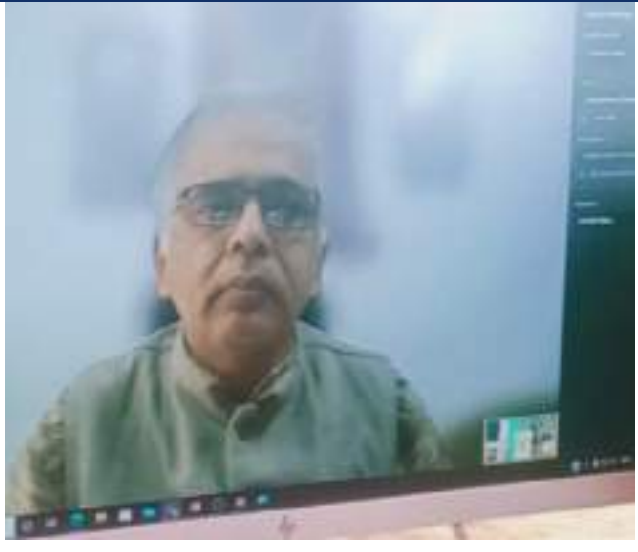
respect to their relevance to (i) Broad Heads of Research (targets for societal needs), (ii) Sustainable Development Goals (SDGs) set by United Nations, (iii) National Thrust Areas of Research, (iv) Disciplines, in addition to value of the contributions as deep discoveries in science and frontline advancements in technological space.

At the online event organized by CSIR to mark the United Nations International Day of Women and Girls in Science, Dr. Kanitkar pointed out that theses repository is a valuable contribution to make the information and knowledge accessible to the world at large and also called upon the women scientists to follow their passion in science.



Kisan Mela organized at CSIR-CIMAP

CSIR-CIMAP, Lucknow has been organizing Kisan Mela every year on 31st January. Kisan mela was organized for 20 days celebrating the main function on 31st January 2021, considering Covid-19 pandemic situation. Daily 100 to 200 farmers participated in the programme by following Covid-19 protocol. Overall, about 4000 farmers from different states of the country like Uttar Pradesh, Madhya Pradesh, Bihar, Uttarakhand, Chhattisgarh, Gujarat, Rajasthan, West Bengal,



Orissa, Haryana, Punjab, Delhi, Karnataka, and Maharashtra etc. and students from 500 different universities also participated. On the occasion, the Chief Guest Dr. Shekhar C. Mande, DG, CSIR joined online and said that the Kisan Mela have a special place in bringing the new experiments being done by CSIR to the general public and CSIR-CIMAP should continuously provide high quality plant material to the farmers. Farmers from all over the country participated in this Kisan Mela through daily pre-registration process.

2.0
Significant S&T Achievements

2.0

Significant S&T Achievements

Major Achievements in Covid-19 Mitigation

CSIR has undertaken multiple initiatives towards mitigation of Covid-19 from March 2020 onwards. Few significant achievements are highlighted in this chapter, and more details of these and other initiatives are covered in the next Chapter.

Diagnostic Testing of Coronavirus Samples

CSIR is deeply involved in the testing of human samples for the presence of coronavirus infection using the RT-PCR test. Several of its laboratories are engaged in the work, and 13 CSIR labs across the country are testing, more than 7.0 lakh samples have been tested with CSIR-IITR and CSIR-CDRI having tested more than 1.5 and 1.0 lakh respectively. CSIR labs have also engaged in training of Human Resources for testing and have helped many hospitals and research institutes in carrying out RT-PCR. CSIR-CCMB is the only non-ICMR but ICMR-approved validation centre that is approved to test the different kits that are being used in Covid-19 testing.

Molecular Surveillance for SARS-CoV-2

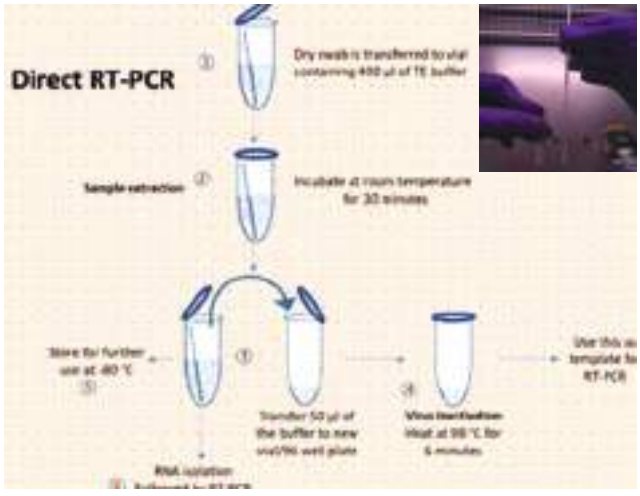
CSIR laboratories have undertaken sequencing of SARS-CoV-2 to find the type of strains present in India and to understand if the virus undergoes genetic changes while it is spreading in the country. Several CSIR labs have sequenced the SARS-CoV-2 genome samples from Indian isolates, and more than 2000 have been sequenced and analysed providing insights into the strains prevalent in India.

Serological Surveillance of SARS-CoV-2

Several CSIR labs have participated in CSIR Phenome India Project led by CSIR-IGIB which is a long-term longitudinal observational cohort study of health outcomes within its employees with an aim to develop risk prediction tools and play an important role towards establishing precision health and medicine for the Indian population. In this regard, the Covid-19 serological tests have been conducted across CSIR labs in the country spearheaded by CSIR-IGIB, and more than 10,000 samples have been tested.

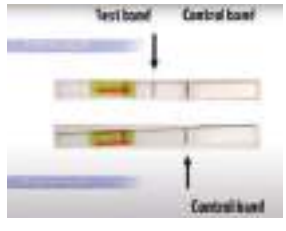
Dry-Swab-Direct-RTPCR Diagnostic for Covid-19

The simple and fast method of Dry Swab-Direct RT-PCR, developed by CSIR's constituent laboratory CCMB, Hyderabad, for scaling up of SARS-CoV-2 detection has been approved by ICMR based on their independent



validation. This method is a simple variation of the existing gold standard RT-PCR method and can easily scale up the testing by 2 to 3 fold with no new investment of resources and training and makes diagnostic tests simpler, faster and cheaper scaling up the testing in the country immediately. Spice Health has signed a Memorandum of Understanding with CSIR-CCMB for faster testing of Covid-19. This MoU with CSIR-CCMB is for conducting these tests in Spice Health's mobile testing laboratories. The Apollo Hospitals is also collaborating with CSIR-CCMB for joint manufacturing and commercialisation of the innovative dry swab test.

CRISPR/ Cas based paper diagnostic test FELUDA for Covid-19



A CRISPR/ Cas-based paper diagnostic test has been developed by CSIR. The FELUDA methodology has been developed in CSIR-IGIB for detecting single nucleotide variants in RNA or DNA or more broadly detecting any DNA or RNA fragment, without the need for sequencing. The principle of discrimination is derived from the natural property of the enzyme being used for the invention, Francisella novicida Cas9 (FnCas9) which shows a very low binding affinity to mismatched substrates. CSIR has licensed this technology to TATA Sons. The kit has been approved by DCGI and TATA has launched this as TATA MD CHECK.

Cost-effective process developed for Favipiravir

A cost-effective process of Favipiravir for the treatment of Covid-19 patients has been developed by CSIR-IICT. CSIR-IICT developed the process using locally available chemicals to synthesise this Active Pharmaceutical Ingredient (API) and transferred the technology to Cipla. Cipla has launched this in the market as Ciplenza.

Clinical trials of Sespivac (Mycobacterium W) for Covid-19

CSIR and Cadila Pharmaceuticals are conducting clinical trials to evaluate the efficacy of an existing gram-negative sepsis drug, called Sepisvac for Covid-19 patients. The drug contains heat-killed Mycobacterium (Mw) and has been clinically developed and approved for gramnegative sepsis, a severe infection and is available commercially as Sepsivac® from Cadila Pharmaceuticals Ltd. After successful completion of Phase II trials on critically ill Covid-19 patients, Phase III trials are underway.

Clinical Trials of Ayurveda based drugs for Covid-19

For the prophylaxis and management of Covid-19 in the population with mild to moderate disease, CSIR and Ministry of AYUSH have joined hands to validate some of the traditional AYUSH formulations for their safety and efficacy through scientific evidence. Five clinical trials are currently under progress.

SwasthVayu: Bi-Level Positive Airway Pressure (BiPAP) System Portable Ventilator developed

CSIR-NAL developed a low-cost indigenised, non-Invasive bilevel positive airway pressure

ventilator device named as “SwasthVayu”. Developed in 36 days, it is a cost-effective device, easy to use in Makeshift hospitals, wards, dispensary and has three modes of operation, continuous, timed and spontaneous. It has successfully passed stringent electrical safety, performance, calibration, bio-compatibility tests at NABL accredited laboratory and certified. It has undergone clinical trials at many hospitals, and CSIR-NAL is providing 1200 ventilators to the Delhi Government.

Design and development of an Electrostatic Disinfection Unit

An electrostatic disinfection unit has been developed by CSIR-CSIO for a 360-degree area and uniform coverage, small droplet size, applicable for all fluid types. The technology was transferred to BHEL, Rite water, M/s. Jhosna Corporation and M/s. Dashmesh Industries. Close to 200 units have been produced. Further, the unit ENCEESPRAY selected for Top Covid-19 Innovation Award with RITE Water Solution Pvt. Ltd, Nagpur, CSIR-CSIO and Univ. of Florida as partners by USISTEF.

Nasal-pharyngeal (NP) Swabs for Covid-19 sample collection

CSIR-NCL has developed NP swabs that can be used for Covid-19 sample collection. It is an appropriately small size for paediatric, nasopharyngeal or urethral genital sample collection. Approved by ICMR, the technology has been licensed to Ms. Chembond Polymers and Materials Pvt. Ltd. (CPML), Mumbai. CPML has now started commercial manufacturing of these nasal swabs under the name, “KEMYLON SWABS”. The company has established a facility to produce 1 lakh swabs/day.

PPE Coveralls developed

CSIR-NAL in a joint Venture with M/s. MAF Clothing Pvt Limited has developed the PPE Coveralls with Indigenous heat sealing tape and polypropylene materials. These are developed Indigenously for frontline health workers involved in the containment zone of Covid-19. CSIR-NAL has prepared and implemented a strict Quality Assurance Plan, and the developed coverall passes ASTM F1670 and ISO 16603 tests and has been tested and passed for blood penetration test as required for Covid-19.

Aarogyapath (आरोग्यपथ)- Healthcare Supply Chain Management System developed

Aarogyapath has been developed as the National Healthcare Supply Chain Management System to address Covid-19 and any future national pandemic. *https://www.aarogyapath.in*, a CSIR National Healthcare Supply Chain Portal that aims to provide real-time availability of critical healthcare supplies was launched.

Kisan Sabha App – Connecting farmer to the supply chain

Kisan Sabha App has been developed by CSIR-CRRI to connect farmers to the supply chain and freight transportation management system. This portal acts as a one-stop solution for farmers, transporters, and other entities engaged in the agriculture Industry. The App is being used widely and has had more than 60,000 downloads so far.

CSIR and Mylan Announce Partnership to identify Advance Therapeutic Options for Management of Covid – 19

CSIR and Mylan Laboratories Limited, the India-based subsidiary of leading global pharmaceutical company Mylan entered into a partnership to address unmet patient needs amidst the evolving Covid-19 pandemic. Under the partnership, CSIR-IICT and Mylan will collaborate to identify potential therapies for Covid-19.

A series of clinical trials will be conducted towards new and innovative solutions to manage Covid-19 pandemic in India as part of this collaboration. The first of the clinical trial to be rolled out is a multiple arm phase 3 study that will be conducted in adult patients with mild to moderate Covid-19 at risk of complications.

The Airport Mobile Sequencing lab at Indira Gandhi International Airport, Delhi

It is first effort in India towards Genome sequencing of the SARS-CoV-2 virus for the International travelers who are found to the RT-PCR positive for the SARS-CoV-2 virus. This Proof-of-concept study is being done by CSIR-IGIB in collaboration with SpiceHealth. The sequencing is being done in a mobile container using the Nanopore sequencing. The virus genome sequencing would help know the strain of the virus and detect new viral strain (like UK variant). It aims to reduce the time taken to know the strain of the virus (post RT-PCR positive), containment of spread of the new strain and help Covid-19 management.

For details on CSIR activities towards combating Covid-19, kindly refer Chapter 3.0 on Major Covid-19 Contributions.

Other Significant S & T Achievements (Non-Covid-19 related)

Golden Peacock Eco-Innovation Award (GPEIA) 2020 for ONEER

CSIR-IITR, Lucknow has been awarded the prestigious Golden Peacock Eco-Innovation Award (GPEIA) 2020 for its technology entitled "Oneer - A Novel and Affordable Solution for the Safe Drinking Water". The Golden Peacock Awards were set up by the Institute of Directors (IOD), India in 1991 and for this year the Awards Jury was constituted under the Chairmanship of Hon'ble Justice M. N. Venkatachaliah, former Chief Justice of India, Chairman, National Human Rights Commission of India and National Commission for Constitution of India.

Oneer, the winner of GPEIA 2020, is a unique patented and highly affordable water disinfection system which has potential for use in residential household communities where the potable water requirement is at mid- to large-scale 5000-100000 liters per day. It is an innovative technology that eliminates all the diseases causing pathogens (7 log reduction) such as virus, bacteria, fungi, protozoa and the cyst to provide safe drinking water to communities as per National and International standards prescribe for potable water by Bureau of Indian Standard (BIS), World Health Organization (WHO), and Environmental Protection Agency (EPA).

Hansa NG - Two Seater Trainer Aircraft

Rollout of Hansa NG. DG-CSIR, Chairman-HAL, JS-MoCA and other dignitaries witnessed the event.

CSIR-NAL designed and developed Hansa-3 aircraft which is an all composite two seat light trainer aircraft to be used as an ab-initio flying training machine for the flying clubs in India. This aircraft Hansa-3 was certified by DGCA under FAR-23 via JAR-VLA in February 2000. During the user interaction of Hansa aircraft, the flying community suggested to have significant modifications on Hansa-3 aircraft to make it more useful as a trainer aircraft. The modification suggested to bring out Hansa-NG (New Generation), which will satisfy the requirements of flying clubs for obtaining PPL (Personal Pilot License) & CPL (Commercial Pilot License) by young generation. The major modifications proposed were changing analogue instruments to digital

state-of-the art fully glass cockpit display system, reducing the pilot load by changing the mechanically operated flaps to electrical operations, economically designed doors for better ingress and egress, increasing the fuel capacity for higher range and endurance, bubble canopy for excellent aerial view, and easy to fly with good handling quality and low operations and maintenance cost. With the modifications to Hansa, the programme was launched in the latter half of 2018 and the Hansa-NG was rolled out on 31st March 2021. CSIR-NAL has received Letter of Intent (LoI) for about 65 aircraft from 7 flying clubs/flight training school. A MoU was signed between CSIR-NAL & Indira Gandhi Rashtirya Uran Academi (IGRUA) on 31st March 2021 for Hansa-NG to be the possible launch customer. The test flights would start in the month of August 2021 and thereafter to be certified by DGCA.

Bio-mimetic and Phyto-technologies Designed for Low-cost Purification and Recycling of Water (INDIA-H2O) (NEERI)

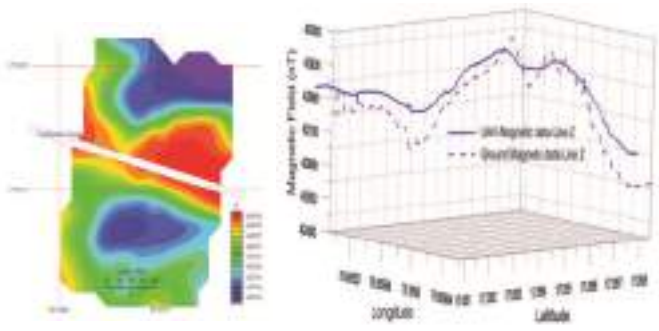
INDIA-H20 will develop, design and demonstrate high-recovery, low-cost water treatment systems for saline groundwater and industrial wastewaters. The focus for developments will be in the arid state of Gujarat, where surface water resources are very scarce. We will develop novel batch-reverse osmosis technology for a 10-fold reduction in specific energy consumption with high fractions of water recovery (80%) reducing /m3 operating costs to below €0.35/m3 (<30 rupees/m3). Forward osmosis will be developed and piloted for use in wastewater recovery applications including hybrid arrangements with reverse osmosis for further reduction in energy consumption. These solutions will be demonstrated in small-scale rurally relevant low-cost systems for use as safe drinking water. Domestics wastewater will also be addressed using phyto-technology solutions for rural settings.

Assessment of Air, Water and Soil Quality in Baghjan Oil Blowout Site and its Vicinity, Tinsukia, Assam

On 27 May 2020, there was a blowout at the well No.5 of Baghjan Oilfield of Oil India Ltd. (OIL) and subsequently caught fire on 9th June 2020, and the effects could be seen in its vicinity around. Apart from the high intensity continuous sound that could be heard from as far as 10km away from the blowout site, no doubt the air, water and soil quality were contaminated throughout the region however the extent of calamity is unknown. During the visit, based on agricultural land, Forest land and village areas of the baghjan sites as per the proposed distance from the blow out site has been identified for sampling based onthe satellite image of the site. The work is still under progress.

Drone based very high-resolution Electrical and magnetic mapping for mineral and near-surface exploration

Earthquake hazard assessment of Uttarakhand with special focus on risk assessment of vital installations in Uttarkashi district. Two important deliverables have been proposed: 1. Earthquake hazard assessment of Uttarakhand focusing on acceleration and displacement spectra; 2. Risk assessment of vital installations (bridges, water tanks, hospitals) in Uttarkashi district. So far, 110 Broad band seismological stations



and Accelerometers have been installed, 350 earthquakes located and seismicity maps prepared and acceleration spectrum estimated at 10 locations for earthquakes magnitude 3.5-5.5.

Technical and hand holding support by CSIR-IHBT Palampur for saffron Production

Saffron (Crocus sativus L.) is important spice used in Indian cuisines. Of the 300 tonnes of saffron produced world over annually, the country has an annual domestic demand of 100 tonnes, but produce less than 6 tonnes per year, grown mainly in parts of Jammu and Kashmir. A major constraint in large scale cultivation of saffron is the scarcity of disease-free planting material, or healthy saffron corms. CSIR-IHBT has addressed this limitation and developed a tissue culture protocol for production of disease-free corms. The institute's efforts in promoting cultivation of saffron in the state to enhance the livelihood of farming communities have been widely acclaimed at the state level. Hon'ble Chief Minister of Himachal Pradesh, Sh. Jai Ram Thakur, in his budget speech, on March 6, 2020, highlighted the efforts of CSIR-IHBT on cultivation of saffron in the state. Consequently, a megaproject has been funded in the form of "Technical and hand holding support by CSIR-IHBT Palampur for saffron Production". In this context, MoU was signed on June 6, 2020 between CSIR-IHBT and Department of Agriculture, HP for saffron corm production at commercial scale within the state. Saffron corms were supplied to farmers of Chamba, Mandi, Kangra districts of himachal Pradesh. 32.78 q of corms were supplied to the farmers during 2020.

Development of lubricating oil for Helicopter Transmission Gearboxes

Transmission gear box are used to control and regulate the speed of the blades, inefficient lubricant results in scuffing of the gear. Scuffing effect the stability and braking of the helicopter. The objective is to enhancing the extreme pressure behaviour of gearbox lubricating oil by 20%.

Design of a Demonstration Plant Based on a Hybrid Process for the production of Grade "A" Helium from Natural Gas: TIP development for Pilot Plant

Helium is a strategic material, and India is totally dependent on the import of helium. Hence, it is very much important to develop

indigenous technology for the production of Grade A helium. This project is focused on the production of Grade A helium from the natural gas source of ONGC by using the hybrid process consisting of Cryogenic and Pressure Swing Adsorption (PSA) sections.

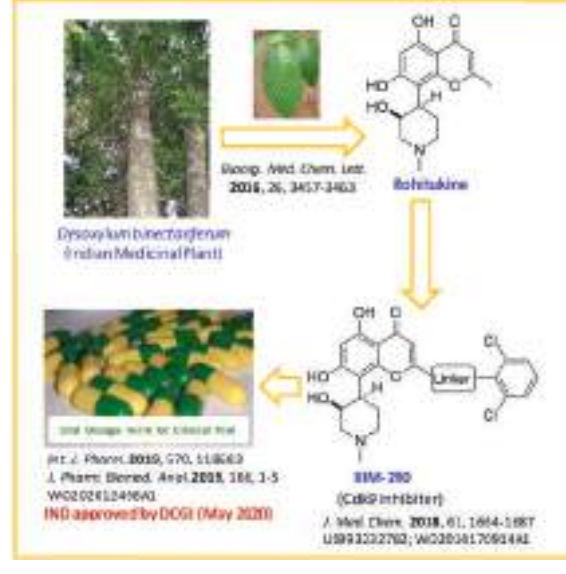
The project involves the conceptualization and development of energy and capital cost-efficient cryogenic section using advanced engineering and energy optimization tools as this section constitutes ~ 70-80% of the hybrid process's capital cost and energy cost. The cryogenic section will be optimized for the best values of operating parameters like distillation columns' operating pressure and temperature, the number of stages, feed tray location etc., to minimize the capital and operating cost. The operating parameters and capacity benchmarking of the adsorbent etc., will also be optimized for the PSA section using the experimental and simulation tools.

The Technology Information Package (TIP) will be prepared for the optimized hybrid process. The TIP will be used to design the demonstration plant to be built up at an appropriate ONGC site having Natural Gas with Helium content.

Zincometer: Sensing device for real-time Zinc weight measurement in galvanized wire lines

Zinc coating is the most effective and widely used process to prevent corrosion and increase the longevity and performance of steel wire and is applied by hot-dip galvanizing (HDG) process. The final quality of galvanized wire depends on the material surface, zinc adhesion, and uniform coating weight. Coating weight is often measured too late in the process to correct. In fact, many producers verify hot-dip zinc coating weight after the coil exits the mill. At this point, if the results are unacceptable the entire coil is downgraded or scrapped. This results wastage of raw materials and production costs. Generally, wiping technologies (Nitrogen wiping for thick coating and Pad wiping for thin coating) are adopted in order to address this issue. Though the Zinc weight control system exists in N2 wiping line but there is no such system is available for Commercial line. However, in the pad wiping galvanizing process during production, due to a number of process conditions steel wire coating weight inevitably fluctuates leading to the variation of coating thickness that not only contributes to the instability of the product quality, but also the loss of costly coating raw materials like zinc. The present technology offers a real-time, non-contact industrial sensing system coupled with data processing and feedforward control mechanism that is capable of working in harsh industrial environments while providing immediate feedback on zinc weight during production in both N2 wiping as well as Pad wiping (Commercial) GI lines.

Grant of IND Application for NCE lead, IIIM-290



IIIM-290 is an orally bioavailable NCE lead based on a natural product rohitukine. It was discovered and developed at IIIM under 12th FYP BSC-205 and CSIR-FTT (MLP-5008) projects. It is a potent inhibitor of Cdk-1/A, Cdk-2/A, Cdk4/D3 Cdk5/p25, Cdk-6/D1 and Cdk-9/T1 with IC50 values in the range of

1.9 to 50 nM. It possesses promising in-vitro cytotoxicity in different types of cancer tissues, with most potent cytotoxicity in pancreatic and leukemia cells (IC50< 1 µM). It display an excellent in-vivo efficacy in human xenograft models of pancreatic cancer and leukemia. The regulatory pharmacology of the lead has been completed as a part of CSIR's FTT grant (MLP-5008), and the IND application was filed to DCGI in January 2020. The approval was received from DCGI on 28th May 2020 for this IND application, for conducting Phase I/ II clinical trial in locally advanced or metastatic pancreatic cancer patients.

IND application of IIIM-160 (*Bergenia ciliata* based phytopharmaceutical lead)

Under the CSIR-Phytopharmaceutical mission I (2017-2020), *Bergeniaciliata* based phytopharmaceutical lead IIIM-160 was developed. The pre-clinical pharmacology, regulatory Tox., and CMC documentation was completed. The lead is positioned for the management of pain in rheumatoid arthritis. The IND application has been filed to DCGI on 20th April 2020.

Trials of car fitted with Fuel Cell Technology (LT-PEMFC) Stack successfully ran by CSIR and KPIT Ltd.

CSIR and KPIT Technologies Ltd. successfully ran trials of India's first Hydrogen Fuel Cell (HFC) prototype car running on an indigenously developed fuel cell stack at CSIR-NCL, Pune. The HFC technology uses chemical reactions between hydrogen and oxygen (from

air) to generate electrical energy, eliminating the use of fossil fuels. Further, the fuel cell technology emits only water, thus cutting down the emission of harmful greenhouse gases along with other air pollutants. The fuel cell is a low temperature PEM (Proton Exchange Membrane) type Fuel Cell that operates at 65-75 degree centigrade, which is suitable for vehicular applications. CSIR and KPIT have developed a ten kWe (Kilowatt-electric) automotive grade LT-PEMFC (low-temperature PEM fuel cell) stack based on the CSIR's know-how.

Safe Biometric-based exploder developed

The exploders available in the market are found unsafe when it is stolen and misused by unauthorised person. To avoid

misuse, a biometric-based exploder has been developedby CSIR-CIMFR. It can only be operated by those peoples who are biometrically registered with the specific device. The fingerprint scanner, with the help of embedded micro-controller, registers the authorised personnel using their fingerprint up to 20 numbers. Once registered, no other person can use these devices. The exploder has been developed for both underground and opencast mines. The technology has been transferred to M/s Pranay Enterprises, Hyderabad.

Anaerobic Gas Lift Reactor (AGR) for generation of biogas and biomanure

Anaerobic Gas lift Reactor

CSIR-IICT has developed and patented a high rate biomethanation technology known as Anaerobic Gas Lift Reactor (AGR) for the generation of biogas and bio manure from organic solid waste like poultry litter, food waste, press mud, cattle manure, organic fraction of municipal solid waste (OFMSW), sewage sludge etc. This technology provides a decentralised treatment option for organic waste based on high rate biomethanation to generate biogas for combined heat and power (CHP) applications. This has been transferred to M/S Ahuja Engineering Services Pvt Limited, Hyderabad and M/s Nyrmalya Bio-Engineering Solutions Pvt. Ltd.

World's Largest Solar Tree fabricated

CSIR-CMERI has developed the World's Largest Solar Tree, which is installed at CSIR-CMERI Residential Colony, Durgapur. The installed capacity of the Solar Tree is above 11.5 kWp and has the annual capacity to generate 12,000-14,000 units of Clean and Green Power. This Solar Tree is a Quantum Leap towards making an Energy Reliant and Carbon Negative India. The solar tree has 35 solar panels, each with a capacity of 330 watts. The solar panels connected through metal branches produce solar power. Has the potential to save 10–12 tons of CO2 from being released into the atmosphere every year. Since the shadow area is minimum in solar trees, they could be set up in agricultural farms to run pumps, e-tractors and tillers as an alternative to diesel. The excess power can be sent to the grid, providing an economic return to farmers.

Sustainable Road Pavements in High Altitude Regions using Geosynthetics'

Under the project 'Sustainable Road Pavements in High Altitude Regions using Geosynthetics' sponsored by the Ministry of Environment, Forest & Climate Change, different regions of the Indian Himalayan States like Arunachal Pradesh and Himachal Pradesh were chosen for the field implementation plan of the project. After having a preliminary design developed on the basis of laboratory model studies, different field test sections were laid at Lahaul & Spiti District of Himachal Pradesh

in the month of August 2020 in addition to the previously laid test sections in Manali, Himachal Pradesh. Different combination and types of geosynthetic materials like Geogrid, Geocell and Geomembrane were considered in the study.

Made in India aviation weather monitoring system installed at Bengaluru International airport

An indigenously-developed Aviation Weather Monitoring System (AWMS) has been installed at the new runway of Kempegowda International Airport (KIA). With this, KIA has become the first airport in the country to install indigenous AWMS technology, developed by Bengaluru based CSIR-NAL, at both ends of the new runway. In addition, KIA has installed four Drishti transmissometers – also developed by NAL, in association with the India Meteorological Department (IMD) – to measure the runway visibility range (RVR). KIA has the unique honour of having NAL's 50th Drishti installed at its runway.

The Drishti Transmissometer is acclaimed for precise reporting, helping pilots with an accurate runway visual range. With the web-enabled feature, the data can be accessed, and maintenance can be carried out from any location. Meanwhile, the 10-meter mast on which AWMS sensors are installed is a first-of-its-kind, designed by NAL, with several unique features, including being eco-friendly and lightweight, with a life of over 60 years. The sliding mechanism enables easy maintenance - a useful feature-considering the busy traffic on the runway. Manufacturing Technology for DRISHTI Transmissometer has been transferred to TATA Power Company Limited - Strategic Engineering Division, Bangalore.

PANI-WATER: Photo-Irradiation and Adsorption Based Novel Innovations

Aviation Weather Monitoring System

Drishti Transmissometer

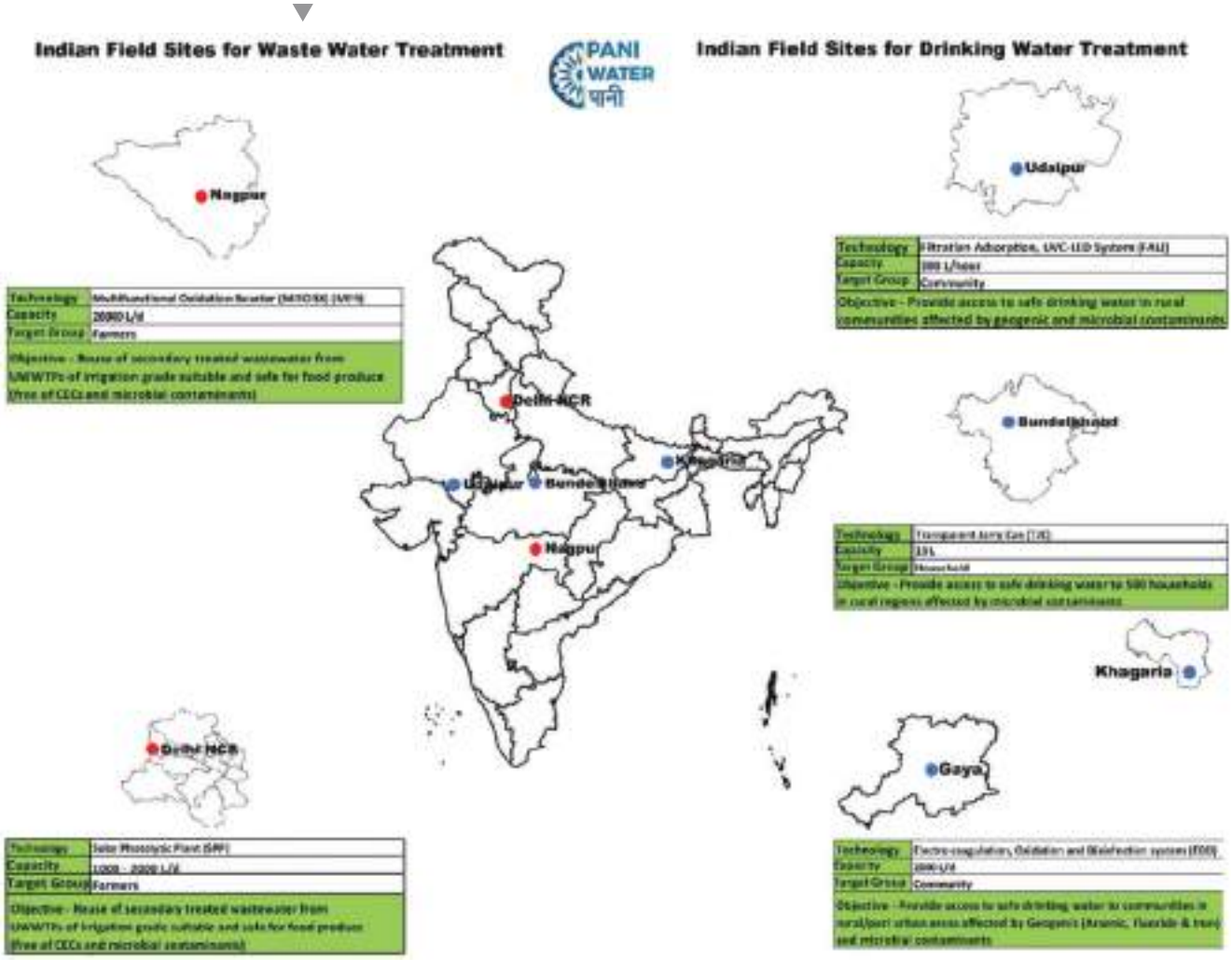
for Water Treatment

PANI-WATER is an international effort under the framework of Indo-EU WATER Research sponsored by DST & EC to develop, deploy and validate six water treatment technologies for the removal of chemical and biological contaminants from wastewater and raw water.

- Profiling of contaminants of Emerging Concerns & Antimicrobial Resistance Genes & Antibiotic Resistance Bacteria in secondary treated sewage in Northern (Delhi) & Central (Nagpur) Indian STPs
- Development of novel adsorbents based on layered double hydroxides for removal of CECs

High-Power S-band, 2.6 MW, Magnetron

Magnetron, a high-powered vacuum tube, is an essential component for Medical LINAC (Lineal accelerator), which are widely used for external radiation treatment of cancer patients. CSIRCEERI had, recently, designed and developed 2.6 MW S-band tunable pulsed Magnetron, which was successfully tested



and used as a microwave source, to generate the required X-ray dose using a LINAC system for Cancer treatment. On July 14, 2020, the technology know-how for S-band Magneton was transferred to M/s Panacea Pvt. Ltd., Bangalore, known for developing advanced radiotherapy systems for Cancer treatment.

Food Business Accelerator to augment startups set up

CSIR-CFTRI inaugurated a "Food Business Accelerator" in August 2020 to augment its startup Innovation System in the Campus. The Centre is targeted to provide opportunities for prospective entrepreneurs and startups to be part of the Accelerator Facility for a period up to 1 year or so. These companies can explore the avenues for product development, Scale-up operations, packaging and shelf-life studies for commercialising their products. Expert mentoring sessions will also be available.

Geochemical baseline atlas under National Geochemical Mapping (NGCM) of soils for 22 elements

First "Geochemical Baseline atlas of India" in continental scale, consisting of geochemical maps of oxides and trace elements in topsoil and bottom soil. This work is a part of the collaborative work with International Union of Geological Sciences (IUGS) Global Geochemical Baselines program where CSIR-NGRI was identified as the Nodal Agency to carry out such studies in India and accordingly have prepared the maps for 22 elements in soil samples.

Foundation for Aerospace Innovation, Research and Entrepreneurship (FAIRE) being setup

Foundation for Aerospace Innovation, Research and Entrepreneurship (FAIRE) a non-profit technology business incubator for aerospace & allied engineering is being set up by NRDC & FISE at CSIR-NAL, Bengaluru. The facilities, technologies, knowledge base, etc. from the CSIR-NAL will be brought in for commercial exploitation to the potential start-ups and MSMEs for the introduction of novel products and services.

CSIR Innovation Centre for Next Generation Energy Storage Solutions (ICeNGESS) launched

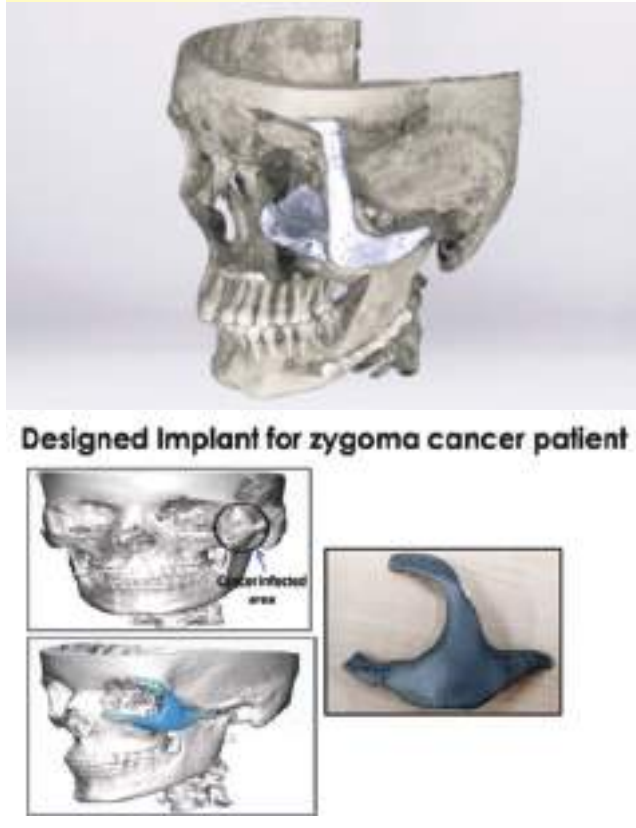
CSIR has launched a Mission Mode Project entitled "CSIR Innovation Centre for Next Generation Energy

Storage Solutions (ICeNGESS)" and is being implemented at CSIR-CECRI, Chennai Center. CECRI's premier research in new generation battery systems like lithium-ion, sodium-ion, lithium-sulphur and metal-air battery technologies, has taken a leap forward in its journey towards establishing a CSIR Innovation Centre for Next Generation Energy Storage Solutions at CSIR Madras Complex, Chennai.

Bharatiya Nirdeshak Dravya (BND®) released

BPCL Quality Assurance (QA) department and M/s Aashvi Technology LLP (ATL) joined hands with CSIR-NPL for manufacturing and marketing of "Bharatiya Nirdeshak Dravya" (Certified Reference Material) to ensure correct and accurate results of laboratory instruments under the "AtmaNirbharBharat" programme of Honourable Prime Minister of India. The BNDs (Bharatiya Nirdeshak Dravya) were released at CSIR-NPL, New Delhi on 18 August 2020. CSIR-NPL is the only National Metrological Institute of India with direct traceability to SI units. Petroleum & Petrochemical Laboratories will use the CRM (BND) for calibration of the equipment. In India, almost 200 Laboratories (including PSUs & Pvt. labs) catering to Petroleum fuel testing will be benefited by using cheap indigenous BND. This will result in cost reduction to the tune of at least 50% and saving of foreign exchange as well. The possibility of exporting the BNDs to neighbouring south Asian countries is also being explored.

3D-Printed Patient-Specific Medical Implants developed



CSIR-CSIO developed a technology for manufacturing patient-specific medical implants for several human body parts. The technology has been transferred to industry for commercial production and marketing of the product. Patient-specific implants are required in trauma, diseases like cancer, fungal infection or other reconstructive surgeries for specifically targeted patients. Patient specific implants are also required in the case of unavailability of implants for specific sites of the human body or when available implants do not fulfil the anatomical requirement of a patient. Researchers worldwide are in a race to make patient-specific implants. Scientists at CSIR-CSIO have attempted to solve this complex problem with the help of Computer Aided Design (CAD) followed by 3D printing of the biocompatible metals. In this process, the patient's CT-Scan/ MRI data is utilised to design the implant with specifications compatible with patients.

Pravasi Bharatiya Academic and Scientific Sampark (PRABHASS) portal launched

Under the directives of Hon'ble Prime Minister, CSIR initiated the efforts to develop a database and a virtual platform to bring on board the Global Indian S&T Community to address the Indian societal challenges / problems.

The virtual platform, a portal, is named PRABHASS which means a ray of light, and is an acronym for "Pravasi Bharatiya Academic and Scientific Sampark - Integrating Indian Diaspora with the Mother Land". PRABHASS is being developed with collaborative effort of all major scientific ministries / departments and the Ministry of External Affairs of India. The vision of the portal is to serve as National Digital Platform to effectively collaborate with Global Indian S&T Community for collectively promoting inclusive growth in India, strengthening Indian innovation ecosystem and contributing towards nation building.

CSIR-SERC, Chennai Develops Indigenous Emergency Retrieval System (ERS) for Power Lines

CSIR-SERC has developed an indigenous technology, Emergency Retrieval System (ERS), for quick retrieval of power transmission in the event of failure of transmission line towers. CSIR-SERC has signed an agreement for licensing of the ERS technology with M/s Advait Infratech, Ahmedabad. At present, the ERS systems are imported. There are very few manufacturers across the world and the cost is relatively high. This technological development will enable the manufacturing in India for the first time, which will be an import substitute and will cost about 40% of imported systems. ERS has huge market requirement in India as well as in SAARC and African countries. Hence, this technological development is a big leap forward towards AtmaNirbhar Bharat and Make in India. The agreement was signed in the presence of Prof. Santosh Kapuria, Director, CSIR-SERC, Chennai and Shri S.K. Ray Mohapatra, Chief Engineer (PSE & TD), Central Electricity Authority, New Delhi.

India International Science Festival-2020 sets five Guinness Records, attracts over 1.3 lakh participants

The sixth edition of India International Science Festival was held online during 22-25 December 2021. With 41 events that saw over 1.3 lakh participants, the event set a Guinness World Record for the largest digital science event organized. The theme of the year's IISF was 'Science for Self- Reliant India and Global Welfare'. Hon'ble Prime Minister, Shri Narendra Modi inaugurated the event. The Hon'ble PM said, "India has a rich legacy in science, technology and innovation. Our scientists have done path breaking research. Our tech industry is at the fore-front of solving global problems. But, India wants to do more. We look at the past with pride but want an even better future." The Valedictory Session of the megaevent was graced by the Hon'ble Vice President of India, Shri Venkaiah Naidu. IISF-2020 was organized by CSIR, Dept. of Science and Technology, Ministry of Earth Science, Department of Biotechnology, Ministry of Health and Family Welfare along with Vijnana Bharathi.

IISF 2020 started on 22 December (Birth Anniversary of India's great mathematician Srinivasa Ramanujan) and culminated on 25 December 2020 (Birth Anniversary of former PM of India Shri Atal Bihari Vajpayee).

Hon'ble Vice President of India speaking at the Valedictory session of IISF 2020

Union Science and Technology Minister Dr Harsh Vardhan observing the participants of Sundial Kit assembly as part of the Guinness World Records in the central lawn of CSIR-NISCAIR, New Delhi.

3.0
Major COVID-19 Contributions

3.0

Major COVID-19 Contributions

The SARS-CoV-2 outbreak in India and the world posed tremendous challenge to the human race, which necessitated urgent S&T driven interventions. CSIR, with its strong network of laboratories across the nation and multifarious portfolio of technologies and interventions, deployed its might to manage the pandemic. To do so, CSIR set up five interdisciplinary verticals and to work in close synergy with other government departments, and with industries, MSMEs, and others for scale-up, delivery, and implementation on the ground.

CSIR's Five Verticals to Combat Covid-19

Considering the complexity and diversity of problems posed by the corona virus epidemic, which required interventions in several areas and multi-pronged strategy, CSIR set up five technology verticals for addressing the pandemic. These verticals are need-based and span multiple research labs and disciplines and draw upon the strength of scientists, students, and harness it for the fight against Covid-19. Besides, CSIR is also working on promoting rural employment and providing ready to eat food to migrants and other outreach programs.

Digital and Molecular Surveillance

Isolation and social distancing being key measures in containing the Covid-19 outbreak, the digital surveillance goal is to trace patients digitally and establish virus transmission chains and mitigate transmission. Molecular surveillance involves the identification of the strain of the virus and its sequence, which are critical towards understanding the molecular epidemiology.

Molecular Surveillance

Large dataset viral genome sequencing in India was the need of the hour to understand the virus dynamics such as its spread & mutation frequency and the impact on the severity of the disease and implications for the vaccine, drug, and diagnostic development. CSIR laboratories have undertaken sequencing of SARS-CoV-2 to find the type of strains present in India and to understand if the virus undergoes genetic changes while it is spreading in the country. Several CSIR labs have sequenced the SARS-CoV-2 genome samples from Indian isolates, and more than 2000 genomes have been sequenced so far. The genome sequencing has led to creation of following resources:

- **IndiCoV**: A comprehensive resource for SARS-CoV genomes and variants from

India. The resource provides a searchable interface for genomes, genomic variants and variant annotations for the SARS-CoV-2 isolates from India.

- **GEAR-19**: A resource developed by CSIR-CCMB to track the genomic evolution of SARS-CoV-2
- **PhyloVis** - Phylogenetic analysis of SARS-CoV-2 genomes from India and the Covid-19 Genomepedia: An integrative & searchable resource of SARS-nCoV-2 genomes is other resource.

Sequencing of viral strains from patient samples to identify mutations and their implications for therapeutics: Coronaviruses possess the largest genomes (26.4–31.7 kb) among all known RNA viruses, with G+C contents varying from 32% to 43%. Variable numbers of small ORFs are present between the various conserved genes (ORF1ab, spike, envelope, membrane and nucleocapsid) and, downstream to the nucleocapsid gene in different coronavirus lineages. Given the high rate of human to human transmission of this virus, it is important to identify the basis of its replication, structure, and pathogenicity for discovering a way to its treatment or the prevention.

Sewage based surveillance: CSIR-CCMB developed the protocol for estimating the extent of SARS-CoV-2 population in large areas via checking for the virus in sewage samples collected from large parts of a city in sewage treatment plants. Considering the fact that wastewater-based epidemiology (WBE) approach can be a tool to minimise the disease spread, surveillance of selected urban cluster with the drainage network has been selected and wastewater samples from in and around Tarnaka nallahs have been collected (from October 2020) and analysed by CSIR-IICT and CSIR-CCMB, for the presence of SARS-CoV-2 viral genome. This can be applicable to the other urban communities for SARS-CoV-2 genome detection. Along with this a comprehensive surveillance of major municipal corporations of Andhra Pradesh State has also been started in November first week, and the work related to this is under progress. CSIR-NEERI is also involved in a major way in the surveillance and carrying it out in different parts of India along with CSIR-CCMB.

Testing for Covid-19 in wastewater as a community surveillance measure at CSIR-IICT in collaboration with CSIR-CCMB.

Sample collection for monitoring of drains and STP in Kolkata for Covid-19 detection study jointly done by CSIR-NEERI & CSIR-CCMB

Pune Municipal Corporation (PMC) and scientists of CSIR-National Chemical Laboratory (CSIR-NCL) also conducted a pilot project showing traces of the virus causing Covid-19 in the sewage. Around 23 wastewater samples from four Sewage Treatment Plants, 17 wastewater samples from open drains entering river, 9 samples from CSIR-NCL residential colony campus were processed and assessed for the presence of SARS-CoV-2 nucleic acid by RT-qPCR. Sewage samples from open drain entering river were also profiled from a period ranging from December 2020 to March 2021 and sequenced by ARTIC V3 protocol on MinION sequencer.

Genome sequencing of corona virus: About the Initiative/Technology: CCMB has obtained coronavirus isolates from across India. It has been a part of the national INSACOG initiative focusing on coronavirus

genome sequencing. About 6500, roughly 12% of all genomes of coronavirus isolates from India have been sequenced at CCMB. These are available publicly. CCMB has identified all the key variants of coronavirus in India, which have come from abroad as well as evolved in India.

Air-borne transmission of coronavirus: To look at evidence of the air-borne nature of coronavirus, CSIR-CCMB and CSIR-IMTECH used air-filters to capture coronavirus. Using these filters, they found the virus in air of hospital rooms occupied by coronavirus infected persons, even after they have left the room. CSIR-CCMB was the first laboratory, along with CSIR-IMTECH to establish that coronavirus spreads in air, and can be found further than even 2 metres from the infected person. It was established that ventilation and isolation among family members in houses of infected persons can reduce the possibility of spread within the family.

Digital Surveillance Platform

Digital Surveillance is a vital step that involves the collection of data of confirmed cases, suspected cases, probable cases, contact cases through contact tracing (that may include asymptomatic as well). The data so generated is closely analysed to interpret the spread of the disease and facilitate the government to take necessary action on a timely basis and mitigate community-level transmission of SARS-CoV-2.

CSIR worked with Intel India and International Institute of Information Technology (IIIT), Hyderabad to help achieve faster and less expensive Covid-19 testing and coronavirus genome sequencing to understand the epidemiology and AI-based risk stratification for patients with comorbidities. As part of the initiative, Intel India is developing an end-to-end system that consists of multiple applications, testing devices, data collection/aggregation gateways, a data exchange SDK, and an AI model-hub platform. CSIR constituent labs such as CSIR-IGIB, CSIR-CCMB, CSIR-IMTECH, CSIR-IIP, CSIR-CLRI and others worked with various hospitals and diagnostic chains in carrying out comprehensive diagnostics.

CSIR Covid-19 Testing Facilities: In the first week of February 2020, only 14 laboratories in India were testing for Covid-19. There was emergent need to increase the

Dr Himanta Biswa Sarma inaugurating the COVID-19 testing laboratory at CSIRNEIST in the presence of director of the institute Dr G. Narahari Sastry, Director of CSIR-NEIST.

number of testing facilities across India. CSIR established several RT-PCR based SARS-CoV-2 screening laboratories. The CSIR laboratories testing details during 2020-2021 is given in Table below:

Sl. no.	Laboratory	Number of tests
1	CSIR-IITR	222011
2	CSIR-IIP	15000
3	CSIR-CLRI	12270
4	CSIR-IICB	85000
5	CSIR-CFTRI	176089
6	CSIR-NBRI	146296
7	CSIR-IIIM	69212
8	CSIR-IHBT	125000
9	CSIR-NEERI	320000
10	CSIR-NEIST	37551

The community-level screening was carried out at Kolar, Karnataka by CSIR-IGIB. The team has set up a model for community surveillance. This was done in collaboration with NIMHANS, THSTI (DBT), and TATA Sons. The pilot study was done, and 1000 random samples that included 200 healthcare workers from a database of 1 million people were screened by a mix of RT-PCR assays and Rapid Antibody test and proper ELISA.

AI tool for Covid-19 detection from X-Rays: CSIR has initiated efforts to reduce the time taken for diagnosis using Artificial Intelligence tools. Efficient deep learning Artificial Intelligence models have been developed by CSIR-IGIB for early diagnosis of Covid-19 through pattern recognition of chest X-rays and CT scans in partnership with industry.

3D View of Covid Data: CSIR-IIP and CSIR-NEERI jointly developed Google Earth enabled 3D handy digital surveillance service which was launched on World Environment

Day (June 5th, 2020) with services for Maharashtra, India and World Covid-19 data in a more realistic and dynamic way. The most unique feature of the link has been a 3D view of the Covid data comparison (i.e. Total Vs Active Vs Cured Vs Death cases). Users can visualise the case counts just by clicking on the 3D bars. Implementing further improvisation in this service, CSIR-NEERI and CSIR-IIP in cooperation with Nagpur Municipal Corporation launched one of its kind of micro-level model for Covid-19 digital surveillance.

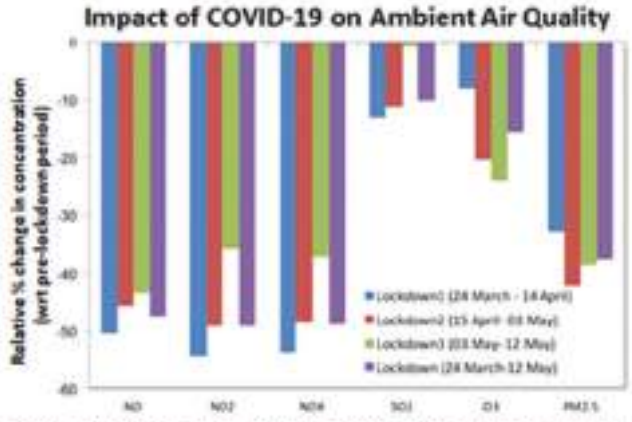
Serological Surveillance: Several CSIR labs are participating in CSIR Phenome India Project led by CSIR-IGIB which is a long-term longitudinal observational cohort study of health outcomes within its employees with an aim to develop risk prediction tools and play an important role towards establishing precision health and medicine for the Indian population. In this regard, the Covid19 serological tests have been conducted across CSIR labs in the country spearheaded by CSIR-IGIB. The serological survey across

the CSIR labs located in varied regions and representing a wide diversity of population provides insight into the spread of the disease in different settings, different categories of people. Also, long term studies will provide insights into the duration and magnitude of the antibody response in antibody-positive patients. The first round of testing has been done on > 10,000 persons.

Ensemble Deep Learning Framework for Covid-19 Prediction: Short-term prediction of Covid-19 positive cases is very crucial in planning for supply chain management. CSIR-4PI carried out deep learning based weekly prediction of Covid-19 positive cases for the state of Karnataka and the district of Bengaluru Urban, since August 2020. The prediction based on ensemble methodology used six variants of LSTM (Long Short Term Memory), a deep learning technique for time series prediction. The models predicted both the number of positive cases as well as the test positivity rates one week in advance (later extended to 15 days in advance as desired by the state government). In addition, CSIR-4PI was also involved in a collaborative effort from IISc, ISI Bangalore and JNCASR to provide district wise positive cases on a weekly basis. These predictions were published in a website (https://www.isibang.ac.in/~athreya/incovid19/wp), which was used by government and also acted as an input to policy decisions.

Development of Weather Integrated AI model for Covid-19 case prediction over India: Artificial Intelligence (AI) techeniques play a tremendous role in time-series forecasting of non-linear problems. CSIR-4PI collaborated with CSIR-IICT to develop a Covid-19 prediction model based on the relationship between the weather parameters and deep learning techineques. The study observed that the specific humidity and temperature play a significant role in the prediction of Covid-19 cases over different states in India.

Assessment of air pollution status during Covid-19 lockdown (March–May 2020) over Bangalore City in India:



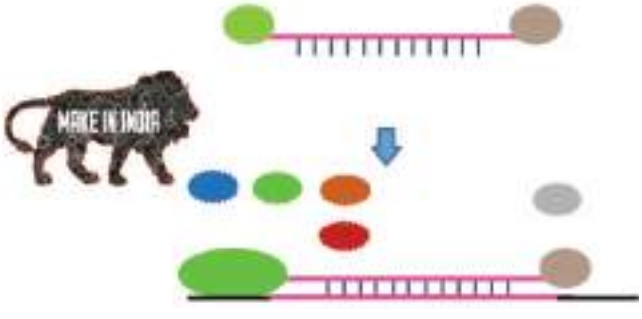
Relative % change in the pollutant concentration observed in whole Bangalore city during different phases of COVID-19 lockdown for the pre-lockdown period in the year 2020

Analysed the impact of Covid-19 lockdown on the ambient concentration of air pollutants over the city of Bangalore. The results have shown a huge reduction in the ambient concentration of air pollutants; 47.3% (NO), 49% (NO2), 49% (NOX), 10% (SO2), 37.7% (PM2.5), and 15.6% (O3), resulting in improved air quality over Bangalore during the Covid-19 lockdown period.

Rapid and Economical Diagnosis

CSIR labs developed many coronavirus diagnostics. Some of the diagnostics developed by CSIR labs are as follows:

Dual labelled probe for RT-PCR:



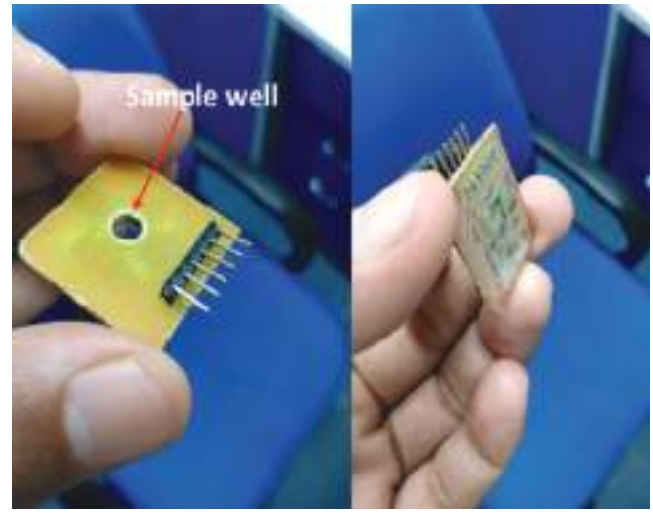
The cornerstone of Covid-19 containment is testing of the SARS-CoV-2 infection, followed by quarantine or treatment of the infected

individuals. Currently, is the most robust and accurate method of testing for the SARS-CoV-2. Several fluorescent dyes and quenchers with a variety of excitation and emission characteristics were prepared for TAQMAN probes, which are used in qRT-PCR diagnostics of Covid-19. The technology of fluorescent dyes and quenchers has been licensed to a company for further development and commercialization.

Dry-Swab-Direct-RTPCR Diagnostic:

The simple and fast method of Dry Swab-Direct RT-PCR, developed by CSIRs constituent lab CCMB, Hyderabad, for scaling up of SARS-CoV-2 detection was approved by ICMR. This method is a simple variation of the existing gold standard RT-PCR method and can easily scale up the testing by 2 to 3 fold with no new investment of resources and makes diagnosis test simpler, faster and cheaper. Compared to conventional RT-PCR method, in the improved method, the swab is collected and transported in a dry state (Dry Swab), and the step of RNA isolation is omitted, and RT-PCR (Direct RT-PCR) is carried out directly. The advantage of this improved method is twofold. Firstly, RNA isolation is a major bottleneck in terms of human resources, time and money and the Dry-Swab-Direct-RT-PCR method circumvent this step. Secondly, dry swab without the liquid VTM is easy to transport and handle in the BSL2 facility and decreases the risk of viral infection. Significantly, CSIR-CCMB has demonstrated that Dry Swab-Direct RT-PCR is comparable in sensitivity and specificity to the gold standard RT-PCR method. Further, it has been independently validated by CDFD (an autonomous institute under DBT), CSIR-NEERI (a CSIR lab at Nagpur) and IISER-Berhampur and several other private and government hospitals and institutes. After evaluating this method and finding an overall concordance of 96.9%, ICMR has issued an advisory for the use of CSIR-CCMB dry swab method, considering its lesser cost and quick turn-around time.

Micro PCR with Disposable Chip:

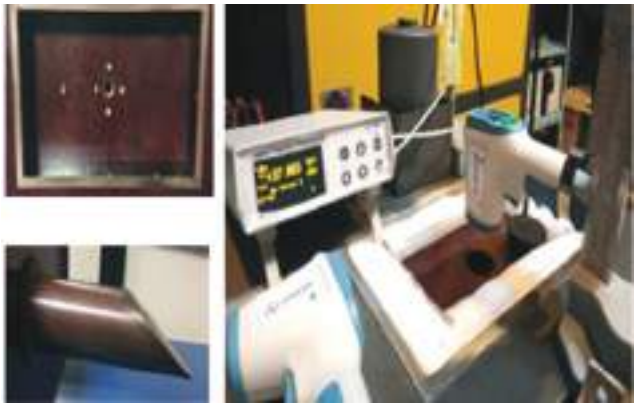


CSIR-CEERI has developed handheld Polymerase Chain Reaction (PCR) system for DNA sequence amplification. It consists of a disposable micro fabricated amplification chip, capable of handling 20-150 µl sample volume. The chip with micro-heater is fabricated using micro fabrication techniques such as lithography, sputtering, etching, etc. which makes it suitable for precise applications. Micro-heater temperature is controlled using precisely designed PID controller. The system is capable of controlling the temperature cycles with precision, suitable for PCR application.

IR Forehead Thermometer Testing Facility

The measurement of body temperature is a basic parameter and vital sign of the human body. During the epidemics like Covid-19, SARS, Ebola, etc the non-contact type IR Clinical thermometers are used for the effective thermal screening. As per the Legal Metrology requirement, all the IR Clinical thermometers, imported or developed in India, need to be tested for their model approval.

For clinical IR thermometers, the laboratory accuracy level of ± 0.3 C is permissible in the temperature range from 35 C to 42 C, as per the IS/ISO 80601-2-56: 2017.



Setup for Testing of IR Forehead Thermometers

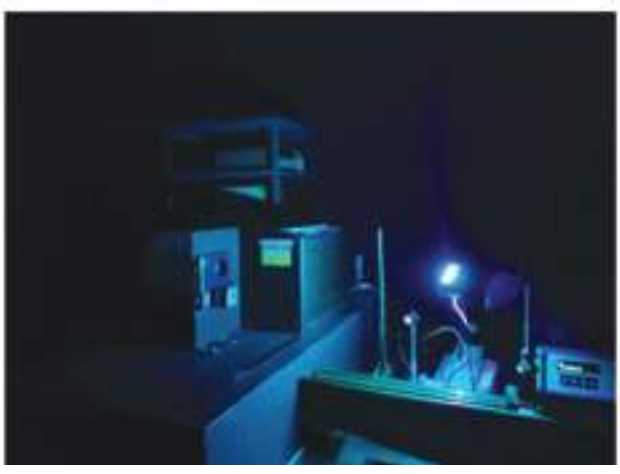
CSIR-NPL has designed and developed a copper blackbody cavity coated with diffused black paint to give the emissivity of 0.998 and placed in a high stability (± 0.003 oC) water bath. Various experimental parameters such as bath stability, uniformity, emissivity variation, temperature difference in cavity, size-of-source and distance effect are measured and optimized to get the overall temperature source uncertainty of ± 0.051 C.

CSIR-NPL has successfully tested about 70 Models for Department of Legal Metrology by March 2021. Supported about six MSMEs making the thermometers in India by standardizing their blackbodies.

CSIR-NML has also developed an infrared thermometer that facilitates temperature check from a distance and deployed in the laboratory for contactless surveillance of body temperature due to Covid

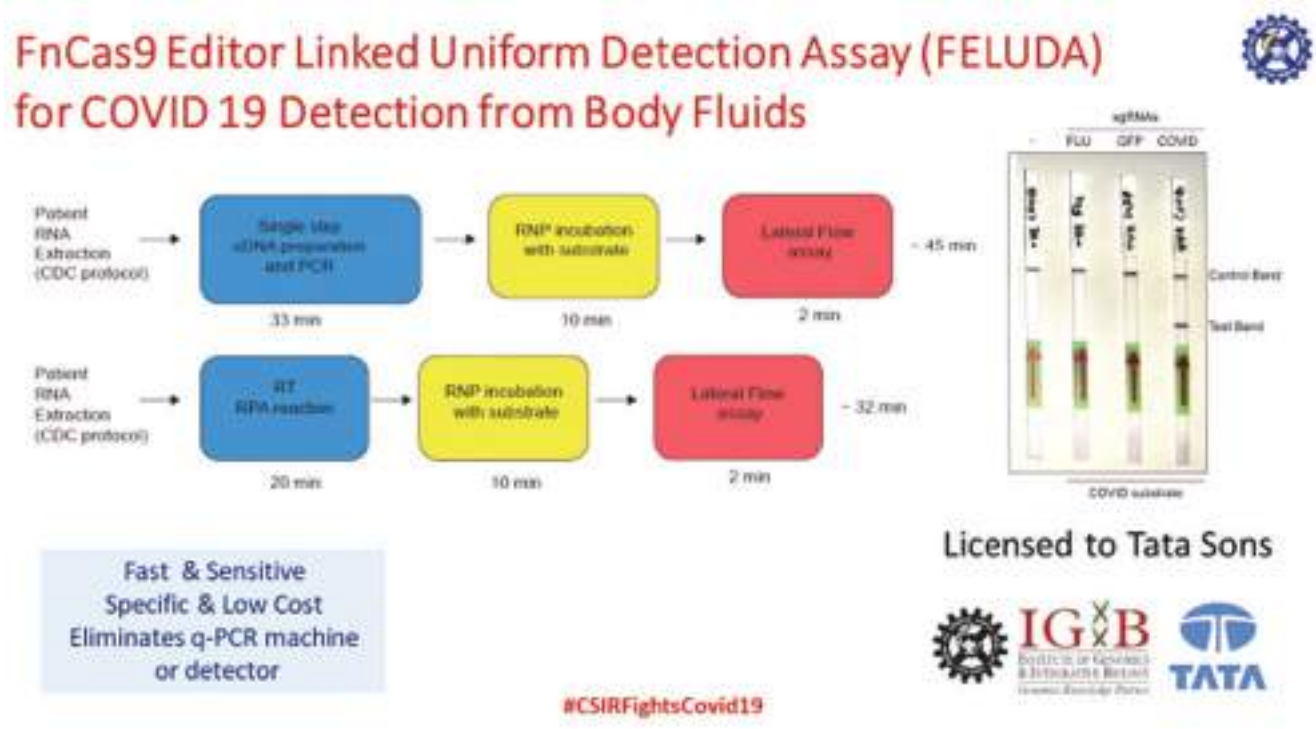
Validation of diagnostic kits, sanitization strategies and therapeutics: CSIR-CCMB tested and validated several diagnostic products because of its in-house coronavirus cell culture and availability to positive coronavirus samples. Sixty drugs, 20 devices and 20 nano-formulations were tested on cell-culture system at CSIR-CCMB.

Derivation of Measurement Traceability for UV Radiation: UV radiation based disinfection emerged out as a simplest way to help contain the SARS-Cov-2 (Novel Corona) virus. CSIR-NPL paved the way for providing traceability and reliable measurements to MSMEs, startups, manufacturing industries, testing-calibration laboratories which are contributing to the development of such radiation based applications to contain the Corona virus. Traceability of irradiance measurement for UV radiation has been derived to provide apex and traceable measurement to support MSMEs, startups, manufacturing industries, test-calibration laboratories which are contributing in the development of such radiation based applications to contain the corona virus.



Spectral Irradiance Measurement of UV-Source

CRISPR/ Cas based paper diagnostic test FELUDA: A CRISPR/ Cas-based paper diagnostic test has been developed by CSIR. The FELUDA methodology has been developed in CSIR-IGIB for detecting single nucleotide variants in RNA or DNA or more broadly detecting any DNA or RNA fragment, without the need for sequencing. The principle of discrimination is derived from the natural property of the enzyme being used for the invention, *Francisella novicida* Cas9 (FnCas9) which shows a very low binding affinity to mismatched substrates. For Covid-19 detection, RNA is isolated from body fluids containing the inactivated virus, converted to DNA, and further amplified to increase the number of copies. The amplification is done using custom generated primers resulting



in DNA products labelled with biotin ligand. Upon incubation of a CRISPR complex (labelled with a Fluorescein amidite group) with these DNA products, the Cas9 protein interacts with the biotin-labelled DNA only if there is a CoV-2 sequence present. The complex formed is then applied on a paper strip whose chemistry is defined by the production of the test line where the Cas9: DNA complex gets deposited giving rise to a visible band. The presence of this line shows that the patient sample is positive for Covid-19. This technology can be adopted for other diseases too. CSIR has licensed this technology to TATA Sons. The kit has been approved by DCGI, and TATA has launched this as TATA MD CHECK and is currently being rolled out.

Next-Generation Sequencing (NGS) based surveillance and diagnostics: CSIR labs have developed many platforms for sequencing based surveillance and diagnostics. Next-generation sequencing (NGS) allows for analysing a large number of viral sequences from infected patients, presenting novel prospects for studying the structure of viral populations and understanding virus evolution and epidemiology. Of these using the Illumina sequencing platform, CSIR-IGIB has been the first to globally validate the CovidSeq assay on clinical samples. This method allows for sequencing for detection and also genetic epidemiology. It has a scalable configuration for 300, 1500, 3000 samples and can provide results of few thousands of samples in 12 hours on the Illumina NovaSeq 6000, leading to the concept of Mega lab which can be deployed at airports or sporting events or red zones where a large number of samples needed to be tested at one go. CSIR-IGIB is working with the Kerala Government to track the viral strains using this method.

CSIR-CCMB has also developed a protocol for sequencing based diagnostics with Syngene as a partner which can also test thousands of samples at one go. In addition to this, a nanopore-based platform has also been tested and protocol developed by CSIR-IGIB, which will aid in testing at low resource settings. This method has the advantage of affordability, low-resource, speed and sensitivity and can be used to sequence the whole genome or amplicon-based detection.

Development of RT-LAMP assay for Molecular Diagnosis of Covid-19:

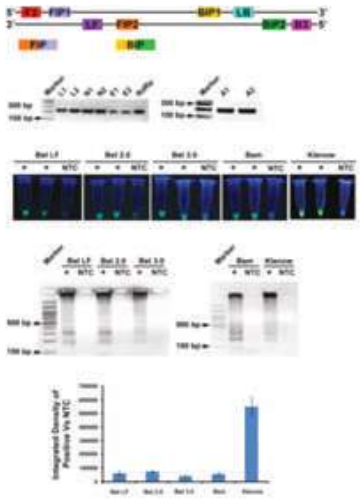


Figure 2a:Designing of LAMP primers

Figure 2b: Evaluation of DNA Polymerases for LAMP. (a) Generation of synthetic templates for LAMP. (b) Florescence imaging of LAMP assays with different DNA polymerases. (c) Agarose Gel Electrophoresis of LAMP amplicons. (d) Densitometry of florescence values from LAMP assays.

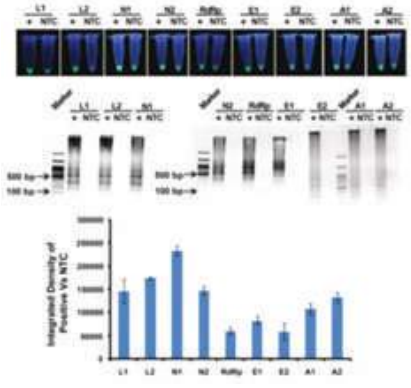


Figure 2c: Evaluation of LAMP Primers. (a) Florescence imaging of LAMP assays of seven primer sets from viral genome and two β-actin primer sets. (b) Agarose Gel Electrophoresis of LAMP amplicons. (c) Densitometry of florescence values from LAMP assays.

CSIR-IIIM and Reliance Industries Limited have together developed a Reverse Transcription Loop-Mediated Isothermal Amplification (RT-LAMP) assay for much cheaper diagnosis of Covid-19. RT-LAMP assays include conversion of viral RNA to cDNA, followed by target DNA amplification using a set of four to six primers, at isothermal conditions

Development of sensitive, cost effective, easy to use dipstick kit for the precise detection of Covid-19 infection: Development of dipstick (easy to use) for detecting SARS-CoV-2 infection in patient saliva samples (point of care, self-administrable) using antibodies generated in chicken (cost effective) against SARS-CoV-2 spike protein derived antigenic peptides (highly specific to SARS- CoV-2).

- Five-epitope peptides specific to Spike protein of SARS-CoV-2 was designed, synthesized and polyclonal IgY antibodies were generated. Out of five, three peptides were highly immunogenic
- The antibodies were validated to detect the immunized peptides as well as recombinant SARS-CoV-2 spike trimer protein in vitro.
- Antibodies have also been separately validated for their reactivity against native SARS-CoV-2 virus in Covid-19 positive swab samples.
- Memorandum of Understanding is signed with the industry partner and the generation of lateral flow dipstick detection kit is currently in progress.
- Patent filling is in process

Development of Repurposed Drugs/New Drugs and Vaccine

The main focus of this vertical is on enabling quick access to drugs against coronavirus for Indian patients as soon as they are developed in India or globally. CSIR is exploring all possible options ranging from repurposed drugs to new drugs to phytopharmaceuticals and AYUSH products and biological therapeutics, including vaccines.

Towards that CSIR is working on the synthesis of the top 'potential' repurposed drugs for carrying out clinical trials etc. For this CSIR has tied up with top pharmaceutical Industries such as Cipla and CSIR has well-established credentials in the synthesis of drugs, having worked closely with industry and being the fountainhead of processes for generic drugs for which India is globally renowned.

Repurposed Drugs: Based on the global therapeutic pipeline, CSIR has identified the top 25 drugs/drug candidates that have the potential to be beneficial in the treatment of Covid-19. This is a dynamic list given that the global therapeutic landscape is changing with several ongoing clinical trials whose results

are likely to impact the outcomes.

Of the drugs/drug candidates shortlisted, CSIR has prioritized drugs for establishing optimal synthetic processes for those drugs for which there is a higher potential of them getting approved and which are not commercially available in India. Developing the synthetic process of these top drugs/drug candidates will enhance the chances of the drugs getting introduced in India by an Industry, once favourable outcomes are obtained in clinical trials. Many CSIR labs across India such as CSIR-IICT, CSIR-CDRI, CSIR-NCL, CSIR-IICB, CSIR-IIIM, CSIR-NIIST, CSIR-NEIST, and others are involved in this strategy.

Key Drugs/Drug Candidates under Development at CSIR

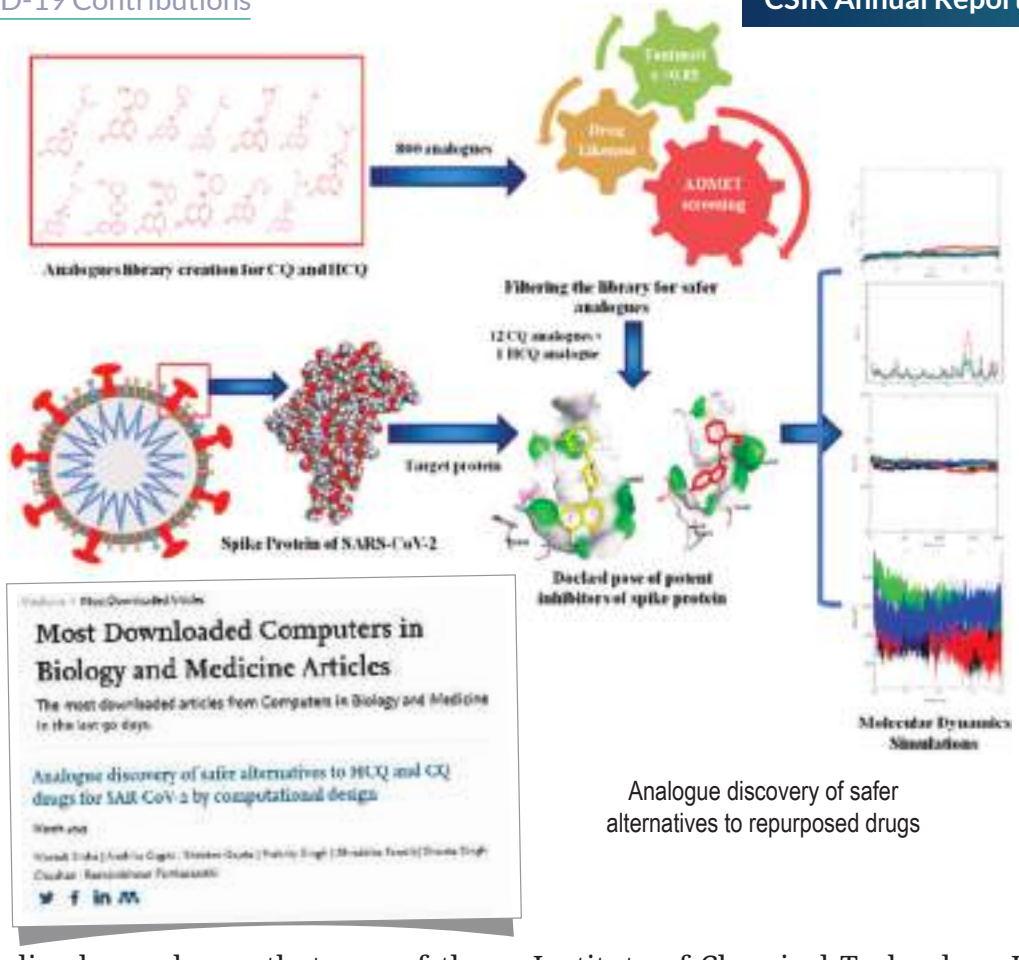
Favipiravir: A cost-effective process of Favipiravir for the treatment of Covid-19 patients has been developed by CSIR-IICT. An off-patent anti-viral drug, Favipiravir, originally discovered by Fuji Pharma in Japan, has shown promise in clinical trials for the treatment of Covid-19 patients, especially in mild and moderate cases. CSIR-IICT developed a cost-effective process using locally available chemicals to synthesise this Active Pharmaceutical Ingredient (API) and transferred the technology to Cipla. Cipla scaled up the process in their manufacturing facility and after receiving permission from DCGI (Drug Controller General of India) launched the product in India as CIPLENZA and the introduction of this lead to affordable pricing of favipiravir in the country.

Computational Drug Development Activities at CSIR-IITR with a focus on toxicology: In the search of specific treatment to cure the Covid-19 infection, drug repurposing allows the rapid identification of the potential drug candidates, at lower cost having detailed information on toxicology and pharmacology to enable rapid regulatory review and clinical trials. Under the Vertical 3: Development of Repurposed Drugs/New Drugs & Vaccine, many CSIR-IITR started working as a part of CSIR consortium and contributing towards developing suitable repurposed drugs against Covid-19. Multiscale computational approaches were employed from virtual screening, docking, quantum chemical methods, molecular dynamics simulation and machine learning with a special emphasis on toxicology.

CSIR-IITR team screened some of the well-known FDA approved drugs such as hydroxychloroquine, chloroquine, anti-influenza drugs, anti-retroviral drugs and plant based bioactive compounds specifically for SARS-CoV-2 and host protein targets. From our study, many of these drugs have been shown to interact directly these molecular targets thus, interfering with the replication of the virus. ADME/Tox studies were performed to improve the overall effect of the drug and to avoid adverse effect on Covid-19 drug repurposing.

Development of Processes for Active Pharmaceutical Ingredients towards COVID: CSIR-IIIM developed the know-how for Molnupiravir (EIDD-1931), Niclosamide, Nafamostat and Ribavirin and fragment of Remdesivir.

Repurposing of colchicine for management of Covid-19 patients: One of the important host-specific event in Covid-19 patients in "cytokine storm".

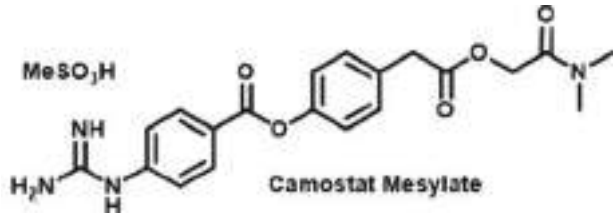


Analogue discovery of safer alternatives to repurposed drugs

Several studies have shown that one of the primary reason for mortality of Covid-19 infected patients is cytokine storm driven complications. Thus, the management of cytokine storm by potent anti-inflammatory drugs is also being investigated. One such potential FDA approved drug is "colchicine". Colchicine is a natural product isolated from meadow saffron (Colchicum autumnale); and is a FDA approved drug for treatment of inflammatory diseases 'gout' and 'Behçet's disease'. It exhibits anti-inflammatory effects via inhibiting the activation and migration of neutrophils to sites of inflammation. It also inhibits pro-inflammatory cytokines IL-6 and IL-1beta. Besides, it has also been reported to possess antiviral activity (in-vitro) against DENV, ZIKV [DENV: EC50 = 150 nM; ZIKV: 89% reduction at 5 µM). Worldwide, there are more than 24 clinical trials currently ongoing on colchicine in Covid-19 because of its potent anti-inflammatory properties. Two CSIR Laboratories namely, Indian Institute of Integrative Medicine Jammu and Indian Institute of Chemical Technology Hyderabad in collaboration with an industry partner M/S Laxai Life Sciences have started phase II clinical trial in Covid-19 patients.

Remdesivir: CSIR-IICT developed the process for the key intermediates and APIs of Remdesivir another promising repurposed drug for Covid-19. CSIR-IICT also developed processes for Arbidol, Baloxavir, Chloroquine/ Hydroxychloroquine and is working with industries such as Mylan, Laxai Life Sciences and CIPLA.

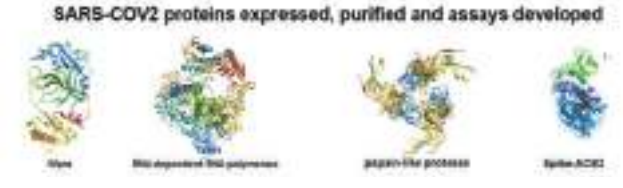
Synthesis of Camostat Mesylate: Camostat mesylate acts as a serine protease inhibitor, which is active against the enzyme transmembrane protease serine 2 (TMPRSS2) partially blocked SARS-CoV-2 S-driven entry into lungs cells and full inhibition was attained when Camostat Mesylate is used in combination with other drugs. Currently the drug is under Phase-II clinical trial for the



treatment of Covid-19 patients. The reported synthesis of Camostat Mesylate relies on the use of customised intermediates, which are generally prepared by employing expensive starting materials, thereby rendering the whole process commercially expensive. Furthermore, the reported methods on the synthesis of Camostat Mesylate often provide modest yield and employ drastic conditions. In this context, CSMCRI has developed an alternative method for the synthesis of Camostat Mesylate through the synthesis of its two key intermediates, namely 2-(Dimethylamino)-2-oxoethyl 2-(4-hydroxyphenyl) acetate (Int-I) and 4-Guanidinobenzoic acid hydrochloride (Int-II), starting from inexpensive and indigenously available raw materials. The present process reduces the number of steps as well as cost compared to the exiting methods.

Process Development of Drugs Repurposed for Covid-19: Process developed for Nitazoxanide, EIDD 1931 & EIDD 2801. Non-infringing routes developed for the APIs. Nitazoxanide is currently under clinical trials in Mexico. EIDD 2801 is currently under clinical trials in USA & UK.

Drug-target based Assay platforms and screening against Covid 19:



Considering the pandemic situation due to Covid-19, enormous efforts are being made to identify lead drug candidates either through drug repurposing or by identification of new chemicals entities. This important activity requires the establishment of Drug-target based Assay platforms and screening against Covid-19. This project on development of drug target based assay platforms and screening against Covid-19 was implemented in CSIR laboratories with CSIR-CDRI as a nodal laboratory. Purification of proteins and assays for targets like m-pro, PL-pro, RNA-dependent RNA polymerase and Spike-ACE2 have been standardized across the laboratories. The FDA approved library of drugs and isolated natural product compounds from important plants like Andrographis paniculata, were screened against them computationally and the best hits were evaluated against them through in vitro inhibition assays and virus culture inhibition assays. The results are being exploited in drug-repurposing strategies as well as in new lead development.

CSIR-IICT and Mylan Laboratories Limited are in partnership to address unmet patient needs amidst the evolving Covid-19 pandemic. Under the partnership, CSIR-IICT and Mylan are collaborating to identify potential therapies for Covid-19. A series of clinical trials will be conducted towards new and innovative solutions to manage Covid-19 pandemic in India as part of this collaboration. Application for phase III of Combination clinical trials was examined by DCGI, and it asked to do Phase II Clinical trial.

CSIR-IICT and LAXAI pharma are undertaking multiple clinical trials of repurposed drugs, and the application of combination drugs was examined by DCGI. DCGI has recommended phase 2 clinical trial of colchicine for use in Covid-19 patients.

Repurposing of the antiviral drug Umifenovir for Covid-19: Umifenovir is an antiviral drug, which have been used for the treatment of influenza infection in

Russia and China. This drug is presently unavailable to Indian patients. Umifenovir is being investigated as a potential treatment and prophylactic agent for Covid-19caused by SARS-CoV2 infections in combination with both currently available and investigational HIV therapies. At CSIR-CDRI we developed the improved and scalable process of Umifenovir on a multi-gram scale and this technology was transferred to our industrial partner Medizest Pharmaceuticals Pvt. Ltd., Goa.

Phase 3, Randomized, Double-blind, comparative trial of Efficacy, Safety and Tolerability of Umifenovir and hydroxychloroquine combination therapy vs hydroxychloroquine therapy in non-severe Covid-19 patients has been done at multiple clinical trial sites in Uttar Pradesh, including King George's Medical University, Lucknow; Ram Manohar Lohia Institute of Medical Sciences, Lucknow; and Eras Lucknow Medical College and Hospital, Lucknow. Drug has showed statistically significant result in the cases of asymptomatic and mild patients. Documents submitted to DCGI for consideration.

Pectin-derived prebiotics as adjuvants for prophylactic treatment of corona and other similar virus diseases: Covid-19 spreads quickly, disease manifestation ranges from asymptomatic to Acute Respiratory Distress Syndrome (ARDS) leading to septic shock and death. The mucosal surfaces play a key role as inductive and effector phases of mucosal response in respiratory infection and may be associated with altered gut microbiome and their correlation is known as the gut-lung axis. It was speculated that inflammatory responses in covid-19 could be associated with gut microbiome variations and pectin-derived prebiotics can be used as prophylactic gut microbiome-immune modulator.

To delineate the role of gut microbiota in Covid-19, gut microbiota and cytokine profiles of Covid-19 patients were studied and compared with age matched non- diseased participants. Method for enzymatic synthesis of POS is standardized at lab scale for production of specific POS and Prophylactic effect of POS was was evaluated in mice induced by poly I: C, a viral dsRNA analogue. It was seen that Patients with variable Covid-19severity showed distinct gut microflora and peripheral Interleukin-21 levels.

Development of Zinc gluconate-Vitamin C formulation for immunity improvement and management of Covid-19:

CSIR-IIIM Jammu has established fermentation based technology for production of various gluconate salts including Zinc gluconate, which has been reported to demonstrate higher bioavailability as compared to other zinc supplements. Zinc has been shown to contribute to a number of innate and adaptive immune signalling pathways. Ionic zinc possesses unique and distinct antiviral properties against a number of human viruses. High Zn^{2+} has been found to inhibit the replication of various RNA viruses, including influenza virus and other respiratory viruses. Vitamin C is also known as an essential antioxidant and enzymatic co-factor for many physiological reactions in the body, such as

hormone production, collagen synthesis and immune potentiation. It is not only necessary for cell-mediated immune responses including leucocyte & macrophage functions, neutrophils motility and phagocytosis, but also for antimicrobial activity, interferon synthesis and antihistamine properties. A combination of zinc gluconate and vitamin-C may support immune function for better potential for defense against viral infections. CSIR-IIIM has developed a formulation of natural vitamin C and Zinc gluconate with the aim to improve immunity for prevention and management of Covid-19. The main constituents include Malpighia emarginata (Acerola cherry), a rich natural source of Vitamin C and Zinc gluconate, an organic source of zinc. The formulation may be used as a promising immuno booster and modulator during the current Covid-19 pandemic.

Reducing import dependency of APIs and drug intermediates:

CSIR labs are also working to reduce dependency on APIs and drug intermediates from other countries. Given the worldwide lockdown and apprehending shortage of supplies, CSIR-NCL, CSIR-IICT and many CSIR labs are working towards self-sufficiency in the drug supply chain for India by developing indigenous processes and platform technology to produce important key starting materials (KSMs)/drug intermediates and active pharmaceutical ingredients (APIs) in the country

Repurposing Anti-dengue Phytopharma formulation AQCH: Collaborative work of CSIR-IIM with ICGEB and Sun Pharmaceuticals, a *Cocculus hirsutus* based phytopharmaceutical AQCH was developed for the treatment of dengue which had completed phase I trials. The drug has shown anti-SARS-CoV-2 effects in-vitro studies conducted in collaboration with ICGEB and Sun Pharmaceuticals. Currently, Phase-II Clinical trials on AQCH by Sun Pharma on Covid-19 patients is in progress. This is the First-ever approval in India in phytopharmaceutical route and Clinical trials on at 12 centres and involves 210 patients.

Sespivac (Mycobacterium W) for Covid-19: CSIR and Cadila Pharmaceuticals are conducting clinical trials to evaluate the efficacy of an existing gram-negative sepsis drug, called Sepisvac for Covid-19 patients. The drug contains heat-killed Mycobacterium (Mw) and is found to be extremely safe in patients, and no systemic side effects are associated with its use. Sepsivac has been clinically developed and approved for gram-negative sepsis, a severe infection. The drug has been shown to reduce the mortality of critically ill patients by more than half. It also leads to faster recovery of organ dysfunction seen in this condition. It is now approved for marketing in India and is available commercially as Sepsivac® from Cadila Pharmaceuticals Ltd. The drug now is being tested in three different trials to combat Covid-19.

Plasma Therapy: A Phase 2 clinical trial for testing convalescent plasma therapy in Covid-19 patients was undertaken by CSIR – IICB in West Bengal, in collaboration with the Department of Health & Family Welfare, Govt. of West Bengal. The study was undertaken by a team of scientists from CSIR-IICB, Kolkata, which was done in Infectious Disease & Beleghata General Hospital (ID & BG) in Kolkata. The study revealed that while among all the patients in this cohort the relative benefit of plasma therapy was not significant, it was found that moderate acute respiratory distress syndrome (ARDS) patients up to 67 years of age were significantly benefited from plasma therapy, in terms of reduction in mortality and early remissions. This suggests that precise targeting of severe Covid-19 patients is necessary for reaping the clinical benefits of convalescent plasma therapy.

Ayurveda based botanical drugs

For the prophylaxis and management of Covid-19 in the population with mild to moderate disease, CSIR and Ministry of AYUSH have joined hands to validate some of the traditional AYUSH formulations for their safety and efficacy through scientific evidence. In this effort, CSIR-IIIM Jammu and CCRAS New Delhi signed an MoU on May 20, 2020. Under this agreement, CSIR-IIIM is validating following formulations through clinical trials in human subjects:

- *Withania somnifera* (Ashwagandha) for prophylaxis against SARS-CoV-2 infection.
- Ayurvedic formulation of *Tinospora cordifolia* + *Piper longum* (Guduchi + Pippali) as an Adjunct to Standard of Care for the management of mild to moderate Covid-19.
- Ayurvedic formulation of *Glycyrrhiza glabra* (Yashtimadhu) as an Adjunct to Standard of Care for the management of mild to moderate Covid-19.
- Ayurvedic Formulation AYUSH-64 as an Adjunct Treatment to Standard of Care for the management of Mild to Moderate Covid-19 Patients.
- A prospective clinical study to assess the role of Vasa Ghana (*Adhatoda Vasica*), Guduchi Ghana (*Tinospora Cordifolia*) and Vasa-Guduchi Ghana in therapeu-c management of symptoms in Covid-19 posi-ve cases: a randomized, open label three armed study

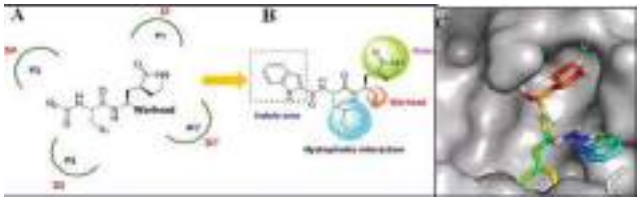
Human Monoclonal Antibodies for Covid-19 Therapy: Hyderabad based Bharat Biotech International Ltd., leads a CSIR-NMITLI supported project to develop human antibodies for Covid-19 therapy. CSIR has sanctioned a project led by Bharat Biotech International Ltd, to develop human monoclonal antibodies as therapy for Covid-19 infections. The project brings together both academia - National Centre for Cell Science (NCCS), Pune, and Indian Institute of Technology, Indore and industry - PredOmix Technologies Pvt. Ltd, Gurgaon and Bharat Biotech International Ltd., Hyderabad in a collaborative model for a public cause. The present project is to develop an alternate therapeutic regimen by generating highly effective and specific human monoclonal antibodies that are capable of neutralizing the SARS-CoV2 virus.

Vaccines for Covid-19: CSIR and Aurobindo Pharma have signed an agreement for the development of several novel Covid-19 vaccines. CSIR-CCMB Hyderabad, CSIR-IMTECH, Chandigarh and CSIR-IICB, Kolkata are developing vaccine candidates using different technology platforms. Aurobindo Pharma will undertake clinical development and commercialization of the vaccines.

Development of aptamer for recombinant SARS-CoV-2 Spike Glycoprotein S1: One of the key hurdles in the production of subunit vaccines is to synthesize the recombinant full-length spike glycoprotein or the corresponding ectodomain as the antigen in a cellular system which is suitable for large scale cultivation. In terms of production parameters such as speed, cost, scale-up capacity, contamination risk and yield of protein, the Pichia expression system is preferred over mammalian and baculovirus expression system. Moreover, diagnostic antigen-based kits presently available today for the detection of Covid-19 infection are based on antibodies. Aptamers also called “synthetic antibodies”, are short sequences of single-stranded oligonucleotides (DNA/RNA) that have several advantages over antibodies. For example, unlike antibodies, aptamers can be synthesized in the laboratory, do not require animals, are cost effective, show minimal or no batch-to-batch variation, are more stable and amenable to large scale production. Moreover, they can easily be modified and integrated into a wide range of diagnostic platforms including optical, electrochemical or label-free sensors for rapid, sensitive and specific detection of antigens.

MoU has been signed between CSIR-CFTRI and industrial partner DeNoVo Biolabs Pvt Ltd., Bengaluru, India to develop an aptamer-based detection platform for SARS-CoV-2. The generated lead aptamers have been sent to industrial partner and initial experiments done independently at their facility have shown promising results. Further optimization experiments to develop the detection platform is in progress."

Discovery & Pre-clinical Development of Antivirals for Covid-19 & Other Viral Diseases.



In this effort few CSIR-labs has come together and after several round of discussion has narrowed down to five high impact drug-targets which can be developed on fast track basis The selection of these targets were done based on the existing strength and capabilities present in these CSIR labs, and also on the recent clinical trial reports and new drug approval for their usage in Covid-19 patients. The project has been initiated at CSIR-IICB and Dr. Arindam Talukdar's lab is involved in the synthesis of target based possible antiviral molecules, which has been shipped to CSIR-IICT.

Assay system development for trypsin/ trypsin like protease cleavage of SARS-CoV-2 spike protein: Trypsin like proteases play important role in facilitating coronavirus infections by cleaving spike protein and promoting interaction with the host receptors for cellular entry. Hence these cleavage reactions can be potential target for antiviral therapeutics and drug screening. The objective of the invention is development of an in vitro assay system for drug screening against cleavage of trypsin/trypsin-like protease of SARS-CoV-2 spike protein. The proof of concept assay system has been developed and application for patent filing is under process.

Antibody production in horses: CSIR-CCMB has entered into MoU with the University of Hyderabad and Vins Bioproducts Ltd to enable the development of antisera against SARS-CoV-using inactivated virus in horses which is amenable for large-scale production. Antisera is the blood serum containing antibodies which can be used for passive immunity, and the work is in progress.

Corona Viral Cultures and Cell lines for Screening Assays and Testing: To take forward new drug discovery, a critical step is the establishment of viral cultures and assays for testing. CSIR-CCMB and CSIR-IMTECH have set up viral culture facilities to enable testing and screening of drugs, devices etc.

CSIR-CCMB has entered into a collaboration with Eyestem Research Private Limited. The research team will use the human lung epithelial cell culture system provided by Eyestem as part of its anti-viral screening (ACS) platform. Eyestem's cell culture system expresses the ACE2 receptor and other genes which are essential determinants.

Drug Discovery HACKATHON (DDH2020): DDH2020 is a joint initiative of AICTE, CSIR and supported by Office of Principal Scientific Advisor, Govt. of India, NIC and MyGov. DDH2020 vision and mission are to establish 'Open innovation Model' for in silico drug discovery against Covid-19 virus and will cover the various processes in drug discovery, including but not limited to, in silico screening of molecules, lead optimization and identification of drug-able non-toxic targets. The targets/tools/lead molecules identified through the process of DDH2020 will be further taken forward for synthesis, followed by subsequent steps in the routine

drug discovery program. Currently, India has more than 15 lakhs students & faculty in the field of computer sciences, pharmaceutical sciences, and biotechnology spread across 3000+ colleges and universities. We also have a large number of scientists working in research organizations, industries, and startups in the field of machine learning, artificial intelligence, drug discovery, in silico chemistry, and big data analytics which can contribute to this endeavour. This wide network of researchers will go a long way to address pandemic and outbreak situations across the world.

Hospital Assistive Devices and PPEs

A major challenge during the corona pandemic globally has been the severe shortage of ventilators and oxygen enrichment devices given that Covid-19 patients develop severe respiratory problems. Another critical requirement in this pandemic has been the need for personal protective equipment (PPEs) to the caregivers such as Doctors, nurses, and paramedical staff given the infectious nature of the virus. The CSIR Covid-19 Vertical had number of laboratories coming-up with numerous hospital assistive devices and PPEs. Some of the devices and PPEs developed by CSIR labs are given below:

SwasthVayu: Bi-Level Positive Airway Pressure (BiPAP) System Portable Ventilator:

CSIR-NAL developed a low cost indigenized, non-Invasive bi-level positive airway pressure ventilator device named as “SwasthVayu”. It is a microcontroller-based closed-loop adaptive control system with a built-in biocompatible “3D printed manifold & coupler” with HEPA filter (Highly Efficient Particulate Air Filter) in inhalation & Exhalation circuits. Developed in 36 days, it is a cost-effective device, easy to use in makeshift hospitals, wards, dispensary and has three modes of operation, continuous, timed and spontaneous. It successfully passed stringent electrical safety, performance, calibration, bio-compatibility tests at NABL accredited laboratory and certified. It is registered with the Central Drug Standard Control Organization (CDSCO). It has undergone clinical trials at many hospitals, and CSIR-NAL is providing 1200 ventilators to the Delhi Government. Technology has been transferred to several Industries.

"BRAVO" Automated ICU Ventilator:

Bravo is an indigenously developed premium ICU ventilator by CSIR-CECRI, which has more than 95% of the parts sourced locally. The design has been done by Broadline Technologies Private Limited, Chennai and the 3D printing and

medical coating done by CECRI, Karaikudi. NIPER, Govt. of India, helped with the clinical trials. Bravo can sense a patient's breath requirements and provide the required oxygen/air to the patient and has in-built alarms and warnings and can detect anyone parameter going out of range. Bravo also has an option to add other critical parameters such as pulse, oxygen saturation and ECG to serve as a comprehensive all in one ventilator.

Respiration Assistance Intervention Device (Respi-AID):

The developed device is based on the Ambu bag where the operation of Ambu bag is automated by a motorized mechanism. It has the provision to set the ventilation parameters i.e., Tidal volume, Respiration rate, I:E ratio, PEEP value, FiO2 etc, through user interface and the device works by applying pressure to the attached Ambu bag. All the parameters are controlled and monitored through the display provided at the front panel. The device can be used as portable ventilator for patients not requiring critical care ventilator and as a transport ventilator in ambulances. The technology of the device is ready and its performance testing was done through NABL accredited lab. Technology is transferred to M/s Sivspriya Exim Pvt. Ltd. Chennai

Pressure Vacum Swing Adsorption System for Onsite Medical Grade Oxygen Production for Hospital Use:

CSIR-IIP has developed a system for onsite generation of MO2 for hospital use. The system is designed for 24/7 operation and can deliver up to 500 litre/min MO2 catering to the need of 100 Covid patients simultaneously at a rate of 5 litre/min per patient. The technology information has been transferred to six companies so far who have started production of the plants based on CSIR-IIP's design inputs.

6NM3/Hr Pilot MO2Plant

30 NM3/Hr Commercial MO2Plant based on CSIR-IIP's Technology

Before commercial transfer of the technology the system was rigorously tested in a pilot scale (100 litre/min MO2 throughput) at CSIR-IIP campus followed by actual field testing at Aundh Chest Hospital, Pune. CSIR-IIP has been mandated to supply over 100 such MO2 plants (500 LPM throughput) to different civil hospitals across India under the PM Cares funding.

Oxygen Enrichment Unit (OEU) for Covid-19 Patients: CSIR-NCL has developed an Oxygen Enrichment Unit (OEU) based on Indigenous, innovative hollow-fibre membrane Technology. The unit intakes compressed air at 5 bar and offer oxygen-enriched air at 5-7 lpm with ~ 35-40% oxygen content in it. OEU is certified by TUV Rheinland (India) Pvt Ltd. OEU is useful in the treatment of chronic lung diseases. It is being used for Covid-19 patients with medium symptoms requiring supplemental oxygen at Dr. Naidu Hospital, Pune. It is portable, easy to operate, low maintenance (needed only for the

compressor) and can serve in villages/remote areas where oxygen therapy is a costly affair. The technology is out-licensed to NCL's spin-off startup company, Genrich Membranes Pvt Ltd., who developed three variants of the unit: (1) Split unit: Compressor & membrane unit separate; (2) Compact, portable unit (3) Battery operated handy unit.

ElectroStatic Disinfection Unit:

An electrostatic disinfection unit has been developed by CSIR-CSIO for a 360-degree area and uniform coverage, small droplet size, applicable for all fluid types. It has a single-headed nozzle with a tank capacity of 10/15 litres and battery usage hours[3] of 10-12 hours. The technology was transferred to BHEL, Rite water, M/s. Jhosna Corporation and M/s. Dashmesh Industries. Close to 200 units have been produced. Further, the unit ENCEESPRAY selected for Top Covid-19 Innovation Award with RITE Water Solution Pvt. Ltd, Nagpur, CSIR-CSIO and Univ. of Florida as partners by USISTEF.

JeevNasl, developed by CSIR-IMMT is a cost-effective aerosol-based spraying system that uniformly spreads a minimum amount of disinfectant, while covering the maximum area.

CSIR-NIIST has developed a UV disinfectant that has a UV chamber with 125 W UV bulb and a rotating base fitted with a shutter door to disinfect personal belongings like masks, key rings, currencies, hanky, tissue, papers, bills etc. and other non-living objects alike. The tests for antibacterial activity of the UV light were done to assess the rate of killing of microorganisms on three different surfaces, namely, surgical face mask, paper (bill), and key. Significant reduction of bacteria was found on the articles within a short time frame. Higher time of exposure will increase the rate of killing of microorganisms.

Automatic air sanitizer is a system engineered by CSIR-NIIST for disinfecting aerosols for application in hospitals, clinics, testing labs, office cabins, meeting rooms, etc. It absorbs aerosols from a distance and exposes it to a combination of germicidal UV radiations and filters and releases out clean and fresh air. The technology was transferred to M/s Ecocure technologies, Thiruvananthapuram

CSIR-NIIST UV-Clean disinfecting unit significantly reduces the transmission risk of microbes by non-chemical approach to pathogen disinfection. Uses UV-C light (λ =254 nm) to destroy microorganisms, including bacteria, virus, protest and fungus/mold (effective UVC dose > 80%). The technology is transferred to M/s Panchtatva technologists and services, Ambernath

Sustained Release Long Acting Steam Inhalation Drops (NiiSTEAM):

CSIR-NIIST's product aims at reducing or alleviating the symptoms of Covid-19 such as fever, cough, fatigue, sputum production and shortness of breath. The active ingredient used in the product is a composition of herbal essential oils which are supported by traditional, pharmacological and clinical studies on their effectiveness as expectorant, antimicrobial, anti-inflammatory, antitussive, decongestant and ability to improve respiratory tract symptoms.

Air and Surface Disinfection System for Covid-19:

CSIR-CSIO Chennai Centre designed and developed battery operated aerosol disinfection and purification system using novel biocidal spray solution and biocidal agent coated filter membrane. Filter membrane have self-healing and re-usable functionality which is alternative to current HEPA and UV based aerosol purifier.

CSIR-CSIO has designed & developed UV-C (ultraviolet light with wavelength 254 nanometres) light based sanitization system in association with M/s Raymold Luminaires Private Limited, Chennai. The UV-C system is designed for disinfecting personal belongings like mobile phone, tablets, purse, currency, cover of office files, etc.

Design and fabrication of decontamination chamber to mitigate PPEs shortage: The CSIR-CSMCRI developed decontamination chamber (50"x60"x100") has electrically operated pump to form disinfectant mist of aqueous hydrogen peroxide on stacked face masks suspended by hangers in chamber, followed by water-wash and hot air treatment (60-80°C). The decontamination process involving chain

of steps like spray of disinfectant, heating temperature, and time for disinfectant spray and heating has been optimized for effective decontamination face masks from Covid-19 and common environmental bacteria/virus load. The vital characteristics like mechanical integrity and function performance of face masks are retained. The exploratory studies on decontamination of face masks from Covid-19 virus in collaboration with ICMR-NIOH, Ahmedabad has been done successfully.

UV-C Disinfectant Systems: CSIR-CSIO along with help from CSIR-CBRI and CSIR-IMTech developed air-sanitization devices based on Ultra-Violet C band irradiation. These devices can be installed as a retro-fit to air-ducts of HVAC systems in buildings, transport vehicles and so on. The stand-alone devices that circulate and sanitize air in a closed space such as a room or imbedded in air conditioners were also developed for situations where HVAC systems are not present.

Programmable UV-C Sterilization Unit: As a safeguard against possible contamination under Covid-19 pandemic situation through daily office use materials, a sterilization unit has been conceptualized, designed and developed at CSIR-CGCRI.

Ultraviolet Germicidal Irradiation (UVGI) has had a long history of use for inactivating microbial aerosols. The use of UV-C has recently grown within the healthcare industry to provide disinfection of room surfaces, in addition to existing cleaning methods. A strong germicidal effect is provided by the Light in the short-wave UV-C band. UV-C provides residue free disinfection, so there is no concern over dangerous residues that need to be wiped down or neutralized after the disinfection occurs.

UVC based microbial disinfectant

CSIR-NPL has developed a microbial UVC Disinfection Casket for disinfection of non-porous surfaces. The technology has been licensed to M/s Motras Scientific, Gurugram however the same technology is available for interested firms.

CSIR-CGCRI Unit is designed to sterilize mobile phone, laptop, office files, papers, letters & parcels, cash, cheques, tools, surgical equipment, garments and clothes, medical aprons and wearing etc. with safety-interlock features to protect users from UV-C radiation along with a view panel of AIS float glass for safe viewing.

Hand sanitisers and soap dispensers

To ensure hand hygiene and prevent the Covid-19 infections, many CSIR laboratories developed thousands of litres of sanitizers, and various models for touch-free and leg operated soap and sanitiser dispensing systems.

CSIR-IHBT was amongst the first develop a formulation of hand sanitizer that has alcohol content as per WHO guidelines. The formulation contains active tea constituents and natural aroma, and is free from parabens, triclosan, phthalates & synthetic fragrance. It has distributed ~5000 litres of hand sanitizer to the front line staff at police stations, medical colleges and hospitals; banks; state disaster management cell; educational institutes; administrative offices and village panchayats. The Himachal Pradesh Chief Minister's Office also was given the sanitizer. In addition to the above, industry partners of the CSIR-IHBT also supplied 4500 litres of sanitizer to the State and Central Government Offices in different parts of the country.

CSIR-IMMT developed a Contactless Sanitizer Dispenser that automatically releases the hand rub alcohol based sanitizer. The bottles come with a hand pressing system at the top by using a sensor and a motor system. The contactless sanitizer machine developed by CSIR-IMMT uses a low cost sensor and motor system to push and release the dispenser top so that the required amount of liquid is released from the dispenser.

Smart Touch-Free (Palm Safe) & Automatic Hand Sanitizer Dispenser (Indoor & Outdoor): CSIR-NIIST developed an automatic table top/wall mount installation type model with sleek design suitable for indoor as well as outdoor applications. The technology was transferred to M/s Tachlog Pvt Ltd., Thiruvananthapuram and M/s. Cabeio Technologies, Thiruvananthapuram.

CSIR-IITR produced hand sanitizers as per WHO formulations (Ethanol/Isopropyl alcohol based non-gel formulations). The sanitizer was distributed to over 30000 personnel including those in Public Distribution System, LPG bottling plant, Central Government Health Scheme, Electricity Supply Administration & Electricity Substations, State Mission for Clean Ganga, Lucknow Nagar Nigam, Police department, CPRF, District hospitals, and King George's Medical University.

CLEANiiST Herbal gel hand sanitizer: CSIR-NIIST developed alcohol based herbal gel hand sanitizer. The active ingredient used in the product is a composition of essential oils that is supported by traditional and pharmacological studies on their effectiveness as antimicrobial, antibacterial, anti-viral and anti-fungal agents.

Launching program of "Alcohol-based Herbal Hand Sanitizer at CSIR-NEIST Branch Lab Manipur

Dr G Narahari Sastry, Director, CSIR-NEIST handling over hand sanitizer to Airport Manager, Jorhat

CSIR-NEIST along with its branch lab at Imphal, Manipur prepared hand sanitizer with alcohol content of ~80% along with other additives as recommended by the World Health Organization (WHO). About 900 litres of hand sanitizer was prepared by CSIR-NEIST and distributed throughout its campus among all divisions, sections and centres including residential colony. The institute also provided hand sanitizer to various nearby establishments such as SBI RRL Branch, Kendriya Vidyalaya, Post Office, Jorhat Airport, District Administration including Police Stations, Airforce Station, Jorhat and Railway Station, ONGC, BCPL, FCI etc.

Alcohol-free water-based hand sanitizer: CSIR-Central Salt and Marine Research Institute (CSMCRI) Bhavnagar has developed an alcohol-free water-based hand sanitizer using stable biomolecule capped aqueous silver nanoparticles with inorganic emulsifying agent and surfactant. It was further tested against Covid-19 and other nine different pathogenic bacteria in collaboration with DBT-Translational Health Science and Technology Institute (THSTI) Faridabad, and found to be efficient and safe for hand sanitization purpose. TThe technology was transferred to two MSMEs M/s Sudh Biotech Pvt. Ltd, Kolkata, West Bengal and M/s AZ14CARE Pvt. Ltd., Bhavnagar, Gujarat.

CSIR-CIMAP has scientifically developed a very effective, safe, broad spectrum anti-bacterial and anti-fungal formulation of hand sanitizing gel, which contains plant, based active molecule and essential oils.

Automated table top hand sanitizer dispenser: CSIR-CECRI developed the automated table top hand sanitizer dispenser.

Germivid-Herbal Hand Sanitizer: CSIR-NBRI, Lucknow, under the CSIR social responsibility programme, developed an alcohol based herbal hand sanitizer. The technology for the same was transferred to M/s. Fervid Healthcare Pvt. Ltd. by the institute in April 2020 and the product has been manufactured in collaboration with N. U. Indian Herbal Research Laboratory Pvt. Ltd. The product is based on an indigenous formula, prepared in compliance with the AYUSH guidelines of Govt. of India and is an excellent disinfectant which also takes care of the moisture content of the hand and protects from dehydration. It's scientifically validated

ingredients and cost-effective value makes this an attention grasping product that is suitable for regular use.

Alcohol Based Herbal Hand Sanitizer gel: A unique combination of herbal antimicrobial and IPA that kills 99.9% germs on skin and hands. Plants are known for their pharmacological properties, particularly antimicrobial to prevent and treat infections caused by human pathogenic bacteria, fungi and viruses. CSIR- National Botanical Research Institute, Lucknow has identified potential herbal antimicrobial that were used to develop an innovative herbal hand sanitizer along with isopropyl alcohol (IPA), as per the guidelines of World Health Organization.

CSIR-CLRI prepared more than 2000 litres of hand sanitizers and supplied it to front-line workers and paramedical staff of Chennai.

CSIR-AMPRI developed alcohol (isopropyl alcohol)-based hand sanitizer compliant to WHO guidelines. The hand sanitizer contains various natural/herbal ingredients that enhance the skincare and also provides fragrance to the hand sanitizer, and the content of the fundamental chemicals such as alcohol was also kept perfect so as to maintain its efficacy against germs. This hand sanitizer kills 99.99% germs (tested by NABL accredited lab). Ampricare - Hand Sanitizer has been transferred to a start-up company M/s MW Social Enterprises Pvt. Ltd., Indore.

Photographic Images of Reusable Sanitizing ViroxyGelly

CSIR-CSIO Chennai Centre developed "Novel Alcohol Free Reusable ViroxyGelly as Surface Sanitizer" which have natural polysaccharide matrix that contains natural minerals and plants derived compounds which act as biocidal agents. Sanitizing ViroxyGelly have effectively absorbs germs on any solid surfaces while rubbing/holding on it.

Electrochemical preparation of sodium hypochlorite (1.0 % NaOCl) disinfectant from common salt:

CSIR-CECRI developed the process for on-site preparation and production of sodium hypochlorite (1.0 % NaOCl) disinfectant from common salt, which is mainly used as a disinfectant in public places and hospitals to kill bacteria, fungi and virus. Technology transferred to M/s. RS Nanotechnologies, Sattur

CSIR-IMMT, Bhubaneswar has developed an innovative way of hand washing system operated by foot without touching with hand the water and liquid soap dispenser. This compact system is mechanically operated by foot and doesn't require any electricity and can be used at any convenient locations. This has built-in mechanism for both water and liquid soap dispensing, controlled by foot through pedal and lever. These systems have been installed at various locations across the Bhubaneswar including IMMT Campus and are working very effectively.

The CSIR-IHBT developed herbal soaps with natural saponins. These soaps are free of mineral oil, sodium lauryl sulphate and sodium dodecyl sulphate. They are proven to be antifungal and antibacterial with cleansing and moisturising benefits.

Makeshift Buildings for Hospitals, Housing & other Purposes: CSIR-CBRI Roorkee & CSIR-AMPRI Bhopal jointly transferred a technology/know-how for a portable and prefabricated structures with adequate insulation, water proofing and fire resistant properties. The structure is modular by design and can be constructed to meet the requirements as per site conditions. The aluminium portal framed, foldable, lightweight & durable single story is a fast to erect the structure. It makes use of semi-skilled manpower for erection. The size of one unit is 3.80 x 2.32 M with provision of 1.5 M wide corridor and the weight of structural system: 100 Kg. approx. It can can provide

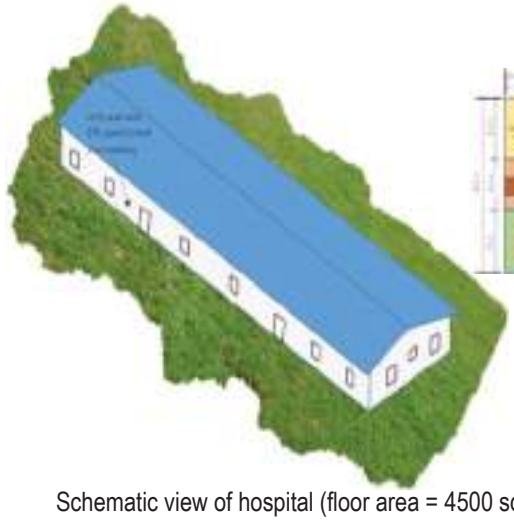
Makeshift Fever clinic at J.P. Hospital, Bhopal

Makeshift Fever clinic at Dewas

immediate solution to the Covid-19/other crises by number of makeshift hospitals, disaster relief camps, blood donation camps, pulse polio derives, earthquake and flood prone areas etc.

The know-how was transferred to M/s JT Events, Bhopal. With the support of M.P. Council of Science &Technology, Bhopal, A demonstrational structure of Makeshift Hospital has been developed at J.P. Hospital, Bhopal and fever clinic is functional. Similarly development of Makeshift hospital was also completed at Dewas and is functional.

Lightweight and Prefabricated Structure for Quarantine Hospitals (Pre-Tal): In the arising need for quickly developing spacious structures for temporary/ quarantine hospitals, even in villages/remote places, it is required to develop innovative concepts for prefabricated, lightweight and modular structures.



Schematic view of hospital (floor area = 4500 sq. ft.)

Layout for a 4 bed COVID Care Centre

The developed scheme, made up of prefabricated steel portal frame, is aimed for short-term hospitals for quarantine purposes. Steel portal frame is chosen since it is very efficient and economical when used for single-storey buildings, and are dominant form of structure for single-storey industrial and commercial building in many developed countries. The designs utilize optimum material (and are hence light weight), ensure stability and can be executed in fast track construction mode. The structures are modular and scalable due to identical units and are suitable for hospitals/quarantine facilities with 50/100/200/500 beds. Based on the functional requirements and the available area, the units can be arranged.

Makeshift hospitals: CSIR labs have developed makeshift hospitals to cater for care of Covid-19 patients. A 10-bed makeshift Covid-19 hospital and isolation centre was developed by CSIR-SERC, Chennai at the 4th Battalion Centre of the National Disaster Relief Force (NDRF) in Chennai. Hon'ble Union minister Dr Harsh Vardhan inaugurated the hospital. Further, CSIR-SERC has signed an agreement for licensing of technology – Portable lightweight foldable module for makeshift hospitals and other needs (PoliTal-M), with L&T, Mumbai. PoliTal-M is a lightweight foldable modular unit for fast deployment in the critical need of shelters, the total weight of the unit is around one ton, and it can be folded and transported easily. The fully folded modules can be taken to the site and erected after levelling the site, and each module can be installed within 30 mins. The size of the module is 6.0m x 3.0m x 2.8m height and the size can be customized as per the requirement from 3m to 6m length.

CSIR-CBRI, Roorkee, in collaboration with NDRF, Ministry of Home Affairs, developed a 10 bedded shift hospital for demonstration purpose as well as the use of NDRF, named as Karuna Bhawan. It would serve the purpose for disaster recovery stage including for use in a long pandemic or emergency situations. Currently, three makeshift hospitals are being made by CSIR-CBRI for the HP State Government.

Nasal-pharyngeal (NP) Swabs:

CSIR-NCL has developed NP swabs that can be used for Covid-19 sample collection. They are made of sterile flocks material with nylon micro-fibre tip and flexible ABS shaft. They have a Breakpoint at which swab can be broken after sampling and put in a sample tube. They facilitated easy collection and release of cells into transport media-nylon microfibers attached vertically to shaft. It is an appropriately small size for paediatric, nasopharyngeal or urethral genital sample collection. They have been approved by ICMR, and the technology has been licensed to Ms. Chembond Polymers and Materials Pvt. Ltd. (CPML), Mumbai. CPML has now started commercial manufacturing of these nasal swabs under the name, "KEMYLON SWABS". The company has established a facility to produce 1 lakh swabs/day.

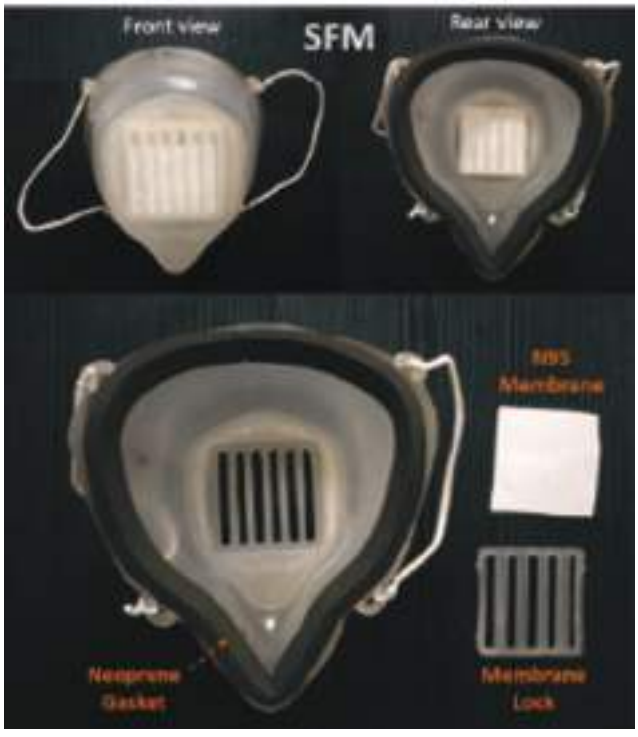
Face masks and face shields

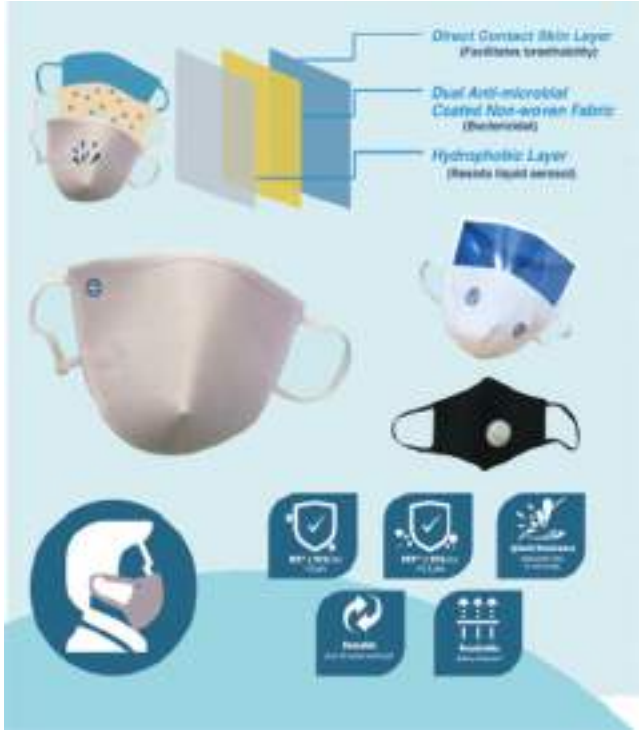
CSIR-AMPRI, Bhopal developed triple layered facemasks that has outer and inner layers of cotton cloth with an intermediate layer of filter fabric. Ampricare – Face mask has been transferred to a start-up company M/s MW Social Enterprises Pvt. Ltd., Indore and is available on Amazon.

CSIR-CLRI developed cost-effective commercial face masks [similar to N95 masks], Lab-coats and other cotton based products with antiviral potential. Benefits of the newly developed CSIR-CLRI antiviral cotton fabric includes 1) covalently attached antiviral drug on cotton fibre, 2) not only prevents the entry of the virus into human body but also kills the virus, 3) washable & reusable, 4) biodegradable and compostable, and 5) cost effective technology for commercial exploitation.

CSIR-NCL used the patented biopolymer technology to develop a highly effective medical-grade mask using GSM-60 grade cloth supplied by SETLAB INDIA, Pune. Specific tests including bacterial filtration efficiency (BFE) test, particulate filter efficiency (PFE) test, splash resistance test, and breathability tests were performed by South India Textile Research Association (SITRA), Coimbatore, to ensure that the developed mask is capable enough to prevent bioaerosols. CSIR-NCL has implemented a strict Quality Assurance Plan to provide a foolproof quality requirement for the facemask. Frequent tests for bacterial filtration efficiency were conducted in-house during the manufacturing of these facemasks. The developed facemask passed ASTM F2101, ASTM F2299/F2299M-03, and IS 16289:2014 Annexure C tests at SITRA. SETLAB INDIA, Pune has a production capacity of 50000 units per day. The Poly-Ti face masks are being manufactured with a strict quality assurance plan of CSIR-NCL. More than one lakh face masks have been supplied to various labs of CSIR and many other companies, medical stores and other smaller enterprises. The users have well appreciated the quality of these coveralls.

CSIR-NIIST developed reusable stopgap face mask (SFM) developed via injection moulding was designed by incorporating the principles of aerodynamics to minimize airflow resistance. Further, the developed SFM also minimized the usage of filter membrane by order of 1/6th when compared with existing N95 respirators. It reduces the environmental impact due to excess polymer membrane waste generated during the Covid-19 outbreak. Certified medical grade materials offer better durability, and is lightweight. The replaceable filter membrane can be used with certified N95, N99 (or)





surgical mask membranes, depending upon the protection required by the user. The technology transferred to A V K Toolings, Thiruvananthapuram.

CSIR–CSMCRI developed facemasks from nonwoven fabrics as barrier for SARS-CoV-2 virus, airborne bacteria and submicron particles. The masks consist of total three to six layers and not less than three layers. Use of the combination of fabrics created barrier and the masks showed complete rejection of the SARS-CoV-2 virus as certified by ICMR-National Institute of Occupational Health, Ahmedabad. These masks are also >99% impermeable to bacteria and are reusable after disinfecting by washing with surfactant solution, warm water at ~50 oC, and water containing hydrogen peroxide, isopropanol and ethanol. The Institute had prepared more than 35,000 such mask in-house during the lockdown period in the year 2020 and distributed the same to educational institutes, banks, municipality workers, health care workers, police department, hospital and others in and around Bhavnagar and Ahmedabad. There was no adverse report received from the users.

CSIR-CECRI developed the reusable face mask with antibacterial coating that protects from particulate emissions and microbes. The tri-layered mask consisting of the hydrophobic outer layer repels the liquid aerosol and the middle bactericidal layer exterminates the microbes that comes in contact with the masks thereby providing dual protection benefits to the end-users. The inner hydrophilic layer absorbs the hot air, sweat and facilitates breathability. These masks and the coatings have been designed and formulated to sustain up to 30-50 washes. These tri-layered masks have ≥ 95% of particulate and bacterial penetration efficiency at 0.3 microns, thus comparable with the commercially available masks with Class I flammability, splash resistance and excellent breathability. Unlike the commercially available masks, the masks developed by the CSIR-CECRI and have additional antibacterial properties which could offer better protection. The properties of the masks have been certified by SITRA Technology. The CSIR-CECRI technology has been transferred to M/s. RS Nanotechnologies, Virudhunagar and M/s. Chola Enterprises, Peravurani, Thanjavur.

CSIR-CMERI, Durgapur, unveiled the Covid Protection System (COPS) for workplace consists of contactless Solar Based Intelligent Mask Automated Dispensing Unit cum Thermal Scanner (IntelliMAST), Touchless Faucet (TouF), 360° Car Flusher, and Dry Fogging Shoe Disinfector. It can be installed at the gateway of the offices, Mall, housing complexes etc. Features included IntelliMAST, an intelligent detection of persons with facemask or without facemask, i-Card based Facemask dispensing mechanism, automatic thermal scanner for taking body temperature, high intensity audio-visual alarm for public awareness, Touchless Faucet (TouF), 360° Car Flusher, Dry Fogging Shoe Disinfector (DFSD). The system can be operated both with grid supply (AC mode) and battery bank power supply (DC mode). When the system operates in DC mode, the unit is mobile and can run for 3-4 hours.

CSIR-CMERI developed UV Sterilized Hydrophobic Mask to address issues of public safety related to the use of proper facemask during the present time of crisis. The mask is highly hydrophobic, has pore size of the used material is 60 µm or smaller, has inhalation Resistance at 85 L/min < 26 mm H2O, is reusable after proper treatment with soap water followed by the sun-drying, etc. The mask is tested and Certified by SITRA and the technology has been transferred to two MSMEs.

Regular Premium

CSIR-CECRI has taken an initiative to indigenously design and fabricate printable face shields to provide added safety to front line workers who have contact with the Covid-19 affected patients. This face shield is fabricated using 3D printing with fused deposition modelling technique and the design could be mimicked with inject moulding. The material used for the development of face shield is bio-degradable polymer based composite. Polymers are widely used materials in different fields owing to their good mechanical and physicochemical properties as well as their economic accessibility. Biopolymers have inherent properties that include, antibacterial activity, biodegradability, and biocompatibility. CSIR-CECRI is tying up with industry to scale up the mass production of 3-D printed face shield and has partnered with a company 3D Lycan, Bangalore for Face Shield. Certification as per the ANSI standard (Certified by CIPET, Chennai) is obtained.

CSIR-CSMCRI has designed face shield to fight Covid-19 pandemic. The face shield weighing under 110 g can be worn simultaneously with masks for broader protection and is comfortable to wear without any uneasiness. The frame of non-allergic material snug fits on to a user head with adjustable elastic headband. The premium quality 1 mm thick optical visor with 90% light transmission is resistant to ignition and penetration. The ease of assembly of face shield and with replaceable either frame or visor makes it cost-effective for prolonged usage. It can easily be disinfected with commercially available disinfectants and will not have complexities owing to soaking of disinfectants, a likelihood for

sponge supported frames in commercial ones. The face shield bears certification for compliance to ANSI/ISEA Z87.1-2015 standard governing design, testing and performance requirements.

PPE Coveralls: CSIR-NAL in a joint Venture with M/s. MAF Clothing Pvt Limited has developed the PPE Coveralls with Indigenous heat sealing tape and polypropylene materials. These are lightweight, breathable, jumpsuit type PPE coveralls using laminated non-woven fabric with features like the attached hood, seam-sealed, zipper front with sealed edges, soft elastic around the neck and long sleeves have been designed and developed indigenously for frontline health workers involved in containment zone of Covid-19. CSIR-NAL has prepared and implemented a strict Quality Assurance Plan, which includes inspection & qualification of raw materials, fabric cutting, sewing, seam sealing the fabric, labelling of coverall, folding and packing of the final product to ensure a foolproof quality requirement for coveralls. The developed coverall passes ASTM F1670 and ISO 16603 tests and has been tested and passed for blood penetration test as required for covid-19. Production capacity at M/s. MAF Clothing is 5000 units per day (can be increased to 30,000 per day). More than one lakhs PPE Coveralls have been supplied so far.

Ozone decomposition in decontamination chamber "Chakr DeCoV": A decontamination chamber was developed to disinfect used PPE kits and N95 masks using ozone-based technology during the Covid-19 pandemic. The ozone concentration required for decontamination is very high than the permissible limit for humans in the atmosphere (<0.1 ppm).

The catalyst prepared for non-noble metal-based diesel oxidation application using Indigenous raw material from Indian Rare Earth Ltd was tested for ozone decomposition application. After fine-tuning the composition,

the ozone decomposition was achieved relatively quickly with consistent results even after 25 cycles. The catalyst prepared was successfully wash coated on ceramic monoliths for fixing in the decontamination chamber. The ozone decomposition time was reasonably short, ten minutes for a bigger chamber for PPE kits and three min for a small chamber for face masks.

NIV-ICMR tested the performance of the ""Chakr DeCoV"" decontamination chamber. This is the first device to be tested on the Covid-19 virus and was found to have complete deactivation efficacy for Covid -19 on many tests. The catalyst has enabled the treatment cycle time to reduce significantly to carry out maximum decontaminations in a day.

Recycling of decontaminated Covid PPE waste: Personal protective equipment (PPE), especially suits or coveralls/gowns, protects front-line healthcare warriors while treating Covid-19 patients. The Covid-19 pandemic has caused rampant usage of PPE kits, resulting in a large quantity of contaminated biomedical waste. The Covid-19 biomedical waste in India was 203 tonnes for just the month of May 2021. Currently, this biomedical waste is either mandatorily incinerated or deeply buried underground due to the lack of any other effective disposal solution. These processes are energy-intensive and cause further pollution of the environment resulting in significantly high carbon

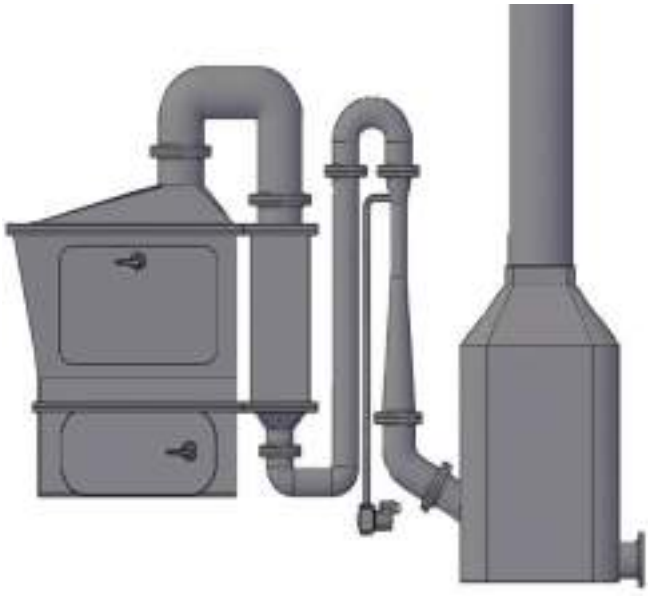
footprints. Thus, there is a need to develop a protocol to recycle this biomedical waste effectively. CSIR-NCL, with support from other CSIR labs such as CSIIR-IIP, Dehradun, has standardized a protocol to decontaminate the biomedical waste and recycle them into valuable products.

CSIR-NCL team has developed the know-how to recycle used efficiently/contaminated PPE - especially overalls and gowns. The team has demonstrated that decontaminated, shredded, and agglomerated PPE material can be used as feed-in polymer melt processing operations such as injection molding. The recycled material has been shown to have comparable rheological and mechanical properties vis-a-vis virgin polyolefins. The team has also successfully injection molded a decorative, non-structural component used in the automotive industry.

The technology has been demonstrated at a 5 kg scale initially. Further, the CSIR-NCL team has already worked with & secured the necessary permissions from the Maharashtra Pollution Control Board (MPCB) to conduct a pilot trial for 100 kg of biomedical PPE waste recycling. More recently, an MOU has been signed by CSIR-NCL and Reliance Industries Ltd. (RIL). Under this MOU, RIL will leverage its existing vendor networks to undertake pilot studies in the vicinity of Pune city jointly with CSIR-NCL, Pune.

Development of Decentralized Waste Incinerator for combating Covid-19 Spread

Waste Management has become a critical component to resstrict the spread of coronavirus, which is highlighted by recent release of the CPCB guidelines on Handling, Treatment and Disposal of Waste Generated during Treatment/Diagnosis/ Quarantine of Covid-19 Patients. Even though the guidelines are compressive and suggest the coronavirus related waste to be disposed in Centralised Bio-medical Waste Treatment Facilities (CBMWF) with multiple care at each steps. This includes,



containers/bins/ trolleys used for storage of Covid-19 waste should be disinfected daily, use of double layered bags (using 2 bags) of collection, regular sanitization of workers, adequate PPEs and vehicle sanitization etc. All these measures would also require rigorous monitoring to curb the spread. Although, if properly implemented, such measures can curb the spread of the virus however, lack in practicality in overcrowded hospitals and those not in major cities connected to CBMWTF and also lack of training of health workers and quarantine facility staff. In such case, the guideline has also made provisions for the use of captive facilities for waste disposal, thus encouraging decentralized waste management, also considering above mentioned storage and transportation related risks. These captive facilities can help dispose the Covid-19 waste immediately at source.

UV sterilization units: Contactless Auto UV Disinfection Unit or Chamber for Touch Screens, Thumb or Finger Scanners and Keypads of Biometric Identification Devices and Other Devices or Systems developed by CSIR-CIMFR: The technology is used for contactless, automatic and chemical free disinfection of surfaces of biometric identification systems and other devices used by multiple users. UV-C germicidal lamp is

used for disinfection of surfaces of biometric attendance systems (BAS) placed inside the Unit. The unit can be used for placing almost all sizes of available biometric attendance machines in the market. The disinfect unit for Biometric Attendance System is tested and certified by ICMR approved lab. The technology has been transferred to M/s Ashta Tech Automation Pvt. Ltd., Vimal Paints, Nagpur.

CSIR-CGCRI developed a programmable UV-C sterilization unit in order to disinfect several day to day office items. Ten such units have been fabricated and are in use at institute premises.

Multi-wavelength UV Source for Killing Pathogens in Real Time (MUKT – मुक्त):

MUKT-मुक्त is Plasma-UV based electronic easy-to-use pathogen inactivation system designed by CSIR-CEERI for its multi-purpose and diverse applications in Medical, Domestic, Food and Grocery. There are two versions of MUKT-मुक्त, namely MUKT-मुक्त Portable Version and MUKT-मुक्त Handheld Version. These systems are easy to operate with a normal AC power supply. The developed systems are a combination of indigenously developed mercury-free broadband UV lamps, and mercury based UV lamps. Multi-wavelength are being generated from dielectric barrier discharge based excimer lamp.

AMPRICARE- Disinfectant Box (UV Rays Hybrid Technology):

AMPRICARE- Disinfectant Box (UV Rays Hybrid Technology)

With arise of Covid-19 pandemic, the need of advanced and easily available equipments have also raised. In view of the above, CSIR-AMPRRI, Bhopal has developed AMPRICARE-Disinfectant Box, (UV Rays Hybrid Technology).

The UVC Rays Hybrid box has advantages like Energy efficient, automatically disconnects when door opens, Easy installation and maintenance, Compact size (can be varied according to requirement).

The UVC Rays Hybrid box has broad application spectrum which helps to disinfect items like Currency notes, Stationary Items,

Mobiles & other Gadgets, PPE Kits & Mask, General shops, Watches & other Wearable's and thus useful in hospitals, medical industries, police and army, factories, banks, general shops especially clothes, commercial buildings, houses etc. The technology/ knowhow has been transferred to M/s Apt Medical System Pvt. Ltd. Pune, Maharashtra.

Hands-free water tap: The idea is to redesign a conventional washbasin tap into a pedal-operated hands-free tap. When the tap is turned sideways, water gushes out, and when turned the other way, it stops. A long and strong leather straps and good tension spring were used for designing the Hands-free tap. While one end of the leather strap is fastened to a hook on the wall, the other end is looped onto the tap using a key ring. Another piece of leather is tied to the tap through a key ring loop and fastened to the pedal that is made out of PVC elbow pipes. When pressure is applied on the pedal, the leather strap pulls the tap sideways, thus enabling water to gush out. Letting of the pedal would turn back the tap to its stop position, thereby preventing water flow.

The fabricating cost of the above two devices are very minimal. In this washbasin, the user has to primarily press a pedal attached to the contactless basin with his feet for water to come out from tap dispensers, without touching any knob with hands.

CSIR-CMERI have developed two mobile indoor disinfection sprayer units (BPDS & POMID) that can be used for the effective cleaning and disinfecting pathogenic micro-organisms present on hospital wards, hospital bed, surfaces, rooms, halls, building corridors etc.

CIM-RespCool: CSIR-Central Institute of Medicinal and Aromatic Plants has been prospecting Medicinal and Aromatic Plants for few decades. Collating the traditional knowledge, text mining and the scientific observations, the institution has come up with a formulation for use in diffusers in hospital wards, hotels or even homes for sanitized air.

CSIR-CIMAP has developed diffuser formulation, which incorporates 5 essential oils from traditionally used herbs and spices, however, the selection is based on the text mining of the anti-viral activity possessed by the molecules present in these essential oils. These plants and (or) essential oils are in daily use in one way or other for food, cosmetics, flavour and fragrance. As per literature, these molecules are very effective against different viruses such as Infectious Bronchitis virus (IBV), Herpes Simplex Type 1 (HSV-1), influenza A and B, avian influenza (H5N1), adenovirus, hepatitis B virus, coxsackie virus, enterovirus 71, feline calicivirus (FCV), tomato leaf curl virus, rhino virus etc.

The formulation has been found to be helpful in bronchospasms and also it is free of any mucous membrane or skin irritation as observed in Swiss Albino Mice. In addition, it was also being tested for cardiovascular toxicity and trachea-bronchial tissue reactivity. CIM-RespCool showed 99% viral (SARS-CoV2) reduction from 10% to 100% concentration in culture. The viral particles reduced from 106.8 to 102.9.as per the test report by CSIR-CCMB. Observational studies on human volunteers have expressed a feeling of decongestion of the respiratory tract.

Tractor mounted road sanitizing unit: CSIR-CMERI developed a prototype for Tractor mounted road sanitizing unit having Span of 16 feet, Pump Spray Capacity of 30 Litre/min,

Line Pressure of 10-15 bars, Tank Capacity of 2000-5000 litres, 6 Nos of Nozzles at the rear end and three on each side (Left and Right), Road Width Coverage of 16 feet on each run, Road Speed during Spray is 5-10 km/hr, Spray Mixture of Water and Sodium Hypochlorite Solution-6%.

UV C based sanitizer system:

UVC based sanitizer system has been developed and deployed in CSIR-CEERI for santization application. UVC in the range of 254-265 nm is considered to be extremely critical in disinfecting harmful pathogens. In this case we have used 254nm Mercury based UV lamps. Few reports suggest that this wavelength can be used for corona virus disinfection as well.

Battery Powered Disinfection System: CSIR-CMERI developed a Cordless machine that deactivates/kills pathogenic micro-organisms inside a chamber like rooms, halls, etc., Two nozzle spray system, Extended arm spray unit - length (full stretch): 250 cm, cost-effective, storage capacity: 20 Litres each tank, Battery back-up time in a single charge: 4 hours, Gross weight (empty tank): 25 Kg

Antiviral-coatings on fabrics: Coating of ZnO nanomaterials onto different fabric types using the CSIR-IICT developed methodology. To further explore the process for coating ZnO supplied by Tata Chemicals Ltd. and other metal oxide-based nanomaterials on fabric.

Ozone Air Disinfection: A new gadget was designed by CSIR-CFTRI for air disinfection in hospital settings like offices, schools, restaurants, hotels and buses, which is effective for controlling Covid-19 spread. The design was standardised for various process design parameters such as ozone concentration, exposure time, temperature, relative humidity, mixing requirements and functional relationship. The results were validated with indicative airborne pathogens as per WHO and USFDA guidelines. The technology has been transferred to Omniscient Treatment Technologies Pvt. Ltd., "Ozone House" Khare Town, Nagpur, India.

Sanitizing Bin (UV based): Handling Covid medical wastes is the biggest challenge for sanitizing/health care workers nowadays due to the fastest community spreading of coronavirus. In contemplations of the present situation and taking care of public health, CSIR-IMMT has developed Sanitizing Bin for safe handling of medical/health care wastes generated from Covid-19. The specialized

Production of sodium hypochlorite

sanitizing bin with inbuilt Ultraviolet-C (UV-C) based disinfection can solve the purpose of safe collection, sanitizing and handling Covid medical wastes, which will lead to safe disposal/incineration. This bin can be placed in Covid isolation wards, hospitals/clinic and public places.


UV Sanitizing Bin

Development of Decentralized Waste Incinerator for combating Covid-19 Spread at CSIR-NEERI: Waste Management has become a critical component to restrict the spread of coronavirus, which is highlighted by the recent release of the CPCB guidelines on Handling, Treatment and Disposal of Waste Generated during Treatment/Diagnosis/ Quarantine of Covid-19 Patients. The compressive guidelines suggest the coronavirus related waste to be disposed in Centralised Bio-medical Waste Treatment Facilities (CBMWF) with multiple care at each step. This includes, containers/bins/ trolleys used for storage of Covid-19 waste should be disinfected daily, use of double-layered bags (using two bags) of collection, regular sanitization of workers, adequate PPEs and vehicle sanitization etc. Although, if properly implemented, such measures can curb the spread of the virus, however, lack in practicality in overcrowded hospitals and those not in major cities connected to CBMWTF and also lack of training of health workers and quarantine facility staff. The guideline has also made provisions for the use of captive facilities for waste disposal, thus encouraging decentralized waste management, also considering storage and risks. These captive facilities can help dispose of the Covid-19 waste immediately at the source.

Incubation Hood: During Covid-19 pandemic time, doctors require a transparent hood while carrying out treatment procedures such as intubation. These can also be used during any oral examination by dentists. Based on the need of doctors at AIIMS Bhubaneswar, Incubation hoods are designed and delivered by CSIR-IMMT. These are made by using acrylic sheets and cutting & fixing procedures in the carpentry section. The cutting can be done using laser cutters. Design can be modified by the special needs of different types of doctors while examining patients.


Incubation Hood


360° Car Flusher

Insulated Coffin: During Covid-19 pandemic a requirement was felt by doctors to preserve the dead body for about 10-12 hours and for that a temporary thermally insulated coffin

Insulated Coffin

was required where the dead body can be kept. There was a space for keeping ice packs for cooling inside the coffin. Accordingly, a new coffin was designed by IMMT and fabricated by an external fabricator for this purpose. One piece is handed over to AIIMS Bhubaneswar for their evaluation.

Supply Chain & Logistics Support Systems

This objective of this vertical has been to Setting up a Rapid Supply Chain Information Platform; offering Regional Inventory Management Solutions where required by local government; Capturing and pre-empting issues in new CSIR launches and Connectivity with and best practices from collateral areas.

Pre-emptive identification of supply chain issues in new launches of CSIR products (Devices, PPE, kits, drugs, vaccines etc.) and services (testing, training) for Covid-19 management was one of the key goals of this vertical. The key task is to prepare a bill of materials for each key item category and to provide a document or link to the specifications. There may be more than one specification for a product category (e.g. home, mobile, and hospital ventilators). An Item master - a standard form capturing all details of the primary use item was prepared.

Setting up a Rapid Health Supply Chain Information Platform

Aarogyapath (आरोग्यपथ), a single stop solution for all the national healthcare needs has been developed as the National Healthcare Supply Chain Management System to address Covid-19 and any future national pandemic.

https://www.aarogyapath.in, a CSIR National Healthcare Supply Chain Portal that aims to provide real-time availability of critical healthcare supplies, was launched.

AarogyaPath would serve manufacturers, suppliers and customers. This integrated public platform provides single-point availability of key healthcare goods can be helpful to customers in tackling a number of routinely experienced issues. These issues include dependence on limited suppliers, time-consuming processes to identify good quality products, limited access to suppliers who can supply standardized products at reasonable prices within desired timelines, lack of awareness about the latest product launches, etc. It also helps manufacturers and suppliers to reach a wide network of customers efficiently, overcoming gaps in connectivity between them and potential demand centres like nearby pathological laboratories, medical stores, hospitals, etc. It will also create opportunities for business expansion due to an expanded slate of buyers and visibility of new requirements for products. Over time, analytics from this platform is expected to generate early signals to manufacturers on overcapacity as well as on looming shortages. This would help to reduce wastage of resources due to inefficient forecasting and excess manufacturing, generate awareness about the demand for new technologies

Kisan Sabha App: Kisan Sabha App has been developed by CSIR-CRRI, New Delhi to connect farmers to supply chain and freight transportation management system. This portal acts as a one-stop solution for farmers, transporters, and other entities engaged in the agriculture Industry. A detailed primary study was undertaken wherein 500+ farmers were interviewed and a 6-day long survey with dealers, transporters and farmers were conducted in Asia's biggest Azadpur Mandi to understand the various issues and gaps in the current environment. Based on this study and the current prevailing situation, the Kisan Sabha App was developed.

- The portal connects the farmers, transporters, Service providers (like pesticides/ fertilizer/ dealers, cold store and warehouse owner), mandi dealers, customers (like big retail outlets, online stores, institutional buyers), and other related entities for a timely and effective solution.
- The portal acts as a single stop for every entity related to agriculture, be they a farmer who needs better price for the crops or mandi dealer who wants to connect to more farmers or truckers who invariably go empty from the mandis.
- KisanSabha also works for people in the agriculture services sector such as dealers of fertilizers/ pesticides, who can reach out to more farmers for their services.
- It would also prove to be useful for those associated with cold store(s) or godown(s). KisanSabha also provides a platform for people who want to buy directly from the farmers.
- Kisan Sabha has six major modules taking care of Farmers/Mandi Dealers/ Transporters/Mandi Board Members/ Service Providers/Consumers.
- Kishan sabha app has seen >60, 000 downloads

Guidelines for Public Transport and Feeder Modes considering Social Distancing Norms

CSIR-CRRI, New Delhi has come out with a document on "Guidelines for Public Transport and Feeder Modes considering Social Distancing Norms" which was released by the Hon'ble Minister Dr. Harsh Vardhan.

CSIR Supply Chain Management - Pre-emptive identification of supply chain issues in new launches of CSIR products and services for Covid-19 management

The objective of this channel is to identify and pre-empt issues in the launch of CSIR products that could affect their scalable deployment. A careful study of the bill of materials and identifying potential issues prior to the launch of the products was done. The products or technologies were studied to identify the key components, whether they are single or multiple source and whether the components are available in India or have to be imported. The study resulted in the smooth launch of competitive and cost-effective products with no infringement or supply chain issues.

CSIR Outreach Programs

In addition to the development of products, technologies, and interventions and R&D, CSIR labs are also actively engaged in supporting the local communities by coming to their aid at this critical juncture by providing masks, sanitisers, and ready to eat food.

Production and distribution of Face Masks and know-how transfer

CSIR-NEIST is training people in the North East for facemask making and other activities. As a national initiative, Digital Training has been conducted by scientists of CSIR for Reusable cotton face mask to the rural public through lectures and videos, explaining the details of stitching face mask, for its wider reach to the unreached society. Such training has been offered by CSIR-CECRI to individuals from various districts of TN, with the aim of not only to produce reusable masks and distribute them at free-of-cost but also to create trained manpower and to deploy their skill sets widely around the state on emergency. CSIR-CMERI provided 43,000+ masks to different organizations by supporting 200 families. CSIR-CECRI's transferred technology of making reusable face masks and in first phase 5000 reusable cotton cloth Face Masks were distributed at the Textile city of Karur. CSIR-CSMCRI has provided 500 masks to the Gujarat Police and 500 membrane-based face-masks. Venture-centre CSIR-NCL to donate 1 lakh face shield masks – every shield is equipped with OHP & MDF sheets, an elastic band & also comes with three additional sheets. CSIR-CSMCRI has given 1200 membrane-based face masks to the Solid Waste Management Dept. of Bhavnagar Municipal Corporation. CSIR-Indian Institute of Chemical Technology (IICT) has joined hands with Cipla Foundation (CF) to make one lakh high-quality masks and distribute across Telangana.

Trikatu syrup

A new palatable Immunomodulator and digestion enhancer formulation of Trikatu Syrup. The know-how has been transferred to Trivandrum-district Palm Products Development Co-operative Federation Ltd. an MSME from Parassala, Thiruvananthapuram.

Ready to eat nutritious food: CSIR-IHBT extended a helping hand towards feeding the migrant workers who had been stuck in various parts of the country. The Institute up-scaled its food processing unit to meet the staggering demands and provided tinned food to the needy. Ready to Eat Food Supplied during Covid-19 situation:

- Ready to eat local cuisine - 320 packs (0.16 ton) - Affected migrants in Bharmat Panchayat, Palampur

- Dal Chawal Aloo mix - 1500 packs (0.75 ton) – COVID affected migrants through SDM Palampur
- Dal Chawal Aloo mix - 5000 packs (2.5 ton) – COVID affected migrants through SDM Palampur
- Dal Chawal Aloo mix - 58000 packs (25 ton) – IIMT Bhuvneshwar
- For local administration, hospitals and medical college
- Dal Chawal Aloo mix - 10000 packs (5 tons)
- Ready to eat local cuisine - 4000 cans packs (2 tons)
- Spirulina peanut Bar (20g) - 1500 nos.
- Multigrain Energy Bar (40g) - 1000 nos.
- Multigrain Protein Powder (50g) - 1500 nos

Food Distribution: Several Ready-to-eat (RTE) products have been developed by CSIR-IHBT and CSIR-CFTRI, which are available through licensee/s for scale-up and distribution to the Covid-19 affected persons. These products include Herbal Khichdi and 'Dal Chawal Aloo Mix' developed by CSIR-IHBT and High protein biscuits; high protein rusks fortified mango bar; Nutra chikki with added Spirulina and cardamom flavoured water developed by CSIR-CFTRI are the key RTE products available for scale-up. CSIR-CFTRI has distributed 7 tonnes of high protein biscuits, 1 tonne of spirulina chikki, 10 tonnes of flavoured water, and 5 tonnes of fruit bars to reaching 31,278 migrant labourers in Bangalore/Delhi, hospital patients, doctors and police departments in two metropolia. CSIR-IMMT delivered 10,000 packets of ready-to-eat food (Khichidi), liquid soap, and sanitiser to Commissionerate Police, Bhubaneswar. CSIR-CIMFR staff club provided food to villagers – 740 meals (430 days 300 night), in Dhanbad district. CSIR-IHBT supplied ready-to-eat food boxes to the HP State Administration. CSIR-IIP employees distributed 350 homemade masks to the needy. The Institute has also been providing food to more than 300 poor people for almost one month. CSIR-CFTRI supplied one tonne each of high protein biscuits and high protein rusks to the Vasant Vihar, New Delhi for distribution to the people at the shelter homes managed by it. CSIR-IHBT also supplied Ready-to-Eat to CSIR-IMMT who handed over to the office of Asstt Labour Commissioner, Bhubaneswar for distribution to the migrants.

Dissemination regarding Covid-19: CSIR-NISCAIR organised Covid-19 focused online Competitions for Drawing, essay writing and video making, weekly Covid-19 Bulletin, Urdu Covid-19 Compendium, E-Handbook on Covid-19 (Hindi), Public awareness posters, Special coverage on Covid-19 in issues of monthly science magazines Science Reporter and Vigyan Pragati. Science communication and dissemination directorate of CSIR HQ undertook dissemination of Covid precautions and various initiatives of CSIR for Covid-19 mitigation through social media, press releases, webinars, compendium and developed a portal for Covid related information *https://covid19csir.urdip.res.in/* and *https://www.iiim.res.in/cured/.*

Development of CUReD Web portal

Developed a website CUReD, which contains the latest updates about Covid related CSIR partnered clinical trials in the area of i) Drugs/Vaccines/Therapeutics, ii) AYUSH Prophylactics / Therapeutics and iii) Diagnostics / Devices. The website was launched by the Hon'ble S&T minister Dr. Harsh Vardhan on 20th October 2020.

Development of Portal: CSIR Covid-19 Portal *(https://covid19csir.urdip.res.in/):* To showcase CSIR India's contributions towards fight against Covid-19, CSIR-URDIP had developed a dedicated portal. This provides information about CSIR India's strategy, products, technologies and other social initiatives in fight against Covid-19.

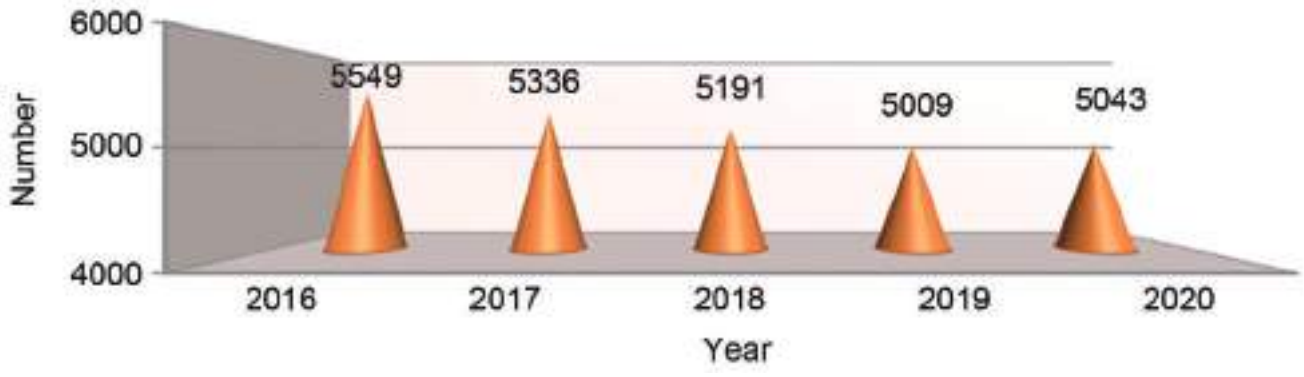
4.0
Scientific Excellence

4.0

Scientific Excellence

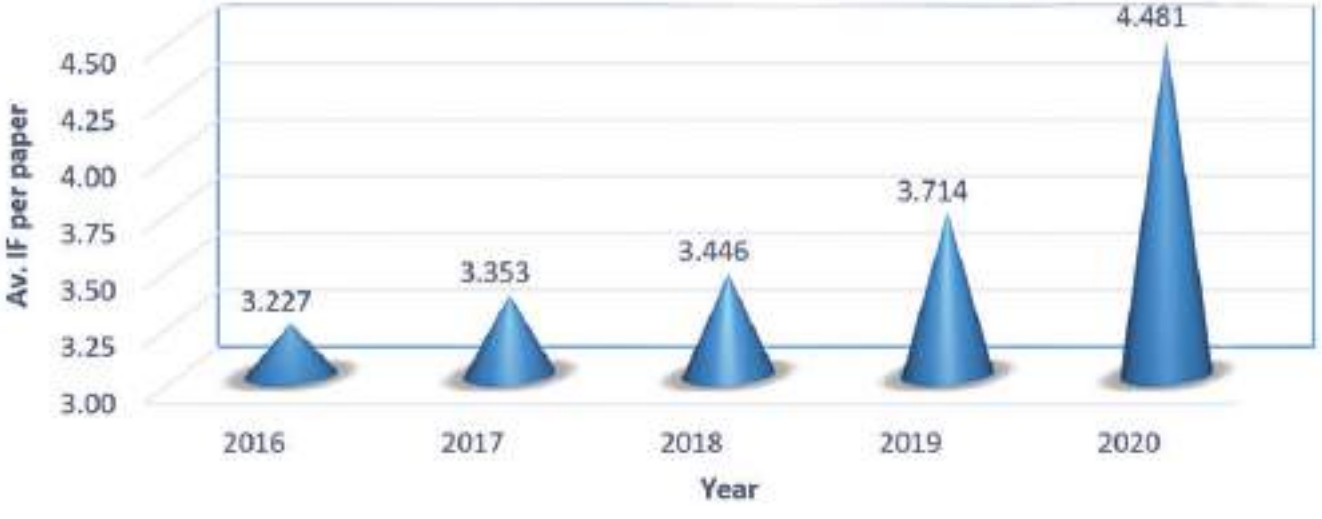
Academic Excellence

CSIR has published 5043 research papers during 2020 in SCI journals of repute.

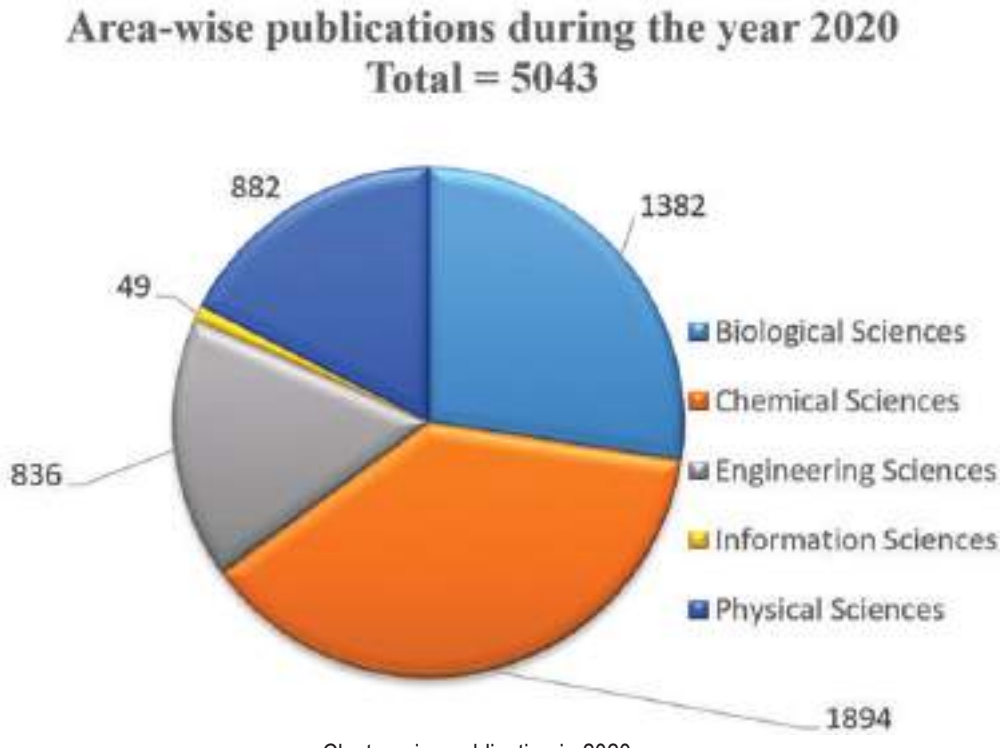


Research Papers during 2016-20

The new knowledge generated from CSIR laboratories is reflected in terms of high average Impact Factor (4.481). Following graphs shows the trend of research over the last five years.



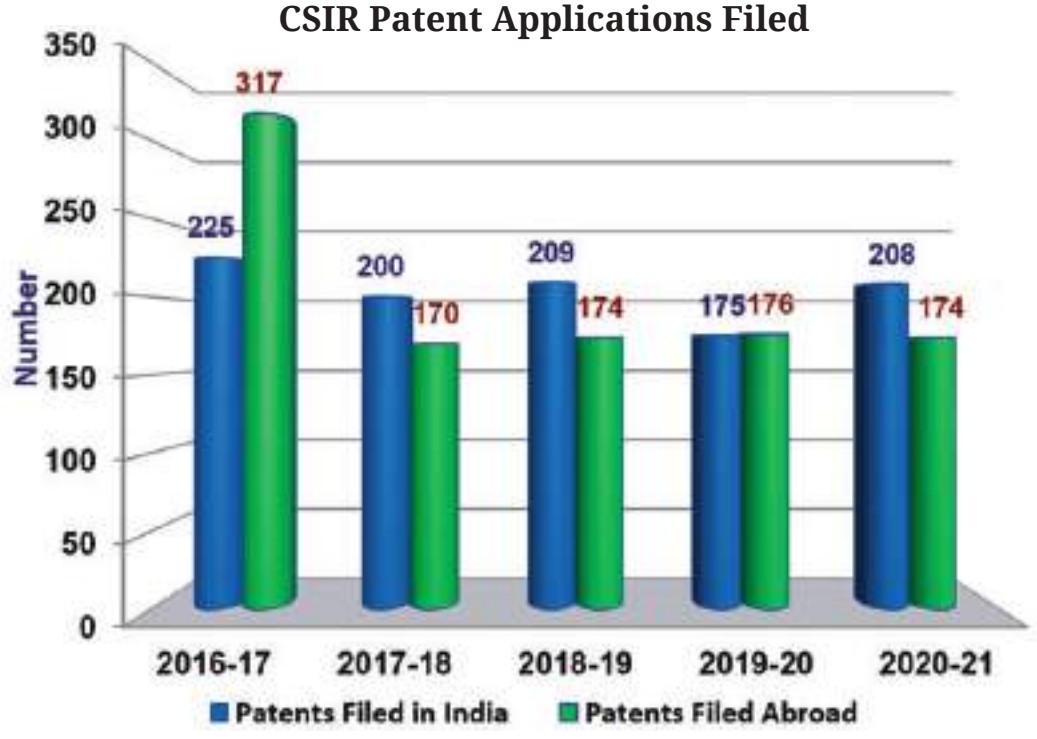
Average Impact Factor per paper during 2016-20



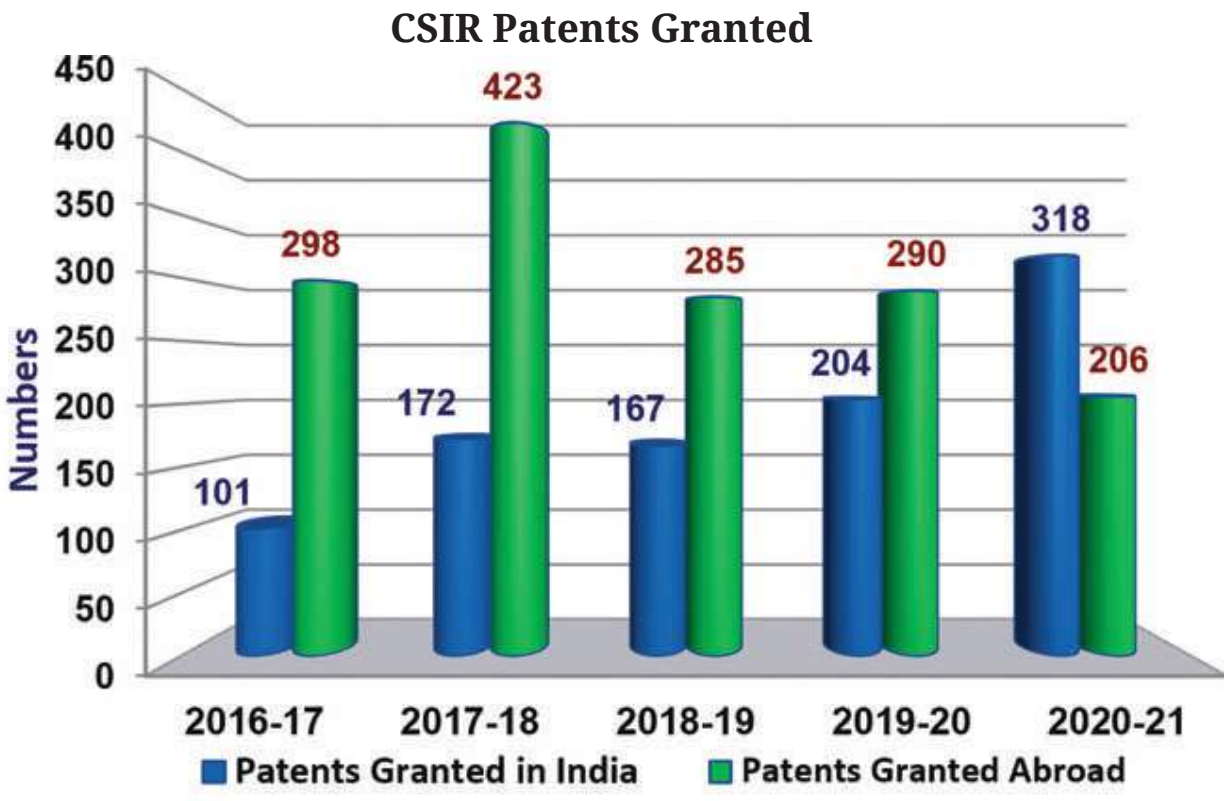
Cluster-wise publication in 2020

Excellence in Intellectual Property

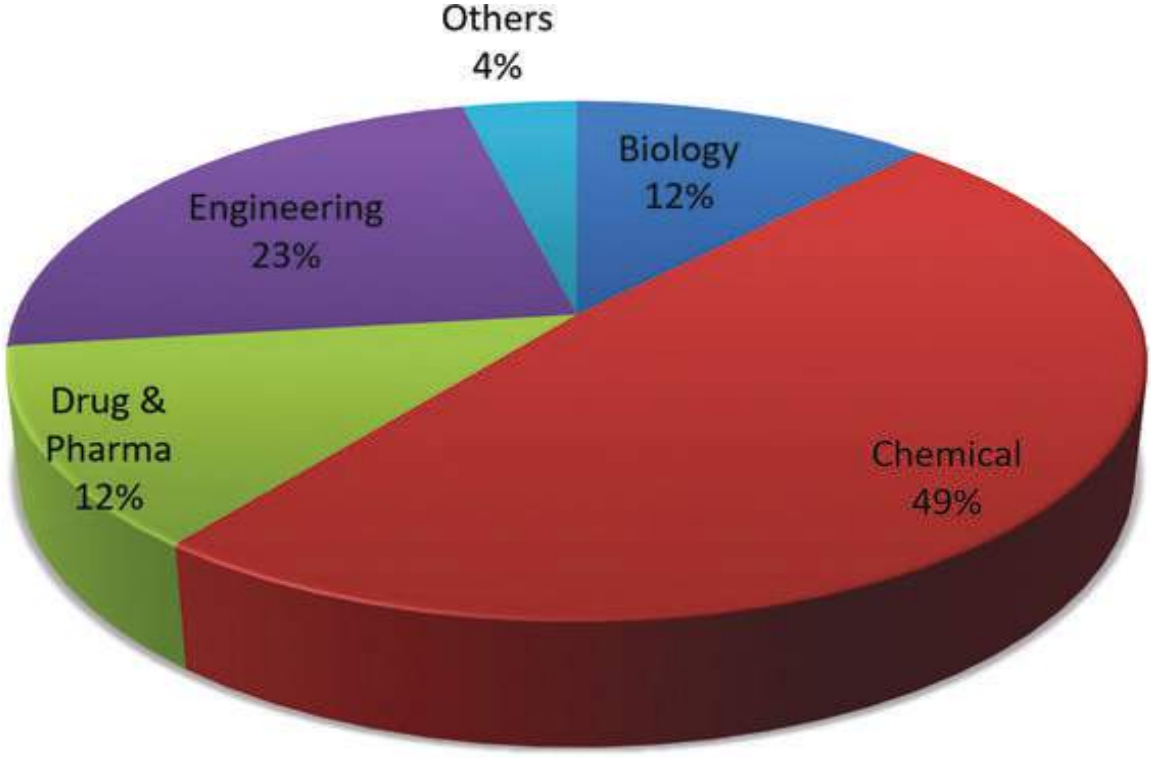
CSIR has filed 174 patents abroad and 208 patents in India during 2020-21, and it has been granted 206 patents in abroad and 318 patents in India. Following graphs provide data on patents filed and patents granted over last five years:



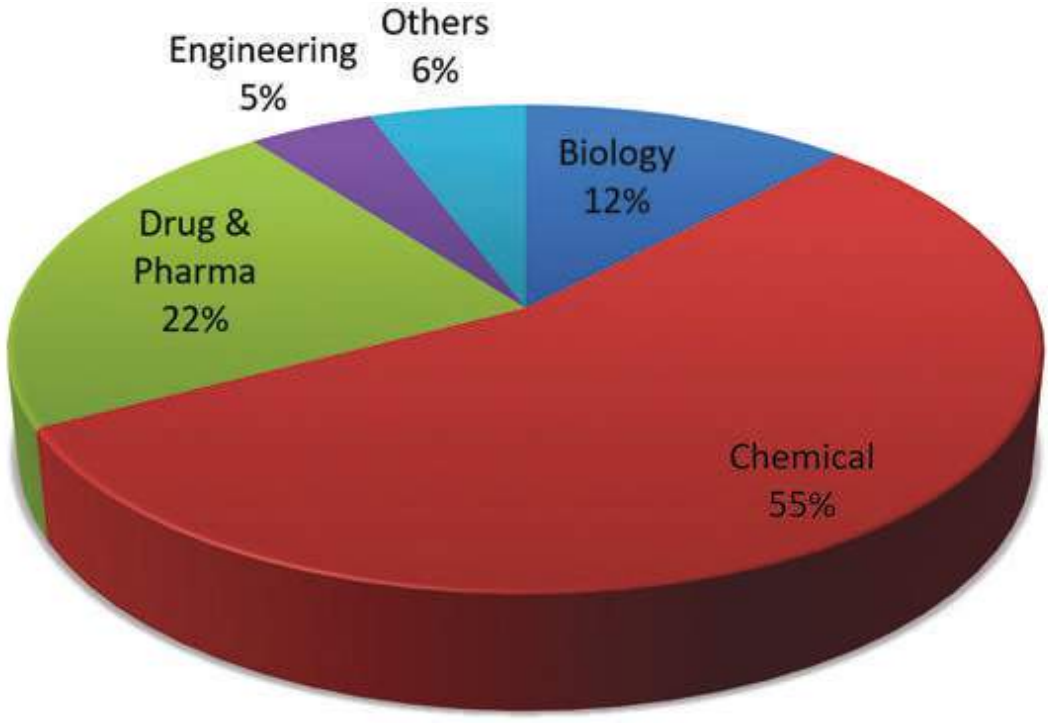
Patents filed in numbers from FY 2016-17 to FY 2020-21



Patents granted in numbers from FY 2016-17 to FY 2020-21



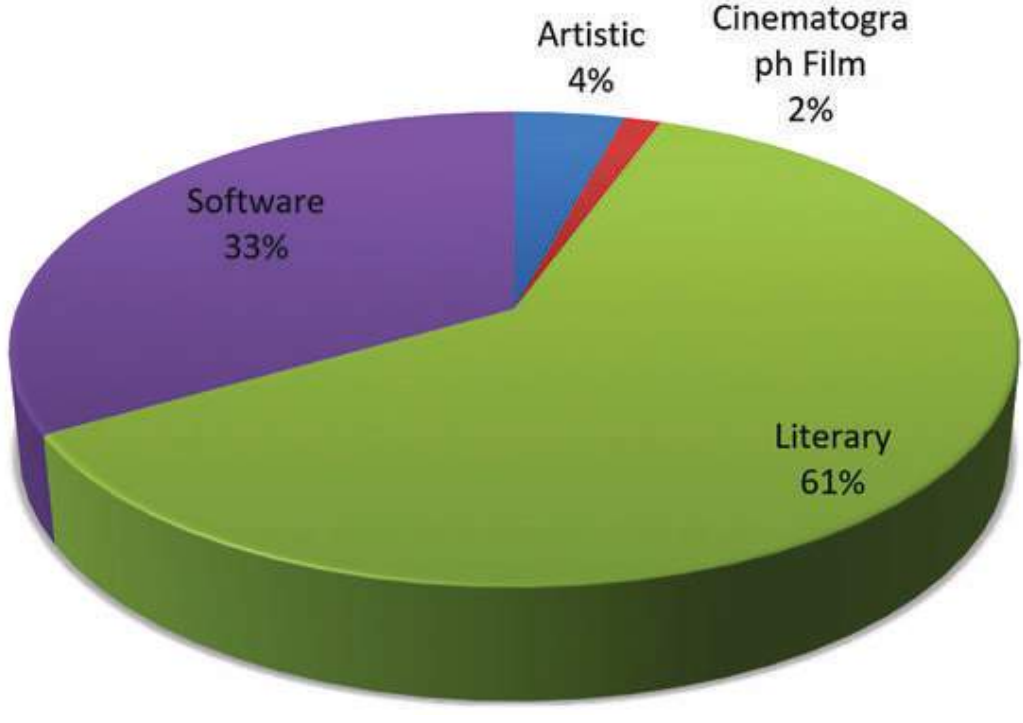
Cluster-wise patents filed in India in 2020-21



Cluster-wise patents filed abroad in 2020-21

CSIR's Copyright Filing

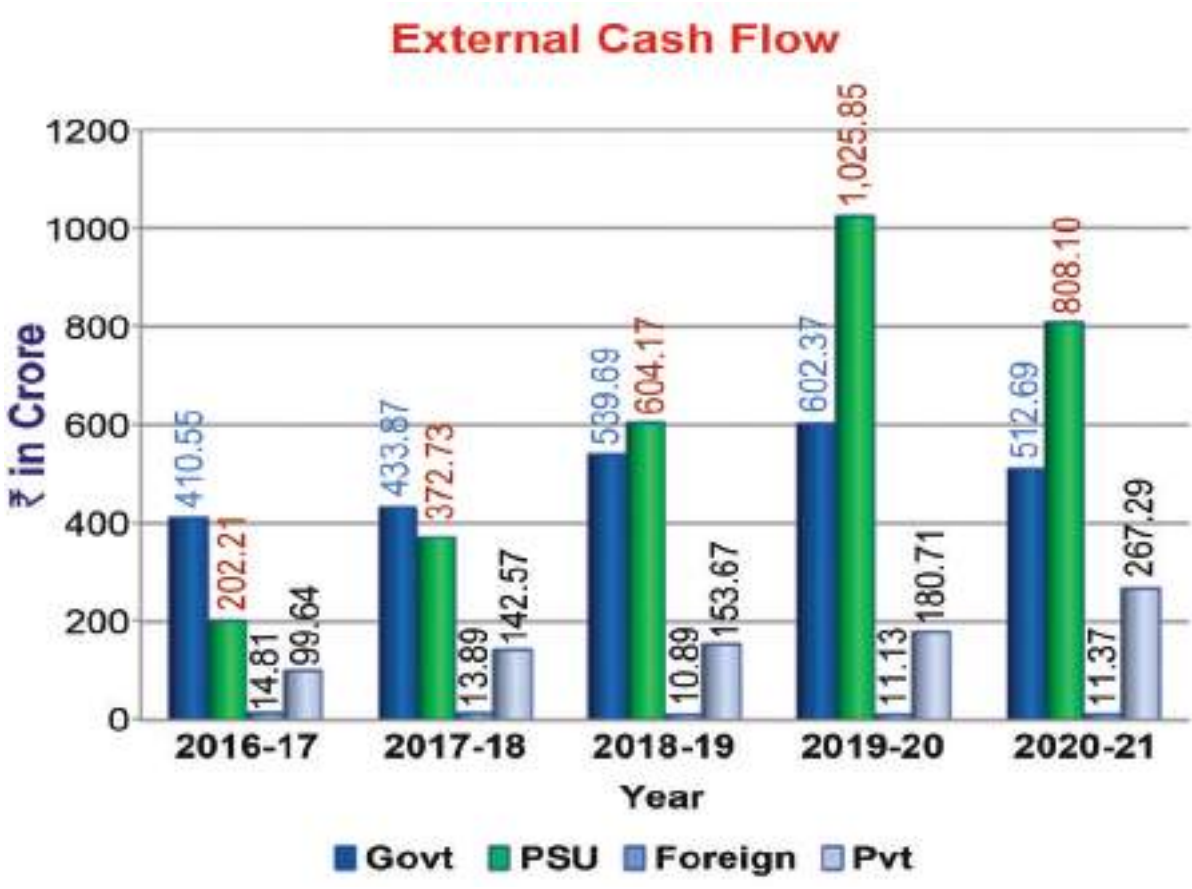
CSIR has filed 72 Copyright applications during 2020-21. The copyright applications filed by CSIR subsist in different categories such as literary work, software and artistic work.



Copyright applications filed during 2020-21

Value Generation through External Cash Flow (ECF)

CSIR has generated External Cash Flow of ₹ 1599.46 crore during 2020-21, through working with various Govt./ Non-Govt. Indian and foreign organizations. Following graphs provide data on ECF generated over the last five years:



External Cash Flow from FY 2016-17 to FY 2020-21

5.0

CSIR Theme Directorates And Theme-Wise Significant S&T Contributions

5.0 CSIR Theme Directorates And Theme-Wise Significant S&T Contributions

5.1 CSIR THEME DIRECTORATES

CSIR has undertaken several initiatives to translate laboratory leads to marketable/ value added technologies/ products and thereby enhance interactions and connect to stakeholders for enabling ease of doing technology licensing. One of the initiatives is a "Thematic approach" to harness multidisciplinary talent and infrastructure for solving specific challenges in identified sectors. Theme Directorates have been formed and cover following specific sectors:

- Aerospace, Electronics, and Instrumentation & Strategic Sectors;
- Civil Infrastructure & Engineering;
- Ecology, Environment, Earth & Ocean Sciences and Water;
- Mining, Minerals, Metals and Materials;
- Chemicals (including leather) and Petrochemicals;
- Energy (conventional and non-conventional) and Energy devices;
- Agri, Nutrition & Biotech; and 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 at substantial contributions towards each of the parameters - public good, private good, strategic good and societal good.

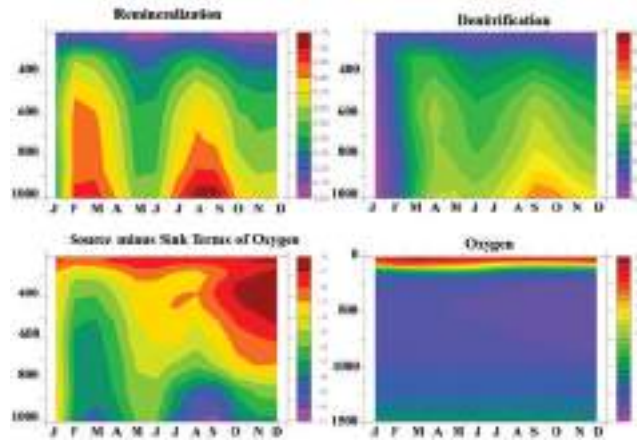
5.2 THEME-WISE SIGNIFICANT S&T CONTRIBUTIONS

Theme 1: Ecology, Environment, Earth & Ocean Sciences and Water (E3OW)

During 2020-21, CSIR has supported 8 projects (FTC-4, FTT-4) under FTT-FTC E3OW theme with a budgetary outlay of Rs 5.38 Cr. About 5 CSIR laboratories participated in these projects in networking mode. The projects supported include diverse areas ranging from electrostatic technologies for dust mitigation and environmental protection, reactive gel curing process for transforming environmental industrial solid wastes into high value building material, contaminant infusion point detection tool for water distribution system, water treatment systems (HF/EDI), etc. The projects undertaken have made considerable progress including tech transfer to a few companies. Few activities under the theme are:

Suboxic Zone in the north Indian Ocean:

Oxygen Minimum zones or Suboxic Zones characterised by low concentration of oxygen in the ocean play an important role in sustainability of marine life and carbon & nitrogen cycle. Anthropogenic emissions of carbon dioxide, and physical and biogeochemical processes change the oxygen concentration in the ocean. One of the intense tropical oxygen minimum zones is observed in the Arabian Sea. To understand the contribution of various biogeochemical processes to spatial, seasonal and inter-annual variations of oxygen concentration in the Arabian Sea (AS) and the Bay of Bengal (BOB), detailed analysis of the results of numerical simulations of marine biogeochemical model (TOPAZ) have been carried out. From the studies conducted at CSIR-4PI it has been summarized that consumption of oxygen due to remineralization and nitrification processes at depths below 200m are responsible for the low oxygen concentration between 200 and 1000m depth in the oxygen minimum zone (OMZ). It has also been observed that both carbon flux from ocean to atmosphere and pCO2 are higher for the regions in OMZ compared to a region in non-OMZ. Detailed analysis of physical, chemical and biological processes like upwelling, primary productivity, recycling of nutrients etc. will be carried out to understand the carbon and nitrogen cycle in the OMZ regions of north Indian Ocean.



Monthly variations of (a) consumption of oxygen due to Remineralization of Detritus (mMol/m3/d), (b) consumption of oxygen due to Nitrification (mMol/m3/d), (c) Source minus Sink terms of oxygen (mMol/m3/d) and (d) Oxygen (mMol/m3), with respect to depth in the region of Oxygen Minimum Zone (OMZ) in the north Arabian Sea

Membrane Filter for purification of drinking water

CSIR-AMPRI developed filter technology is user friendly as it simply keeps arsenic or fluoride contaminated water in overhead tank -which is connected to nano-adsorbent incorporated filter and get arsenic or fluoride removed (below the permissible level) treated water coming from the outlet of the filter. Developed filter works under gravity, so no electricity is required for the treatment of water. The filtration rate of the water depends on the height of overhead tank from where water comes in to the filter. Filter works efficiently at pH range 6.5 -8.5 and total dissolved solid within 500 mg/l of raw water is more suitable for obtaining maximum

arsenic or fluoride removal efficiency of the developed filter. The developed filter can also remove toxic contaminants like chromium, lead etc. of the contaminated water. Nano-adsorbent used in filter for arsenic or fluoride removal, is of low cost and can be synthesized in bulk without any waste generation. There is no mineral losses as total dissolved solid of the treated water is almost same after treatment. The treated water follows the drinking water standard as per BIS.

Membrane Filter for purification of drinking water

Solid Waste Management

CSIR-NEERI has enforced segregation of waste (organic and inorganic waste) at household levels. Keeping in the view of the waste processing of the waste collected, a composting unit has been set up in the campus by CSIR-NEERI for the same. There is a need of further maintenance of the compost pits and also few modifications are needed for further research and development. The effectiveness, suitability or viability of composting of organic waste will be analyzed, with respect to social acceptance, economic feasibility and environmental sustainability. Optimization of composting will be studied in an attempt to minimize the overall cost of operation. The similar model will be demonstrated at various localities after the improvement in the performance is substantiated in comparison to the existing system.

Reactive Gel curing process for transforming industrial wastes into building materials

CSIR-NIIST identified a Reactive Gel curing process for transforming environmentally threatening hazardous industrial wastes into high value building materials. The illmenite mineral processing industries in Kerala produce red gypsum and hydrated illmenite sludge wastes. CSIR-NIIST transformed these wastes into high strength bricks. A reactive Acrylic-silicate binder system was developed for brick making. The process is successfully optimized in lab conditions. Products showed compressive strength as high as 70 kg/cm2. More importantly, the process is cold-compression and no firing is involved. Only 20% cement is employed. Since the sludge also contains 60% TiO2 and 40% Fe2O3, NIIST developed IR reflective functional pigments out of this industrial wastes.

Gas hydrates/methane seeps

The Mannar basin, located between India and Sri Lanka, is poorly explored for hydrocarbon compared to other petroliferous basins in the Indian offshore. 2D multichannel seismic data were acquired onboard R/V Samudra Ratnakar for exploring gas hydrate deposits in this basin. CSIR-NIO observed some chimney-like features, which extend from a deeper horizon up to the seafloor. An automated version of migration velocity

analysis was used to estimate P-wave velocities along selected seismic lines. High interval velocities (>1.7 km/s) are observed above the BSR for ~100 ms TWT across the chimney locations, indicating the presence of gas hydrates for the first time in the Mannar basin. Low velocities are observed below the BSR, indicating a widespread region of free gas-bearing sediments. CSIR-NIO propose that chimneys and small sub-vertical fractures provide pathways for the migration of deep-seated gases to shallower regions. The hydrate deposits of the Mannar basin are unique as the organic-rich sediments are not supplied through any major rivers. Instead, they are derived from the high biomass due to the unusual physiography of the Mannar basin.

Heliborne Geophysical Exploration for Atomic Minerlas

Heliborne Geophysical Exploration in Chotanagpur Granite Gneiss Complex (CGGC) and singhbhum Shear Zone, Eastren India for atomic minerals. During last year, the helicopter contract was finalized and the VTEM equipment was upgraded to VTEM-Plus. During the present field season, CSIR-NGRI has commenced heliborne data acquisition in Singrauli district (Madhya Pradesh) and Sonbhadra district (Uttar Pradesh) and has acquired 4636 LKM transient EM, magnetic and gamma-ray radiometric data till 15 January 2020. The target is to achieve 25,000 LKM data acquisition during this field season.

Heliborne Geophysical Exploration

Theme 2: Civil Infrastructure & Engineering (CIE)

Under CIE theme, CSIR has approved 10 FTT/FTC (9 FTT and 1 FTC) projects for implementation in 4 CSIR laboratories i.e., CSIR-CBRI, CSIIR-CMERI, CSIR-CRRI, and CSIR-SERC during 2020-22. The projects broadly include development of technology for high strength binder using flue gas desulphurization (FGD) gypsum-a by-product of coal based thermal power plants, Technology package for eco-friendly burnt clay bricks with low carbon footprints, Valorization of lime sludge through development of environmental friendly building products, Batch scale production of high quality activated carbon from biomass wastes for waste water treatment – An initiative towards waste to wealth, Design & development of self-sustainable integrated municipal solid waste disposal system (iMSWDS) for bulk waste generator, and others. Activities under the theme have been:

Structural Safety Audit of Selected Spans and Suggestions for Strengthening Measures for Elevated Section of Gurugram Sohna National Highway Under NHDP-IV

CSIR-CRRI undertook structural safety audit of the under-construction six-lane PSC double cell box-girder shaped flyover. Concrete cores were extracted and tested at CSIR-CRRI laboratory with the objective to do Structural safety audit and to suggest strengthening measures of elevated section of Gurugram Sohna National Highway.

Inspection and Testing of the Six lane Elevated structure

Design & Development of Self Sustainable Integrated Municipal Solid Waste Disposal System (iMSWDS) for Bulk Waste Generator

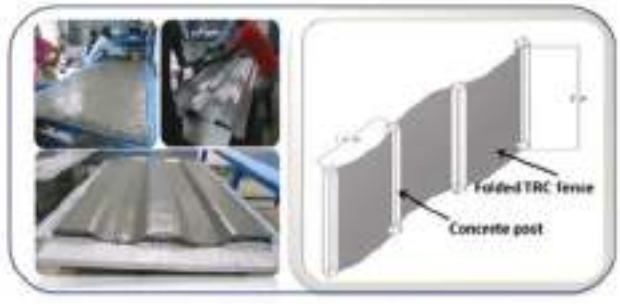
The major objectives of the project has been to develop self-sustainable Integrated Municipal Solid Waste Disposal System (iMSWDS) for bulk waste generator. A pilot plant for Integrated Municipal Solid Waste management has been set-up at CSIR-CMERI for scientific and sustainable waste management, clean and green environment, improved health and hygiene and enhancement of the quality of life. This also helps in development of micro/ small entrepreneurship and employment generation. The project caters to the "Swatch Bharat" & "Swastha Bharat" thus offering "Behtar Jeevans" to the citizen of India and help in making clean India a reality.

Analysis and Design of Hardened Aircraft Shelter (HAS)

Characterisation of materials to be used in outer layer of the layered configuration Characterisation of the materials in terms of their physical properties, methodology and mix proportions of Plain and Steel Fibre Reinforced Concrete (SFRC) using Fly Ash for use in outerlayer of Hardened Aircraft Shelter was carried out. For finding the mechanical, toughness and impact resistance of the steel fibre reinforced concrete, eight series of concrete mixtures of the grade M80 were experimented. All the mixes were designed based on absolute volume method given by IS: 10262-2019. Superplasticizer was added as the water reducing admixture for enhancing the workability of the mix. The mixes comprised of 12.5mm coarse aggregate. Each batch of concrete was proportioned in such a way as to leave about 10% excess after moulding the desired number of specimens. Steel Fibres of 30mm length and 0.5mm diameter were added to specific mixes. The designed mix for various proportions according to the specimen are mixed in a 50kg batch mixer with the period of mixing of not less than 2 minutes. The cylindrical moulds have been filled by the prepared concrete mix in layers. Each layer of the specimens was compacted by the vibrating table and the top surface of the concrete specimen was finished level using a trowel. The specimens were then cured on the site in a curing tub for a period of 28 days. For each mix 12 cylindrical specimens were cast for studying the various properties.

Cost effective textile reinforced concrete (TRC) system for developing folded TRC fence panel

A cost effective TRC system has been finalized for developing folded TRC fence panel. The binder ingredients of TRC consist of cement, flyash, silica fume, manufactured sand, water and super plasticizer with a target compressive strength of 40MPa. An indigenous textile with tensile strength 30kN/m is finalized as reinforcement. With the proposed TRC system, the standardization of folded TRC fence panel is under progress to achieve a low weight to strength ratio.



Evaluation of Seismic Performance of a False Ceiling Array using Shake Table

Dynamic tests were performed on 6 kinds of different false ceiling arrays, fixed on a purpose-built support structure, using the 4m x 4m tri-axial shake table facility available at Advanced Seismic Testing and Research (ASTaR) Laboratory of CSIR-SERC. Sweep sine tests were carried out for identifying the modal properties of the ceilings systems. Subsequently, earthquake excitations corresponding to IS 1893:2016 – Medium soil condition was imparted to the ceiling

system and the responses were recorded and observed, until Zone-V (0.36g) PGA. The responses were recorded using accelerometer sensors placed at various locations. Data post processing will help in better understanding the behavior of ceiling system under dynamic and earthquake excitations.

Theme 3: Mining, Minerals, Metals and Materials (4M)

Under 4M theme, CSIR has approved 16 FTT/FTC (13 FTT and 3 FTC) projects for implementation to 5 CSIR laboratories i.e. CSIR-AMPRI, CSIIR-CECRI, CSIR-CGCRI, CSIR-IMMT and CSIR-NML during 2020-22. The projects broadly include development of radiation shielding material, lightweight aluminium alloy matrix composites, phosphors for image intensifier tubes, super hard nanocomposite coatings, high-power optical amplifier, high piezoelectric coefficient composites, etc. Activities under the theme have been:

Development of WO3/Graphene nanocomposite thin films for k electrochromic display

The work aims to develop WO3/Graphene (SLG and RGO) nanocomposite based electrochromic display on glass and flexible polymer substrates capable of manifesting fast, reversible and controllable switching of high contrast with chemical and electrochemical stability. During the reporting period, tungsten oxide and reduced graphene oxide (rGO) doped tungsten oxide sols of different concentrations have been prepared at CSIR-CGCRI and corresponding thin films were deposited on ITO coated glass and flexible substrates and detailed characterizations are under progress. Growth and characterization of Single layer graphene (SLG) on copper substrates and transfer of SLG on FTO coated glass and subsequent characterization has been carried out.

Development of advanced nano-engineered specialty optical fibers for OCT application

The objective of the project is to meet the broad-band emission within 1100-1500nm based on Cr+4 doped YAG nano-engineered silica-based optical fiber as well as Bi-doped nano-engineered multicomponent silica-based optical fiber for enhancing the emission covering the wavelength range of 1100 – 1500 nm for making of white light source to be applicable for OCT applications. Developed with Ca and Mn assisted Cr+4 doped nano-engineered yttria-alumina-silica (YAS) glass based optical fiber from drawing of annealed preform made through MCVD process in combination with solution doping technique confirmed from optical absorption as well as TEM analyses. The broad band emission characteristics of such kind of fibers is going-on under pumping at 980 nm and 1064nm wavelengths.

Electrolytic Manganese Metal (EMM) & Electrolytic Manganese Dioxide (EMD)

India is having the 6th largest Mn-ore reserves, however, till date does not produce Electrolytic Manganese Metal (EMM) commercially and produces only meagre quantity of Electrolytic Manganese Di-oxide (EMD) (0.3% of global EMD). CSIR-NML had pioneered the pilot scale production of both EMM and EMD during late eighties; and the only commercial EMD plant in the country by MOIL, Ltd., Nagpur is operating on CSIR-

NML's technology for past 28 years. CSIR-NML has re-initiated its R&D activities on process developments for production of high pure EMM (purity >99.8%) and EMD (purity >93%) from various indigenous medium to low grade Mn ores mainly for LiBs and other battery applications. Few of these activities are financially supported by MOIL, Ltd. Nagpur and are carried out jointly with CSIR-IMMT.

Energy Storage Application

Energy Storage Application of VO2(D)-Graphene Hybrid Material a rare VO2(D) phase plate-like structures and integrated with graphene (rGO/VO2(D)) has been developed at CSIR-IMMT by facile hydrothermal route, explored their activity towards supercapacitor application and validated by the extensive ab-initio simulations using Density Functional Theory (DFT) study. After successful synthesis, the samples have been characterized by various techniques to know its crystal phase, surface morphology and elemental composition.

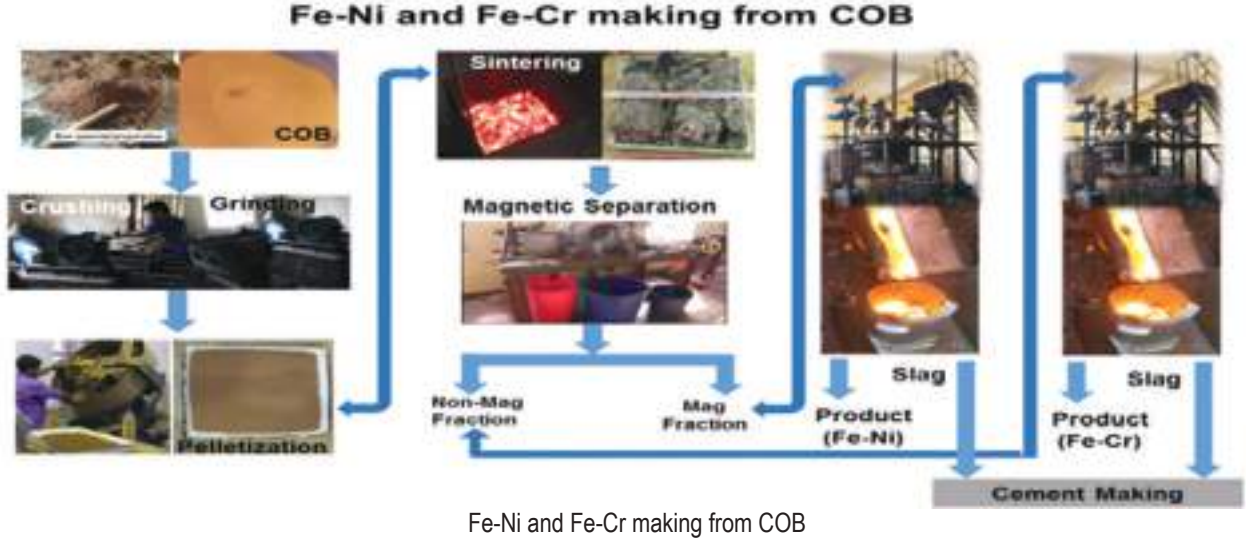
Recovery of Nickel, Chromium and Iron from Chromite Overburden (COB)

Chromite overburden (COB) is a waste generated to the tune of 6-8 tons per ton mining of chrome ore. It contains metal values like iron, chromium and nickel along with other non-metallic oxides like silica, alumina etc. These metal values carry huge commercial value. Nickel percentage in COB ranges between 0.3-0.8 and it is also considered as lateritic ore of nickel.

Plasmonic nanoparticle decorated 2D nanosheets for detection of the fluoride and arsenic in drinking water

Fabrication of a paper based analytical device nanocomposite material was identified as lead for the successfully utilized for the colorimetric detection of As (III) in water. The synthesized nanocomposite is able to detect As (III) upto 50 ppb, which is suitable for the environmental monitoring of this pollutant. Low cost and eco-friendly, paper based analytical device meant for microfluidic flow (μPAD) has been successfully fabricated for multiple analyte/specimen detections. The method of preparation of the device is a simple laser engraver technique. Patent application has been submitted design and fabrication μPAD.

μPAD Design



Fe-Ni and Fe-Cr making from COB

Production of CQDTs from coal feedstock

The low-grade coal resources are less attractive for metallurgical and power applications because of its inherent chemical properties but at the same time there are abundant coal reserves which need to be explored for economic benefits. Therefore, the process value addition to such Indian coals for preparation of the Carbon Quantum Dots (CQD) can deploy significant economic value addition and will get another area of application and can compete in the market. Development of scale-up and size-controlled process for producing blue-fluorescent carbon quantum dots (CQDTs) from high sulfur sub-bituminous Northeast Indian low-grade coals was made through an FTT project entitled "Efficient and large-scale production of carbon quantum dots (CQDT's) from cheap coal feedstock". A complete cost effective, large scale, and energy efficient technology package is made for production of CQDTs from coal feedstock. License for limited market analysis on "CQDs" with M/S SigmaAldrich, USA was signed. US patent is granted (US10655061B2).

CSIR-NEIST's indigenous process/product of coal-based carbon quantum dots

Pilot scale processes for recycling of metals/ materials from e-waste

Based on the developed and proven know-how at CSIR-NML, scale-up and pilot scale trials for the recovery of marketable metals and materials from e-waste (devices, magnets, li-ion batteries) will be carried out. Physical pre-treatment using Individual/ hybrid techniques viz. pyrolysis/ chemical pre-treatment for the beneficiation of e-waste are carried out. Recovery of metals viz. Cu, Ni, Zn, Al, Au, Ag, Pt, Pd, Nd, Co, etc., using hydrometallurgical processes viz. leaching, solvent extraction, ion-exchange, cementation, precipitation, electrolysis/ electrowinning, etc. are carried out to get salts/ metals and other valuable by-products.

Self-healing coating for corrosion protection of steel & Aluminium alloys

The organic/inorganic composite self-healing anticorrosive coating is formulated using a simple process of blending organic polymer solution/dispersion with inorganic additives. The process is scalable and suitable for onsite application using conventional paint application techniques like brushing and spraying. Autonomous self-healing of the cut/scratch in the coating is achieved when the area is exposed to water/moisture. The coating passes 1000 hours of salt spray test after creation of cut. Several techniques like electrochemical impedance spectroscopy (EIS), optical profilometer, scanning electron microscopy (SEM), salt spray and localized electrochemical impedance spectroscopy (LEIS) were used to confirm self-healing ability of the coating.

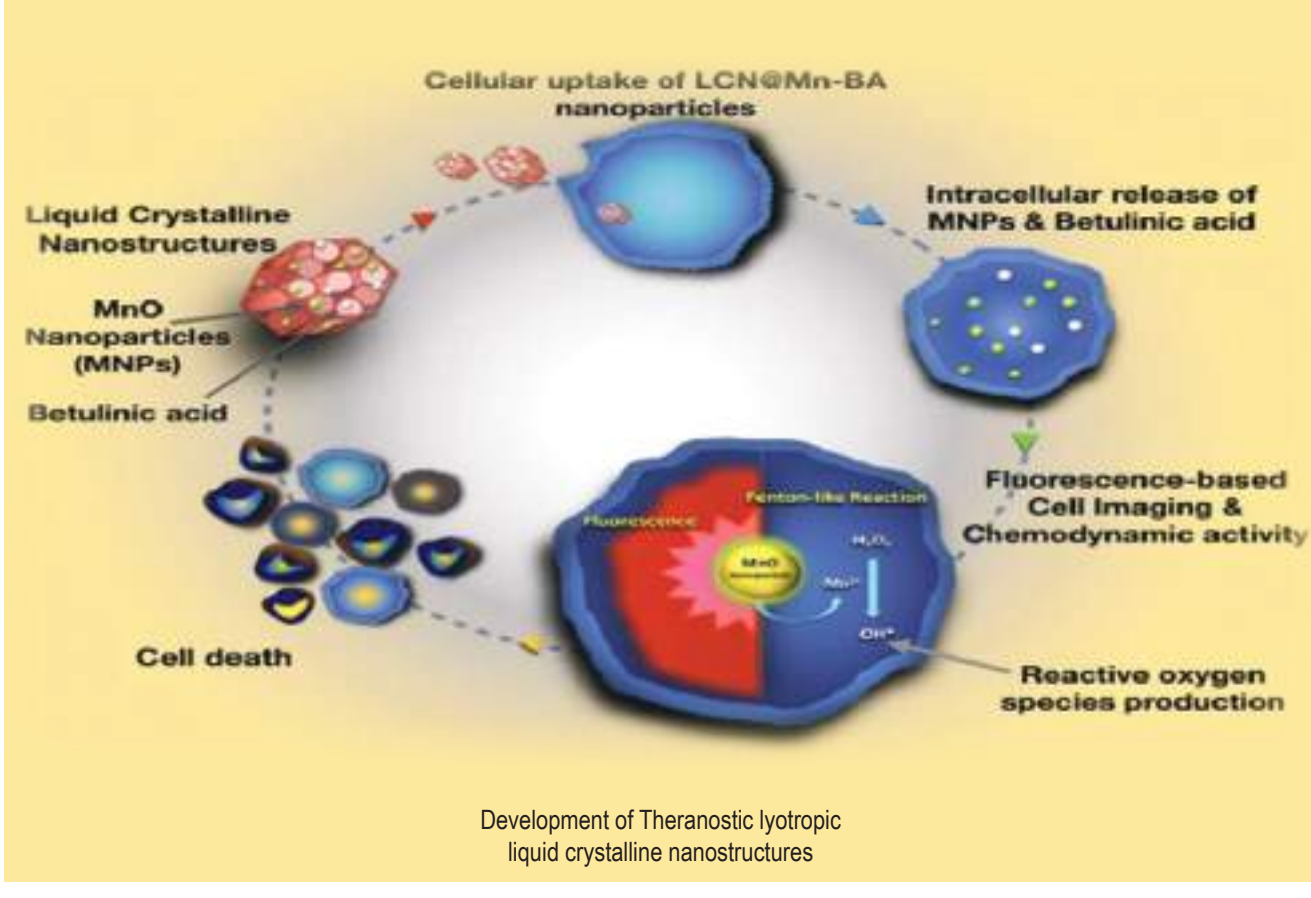
Theme 4: Healthcare (HTC)

Health Care Theme (HTC) is one of the eight Theme Directorates, created in 2018. Under the theme, CSIR has supported 10 FTT/FTC projects for implementation. These projects are being implemented by CSIR laboratories during 2020-21. The projects are broadly

focused towards development of FET devices for lung cancer VOC biomarker detection, development of cellular sensors, validation of bio-molecules against Parkinson's disease, Genomic approaches for rare genetic disease diagnosis etc. Some of the activities under this theme carried out are:

Theranostic lyotropic liquid crystalline nanostructures for selective breast cancer imaging and therapy

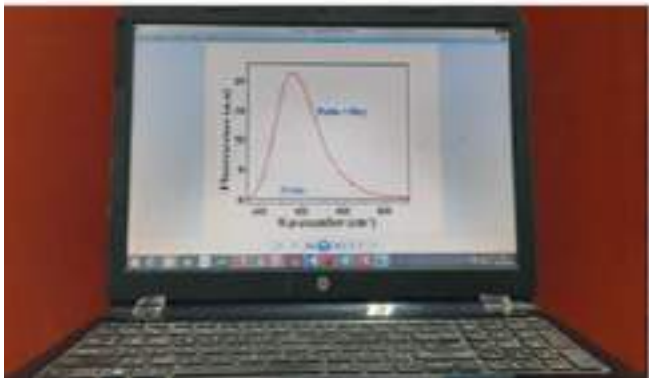
CSIR-CDRI developed theranostic lyotropic liquid crystalline nanostructures (LCN's) loaded with unique MnO nanoparticles (MNPs) for selective cancer imaging and therapy. MNPs serves as a fluorescent agent as well as a source of manganese (Mn^{2+}) and enables localized oxidative stress under the hallmarks of cancer (acidosis, high H_2O_2 level). In pursuit of synergistic amplification of Mn^{2+} antitumor activity, betulinic acid (BA) is loaded in LCN's. In this investigation, nano-architecture of LCN's phase interface is established via SAXS, Cryo-TEM and Cryo-FESEM. Intriguing in-vitro studies showed that the LCN's triggered hydroxyl radical production and exhibited greater selective cytotoxicity in cancer cells, ensuring the safety of normal cells. Significant tumor ablation is realized by the 96.5 % of tumor growth inhibition index of LCN's as compared to control group. Key insights into on-site drug release, local anti-cancer response, and tumor location are gained through precise guidance of fluorescent MNPs. In addition, comprehensive assessment of the safety, pharmacokinetics and tumor distribution behavior of LCN's is performed in vivo or ex vivo. This work emphasizes the promise of modulating tumor microenvironment with smart endogenous stimuli sensitive nano systems to achieve advanced comprehensive cancer nano-theranostics without any external stimulus.

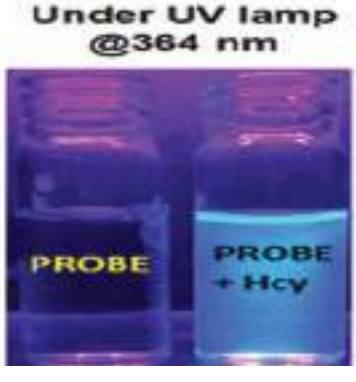


Development of Theranostic lyotropic liquid crystalline nanostructures

Development of Indigenous Optical Kit for Homocysteine Measurement

Elevated homocysteine levels in human plasma refers to a health condition known as hyperhomocysteinemia, which is connected with the early onset of several critical health illnesses and age related pathologies. In view of this, rapid diagnostic assay at minimal operational cost for clinical testing of patients' samples is exigently desirable. Indian healthcare market is entirely dependent on imported biothiol kits. Furthermore, there is no optical kit available in the Indian market that can measure homocysteine directly in human plasma. CSIR-CSMCRI has developed a simple, straightforward, and rapid diagnostic kit to be useful for the routine analysis and prognosis of various critical health illnesses connected to hyperhomocysteinemia.





Diagnostic kit for measurement of homocysteine

Development and Pilot Implementation of Genetic Information Access and analysis system for genetic diseases

Providing technological basis, clinical outreach and implementation of genomic medicine in India with an emphasis on automation for clinical application, impacting lives of millions of Indians suffering from a genetic disease. CSIR-IGIB developed whole genome based computational analysis pipelines and genome-guided molecular diagnostic assays for cost-effective diagnosis and for enabling preventive measures for patients/ families with rare genetic diseases in India. Established partnership with 05 commercial companies and over 280 clinicians/ researchers in 70 medical colleges/ research centers for translating genome-guided assays and genomics driven technologies for benefit of patients in India. Also partnered with rare diseases organizations for ensuring that benefits of genomic medicine reaches the rare disease patients and families.

RAPID-CT: Radiological AI system for Parallel Informatic Detection of Clinical Triage Emergencies General

One such platform has been created at CSIR-IGIB for detection of Intracranial Haemorrhages (ICH) on CT scans as a case study for it is an area of trauma medicine where AI could help achieve diagnostic triaging. Through collected and publicly available datasets; models have been developed for ICH diagnosis at three-levels: 1) ICH detection (95.6% accuracy) and subtype detection (93.4% accuracy), 2) ICH Segmentation (~0.7 Intersection over Union (IoU); 98.4% detection accuracy). Another algorithm for

detection of COVID-19 Pneumonia on Chest X-Rays (CovBaseAI; 87% accuracy) has also been developed during initial COVID times. The algorithm is an ensemble of three deep learning algorithms which feed information to a radiologist-designed Expert Decision System to detect COVID-19 presence and outputs figures to explain its decision making. The algorithm was never fed any COVID scans as training input but can still detect COVID-19 with considerable NPV.

RAPID-CT in future would be improvised for early detection of microbleed detection in CT scans including optimizing the current ones and standardize the models used for COVID-19 detection. It also aims for prospective clinical testing / acceptance and improving generalization performance in view of inter-organization image acquisition variability.

The "Dengue Covid-19" conundrum

CSIR-IICB first reported globally in July 2020 that dengue and Covid-19 severity and mortality global maps do not tend to overlap. Dr Subhajit Biswas' Virus Reserach Lab further supported this observation by demonstrating that archived dengue serum samples from 2017, predating the Covid-19 pandemic, produced significant false-positive results in Covid-19 rapid antibody tests. Computational studies were carried out that supported that dengue virus envelope antibodies can indeed, bind to SARS-CoV-2 receptor binding sites. CSIR-IICB's discovery of dengue virus cross-reactivity in Covid-19 antibody tests has huge implications on sero-surveillance in regions where both viruses now co-exist, like the Indian sub-continent. The finding has been cited in "National Guidelines for Dengue Case Management during Covid-19 pandemic" by the Ministry of Health & Family Welfare, Govt. of India. The molecular basis of this antigenic similarity between the two viruses belonging to different virus families, and whether this mutual cross-reactivity has any effect on severity/mortality due to either disease, are the current areas of investigation.

Architecture of biocompatible catalyst, synthesis and uses for poly (lactic acid) (PLA) based polymer for biomedical application

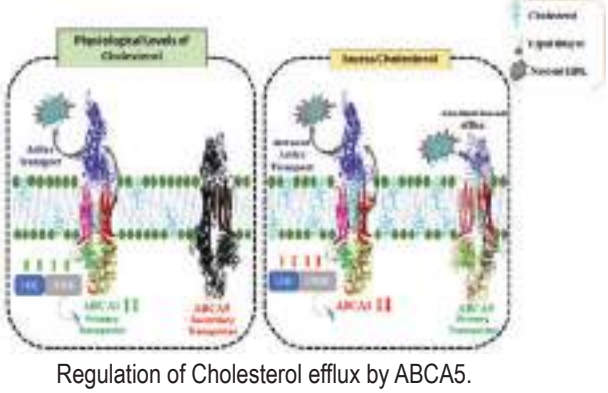
Poly (lactic acid) based homopolymer and copolymer such as P(L-LA), poly(lactide-glycolide) (PLGA), (MPEG-PLGA) have been attracted tremendous attention due to its biocompatibility, biodegradability and low immunogenicity which are significant for regulatory purposes. Poly (lactide) (PLA), PLGA, and MPEG-PLGA copolymers, etc. have been approved as the carrier for several products by US-FDA. Hydrolysis of these polymers in the physiological media occurs and breaks down to lactic, glycolic acid which again converts to carbon dioxide and water as by-products. The literature study reveals that the residual tin in polylactide was in the range of 300-400 ppm, whereas the level of zinc was in the range of 20-40 ppm. Further, zinc is an essential element for the human metabolic system. The new initiators/ catalysts were designed based on zinc metal and L-proline as ligand at CSIR-NCL. Zinc silane complex was also synthesized. The cyclic tin catalysts were also synthesized. Ring-opening polymerization of lactones were carried out using these catalysts in bulk through the green route. These synthesized PLA-based polymers were characterized and used for nanofabrication, such as drug-loaded nanoparticles and nanofibers. These nanomaterials could be used to combat colon cancer, prostate cancer and wound healing applications.

Novel mechanism of cholesterol transport by ABCA5 and its role in dyslipidaemia

High level of plasma cholesterol poses a considerable risk for atherosclerosis and coronary artery disease. Cholesterol is an essential component of the cell and its homeostasis is one of the critically regulated processes. Cholesterol homeostasis results from a delicate interplay between influx and

efflux of free cholesterol primarily mediated by ABCA1. At CSIR-IICB, research has established that ABCA1 is downregulated in hyper-cholesterol conditions in macrophages which might be responsible for compromised RCT and hyperlipidemia. This is accompanied by the upregulation of a lesser known family member ABCA5 to maintain cholesterol efflux. The relative contribution of ABCA1 and ABCA5 towards cholesterol efflux was evaluated and revealed ABCA5 as the primary efflux mediator under high cholesterol load. These observations were validated in mice models of atherosclerosis (ApoE-/-) and hyperlipidemia (PPARα-/-) in response to high cholesterol diet. Findings were further validated in human plasma samples. Simulation studies revealed a unique conformation of ABCA5 proposing a favoured route for cholesterol loading onto HDLs for RCT.

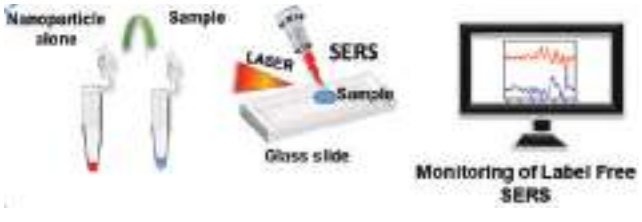
The inverse plasma levels of ABCA1 and ABCA5 can act as a good indicator of cholesterol load in circulation. Research revealed that the expression of these transporters and the molecular regulation driven by cholesterol loading might be critical in cardiovascular pathophysiology.

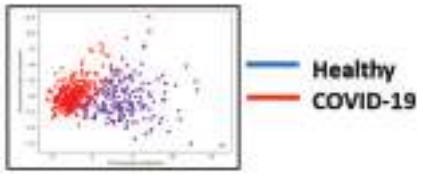


Regulation of Cholesterol efflux by ABCA5.

Development of portable Raman spectrometer

A prototype having automated focusing and scanning facility and embedded software for screening for the detection of breast cancer biomarkers using SERS-nanotags and enable multicentric clinical validation using the portable Raman spectrometer is under progress at CSIR-NIIST. SERS Based Diagnostic platform for COVID-19 is an on-going activity and Development of Ultrasensitive, Rapid and Portable system for COVID-19 Screening using Label-free Raman Fingerprinting and AI is also progressing.





Development of portable Raman spectrometer

Detection of type-1 diabetes

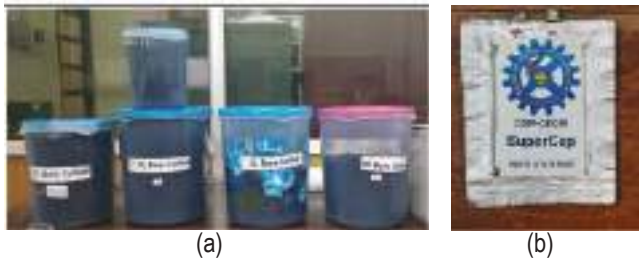
Often diabetes Types 1 and 2 are misdiagnosed. This is a problem because they need different treatment regimes. CSIR-CCMB, in collaboration with KEM Hospital, Pune and University of Exeter have developed a genetic risk score to determine the chances of type-1 diabetes. The test works for both European and Indians in its current form.

Theme 5: Energy and Energy Devices (EED)

Energy (Conventional & Non-Conventional) and Energy Devices is one of the eight Theme Directorates, created in 2018. Under the theme, CSIR has supported 8 FTT/FTC projects for implementation. These projects are being implemented by CSIR laboratories during 2020-22. The projects broadly in development of smart battery, methanol fuel cell stack, super capacitor device, cathode materials, coal mine water usage, Bio-gas to Bio-methane, coatings and translating electrochromic devices etc. Few activities under this theme are

Fabrication of 12 V, 500 F supercapacitor device assembly

Supercapacitor cell assembly with 500 F capacitance and working voltage of 12 V has been fabricated at CSIR-CECRI. Parameters of electrode materials, coating thickness, winding and electrolyte have been optimized to obtain maximum energy density in device level. Large-scale synthesis of activated carbon from the bio-waste source for supercapacitor electrode material has been performed in two stages. Carbonization of the bio-waste has been performed with activation of the bio-waste carbon by the chemical activation process. Fabrication of pouch type supercapacitor device with 261 F @ 2.5 V has been achieved.



(a) (b)

Fig. (a) Pic of bio-waste derived activated carbon via chemical activation process and (b) Symmetric pouch-type supercapacitor device fabricated using bio-waste derived activated carbon

Development of 250 W direct methanol fuel cell stack with in-house nafion based hybrid membranes for portable and strategic applications

Development and demonstration of DMFC stack with hybrid membrane. Fabrication of methanol barrier in-house membrane by suitable fabrication methods and scale it up to higher active area (100 – 200 cm^2) by optimizing various parameters. Designing of a compact DMFC stack with innovative flow-field design and evaluation of cell performance (active area in between 25 cm^2 – 200 cm^2). Modelling of anode side flow field for efficient distribution of methanol and optimization of flowfield channel for DMFC fuel cell. This will reduce the cost of a PEMFC stack in terms of balance of plant (BOP) as it eliminates the humidification process unlike

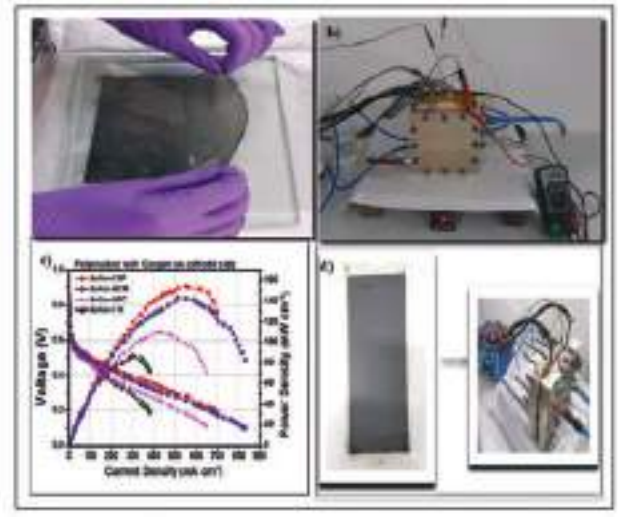


Fig. (a) Casting and peeling of 100 cm2 active areas methanol barrier 150-micron thick membrane, (b) DMFC performance evaluation in 100 cm2 active area, (c) Polarization and performance data of 100 cm2 in-house hybrid membranes, (d) Scaling up of MEA to 200 cm2 active area

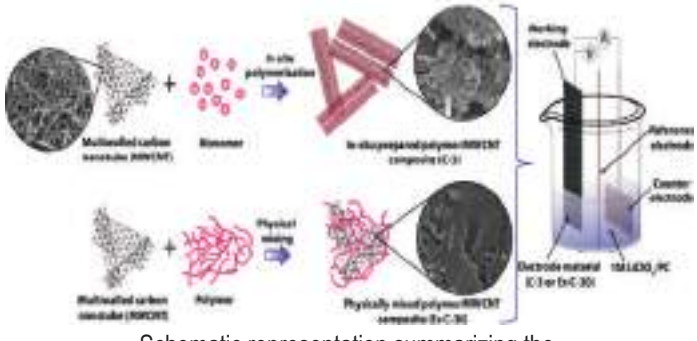
H-based fuel cell and 2 offers system simplicity with the usage of methanol, a cheapest source for fuel. Peak power density of 150 mW cm-2 is realized with in-house developed methanol barrier membrane compared to 80 mW cm-2 usually obtained with commercial Nafion membrane. Designing of anode flow-field pattern and 250 W DMFC stack is in progress for defense and other strategic applications.

CSIR Innovation Centre for Next Generation Energy Storage Solutions (ICeNGESS).

First attempt in India towards indigenous development of Li-ion batteries using indigenous electrode materials developed in a commercially viable manner. CSIR-CECRI developed Indigenous LIBs have been successfully demonstrated for applications such as E-bike, Electric Scooter, 1.5 KVA UPS back up, Solar street light application, 10,000 mAh Power bank, Consumer electronics like rechargeable torches, emergency lamps etc. Current Technology Readiness Level of 6 enable Indian Industries to go for cell manufacturing. Attracted 100 Crore grant from CSIR to scale up the indigenous Lithium ion battery technology to the level of producing 100MW/year and to enable Make in India as well as Made in India policies to ensure Self Reliant India (Atma Nirbhar Bharat). The Technology was transferred to TATA Chemicals and many other companies are currently negotiating.

Hybrid supercapacitor

P(NDI2OD-T2), also known as Polyera ActivInk N2200, is a widely accepted non-fullerene acceptor polymer that figures prominently in the energy harvesting application due to its ease of synthesis, high electron mobility, and other desirable semiconducting properties. CSIR-NCL developed a facile synthetic route for N2200 composites with multiwalled carbon nanotubes (MWCNTs) following an in-situ approach to include MWCNT into the polymer matrix, improving its electrochemical performance in an organic electrolyte (1M LiClO4/propylene carbonate). The composite material with an optimum MWCNT content exhibited prominent redox behavior delivering a specific capacity of 80 mAh g-1(polymer) in a standard three-electrode cell. The N2200/MWCNT composite material exhibited a battery-type electrochemical signature. It could perform as an efficient negative electrode in a high-voltage (2.4V) hybrid supercapacitor device comprising capacitive activated carbon as the positive electrode.



Schematic representation summarizing the polymerization of P(NDI2OD-T2)

Fabrication and testing of dye-sensitized solar cells

Add on facility for fabrication and testing of dye-sensitized solar cells and Indigenous fabrication of transparent conducting oxide (TCO) coatings by spray pyrolysis for dye sensitized solar cell application is in progress at CSIR-NIIST. MoU is signed with M/s. Delgado Coating & Technology Solutions Pvt Ltd, Kochi for Collaborating in the establishment of the facility. Translating electrochromic devices 1'x1' dynamic windows towards industrial smart glass technologies is initiated.

Coal Characterization of different mines of India

The coal research group at CSIR-NML is primarily working on the two prime challenges Indian coal is facing today, a) high ash content and b) scarcity of coking coal. The process of oil agglomeration relies on the difference in surface functionality of coal and minerals, thereby imparting selective coating of organic coal molecules using hydrophobic oil particles. Team at CSIR-NML has optimized the physical parameters such as pH, ionic strength, pulp density, agitation conditions and oil dosage for the process. Under the optimized conditions, approximately 50% reduction in ash content with around 60% recovery of combustible yield has been achieved for most of the chosen coals. However, considering the structural heterogeneity and complexity of Indian coals, further optimization of type of oil, dosage of oil, pulp density and agitation conditions needs to be performed for both high grade and low grade coal types. Such optimizations, with economic considerations, are ongoing for both low grade coals and coking coals.

Theme 6: Aerospace Electronics and Instrumentation & strategic Sectors (AEISS)

Under AEISS theme, CSIR has approved 14 FTT/FTC (11 FTT and 3 FTC) projects for implementation to 9 CSIR laboratories i.e., CSIR-AMPRI, CSIR-CECRI, CSIR-CEERI, CSIR-IIIM, CSIR-CFTRI, CSIR-IMMT, CSIR-CSIO, CSIR-NPL and CSIR-NAL during 2020-22. The projects broadly include Lightweight Aluminium hybrid foam core multi-layer sandwich panels with metal / 3D Carbon Fibre / Kevlar as face sheets for aerospace, blast resistance and transportation applications, Aerogel based thermal protection systems for nozzle surfaces in space and aerospace applications, Development of High Power Thyratrons for Fast Switching Applications, Batch digital microscopy with marker-specific auto-scoring for high-throughput analytics, Development of force-distance curve based Atomic Force Microscope for multi-parametric Imaging of Biological Systems, etc. Some of the activities carried-out under this theme are:

Development of Dielectric barrier discharge based cold atmospheric pressure plasma jet

R&D works have been initiated for the design and development of Dielectric barrier discharge (DBD) based cold atmospheric pressure plasma jet (C-APPJ) for food, agriculture and biomedical applications at CSIR-CEERI. Initial design of a tapered structured C-APPJ have been fabricated for the formation of stable and focused plasma plume. The experiment has been carried out for the electrical and spectroscopic characterization of cold atmospheric pressure plasma jet at different operating parameters, such as, applied voltages (up to 10kV), frequencies 10-25 kHz, and gas flow rates 1-5 SLM. It has been observed that higher flow rate leads the transition to the turbulent mode which causes the shorter length of the plasma plume. It is also observed that the plasma plume gets wider at higher flow rate of 3 SLM. The effect of shortening and widening of the plasma plume is happening at higher gas flow rates because at higher gas flow rate, there is possibility for increase in the mixing of the air with the plasma plume. It has been observed

that the length of the plasma plume increases on increasing the pulse frequency. This is because of the higher propagation velocities of plasma bullet at higher frequencies. The plume length has been found to be 18 and 19 mm at pulse frequencies of 15 and 20 kHz, respectively.

Development of AI Computing Facility

AI Computing Facility created under the CSIR Intelligent Systems Mission Mode project was extensively utilized for developing the system. FRAS is being used at CSIR-CEERI for Regular, Temporary, and Contract Staff Attendance since October 2020. Development of 50 devices is completed. It is also installed and is in use at CSIR - Human Resource Development Centre (CSIR-HRDC), Ghaziabad. The system was inaugurated by Dr. Shekhar C Mande, DG CSIR and Secretary, DSIR, on January 15, 2021.

Development of MEMS piezo-resistive pressure sensor

MEMS piezo-resistive pressure sensor interfaced with a commercial IC for sensor output amplification, bias generation and temperature compensation has been developed at CSIR-CEERI. The developed product, pressure and output voltage range is configurable. Currently, the pressure output is in analog form. Pressure port connectivity can be configured as per user requirement. In addition, self-test, voltage protection options are also available to user optionally. Double side polished silicon wafers with (100) orientation and a thickness of 370 ± 1 µm are used as starting substrate. Thermal oxide used as insulator and etching performed using buffered HF. Poly silicon resistors are implemented on a diaphragm achieved by back-side etching. Poly resistors are connected in wheatstone bridge configuration. A commercial interface IC interfaced with a closed bridge pressure sensor. An on chip temperature sensor compensates temperature induced non-linearities generated from sensor.

(a)

(b)

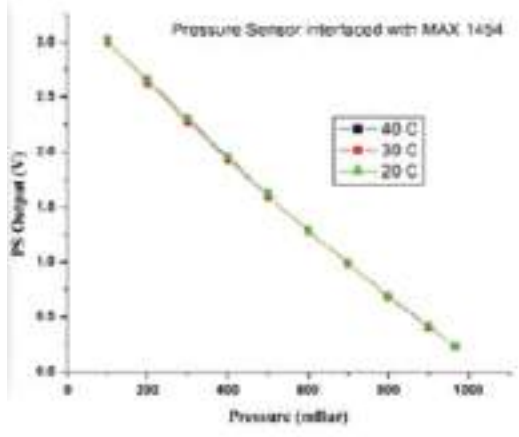


Fig. (a) Developed MEMS piezo-resistive Pressure sensor under test and (b) System characteristics: Applied pressure vs Pressure Sensor output

Ligament Injury Assessment & Therapy Device for motor-rehabilitation of Soldiers "L-GEAR"

L-GEAR developed by CSIR-CSIO is wearable sensors based device for goal-directed rehabilitation therapy for people suffering joint movement disabilities and to assess the effects of therapy. The device has real time IMU based wearable sensor, to measure the ROM value and provide immediate feedback to alert patients about the movement errors. Real time data from the sensor module is acquired by a handheld device, such as Tab or Mobile phone, using wireless communication for assessment by the physiotherapist or clinician. Software provides scalable assessment and therapy modules for upper

and lower limb ligament injuries. The patient trials of the developed system were conducted at ISIC New Delhi for frozen shoulder and total knee replacement rehabilitation.

Packaged wearable sensor module of L-Gear and Gaming based biofeedback platform

Development of Fluid flow rate measurement device through a narrow tube

CSIR-NML jointly with Indian Space Research Organisation (ISRO) developed a device for fluid flow rate measurement through a narrow tube. This technology finds its application in estimating the amount of propellant available in a spacecraft on-board. Propellant availability is one of the main factors determining the spacecraft life. It is essential to gauge the propellant accurately for estimation of spacecraft end-of-life (EOL) and to optimize mission strategy. The conventional methods (like pVT and book keeping) are used to calculate the remaining propellant after orbit transfer whereas more than 80% of the propellant is consumed during apogee raising maneuvers. As both pVT and book keeping methods are starting their evaluation at the beginning of satellite orbital life, the accuracy of the remaining propellant mass prediction is eventually driven and limited by the precision in the estimation on the quantity of propellant consumed during Liquid Apogee Engines (LAE) firing. As a result, the error in estimation of EOL of the Indian spacecraft amounts to as much as six months. Thus, many spacecrafts are prematurely deorbited before their propellant has been exhausted and/ or few spacecrafts may fully consume the propellant and non-functionally occupy its space in the orbit. This technology equipped with a special signal analysis algorithm made it possible to detect time differences of the order of 1 ns which is the main scientific and technological contribution. The prototype is able to measure flow rate with 0.1% accuracy.

Integrated Avionics and Display Computer (IADC)

The avionics architecture whose life-cycle costs are currently estimated in millions needs to go as an architectural change to keep itself up to growing demand of low operating cost in high performance scenario. The developed IADC employ an array of new technologies to implement multiple flight critical applications to be hosted in same computing platform thus reducing multiple dedicated LRU requirements. CSIR-NAL is working on development of the Integrated Modular Avionics (IMA) based display computer, a display software's developed to demonstrate IMA functionalities.

Integrated Avionics and Display Computer (IADC).

Using aircraft data networked based approach the requirement of enormous interface wiring will be reduced. This sustainable architecture can last for 20-30 years with incremental addition of functionalities on same platform thus reducing the life cycle cost of aircraft system development. Engineering porotype of IADC (IMA platform) has been developed along with system software and application software. The developed IADC can be adopted for any IMA architecture based aircraft.

Multi Zone Hotbonder (MZHB) for in-situ repair of composites

Hot bonding performed using flexible heater blanket and vacuum bag is the most suitable method for in situ repair of aerospace and other advanced composite structures. Hot bonding is performed through elevated temperature cured adhesive system, which increases the glass transition temperature and hence the service temperature of the final product. These adhesive systems are sensitive to temperature gradient. The hot bonding equipment currently being imported does not ensure temperature uniformity. To overcome these problems CSIR-NAL has designed and developed a multi zone, portable hot bonding equipment that uses multiple numbers of appropriately placed heater blankets, sensors and a data acquisition device coupled with a novel control algorithm and software. This product can maintain the given temperature profile simultaneously at 12 locations. During the current year a compact version of the MZHB that houses the accessories inside the equipment case was developed with wheels for ease of transportation. NAL's ToT licensee, M/s San Process Automation, Bangalore, has supplied Dual zone hot bonders customized for HAL's requirement as well East Africa, Kenya. The MZHB facility was extended to LCA program for the repair of drop tank and engine bay cover.

Dual zone hot bonder.

Theme 7: Agri, Nutrition and Biotech (ANB)

Agri Nutri& Biotech (ANB) is one of the eight Theme Directorates, created in 2018. Under the theme, CSIR has supported 21 FTT/FTC projects for implementation during 2020-21. The projects are broadly focused towards development of bamboo composite beam, low dietary fiber food with commercial application, racinolic acid from castor oil, extension process for shelf life of fruit, up-scaled production of disease free corms of saffron etc. Some of the activities under this theme are

CSIR AROMA Mission

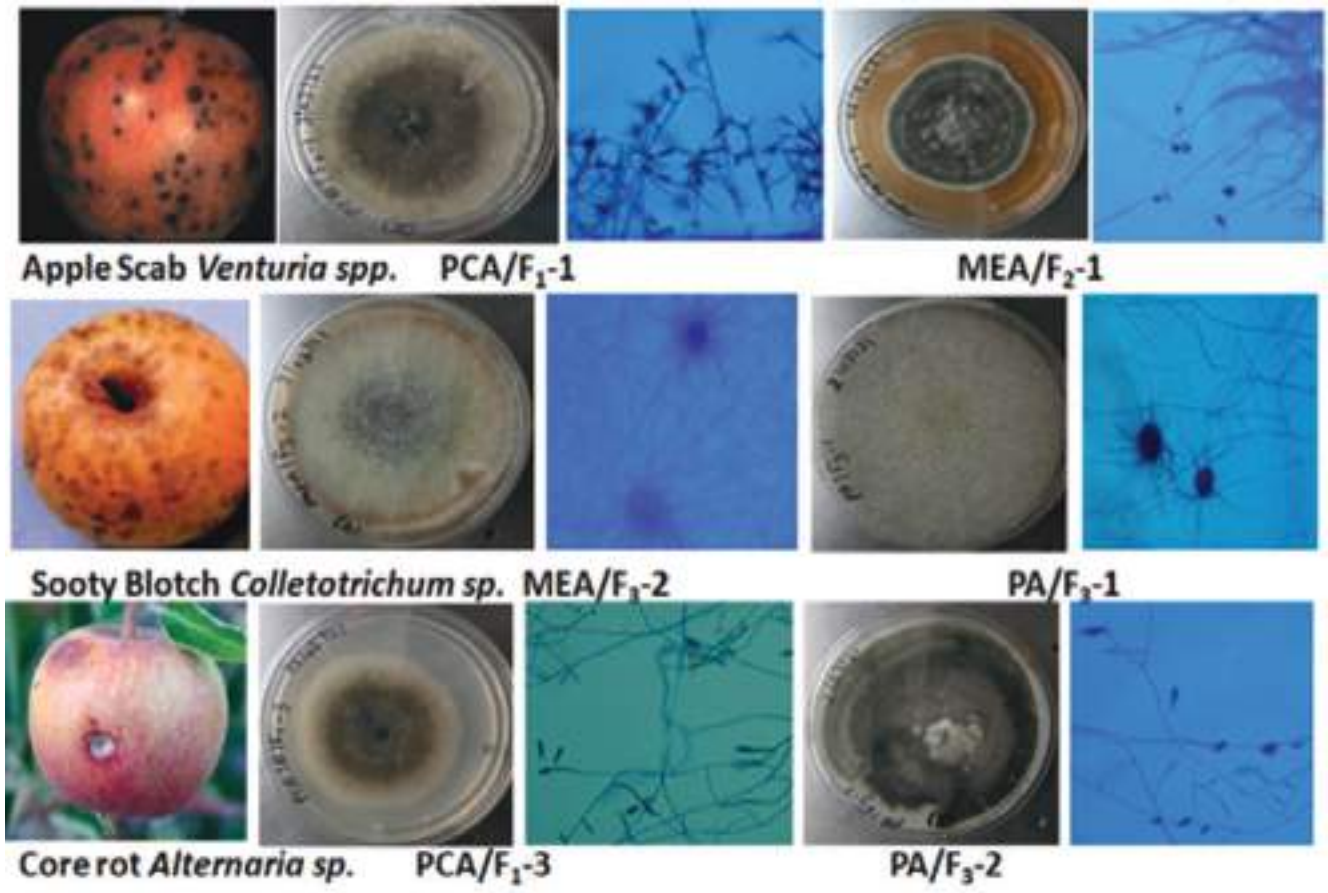
Launched in 2017, CSIR's Aroma Mission aims to increase the income of the farmers through cultivation of high value and high demand aromatic crops in non-agricultural land by about 45,000 to 60,000/ha/year. Under this mission, a new crop with high income generating potential was introduced in the phase II, Kaempferia galanga in 10 ha land. Major crops which were introduced in the phase I have been expanded to larger areas. CSIR-NEIST deployed 5 nos of improved and efficient distillation technologies / units at the a. Runne, Arunachal Pradesh, b. Oyun, Arunachal Pradesh, c. Leimekuri, Assam, d. Changlang, Arunachal Pradesh, e. Roing, Arunachal Pradesh.

An essential oil based formulation for postharvest storage of fruits: CSIR-Aroma Mission (Phase-II)

The diseased apples with the lesions were collected and pathogens were isolated on different media. The morphological identification of the pathogens was done. The dried aerial parts of M. citriodora (300 gm) were subjected to hydro-distillation for 4 hrs in Clevenger type apparatus. The distilled oil was dried over anhydrous Na2SO4. The oil sample was stored at 4°C until used for chemical analysis. GC and GC-MS analysis was performed by using Varian GC-4000 Gas Chromatograph, equipped with Flame Ionization Detector (FID). Identification of individual compounds was made by comparison of their mass spectra with those of the internal reference mass spectra library (Wiley/NIST) or with authentic compounds or with those of reported in literature database.

Formulation of Guidelines of CPCSEA for Reuse/Rehabilitation of Large Animals post experimentation and evaluation of Nano-based agri-input and food products in India

CSIR-IITR contributed to the formulation of Guidelines of CPCSEA for Reuse/Rehabilitation of Large Animals post experimentation and for Evaluation of Nano-based agri-input and food products in India. CSIR-IITR contributed to the Guidelines for Evaluation of Nano-based agri-input and food products in India released on 7th July 2020 by Dr Harsh Vardhan, Hon'ble Union Minister for Science & Technology, Earth Sciences, Government of India and CPCSEA released on October 2020. These guidelines would help policy makers and regulators to frame effective provisions for future novel nano-based products in the agriinput and food sectors of India. These guidelines would be useful to the



Isolation of pathogenic fungi from apples and their morphological characterization

researchers, manufacturers, importers and other stakeholders involved in research and development of these products. This is yet another step of CSIR-IITR towards enabling innovation and ensuring safer products to market for the benefit of masses and good laboratory practices leading to humane use of animals.

Development of bare-root seedling simulations system and automatic seedling transplanted for stevia

Development of an apparatus to perform the task of seedling Singulation for stevia seedlings at the nursery bed level during or after uprooting the seedlings at CSIR-CMERI. Lab scale prototype of stevia seedling manager and lab scale prototype of automatic transplanter for stevia has been developed. Development of method for seedling Singulation at nursery level and development of metering, feeding and transplanting mechanism for automatic transplanter has been performed. The method of Singulation can further be extended for other horticulture crops.

Development of protocols for drone data acquisition, processing and analyses for commercial aromatic crop of mountainous region

In a pioneer effort, protocols for drone data acquisition, processing and analyses for Rosa damascena (a commercial aromatic crop of mountainous region) were achieved at CSIR-IHBT. Led to automated plant counting, plant height calculation, and very high resolution land use mapping of Rosa damascena with just a brisk survey through drone. Manual counting of flowers was done in 5.94 hrs while the automated with the help of drone images took 30 minutes for 4363 m2 area and 2002 plants. Canopy temperature was estimated with 98.54 % accuracy. Height of each crop was estimated with 96.69 % accuracy.

Natural dye extraction, optimization and process development

There are many plants available in India which contain natural colour. Therefore, investigations are needed to assess the real potential and availability of natural dyes yielding resources for propagation of species and an economical process for separation of dyes for commercial exploitation. In view of this at CSIR-NEIST, membrane and adsorptive separation has been adopted as a techno economically attractive processes for dye extraction, optimization and process development. Although there are several methods for removal of dye from extracted solution of natural dye solution, the membrane and adsorptive technology has been chosen for the project work mainly because of the fact that membrane separation studies reveal that treatment cost of membrane based process can be expected to be 1/10th of that involved in the presently practised process. It has also been proposed to make membrane device using indigenous membrane for the project work. Three natural colors have been extracted from different plant species using green solvent. The colors are Deep Pink colour, Orange colour and Red colour. The process parameters have been established for extraction of these colors from plant species.

Dyes after membrane treatment

Developmental and Incubation activities for Agri Entrepreneurs for processing of millet herbs with the support of Kerala Government

Setting up of a fruit and Vegetable processing unit for the Horticorp, Kerala Government Valorization of spent materials from food

and Agri industries signed an NDA with M/s Tex Biosciences, Chennai through CSIR headquarter for Biomass hydrolyzing enzyme cocktail. Production process for Exopolysachharide from food grade lactic acid bacteria. Biomass valoarization for fuels and chemicals – 2G ethanol, amino acids, diols, sugar acids and alcohols etc. Identified novel nitrogen fixing rhizobacteria strain 3p from pokkali rice roots able to show promising plant growth abilities in rice plants. Based on complete polyphasic taxonomic studies, we classify this strain as a novel genus in the family Rhizobiaceae.

Theme 8: Chemical (including leather) and Petrochemicals (CLP)

Chemical (including Leather) and Petrochemicals is one of the eight Theme Directorates, created in 2018. Under the theme, CSIR has supported 13 FTT/FTC projects for implementation. These projects are being implemented by CSIR laboratories during 2020-22. The projects broadly in development of catalysts, Electrodes, leather processing, organic supplement, perfumery chemicals, spent wash management etc. Some of the activities under this theme are

Separation of high purity salts from crudes containing sodium chloride and sodium sulphate:

Rajasthan is third largest salt producing state in India, after Gujarat and Tamil Nadu, by contributing 10-12 % of total Indian salt production. Rajasthan has no seacoast, and therefore, solar salt production is exclusively dependent on sub-soil/lake brine in the area. Composition of brine of this region is typical and different with sea brine as it does not have much calcium and magnesium impurities but contains high level of sulphate impurities. The major impurities being sodium sulphate (in the form of Glauber salt, i.e. Na2SO4.10 H2O) which seems easy to remove by simple washing with fresh water to achieve good quality of salt. However, Rajasthan having hot climate, this Glauber salt turns to anhydrous Na2SO4, which has a less solubility, and is very difficult remove from salt just by washing. Thus higher percentage of sodium sulphate leads to low purity salt, and therefore, difficult to cop up with edible or industrial grade salt specifications. CSIR-CSMCRI has developed a novel, easy-to-apply and cost-effective method for separation of sodium sulphate with >98% purity and NaCl with >98.5% purity on dry weight basis based on solubility differences of mixed salts. The process involves multi-stage counter current washing of the reject salt in screw conveyors followed by cooling crystallization of washed liquor and then recycling of sodium sulphate deficient brine for next cycle of washing.

Separation of high purity salts from crudes

Chemicals for Low Temperature Applications of Leather in Strategic sector (CHILLS)

Development of chemicals/ combination materials employed in the preparation of leathers for gloves and the critical requirements when such leathers are turned into products to meet the low temperature conditions, in the -30 to -10°C range extendable to (-50°C). An indigenous

product made predominantly of leather finds applications in low temperature climates in the defence sector. Protective clothing used by defense personnel in areas such as Siachen and Doklam is one such application wherein the leather will be made to endure extreme weather conditions. Cold weather (-30 to -10°C) and extreme cold weather (-50 to -30°C) protective leather products like gloves/ garments/boots can be advantageous as they can minimize the heat loss of the body to the environment at the same time allowing the sweat to evaporate.

Preservation-cum-Unhairing (PCU)

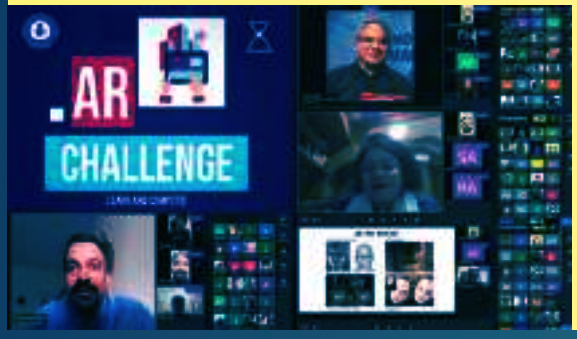
Use of salt in preservation generates large amount of contaminated salt and enormous total dissolved solids (TDS) in wastewater. Toxic sodium sulphide is employed for conventional unhairing of hides/skins. A single compound performing dual functions viz. preservation and unhairing at neutral pH and ambient conditions has been developed at CSIR-CLRI, which is a one step process for preservation and unhairing and completly elimination of salt from preservation process, reducing of TDS in wastewater. Treated skins/ hides can be stored for more than 30 days at ambient conditions without dehydration. Reduction in sulphide up to 70% is possible for complete removal of hair.

A process for the preparation of solvent-resistant-nanofiltration composite membranes and use thereof

A composite solvent resistant nanofiltration (SRNF) membrane is used for removing solvents from the extract of crude vegetable oil from oil-bearing materials, consequently for recovery and recycling of solvents in similar extraction processes. It not only rejects oil with an adequate process flux but also exhibits a longer life of 1-2 years with stable membrane performance.

6.0

Contribution To Government of India (GoI) Missions



6.0

Contribution To Government of India (GoI) Missions

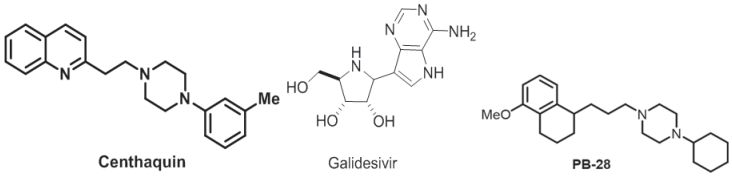
6.1 Contributions towards Swasth Bharat Mission

User friendly water filter

CSIR-AMPRI developed user friendly filter that works without electricity treatment of water. The filter can remove Chromium, Lead etc of the contaminated water. Nanoadsorbent used in filter for Arsenic or Fluoride removal is of low cost and can be synthesized in bulk without any waste generation. There are no mineral losses. The treated water follows the drinking water standard as per BIS.The technology has been transferred to M/s IBS Water Nano Purifier LLP, Bhopal, Madhya Pradesh.

Indigenized Process Technologies for Covid-19

Considering the pandemic situation due to Covid-19, our efforts have been focused towards providing solution through repurposing route that would be the fastest way to find a cure. Apart from the ongoing work on repurposing of Umifenovir, in the mission mode project from CSIR work has been performed on Niclosamide, Galidesivir, PB-28, and Centhaquine. For Centhaquin and Niclosamide, reaction conditions on 10g scale has been optimized.



Establishment of Covid-19 Testing Centre at Mysuru

Aligning with the CSIR's efforts to step up testing of Covid-19, CSIR-CFTRI established a Testing Centre at the premises of Govt. Ayurvedic HighTech Panchakarma Hospital, Mysuru. The centre was inaugurated on August 10, 2020. More than 3 lakh tests have been carried out at the centre. Establishment of the centre has also helped the neighbouring districts of Mysore.

Ready-to-eat food supplements

CSIR-CFTRI distributed large quantity of Ready-to-Eat (RTE) food products manufactured using CFTRI's technologies in association with government departments and NGOs during the lockdown period.The beneficiaries included migrant labourers, Covid warriors, State police force across cities such as Delhi, Bangalore, Mandya and Mysore. Almost 40 tonnes of food material were supplied which included High Protein Biscuits, High Protein Rusks, Fortified Mango & Fruit bars, Spirulina chikki and Flavoured water. The food was manufactured by CFTRI licensees as per the Institute's specifications and supply chain logic was provided by Government agencies such as Income Tax Department (Bengaluru), Indian Society of Agriculture Professionals (ISAP), New Delhi and Zila Panchayat (Mysore & Mandya) etc.

Successful installation of seven RO plants (1000-1500 LPH capacity) in 2020-21 in Ramanathapuram district, Tamil Nadu that

would serve roughly 8000-10000 people water needs. In addition, CSMCRI has successfully installed a water desalination and purification unit of 1000-1500 LPH capacity at Mota- Asota Village of Devbhoomi Dwarka district of Gujarat

Development and Pilot Implementation of Genetic Information Access and analysis system for genetic diseases.

Clinical outreach and implementation of genomic medicine in India. Established partnership with 05 commercial companies and over 280 clinicians/ researchers for translating genomics driven technologies for benefit of patients in India.

Development of cost effective process technology for Generic Drugs

A cost-effective and industry-friendly process has been developed for the synthesis of Tilorone dihydrochloride from commercially available cheap starting materials. To support urgent research to combat the ongoing outbreak of Covid-19.

Development of Clinical therapeutics under Ayush mode

CSIR-IIIM Jammu conducted the Phase I Clinical trial titled "A Phase- I, Dose-escalation study to evaluate the safety, tolerability and Pharmacokinetic of ICB014-A002, Herbal Capsule in healthy adult volunteers" in collaboration with one of the Indian CRO company at Apollo Hospitals, Ahmadabad, Gujarat. As per the current status of the study, it is informed that a complete Phase-I Clinical trial study was completed.

6.2 Contributions towards Swachh Bharat Mission

Upgradation and Augmentation of Sewage Treatment Plants

(a) MEPZ-SEZ, Chennai

(b) Old Aeration Tank

CSIR-NEERI has done Upgradation and Augmentation of 1.0 mld Sewage Treatment Plants (STP) to 3.5 mld at MEPZ-SE Chennai. This project mainly focuses on upgradation of 1.0 mld STP and implementation of additional 3.5 mld primary & tertiary treatment and 2.5 mld secondary treatment with the aim providing treated effluent quality for reuse in gardening/ irrigation purpose within MEPZ. The STP was upgraded for environmental compliance.

Commemoration of 150th Birth Anniversary of Mahatma Gandhi

The 150thBirth Anniversary Celebration of Mahatma Gandhi was held on 01.10.2020 (Online). Shri. K. Natarajan, Programme Director, All India Radio, Tiruchirappalli participated as Chief Guest and delivered the 150thGandhi Jayanthi Talk. 150 tree saplings have been planted near CECRI Gate at on 02.10.2020. CECRI staff (including research scholars, project assistants) participated in the occasion in large numbers.

A "Campus Clean" driven on the occasion of Gandhi Jayanti was carried out at CSIR-IIIM,

Jammu on **2nd October** 2020. All the staff members, led by the Director, IIIM actively took part in the drive.

Development of Design Guidelines and Specifications for Utilization of Steel Slag in Road Construction

Steel slag is one of the major solid wastes generated in an integrated steel plant. During production of one-ton processed steel around 400kg of steel slag is generated as solid waste. Processed Electric Arc Furnace (EAF) steel slag aggregate of Arcellor Mittal and Nippon Steel has been successfully utilized as 100 % substitute of natural aggregate in the constriction of 1.4 km long six lane divided carriageway of NH-03 connecting Hazira to Hazira port. Outcome of the work have been: Identification and comparative evaluation of prevailing steel slag aging technologies; Petrographic examination and mechanical characterization of steel slag aggregate forutilization in flexible and rigid pavement; Assessment of mechanical properties of bituminous, cement concrete and granular mixes having processed steel slag as aggregate;

.(a) Steel Slag Sub-grade

(b) Laying of Granular Sub-Base using Steel slag

(c) Laying of DBM using Steel

Development of road construction guidelines and State of Art Technologyfor Utilization of steel slag as substitute of natural aggregate in flexible and rigid pavement; Assessment of environmental benefits of uses of steel slag in road construction; Establishment of national level “Centre of Excellence” for steel slag utilization in road construction.

6.3 Contributions towards Sashakt Bharat Mission

Safe Road Connectivity for Tripura State of North East Region ofIndia

This study develops Safe Road Connectivity Index (SFCI), a systematic approach for prioritizing road connectivity and safety improvements. The study focuses on updating the existing criteria of connectivity needs. Apart from connecting habitations by road, the quantification of their level of access to educational and medical facilities is considered to strengthen the improvement strategies of government. GIS based database prepared for collected secondary data i.e. habitations, education, health centres, road network supported with census data and information collected through personal interviews of 5000+ households. Outcome: development of Self Sufficient Score (3S) for all habitations of Tripura state; development of Road Connectivity Index (RCI) for all the habitations of Tripura state;development of Safe Road Index (SRI) for all the roads of Tripura state; development of Safe Road Connectivity Index (SFCI), a systematic approach for prioritizing road connectivity and safety improvements based on score of RCI and SRI.

LED testing facility

CSIR-NPL is making tirelessly efforts through creation of ani-house apex level LED testing and calibration facility as per national/ international standards at CSIR-NPL. This would make CSIR-NPL self-reliant in sufficing need of traceability of LED based lightings. It also help in cutting influx of substandard LED products coming into market and thereby also reduce electronic waste.

Integrating Sphere

6.4 Contributions towards Make in India Mission

CSIR Innovation Centre for Next Generation Energy Storage Solutions

CSIR has launched a Mission Mode Project entitled “CSIR Innovation Centre for Next Generation Energy Storage Solutions (ICeNGESS)” and is being implemented at CSIR-CECRI, Chennai Center. CECRI's premier research in new generation battery systems like lithium-ion, sodium-ion, lithium sulphur and metal-air battery technologies, has taken a leap forward in its journey.

Solar Biodiesel Hybrid Minigrid of 50kW Peak Capacity

To provide power to remote places which are isolated like Andaman Nicobar Islands. It provides power to the residents as an alternative source of energy and is used as fuel to run Diesel Genset. It provides power to the residents as an alternative source of energy and is used as fuel to run Diesel Genset.To provide power to the residents of the CSIR-CMERI-CoEFM Colony, Guest Houses, Agricultural pumps and Street Lights.

Specifications:Peak Capacity: 50kWp & Solar PV Capacity: 48.35kWp, Diesel Genset Capacity: 50kW, 62.5kVA, Lead Acid Battery Bank: 48V, 2350 AH, Load: Residential Colony (37 Households), Guest House (10 Rooms), Agricultural pumps (10HP Submersible pump & 5 HP Monobloc Pump), Street Lights (~2.5kW).

Salient Features:Powered by 100% Renewable Energy sources viz. Solar Photovoltaics & Biodiesel; Designed for supplying wide spectrum of loads like Domestic loads (Fans, lights, ACs, Home appliances etc.), Street Lights, Agricultural pumps; Biodiesel generated from low cost feed stocks used as fuel to run Diesel Genset.

Development of Mobile Cold Mixer cum Paver (MCMP)

Remotely located hill sites provide only minimal space for plant set-up for production of road construction materials. To alleviate this problem, need of the hour is to develop a cold bituminous mixer cum paver for construction of pavement using bitumen emulsion based road construction technology. MCMP has been designed and developed to facilitate the onsite mixing and laying of bituminous material on a prepared granular/ old surface. Developed equipment contains storage units (aggregate, emulsion, water, filler and additive), mixing unit, spreader box and paving unit with PLC controller to proportionate the materials as per mix design and operation of mixing and paving system.

Development of Particle Board Material from Agricultural Waste (Rice Straw)

Rice husk composite particle boards have been developed at CSIR-NPL. The particle board material thus prepared were subjected to characterization for the different properties as per IS 3087:2005.In addition to rice husk burning problem the technology will be helpful in proper utilization of the waste for developing particle boards which can be used in designing furniture and structures

ZLD process for alginic acid

Alginic acid is produced from alginophytes by treatment with acids and alkali and the process produces huge amounts of alkali and acids solutions containing algal pigments and other organic molecules as effluents. The disposal of the effluent pose serious problem to the environment due to their very high BOD and COD content. CSIR-CSMCRI has developed a process for the production of alginic acid or its derivatives with zero liquid discharge.

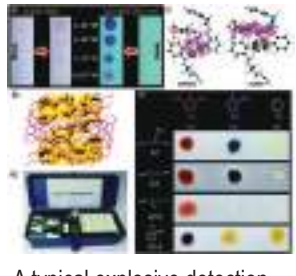
Indigenous process for edible oil

India, being an import-dependent country (~84% in 2018-19) for edible oil, a non-plant-based oil developed from inexpensive carbonaceous feedstock could be envisaged as an alternative source of edible oil to reduce the import duty. Yeast SCO has been envisioned as a plausible edible oil blend in this proposed concept. While yeast single cell oil has so far been envisaged as a potential feedstock for biofuels and oleochemicals; The project is to find its feasibility for use as edible oil.

National Repository of GMP cell line for Biopharmaceutical products (NRGCBIO)' was awarded to CSIR-IMTECH from NBM-BIRAC. India's first cell bank repository to support Biopharmasceutical (Vaccine & Biotherapeutics) development.The facility will facilitate the accessibility to the research organizations, start-ups, MSMEs, Industries and entrepreneurs with microbial cell banks and technologies used for development of Biopharmaceuticals.

Dual mode selective detection and differentiation of TNT from other nitroaromatic compounds

The TNT detection kit can be easily handled by both civilian and military officials to prevent TNT's illegal transport and is expected to reduce terrorist attacks globally.



A typical explosive detection kit for selective sensing of TNT

Indigenous process technology to produce Dimethyl Ether from methanol dehydration

Catalysis for Sustainable Development was undertaken to develop an indigenous process technology to produce Dimethyl Ether from methanol dehydration. It is ready for pilot plant demonstration at TRL 6-7 level. This process performs better than known commercial process at lab-scale level. The catalyst and process cost is economically comparable with the available procedures. Various applications of DME are being developed as it can be blended with LPG of up to 20%.

Coral Reef Monitoring Robot (C-Bot)

Coral reef monitoring is considered by most climate scientists as a reliable proxy indicator of climate change because corals are sensitive to small changes in temperature. Conventional diver approach involves high cost and strenuous human effort to survey the coral reef area. Coral Reef Monitoring Robot (C-Bot) being developed at the CSIR-NIO shall address the challenge of large area coral reef bed monitoring.

C-BOT tested for depth and altitude control in swimming pool

6.5 Contribution towards Namami Gange Mission

Inspection of Grossly Polluting Industries (GPIs) in Ganga river basin

CSIR-CLRI has been working on inspection of 150 tanneries in Jajmau, Kanpur region under the project "Inspection of Grossly Polluting Industries (GPIs) in Ganga river basin" awarded by Central Pollution Control Board (CPCB).

Work on National Mission for Clean Ganga

CSIR-CIMAP has worked on National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, Govt. of India along with CSIR-NEERI. Under the sanctioned project, CSIR-CIMAP surveyed and identified the distribution of the prominent medicinal and aromatic plants (MAPs) in the upper catchment of Ganga to find possible leaching of phytochemicals in Ganga water. Under this study, total of 78 medicinal plant species belonging to 46 families and 69 genus were recorded in the upper Ganga Catchment from Gangotri and Alaknanda river to Ganga at Haridwar, Harki Pedi. Plants belonging to Asteraceae and Lamiaceae family were found in majority. Thirty (30) species were reported to be used in classical traditional system of medicines for the management of various ailment. CSIR-

CIMAP has also carried out two studies under National Mission for Clean Ganga (NMCG). Under these studies, it was observed that the plantation not only helped in protection, eco-restoration and conservation of the natural landscapes around river Ganga basin but also provided livelihood and income enhancement of the farmer community in the vicinity.The work has enabled river basin people through Development of MAPs Corridor by Multiplication of Quality Planting/ Seed Materials, Cultivation, Processing, Value Addition and Marketing.

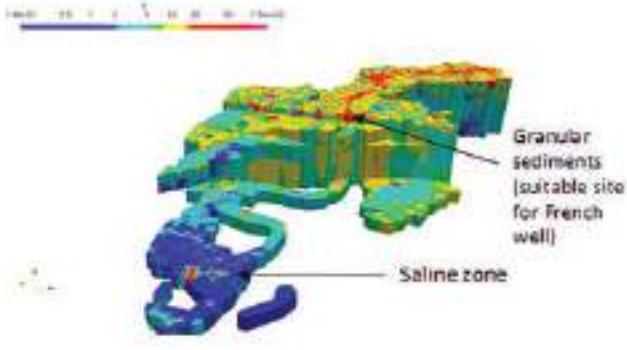
Ganga Aamantran Rafting Expedition

During the year, team CSIR-IITR took prominent actions in Ganga Aamantran, the river rafting expedition from Devprayag to Ganga Sagar. Local ecosystem of the tributaries of river Ganga found to be rejuvenating due to participation of state and central missions. Various drains and sewages are treated. With public awareness has resulted in improved water quality and biodiversity.

Ganga expedition and interaction with public and students at Devprayag and Haridwar

AEM survey for aquifer mapping

The AEM survey employing multi-moment SkyTEM312 have been carried out at Ganga-Yamuna Doab, at Prayagraj for aquifer mapping with special reference to paleochannels which resulted in mapping of a prominent resistive buried feature between Ganga and Yamuna river.



6.6 Contribution towards Startup India Mission

Launch of Food Business Accelerator

CSIR-CFTRI launched "Food Business Accelerator" on August 31, 2020 to augment the existing startup Innovation System with a total of 20 startups accomodated in the Campus. The Centre will provide opportunities for prospective entrepreneurs and startups to be part of the Accelerator Facility for a period up to 1 year or so. These companies can explore the avenues for product development, Scale-up operations, packaging and shelf-life studies for commercialising their products. Expert mentoring sessions also will be available for sharpening the technical and business skills in fulfilling the tasks effortlessly. One of the companies, Athletebit Healthcare Pvt Ltd has already comeout with natural sports beverage which is marketed across various national and international bodies.

Protective Biker Jackets prototypes

Design package on Protective Biker Jackets, the prototypes have been developed for M/s Wiserby the Mile, a start-up company.

Establishment of Innovation and Incubation Ecosystem

CSIR-IITRisestablishedDSIR-CRTDHsupported Environmental Monitoring & Intervention Hub and BIRAC-BioNEST supported Centre for Innovation and Translational Research for promoting startups. CSIR-IITR is serving the startups, entrepreneurs and industries on developing new technological innovation backed by science and research and providing services.

6.7 Contribution towards Skill India Mission

CSIR Skill Initiative: 31,490 trainees trained in 327 no. of programmes.

CSIR's Integrated Skill Initiative programme is to enable and empower a large number of Indian youths to take up the industry-relevant skill training that will help them in skilling in their interesting

field to earn their better livelihood.Various skill development training programme were conducted through online mode such as Operation & maintenance of analytical instruments, Lithium ion battery science &technology etc., No. of Participants: 665

CEERI conducted Online Workshop during 'AR Challenge Learn n Compete' for skilling the youth to prepare the manpower for such upcoming technological requirements.

Farmer's Training on Food Processing under 'PM FME' (PM Formalisation of Micro food processing Enterprises)Scheme in association with Dept. of Agriculture, Govt. of Karnataka and KAPPEC was launched on January 19, 2021 by Shri. B.C. Patil, Hon'ble Minister of Agriculture, Govt. of Karnataka. Under this scheme, training programmes were conducted aligning with One District One Product (ODOP) which included Fruits and Vegetables Processing; Plantation Products; Bakery Products & Confectionery; Millet Processing; Processing of Millets & Pulses; Processing of Meat & Marine Products; Processing of Oil seeds. A total of 321 Farmers/ FPO entrepreneurs across the state were trained.

Technical training in Leather Goods Manufacture

Technical training (Skill Development Programme) in Leather Goods Manufacture imparted to 20 personnelfrom KH Exports India Private Limited, Chennai at the premises of KH Exports as KH Management Trainee (KHMT)programme for a total period of 18

months.It was a combination of theoretical and practical lecture sessions where each session was structured for 2.5 hours per day for 4 days a week.To train the students to join in R&D in research laboratories with advanced training in high-end instruments, CSIR-IICB initiated a special skill development program on RT-PCR and trained significant number of people. Nearly 100 people were trained in various skill development programs.

CSIR-SRTP-2020 Training Programme: CSIR-IIIM has participated in the online CSIR-Summer Research Training Programme-2020 training program organised by CSIR-NEIST from June 2020 to August 2020. 86 candidates were provided with online summer research training in our areas of Biological and Chemical Sciences from CSIR-IIIM. Training certificates were issued to the trainees who had submitted their training report from the PME Division.

Online Training Programme on Computer-Aided Drug Designing (CADD) Training: Two months online training from Discovery Informatics Division of the Institute has been provided on Computer-Aided Drug Designing (CADD). The highlights of the training have been: Sequence Analysis; Phylogenetic Analysis; Structure Analysis and Validation etc.

Specialized and highly skilled workforce for life sciences industries

CSIR-IMTech has been organizing workshops/webinars/training programs under CSIR Integrated Skill Initiative. Conducted 7 webinars and one hands on training program, One Dissertation/ Internship Training Program and One CSIR-SRTP-2020.

STINER Project

A group of women from one Self-Help Group (SHG), 'Prerana' were invited on 18 May, 2020 to brief them about NEIST Technologies. Further, they were given hands on training on preparing decorative and mosquito repellent candle during 20 May, 2020 to 2nd June 2020.

"Prerna" SHG Women under traning at CSIR-NEIST

Livelihood improvement of fishermen

CSIR-NIO imparted skill training to 15 local fishermen through Tech-Demo of Green Mussel Culture. The initiative resulted in sustainable improvement in the income of local fishermen.

Hands-on Training to local Fishermen of Goa

6.8 Contribution towards Digital India Mission

Digital resources for high schoolers for CSIR's Virtual Lab and DST-funded Milo CCMB projects. Outcome: zines, comics, game.

Food Processing Machineries Portal

The portal has been initiated and CSIR-

CFTRI is trying to reach all the machinery manufacturers across the country to create a repository of diverse machinery into the database. CSIR-CFTRI would like to play an enabler role in empowering emerging startups and entrepreneurs in this sector. This would supplement our clientbase along with the other existing digital platforms such as SMECorner, FreeTech Portal, Micro-entrepreneurs network etc.

RAPID-CT

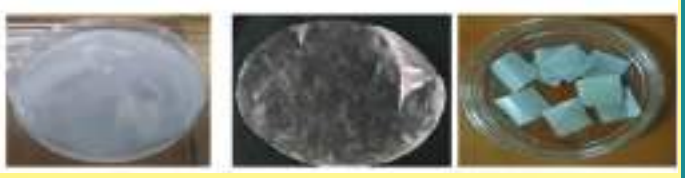
Radiological AI system for Parallel Informatic Detection of Clinical Triage emergencies Created platform for detection of Intracranial Haemorrhages (ICH) on CT scans. RAPID-CT in future would be improvised for early detection of microbleed detection in CT scans.

Tower Testing & Research Station

The Tower Testing & Research Station (TTRS) of CSIR-SERC is one of the major testing facilities for testing prototype towers of different types. It contributes to the development of more reliable and economical towers for power sector and telecom sector. Full-scale testing of prototype towers is mandatory since it is used in large numbers involving huge quantity of steel and its failure in site can lead to outage of power and will have huge impact on national economy. Testing of TL towers conducted by our team helps to provide uninterrupted power supply to the industry and to the domestic consumers. TL Towers are tested for Rwanda, Ghana, Nepal, Chile, Tanzania. The towers are optimized by testing and thereby reduce the steel consumption which helps in reducing the carbon foot print. Suggestions are given to the clients to improve their designs prior to testing and also the probable causes of failure are analysed in case of premature failure and strengthening measures are suggested.

7.0

Important Technological Contributions Against Sustainable Development Goals (SDGs)



7.0

Important Technological Contributions Against Sustainable Development Goals (SDGs)

Many CSIR technologies and research activities carried out under different Themes have been aligned with the UN Sustainable Development Goals (SDGs):

Transfer of technologies for Agrobased products (Goal: No Poverty): Various Agro and processing technologies for indigenous production of heeng, saffron, wild marigold, monk fruit and other agro based products have been transferred to the local farmers in different states in the country that has helped making their living and also enhanced the quality of life. CSIR-IHBT has standardized the technology for production of disease free quality corms through tissue culture and also the agrotechnology for introduction of saffron in non-traditional areas of Himachal Pradesh and Uttarakhand. The institute has developed the basic agrotechnology for fruiting of monk fruit (siraitia grosvenorii) in Palampur .

Rice puffed bars (Goal: Zero hunger): These are ready to eat sweet snack. It is crisp and sweet in taste and can be consumed by all sections of population. It is different from the traditional product that is available in the country, not only in shape but unique in texture as well.

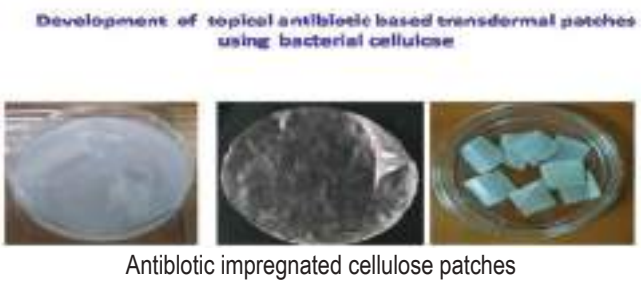
Spirulina bars(Goal: Zero hunger): These are 100% natural, preservative free up to 2g spirulina per serving, 25% RDA levels of iron and zinc per serving (25 g). and Beta-carotene content – 122 µg/serving (25g)

Millets and oats bar (Goal: Zero hunger): These are 100% natural, preservative free, multi grain- rich in millets and pulses, natural fruit and honey based, 4 to 5 g protein/ serving, 3 g complex dietary fiber per serving less than 6 g sugar/ serving

Tea vinegar (Goal: Good Health and Well-being): Each ml of Tea vinegar contains 350-500 µg of trolox equivalent antioxidants, contains no added chemicals and preservative sand shelf preserving herbal health product.

Food and Consumer Safety Solutions (Goal: Good Health and Well-being): CSIR-IITR playing a key role in food safety domain, led the Food and Consumer Safety Solutions (FOCUS) CSIR-mission mode project on delivering technologies for food safety and preventing post-harvest losses. As part of Global Disease Burden programme elucidated health data on diseases burden and institute provided inputs for policy outcomes to nanotechnologies for food and agriculture.

Development of Trans-dermal patches using bacterial cellulose (Goal: Good Health and Well-being): Production of bacterial cellulose membranes to develop trans dermal patches for pain management. The technology transfer agreement has been signed with M/S Hemp Street Medicare Private Limited, Delhi on 16th Day of November 2020.



Antiblotic impregnated cellulose patches

Rapid Diagnostic Kit for Detection of Kala- azar (Goal: Good Health and Well-being): Dipstick transformed into colloidal Gold based Lateral Flow Technology for field Adaptable, Easy and non-invasive diagnosis of kala-azar. Result can be seen by naked eyes in two minutes without the use of any sophisticated instruments.

Biomarker for Rheumatic Heart Disease (RHD)(Goal: Good Health and Well-being): It is a protein based biomarker detected in serum and urine, the test kit would help measurement of clinical activity in quiescent rheumatic heart disease, post penicillin treatment and overall management of the disease.

Convenience flour from ragi suitable for stiff porridge (Mudde) (Goal: Good Health and Well-being): CSIR-CFTRI has standardized the technology and general methods for processing of convenience flour from ragi suitable for stiff porridge (Mudde). Apart from this procedure for quality control, packaging and packaging material specifications, equipment details are also provided by the institute.

Low glycemic index noodles (Goal: Good Health and Well-being): Noodles are considered to be high glycemic foods because of its high release of sugars during digestion and absorption. Incorporation of low glycemic index ingredients to these noodles will lower the glycemic response. The developed Low GI noodles formulation could be used for normal and diabetic. The Low GI noodles have increased fiber content by 3-4% compared to normal noodles. It can be consumed along with tastemaker as a main course.

Development of a biodegradable and biocompatible nano ceramics/ bioactive glass-polymer composite material with antibacterial properties for use in female sanitary hygiene products (Goal: Good Health and Well-being): Reproductive Tract Infections (RTI) and Urinary Tract Infections (UTI) are a major concern in public health. Occurrences of these infections are found to be strongly correlated to menstrual hygiene management. Access to proper hygiene products with requisite antibacterial properties is still inadequate in the lower socio-economic population of the country. Moreover, the sanitary products available commercially are non-biodegradable, causing a serious environmental hazard. CSIR-CGCRI has initiated activities to synthesize a cost-

effective, biodegradable, biocompatible composite material with antibacterial properties that can be used in sanitary products to reduce the incidence of RTIs and UTIs in women.

Membrane Filter for purification of drinking water (Goal: Clean Water and Sanitation): CSIR-AMPRI developed user friendly filter that works without electricity treatment of water. The filter can remove chromium, lead etc of the contaminated water. Nanoadsorbent used in filter for arsenic or fluoride removal is of low cost and can be synthesized in bulk without any waste generation. There is no mineral loss. The treated water follows the drinking water standard as per BIS. The technology has been transferred to M/s IBS Water Nano Purifier LLP, Bhopal, Madhya Pradesh.

High Flow Rate Fluoride & Iron Removal Plant (Goal: Clean Water and Sanitation): Water in nearly 140 districts of India is affected with fluoride contamination. Excess fluoride exposure may come from public water fluoridation, high concentrations of fluoride in natural fresh water, untested bottled water causing dental, skeletal fluorosis. System developed by CSIR-CMERI provides Fluoride free water for the benefit of the masses in the country like UP, Assam and Jharkhand. An integrated adsorbent based water purification system for effective removal of fluoride as well as iron in an efficient manner from contaminated water bodies.is an initiative towards solving dual contaminants problem in ground water (F- as well as Fe3+). The system has three stage purification process to purify water as per WHO limit (1.5 ppm for fluoride and 0.3 ppm for iron) and has high flow rate (10,000 litres/h) integrated purification system. The technology has been transferred to 4 MSMEs.

Water Calibration and standardization program (Goal: Clean Water and Sanitation): Clean and better water quality is essential for human and marine life. CSIR-NPL Water Calibration and standardization program aims to provide expertise at measuring water quality, its parameters and certifying them and also working on related reference Materials.

ONEER and Terafil(Goal: Clean Water and Sanitation): CSIR-IITR is contributing in the SDG through the development of Oneer – Solution for safe drinking water, technologies for water quality assessment and disinfection, clean water technology development and deployment. CSIR-IMMT developed a highly cost effective and sustainable water purification technology Terafil with clay media (disc/candle) for efficient treatment and filtration of turbid and high iron containing drinking water. This has been a huge success for domestic and community usage.

Restoration of Nallah with Ecological Units (RENEU) (Goal: Clean Water and Sanitation): RENEU technology promotes the enhanced the natural attenuation of In-Situ wastewater treatment and facilitates low-cost treatment. This system treats the pollute water as it flows down the nallahs thereby ensuring that the pollution load does not reach the river. The developed treatment uses engineered design to enhance the natural bioremediation processes wherein microbes and plants lead to biodegradation of organics and nutrient uptake respectively, cleaning the wastewater as it flows through the nallahs.

Onsite wastewater treatment and resource recovery (Goal: Clean Water and Sanitation): The NOWA is a modular type, onsite treatment system for recovering reuse quality water and biogas from organic rich wastewater. The major highlights of the system include compact size, recovery of water and biogas, capable of treating high strength wastewater, no secondary sludge production, low CAPEX and OPEX. The unit successfully integrates anaerobic and aerobic microbial process with specially developed microbial system. The unit is installed in field (up to 10 KLD).

Evaluation of Materials and Energy Application (Goal: Affordable and Clean Energy): CSIR-NML has been working for the evaluation of Materials for Advanced

Ultra-Super Critical Power Plants; Pilot scale development of amorphous electrical steel for energy applications and Energy Efficient Coke-based Brass and Bell metal melting Furnace.

Kappaphycus alvarezii elite seedling production through mircopropagation of tissue culture plants and supplied to the seaweed farmers for sustainable cultivation (Goal: Decent Work and Economic Growth): Kappaphycus alvarezii commercial cultivation was initiated in 2001 along the southeast coast of Tamil Nadu. However, the production achieved till June 2019 was only 181 dry wt. Only few hundred farmers are involving in K.alvarezii cultivation. There was huge demand for seed material for continuing the cultivation. To make K. alvarezii a sustainable cultivation, CSIR-CSMCRI has produced elite seedlings of K. alvarezii through micropropagation of tissue cultured plants and supplied the seedlings to the seaweed cultivators. So far 6800 elite seedlings were produced and supplied to the farmers. Elite seedlings showed 20% higher growth as compared to the conventional farm plants and the farmers earning 20% more money. Honourable Union Minister for Fisheries, Animal Husbandry and Diary Shri. Giriraj Singh distributed the elite seedlings to the farmers at Mandapam coast on 23.01.2021.

Ramming mass composition for induction furnace (Goal: Industry, Innovation and Infrastructure): The steel production capacity of our country is continuously increasing and as per the National Steel Policy-2017, the targeted installed capacity is 300 million ton in the year 2030. Presently, acidic ramming mass is used as lining material for induction furnace, which is not suitable to carry out the refining reactions particularly removal of sulphur and phosphorous. The aim has been to develop a suitable ramming mass composition for induction furnace lining under which slag can be suitably conditioned for effective sulphur and phosphorous removal from steel. Magnesia based basic ramming mass was developed for induction furnace lining, which will enable refining of steel in induction furnace. Revalidation of the prepared ramming mass was completed in 40 kg laboratory induction furnace and achieved 24 heats without any repairing of furnace lining. It is now ready for industrial trial in 8-ton induction furnace.

Indian Foot Sizing System (Goal: Industry, Innovation and Infrastructure): Design of footwear is a complex, multidisciplinary task spanning many fields of Science and Engineering. Comfort of a shoe

and proper foot health is ensured by a proper footwear size. In the absence of a 'Footwear Sizing System' in India, it is imperative that an 'Indian Footwear Sizing system' be developed based on the Foot Dimensions of the Indian feet. Department for Promotion of Industry & Internal Trade (DPIIT), Ministry of Commerce and Industry has sanctioned the project proposal from CSIR-CLRI for Revision of Standards on Indian Footwear Sizing worth of Rs.10.79 crores and has released 50% to CSIR-CRLI as first instalment during October 2020 towards project execution. CSIR-CLRI under the aegis of DPIIT, would conduct a nationwide survey for reliable data on foot dimensions of the Indian population using 3D Digital Imaging technique to establish the Indian Footwear Sizing System. CSIR-CLRI would capture the foot data pan India, statistically analyse the data and evolve the 'Footwear Sizing System' for the Indian feet.

Preparation of Tissue Equivalent Liquids as per IEEE-1528 for SAR compliance Testing (Goal: Industry, Innovation and Infrastructure): Technology transferred along with know-how document containing description of the process developed at CSIR-NPL for the preparation of Tissue Equivalent Liquids as per IEEE-1528 for SAR compliance Testing. The standard document, IEEE-1528, specifies properties of human body tissues and their equivalent materials to be used for SAR assessment and testing. The TELs are composed of specific ratios of selected chemicals and salts, to ensure dielectric properties i.e. dielectric constant (ε'r) and electrical conductivity (σ) equivalent to human body tissues at their respective frequencies.

Mechanized Drain Cleaning System (Goal: Industry, Innovation and Infrastructure): The system reduces the drudgeries encountered by the manual scavengers. Cleaning of drains is done scientifically. The city authority/ municipality/ corporation need a mechanized system to clean the sewerage system on regular basis to avoid water logging in the country during rainy season. Salient Features of the system are extraction of slurry extractor from the manhole opening, high pressure water jet based chockage clearing system, floating material separation system from sewerage water, cleaning system of sewerage water for re-use in the pressure jet, remotely operated vehicle system for visual inspection of the sewage pipes, arrangement for telescopic boom based grab bucket for clearing sludge from the manhole, vehicle mounted Modular Mechanized Sewage Cleaning System.

Pre-fabricated Steel-Foam Concrete Composite (SFCC) Building Components for Seismic Resistant Buildings (Goal: Industry, Innovation and Infrastructure): Severe damages experienced during the past earthquakes across the world has raised questions about the seismic safety of buildings and houses that endangers the safety of people. CSIR-SERC has developed

the Pre-fabricated Steel-Foam Concrete Composite (SFCC) Building Components for Seismic Resistant Buildings technology for constructing prefabricated, seismic-resistant, low-rise, load-bearing buildings by employing light-weight Steel-Foam Concrete Composite (SFCC) wall, floor elements and the novel connections. Thin profiled cold-formed steel sheets act as the skins on both the sides are connected by using mild steel connectors and the gap between is filled with cellular foam concrete of density 1200 kg/m3. The integration of both lightweight materials in SFCC elements results in reduction of dead weight by 40% than the conventional elements. Experimental studies have been conducted to examine the behaviour of proposed SFCC panel under axial compression, flexural and in-plane lateral loads. For the first time, simple prefabricated connections are developed to join SFCC elements and are verified experimentally.

Development of integrated pilot plant for recycling of metals (non-ferrous, precious, rare and rare earths) from E-waste (Goal: Responsible Consumption and Production): The technology performs E-Waste Management including product, process, technology, S&T service, and S&T intervention. Recovery of gold from printed circuit boards of mobile phones, medical and telecommunication equipment as well as from the surface of connectors, small electronic devices. Recovery of valuable metals from black cathodic

powder of scrap batteries used in electronic devices. Precious metals (Au, Ag, Pt & Pd) recovery from integrated circuits found in printed circuit boards of computers. Recovery of lead, tin, copper and epoxy resin from the various depopulated PCBs using organic swelling and advance separation techniques. Recovery of rare earth metals from the phosphor powder of fluorescent lamp. Setting up of National Test Facility for Restriction of Hazardous Substances (RoHS).

Application of Cold Bituminous Based Eco-friendly Road Building Technology for the Special Featured Himalayan Regions (Goal: Climate Action): Design and technical specification for low cost compact portable cold bituminous mix plant with paver has been finalized. The machine has been fabricated and demonstrated within the CSIR-CRRI campus. Construction of road using emulsion based cold mix technology using mobile cold mixer cum paver fabricated unit is to be conducted at Uttarakhand, with collaboration of the execution partner, URRDA.

8.0
High Impact Technologies Licensed/ Commercialized

8.0

High Impact Technologies Licensed/ Commercialized

Nanoadsorbent-Nano biocides based membrane filter for removal of arsenic, fluoride, micro-organisms etc in drinking water

Long term drinking of water containing excessive fluoride(>1.5 mg/l) cause fluorosis problems to human. Similarly drinking of excessive arsenic (> 10 µg/l) contaminated water causes arsenicosis problem. CSIR-AMPRI, developed filter is user friendly, works under gravity and no electricity required. The developed filter can also remove toxic contaminants like chromium, lead etc of the contaminated water. Nanoadsorbent used in filter for arsenic or fluoride removal, is of low cost and can be synthesized in bulk without any waste generation.There is no mineral losses. The treated water follows the drinking water standard as per BIS. The technology transferred to M/s IBS WaterNano Purifier LLP, Bhopal on 01/01/2021.

One step direct RT-PCR testing- Dry Swab based Covid-19 Diagnostics

A RNA extraction-free dry swab method for RTPCR based detection of SARS-CoV-2 has been developed by CSIR-CCMB, Hyderabad. This method does not require use of viral transfer medium (VTM) and also does not require RNA extraction step as compared to standard PCR test and, therefore, saves cost, time and, very importantly, is much safer for the healthcare workers involved in COVID testing. This method involves collection of a VTM less dry oropharyngeal / nasopharyngeal swab from suspect SARS-COV-2 patients. The swab is then transported to the lab wherein Tris-EDTA- Proteinase K buffer is added, and the sample is incubated for 30 minutes at room temperature. The sample is then subjected to heat inactivation at 98°C for 6 minutes. The extract is then used for RT-PCR. The technology has been transferred to Meril Diagnostics Ltd.; Apollo Hospitals and Spice Health.

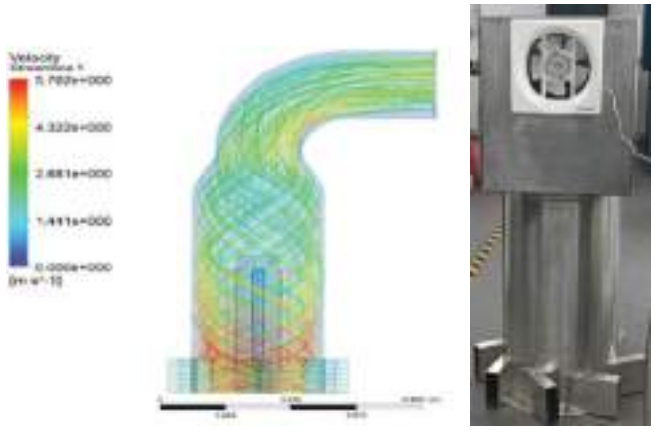
Production of indigenous qRT-PCR (INDI-FluorAMP) kit for testing Covid-19 with Make-in-India ingredients

CSIR-CDRI transferred the technology to Biotech Desk Pvt. Ltd. (BDPL), Hyderabad during February 11-15, 2021, for developing a testing kit for Covid-19 to test RT-PCR in PPP mode to make India self-reliant in serological testing for corona virus.

Transfer of technology to M/S Biotech Desk Pvt. Ltd., Hyderabad.

Air Disinfection & Purification System for Indoor Applications

Prevention of indoor transmission of SARS-CoV-2 virus in specific and prevention of transmission of diseases through air due to micro-organisms in indoors in general and also supply purified air for indoor spaces. CSIR-CBRI transferred the technology to PARAS Defense & Space Technologies Ltd.



Air disinfection and purification system for indoor application

Process for the preparation of Umifenovir

CSIR-CDRI transferred the technology to Medizest during April 27-29, 2020. The transferred technology of KNOW-HOW process of an antiviral drug Umifenovir may be the possible drug for the treatment of Covid-19.

License Agreement signed between CSIR-CDRI and M/s Medizest Pharmaceuticals Pvt. Ltd. Goa for Umifenovir

High-Power S-band, 2.6 MW, Magnetron

Magnetron, a high-powered vacuum tube, is an essential component for Medical LINAC (Lineal accelerator), which are widely used for external radiation treatment of cancer patients. CSIR-CEERI recently designed and developed 2.6 MW S-band tunable pulsed Magnetron, which was successfully tested and used as a microwave source, to generate the required X-ray dose using a LINAC system for Cancer treatment. On July 14, 2020 the technology know-how for S-band Magneton was transferred to M/s Panacea Pvt. Ltd., Bangalore, known for developing advanced radiotherapy systems for Cancer treatment.

Ozone Based Disinfection System

Ozone-based air disinfection system developed by CSIR-CFTRI is validated in actual closed un-occupied chambers (canteen, washroom, office and instrumentation room). Hence it can be used for air disinfection in hospital and non-hospital settings like offices,schools, restaurants, hotels and transport sector. It is also validated in closed chamber in BSL-II facility with 5 indicative microbes. Since the process is water and chemical residue-free, it is environment friendly. The technology has been transferred to Faraday Ozone Products Ltd., Coimbatore and Omniscient Treatment Technologies Pvt. Ltd., Nagpur.

Utilization of offered flowers for making incense sticks and fragrant cones

Floral offerings from the places of worship such as temples, dargah, etc. pose the problems to for hygiene and environment. Tonnes of floral wastes are either disposed off recklessly in rivers Ganga, ponds, fields or left to decompose in open, especially in and around the places of worship, where devotees offer floral reverence to Gods and deities. Such floral wastes and other biomass can be utilized to obtain useful products and

to provide employment to local people. It will also strengthen the "Swachh Bharat Mission" "National Mission for Ganga Cleaning" around temples and the places of worship and also in Ghats of Ganga/river. After development of this technologies, training-cum-demonstration programmes was conducted in rural areas to provide employment to the women and unemployed youth in their areas. It will also stop the rural migration and stop the flower decomposition in the holy rivers. After training to the women, they can make 3-4 kg incense sticks in their leisure time and earn Rs. 300 to 500 per day by available local resources. Till date, we have trained more than 5000 women and most of them are making incense sticks and marketing in areas/places of worship.

Biometric-based exploder

The exploders available in the market are found unsafe when it is stolen and misused by the unauthorised person. To avoid misuse, a biometric-based exploder has been developed. It can only be operated by those peoples who are biometrically registered with the specific device. The device comprises of an embedded microcontroller, converter circuit, rectification circuit, safe discharge circuit, authentication circuit and display unit. The fingerprint scanner with the help of embedded micro-controller registers the authorized personnel using their fingerprint upto 20 numbers. Once registered, no other person can use these devices. The exploder have been developed both for underground and opencast mines. The CSIR-CIMFR's Biometric-based exploder has been transferred to M/s Pranay Enterprises, Hyderabad.

Waterless Chrome Tanning Process

The technology relates to avoiding the use of water during chrome tanning process. Fatliquors are used to enhance the exhaustion of chromium during tanning process. Moreover, the (use of salt) pickling and the basification processes are avoided in the new process.

CSIR-CLRI licensed Waterless chrome tanning technology to 26 tanneries during 2020-21, including M/s Ahmad International, Kanpur, M/s Indian Tanning Industries, Kanpur and M/s Superhouse Limited, Kanpur, Uttar Pardesh.

Oxygen Enrichment Unit (5-10 LPM)

In the recent Covid-19 pandemic, there is a huge deficit of Oxygen Cylinder throughout the country. The unit is extremely useful for the Covid-19 patients in hospitals and for patients with chronic obstructive pulmonary diseases (COPD), chronic hypoxemia and pulmonary edema.It may be used as an adjunct treatment for severe sleep apnea (in conjunction with a continuous positive airway pressure unit). CSIR-CMERI transferred the technology to M/s Zen Medical Technologies Private Limited Telangana.

UV Sterilized Integrated Municipal Solid Waste Disposal System(Modular forms)

Eco-friendly disposal of plastic waste through electric ionization utilizing high temperature plasma with zero level toxin emission. Integrated & mechanized segregation system for bio-degradable & non-biodegradable waste. Large volume reduction, slag is 1/10th of the volume of processed solid waste. Utilization of by-product Pyrolysis oil as fuel in engine for energy harvesting and Syngas for generation of electricity.Generation of biogas from organic waste and utilization for house hold cooking purpose and to run gas engine for power generation. Utilization of Manure in agricultural and horticultural work. Conversion of agro waste into briquette and utilization as fuel. Recycling & re-use of construction & demolition waste for construction work. The technology has been transferred by CSIR-CMERI to M/s Sainath Enviro Tech, Tuticorin, Tamilnadu.

Macrosurfacing Technology "Thin Surfacing for Cement Concrete Pavement"

The technology is meant for cost effective maintenance and rehabilitation of cement concrete pavement to improve riding quality of worn out cement concrete road surfaces. Technology offers a cost effective bituminous thin surfacing on cement concrete road as preventive and periodic renewal treatment. CSIR-CRRI has transferred the technology to JMVD Industries, Luknow, U.P.

Tersurfacing: Micro-surfacing Technology with Industrial Waste Materials, i.e. steel slag, fly ash and marble dust

Technology facilitate the utilization of industrial waste materials i.e fly ash, marble dust and steel slag as thin preventive and periodic treatment of bituminous pavements. It facilitate industrial waste utilization and minimizes the requirement of natural aggregate and has been transferred to Verma Industries, New Delhi by CSIR-CRRI.

UV Based Disinfection Systems

CSIR-CSIO has developed and engineered Induct UV-C disinfectant system for HVAC ducts which has wide applications for disinfecting mechanically ventilated indoor spaces with a view to prevent the spread of Covid-19 like viruses, fungi, mold, bacteria etc. The retrofit UV-C system is designed to fit into any existing air-ducts / AHU with very minimal modifications. The virucidal dosages using UVC intensity and residence time have been optimized according to the existing spaces after considering the necessary air flow rates, shape and size of the air duct. The virus is deactivated in any aerosol particles or freely floating virus/bacteria in air and at the surfaces of the air ducts by the calibrated levels of UVC light. The technology has been transferred to M/s DICCI Sahayog Enterprises Pvt. Ltd., Pune.

SwasthVayu - Non-Invasive BiPAP Ventilator

BiPAP Non-Invasive ventilator – SwasthVayu developed by CSIR-NAL is a bi-level positive airway pressure. The expert committee constituted under the DGHS, Ministry of Health & Family Welfare, Delhi has approved the use of SwsathVayu in patients who require oxygen supplementation upto 35%. In order to bring the ventilator quickly to the use by hospitals, CSIR-NAL in a record time transferred the technology to six industries. In all about 1500 units produced by the industry partner are currently used in various hospitals in Delhi, Ramgarh & Chatra - Jharkhand, Bhopal-Madhya Pradesh, Mysore, and Hyderabad. Many states and hospitals are approaching CSIR-NAL and industry partners for their interest in procuring these units in mitigating the current pandemic. Transferred to six MSMEs namely (1) Apollo Computing Laboratories, Hyderabad, (2) Analogic Controls India Ltd,., Hyderabad, (3) Datsol Pvt. Ltd., Bangalore (4) Kavitul Technologies Pvt. Ltd, Vadodara, (5) Paras Defence & space technologies, Mumbai and (6) Unimech Aerospace Pvt. Ltd., Bangalore.

Electrostatic Disinfection Machine

Electrostatic Disinfection Machine is developed based on the electrostatic principle. It produces uniform and fine spray droplets of disinfectants in the size range of 10-20 micrometre to kill microorganisms and viruses. Due to the small size of droplets, the surface area of spray droplets increases thereby enhancing the interaction with harmful microorganisms and coronavirus. The machine uses very less disinfection material as compared to conventional methods, which helps to save natural resources with negligible increase of chemical waste in the environment. CSIR-CSIO transferred the technology to M/s Rite Water Solutions (I) Pvt Ltd, Nagpur.

Aerosol Canopy for Dental Procedures

CSIR-CSIO designed Aerosol Canopy to shield/ protect dental & oral health doctors, and other healthcare professionals from infectious droplets & aerosol of patients during dental procedures by effectively shielding doctor's and dental assistant's face from a patient's airway while allowing the doctor to move his/ her arms freely to perform all necessary tasks during dental procedures. This will provide much needed protection from the infectious droplets and aerosols of Covid-19.This has been transferred to M/s Nigam Scientific Works, Chandigarh and Health Sciences Centre, PGIMER Chandigarh.

Seaweed based new animal feed additive formulations for improving productivity and health

This seaweed based food additive developed at CSIR-CSMCRI improves performance of poultry and cattle, gives better immuno-responsiveness, improves gut health in poultry, provided higher egg production and enables higher calcium and iron content in milk. It also reduces methane emission. The formulations have been tested and validated by different ICAR institutes working on animals (IVRI, NDRI) and poultry (CARI). It has been transferred to AquAgri Processing (P) Ltd.,Manamadurai (Tamil Nadu).

Seaweed based cattle lick.

FnCas9 Editor Linked Uniform Detection Assay (FELUDA)

FELUDA (FnCas9 Editor Linked Uniform Detection Assay) utilizes the high specificity and sensitivity of Francisella novicida Cas9 (FnCAs9), a CRISPR-Cas system, which can be adapted for generation of a reporter-based outcome for multiple signal detection platforms that makes it ideal for robust and rapid point-of-care diagnostics. The adaptability of FELUDA got tested during the COVID-19's first and (the ensuing) second wave in the country, when testing and tracing were crucial in containing the spread.FELUDA also highlighted the importance of industry partnership for swift commercialization of technologies (TATA MD commercialized FELUDA as TATA MD check kit) developed in CSIR labs along with ensuring that India catches up with the rapid pace at which new technologies (SHERLOCK and DETECTR amongst others are CRISPR-Cas based diagnostics being used in other countries) are being developed around the world.

RT PCR kit for Covid-19 testing

Nation-wide need for indigenous development for molecular tests for Covid-19 led to the development of a Multiplex Realtime RT-PCR Kit by CSIR-IGIB. This kit is an open platform, qualitative, RT-PCR test based on Taqman Chemistry intended to be used for in vitro detection of SARS-CoV-2 (Covid-19) in respiratory specimens (nasopharyngeal swab, oropharyngeal swab) of suspected cases of Covid-19 disease. The RT-PCR test is expected to be the main stay for molecular diagnosis of Covid-19 for the foreseeable future and is transferred to Trivitron Healthcare Pvt Ltd.

Agreement for ToT of newly developed agro technologies of Heeng & Saffron with the Directorate of Agriculture, Government of Himachal Pradesh

The institute CSIR-IHBT figured in the budget speech (2020-2021) of Honourable Chief Minister of Himachal Pradesh for the work on Heeng (asafoetida) and saffron. The state Government initiated a scheme "Krishi se Sampannta Yojana" (KSY) and allocated ~Rs. 10 crores to the institute for the purpose.

An Improved Domestic Cooking Burner for PNG

The designed burner by CSIR-IIP has following salient features; 25% Improved Thermal Efficiency, Ensures safety against possible flame lift and flash back, Avoids loss of fuel to atmosphere; unnecessary incremental GHG emissions, The burner is designed in capacities to cover the entire range of cooking burners prevailing in India, PNG stoves are available in all types and models (Glass-top, Steel Body, Three Burner, Four Burner etc.), Exceeding the Specification of IS: 17153. A non-exclusive license is given to forty (40) stove/burner manufacturing companies in India.

Improved PNG Burner for Domestic Cooking

172° cure NAL Aerospace Grade Hot-melt Epoxy Resin

Epoxy resins dominate the overall dry carbon fiber market as they are widely applicable in aerospace & defense, automotive, sports & recreation, wind energy, and other industries. The processing cost of epoxy resins is high for various end-use applications; which makes them very expensive. However, due to their rigid inter-linking molecular structure, inert chemical composition, and resistance to UV and chemical attack, epoxy resins are very durable. Epoxy resin with carbon fiber reinforcement is primarily used in aerospace & defense and automotive industries. It also has a faster curing time compared to other thermoset resins, which makes it the preferred choice among automakers. The etechnology eliminates dependency on imported resins for manufacturing of Carbon Fiber Prepreg. CSIR-NAL transferred the technology to Bhor Chemicals & Plastics Pvt. Ltd, Mumbai.

WAYU-II Technology

To combat the worsening air quality, CSIR-NEERI, has developed the WAYU (Wind Augmentation and Purification Units) device. The WAYU device works in two stages. The first stage uses a fan to suck in air around the device, which contains all kinds of pollutants like dust and particulate matter. These are separated using three blades of different dimensions. Post this, the air enters into a specially designed chamber where oxidation takes place using activated carbon coated with titanium oxide. The oxidation is supported by two ultraviolet lights. The purified air

is then pumped out into the atmosphere. Filters were made of non-woven fabric and their removal efficiency for particulate matter was 80 to 90 percent and of the poisonous gases 40 to 50 percent. The device is 5.5 feet tall and one foot wide and has been transferred to M/s. ESS Environment Consultants Pvt. Ltd, New Delhi.

Transfer of Know-How (Lab scale) for extraction of valuable and precious metals(Cu, Au, Ag & Co, Mn) from scrap of electronic waste & waste Li-Cobalt Batteries.

High value of metals and materials Li, Mn, Cu, Ni and reusable Graphite, Cu, Ni, Sn, Pb, Al, Rare earth (Nd, Sm), Rare metals (Co, In), Precious metals (Au, Ag, Pd, Pt). Remained Plastic, epoxy resins, Rubber, Iron sheets and ceramics as value additions. Helps in pollution mitigation, Prevent the toxic inlet of metals in the soil. Technology transferred by CSIR-NML to M/s. Walle Infotech, Ranchi.

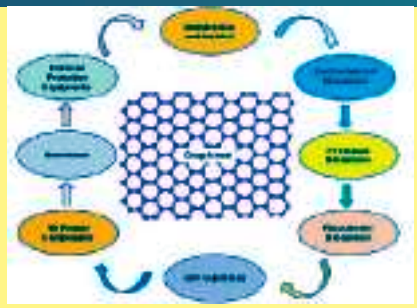
Portable Lightweight Foldable Module for Makeshift hospitals

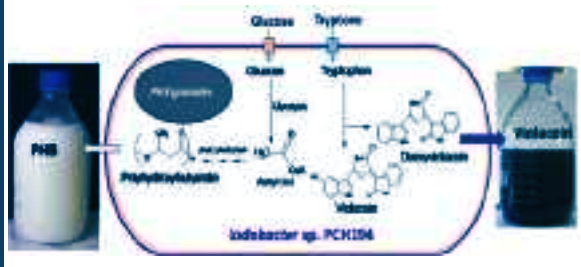
The modular unit is a single foldable unit having a total weight of around one tonne. This structure module can be folded flat so that it can be transported easily. The module can be fabricated in a yard with simple fabrication technology that utilizes welded standard steel sections. The fully folded modules can be taken to the site and deployed after making the site levelled and ready. One hospital of around 100 beds can be installed within a week including beds, electricity and water supply etc. All piping can be accommodated within the panels including switch boards and pipe connections. The modular units are spacious and are multifunctional, can be used for patients, doctor's cabins and testing labs. Some of the units can be converted and made as Toilet core units commonly for four to five units. CSIR-SERC licenced the technology to M/s L&T Construction – Building & Factories IC, Chennai on 5 November 2020 and M/s PressMach, Chennai, on 14 December 2020.

Emergency Retrieval System for Power Lines (ERS)

This indigenous technology has been developed by CSIR-SERC for quick retrieval of the collapsed TL towers and is the first of its kind in India, which forms part of 'Make in India' initiative. The system consists of lightweight modules, which are connected with an innovative connection system and supported by using unique two pin gimbal joint and easy to construct foundation system. This enables faster installation of ERS at site. The use of unique two-pin gimbal joint is easy to handle at site and provides better stability to the structure. The present system is designed as scalable system for 33 to 800 kV class of power lines. The cost of developed ERS is about 40% less than the available alternate imported systems. This technology is a cost effective import substitution providing the manufacturing opportunities to Indian industry. The technology has been licencedto M/s Advait Infratech Ltd., Gujarat on 12 November 2020.

9.0
Important Scientific & Technical Achievements – (Academic Impact)





Overview of the Indigenomes sample collection and data analysis.

9.0

Important Scientific & Technical Achievements – (Academic Impact)

Dengue situation in India: Suitability and transmission potential model for present and projected climate change scenarios

Dengue fever is mosquito borne viral disease caused by dengue virus and transmitted by Aedes mosquitoes. Dengue transmission is strongly influenced by environmental factors such as temperature and rainfall.In the present study, a climate driven dengue model was developed and predicted areas vulnerable for dengue transmission under the present and future climate change scenarios in India. The study also projected the dengue distribution risk map using representative concentration pathways (RCP4.5 and RCP8.5) in India in 2018-2030 (forthcoming period), 2031-2050 (intermediate period) and 2051-2080 (long period). The dengue cases assessed in India from 1998 to 2018 and found that the dengue transmission is gradually increasing year over year. The temperature data from 1980 to 2017 shows that, the mean temperatures are raising in the Southern region of India. During 2000-2017 periods the dengue transmission is steadily increasing across the India in compare with 1980-1999 periods. The dengue distribution risk is predicted and it is revealed that the coastal states have yearlong transmission possibility, but the high transmission potential is observed throughout the monsoon period. Due to the climate change, the expansion two more months of dengue transmission risk occurs in many regions of India. Both RCP4.5 and RCP8.5 scenarios revealed that dengue outbreaks might occur at larger volume in Southern, Eastern, and Central regions of India. Furthermore, a sensitivity analysis was performed to explore the impact of climate change on dengue transmission. These results helps to suggest appropriate control measures should be implemented to limit the spread in future warmer climates. Besides these, a proper plan is required to mitigate greenhouse gas emissions to reduce the epidemic potential of dengue in India.

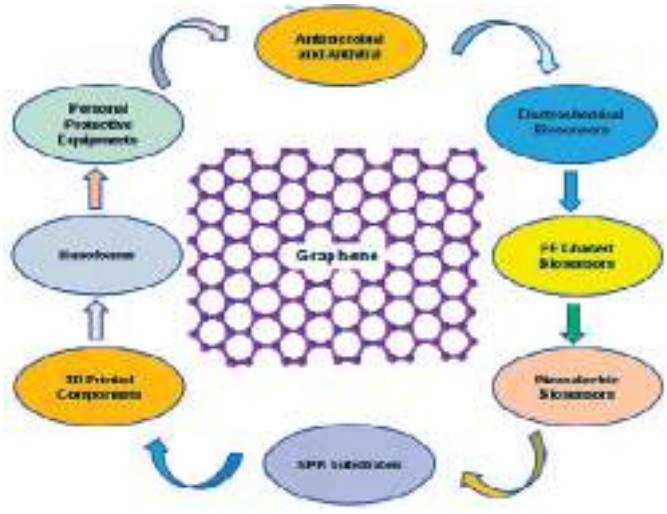
Non-centrosymmetric zinc silicate-graphene based transparent flexible piezoelectric nanogenerator

Rapid advancement of transparent flexible electronics has great potential for next-generation energy devices for self-powered nanosystems and nanosensors. Here, we present the transparent and flexible piezoelectric lead free zinc silicate (Zn_2SiO_4) nanorods-graphene based nanogenerators for harvesting mechanical energies for the first time. A simple and cost effective hydrothermal method was used to synthesize the piezoelectric Zn_2SiO_4 nanorods with non-centrosymmetricity property. Tetragonal crystal system and dimension of nanorods were investigated using X-ray diffraction spectroscopy and high resolution electron microscopies, respectively. Raman spectra exhibited all characteristic signature peaks of the Zn_2SiO_4 nanorods.Piezoelectricproperties of grown Zn_2SiO_4 nanorods was confirmed

and a piezoelectric charge coefficient (d33) of about 117 p.m./V was obtained through piezoelectric force microscopy study. A high performance piezoelectric hybrid composite nanogenerator was successfully fabricated using polydimethylsiloxane (PDMS) polymer, Zn2SiO4 nanorods and CVD grown monolayer graphene sheet. The average piezoelectric output voltage and current density of 5.5 V and 0.50 μA/cm2 were obtained under very small pressure of 0.15 kgf applied through computer controlled dynamic shaker without applying any external electric poling. The average energy conversion efficiency of the flexible piezoelectric Zn2SiO4: PDMS-based device was found to be ≈ 29.10%. The mechanism of high piezoelectric output performance from Zn2SiO4 nanorods device was discussed and co-related with dielectric, piezoelectric and proper adhesion of graphene sheet with polymer composites.

Potential of graphene-based materials to combat Covid-19: properties, perspectives, and prospects

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a new virus in the coronavirus family that causes coronavirus disease (Covid-19), emerges as a big threat to the human race. While the development of medicines and vaccines are essentially and urgently required, what is also extremely important is the repurposing of smart materials to design effective systems for combating Covid-19. Graphene and graphene-related materials (GRMs) exhibit extraordinary physicochemical, electrical, optical, antiviral, antimicrobial, and other fascinating properties that warrant them as potential candidates for designing and development of high-performance components and devices required for Covid-19 pandemic and other futuristic calamities. In this article, we comprehensively discussed the possible roles of graphene and graphene related materials for the development of antiviral and antibacterial surfaces to minimize infection spread, a variety of biosensors so as to early diagnose the disease, and high-performance PPEs development for combating Covid-19 and other diseases.



Potential role of graphene and GRMs for healthcare applications and in fighting against Covid-19

Recruitment of archaeal DTD is a key event toward the emergence of land plants

Streptophyte algae emerged as a land plant with adaptations that eventually led to terrestrialization. Land plants encounter a range of biotic and abiotic stresses that elicit anaerobic stress responses. This study shows that acetaldehyde, a toxic metabolite of anaerobic stress, targets and generates ethyl adducts on aminoacyl-tRNA, a central component of the translation machinery. However, elongation factor thermo unstable (EF-Tu) safeguards L-aminoacyl-tRNA, but not D-aminoacyl-tRNA, from being modified by acetaldehyde. A unique activity of archaeal-derived chiral proofreading module, D-aminoacyl-tRNA deacylase 2 (DTD2), that removes N-ethyl adducts formed on D-aminoacyl-tRNAs (NEDATs) was identified. Thus, the study provides the molecular basis of ethanol and acetaldehyde hypersensitivity in DTD2 knockout plants. An important gene transfer event from methanogenic archaea to the ancestor of land plants was uncovered.

While missing in other algal lineages, DTD2 is conserved from streptophyte algae to land plants, suggesting its role toward the emergence and evolution of land plants.

Transient transfection of the respiratory epithelium with gamma interferon for host-directed therapy in pulmonary tuberculosis

Nebulized gamma interferon (IFN-γ) protein has been studied for clinical safety and efficacy against pulmonary tuberculosis (TB). The protein is expensive, requires a cold chain, and is difficult to deploy in limited-resource, high-incidence settings. We generated a preclinical proof of concept (PoC) for a dry powder inhalation (DPI) containing DNA constructs to transiently transfect the lung and airway epithelium of mice with murine IFN-γ. Bacterial colony-forming units (CFU) in the lungs of mice infected with Mycobacterium tuberculosis (Mtb) reduced from about 106/g of tissue to ~104 after four doses given once a week. Nodular inflammatory lesions in the lungs reduced significantly in number. Immunohistochemistry of infected lung sections for LC3-1 and LAMP-1 indicated autophagy induction between 18 and 48 h after inhalation.

Biofuel powered glucose detection in bodily fluids with an n-type conjugated polymer

The integration of an n-type conjugated polymer with a redox enzyme for the autonomous detection of glucose and power generation from bodily fluids was demonstrated. The reversible, mediator-free, miniaturized glucose sensor is an enzyme-coupled organic electrochemical transistor with a detection range of six orders of magnitude. This cell shows a performance that scales with the glucose content in the solution and a stability exceeding 30 days. At physiologically relevant glucose concentrations and from human saliva, it generates enough power to operate an organic electrochemical transistor contributing to the technological advancement of self-powered micrometre-scale sensors and actuators.

Observation of inhomogeneous plasmonic field distribution in a nanocavity

The progress of plasmon-based technologies relies on an understanding of the properties of the enhanced electromagnetic fields generated by the coupling nanostrucutres. Precise determination of plasmon field intensity distribution within a nanogap remains challenging. We demonstrate a molecular ruler made from a set of viologen-based, self-assembly monolayers with which we precisely measures field distribution within a plasmon nanocavity with ~2-Å spatial resolution. We observed an unusually large plasmon field intensity inhomogeneity that we attribute to the formation of a plasmonic comb in the nanocavity. As a consequence, the generally adopted continuous media approximation for molecular monolayers should be used carefully.

Nickel oxide (NiO) thin film optimization by reactive sputtering for highly sensitive formaldehyde sensing

This work is about the optimization if NiO thin film for the sensing of HCHO (fomaldehyde). obtained results show a highly sensitive and selective sensing of HCHO. Trace level detection of formaldehyde (HCHO) is of utmost importance due to its harmful effects (carcinogenic) on humans. In the present work, nickel oxide (NiO) was deposited using reactive sputtering technique with varying Ar:O2 ratio. It was found that NiO developed with Ar:O2 ratio of 70:30 exhibited the best response (operating temperature 200 °C) for formaldehyde. Developed metal oxide material is highly sensitive to formaldehyde with limit of detection as low as 50 ppb. Developed films were characterized for crystal structure

using XRD, and surface morphology using AFM and SEM. Crystallographic assessment confirms the presence of face centered cubic phase of NiO and surface morphology of the film clearly shows the granular structure of the metal oxide film. Deposited NiO is found to be p-type which is confirmed by hotpoint probe, hall measurement as well as gas sensing behavior. The developed material was tested for various other indoor gases such as benzene (C6H6), carbon monoxide (CO), toluene (C7H8), and ammonia (NH3) and the material exhibited high selectivity towards HCHO. HCHO gas concentration ranging from 0.3 ppm to 2.5 ppm was tested on the sample. The material also showed good stability over the period of 3 months.

Ozonation as non-thermal option for bacterial load reduction of Chlorella biomass cultivated in airlift photobioreactor

The study proposed the selective reduction of bacterial load in the microalgal cultures without affecting the microalgae. Bacteria was found to be symbiotically associated with microalgae and exponentially increased in the range of 103–1011 CFU mL-1 during Chlorella cultivation in the airlift photobioreactor. The bacterial load needs to be reduced to meet USFDA standards (~103 CFU mL-1) for the use of microalgal biomass in food and feed applications. Ozone was evaluated as a non-thermal option for bacterial load reduction of Chlorella cultivated in the airlift photobioreactor. The results of ozonation w.r.t to time (5, 10, 15, 20, 25, and 30 min) and dissolved ozone concentrations (0.25, 0.49, 0.75, 0.99, and 1.25 mg of O3 L-1) showed a significant reduction of bacterial load in the range of 3 – 6.5 log. The bacterial disinfection kinetics of ozonation showed an overall second-order reaction with a rate constant (K) of 0.93 mg−1 min−1 L. Further, confocal laser microscopy imaging of Chlorella and its associated bacterial cells confirmed the selective and significant reduction of associated bacteria. The viability of the Chlorella cells were confirmed with trypan blue viability assay (~99%) under a fluorescent microscope. The biomass quality with respect to metabolite integrity was also validated. In conclusion, ozonation can be a potential solution for selective reduction of bacterial load associated with Chlorella without affecting Chlorella cells viability.

In Situ-Grown Cdot-Wrapped Boehmite Nanoparticles for Cr(VI) Sensing in Wastewater and a Theoretical Probe for Chromium-Induced Carcinogen Detection

This study reports a carbon dot (cdot)-based fluorometric probe for detecting hexavalent chromium in water. This is the very first time that cdots are tailored over the boehmite nanoparticle's surface using an in situ approach. Validation of formation of the nanocomposite has been discussed in detail employing the Rietveld refinement-based X-ray crystallography method.

In modern society, massive industrialization escalates environmental degradation by liberating various contaminants into the environment. Hexavalent chromium is a heavy metal that is being discharged from tannery and other industries, resulting in various carcinogenic diseases. This study reports a carbon dot (cdot)-based fluorometric probe for detecting hexavalent chromium in water. This is the very first time that cdots are tailored over the boehmite nanoparticle's surface using an in situ approach. Validation of formation of the nanocomposite has been discussed in detail employing the Rietveld refinement-based X-ray crystallography method. Vibrational spectroscopy and electron microscopy of the sample authenticate the nucleation process and the growth mechanism. The Stern–Volmer approach and time-resolvedfluorescence measurements justify the sensitivity of the sensor (~58 nM), and selectivity is analyzed by exposing the

material to different ionic environments. Density functional theory (DFT) is applied herein to analyze the origin of fluorescence and the sensing mechanism of the probe, which shows that photoinduced electron transfer is responsible for the turn-off-based sensing of Cr(VI). The molecular docking simulation is carried out to ensure the binding of cdots to the binding pocket of the glutathione enzyme, which is responsible for treating reactive oxygen species-mediated DNA damage due to elements such as hexavalent chromium. Time-dependent density functional calculations show that the fluorometric probe is capable of detecting Cr(VI) in living cells making it an early stage chromium-mediated carcinogen detector.

Electrocatalytic Reduction of CO2 to Ethylene by Molecular Cu-Complex Immobilized on Graphitized Mesoporous Carbon

The electrochemical reduction of CO2 to hydrocarbons is a challenging task because of the issues in controlling the efficiency and selectivity of the products. Among the various transition metals, copper has attracted attention as it yields more reduced and C2 products while using mononuclear copper center as catalysts., It is found that reversible formation of copper nanoparticle acts as the real catalytically active site for the conversion of CO2 to reduced products.

Scalable chemical vapor deposited graphene field-effect transistors for bio/chemical assay

The adsorption of chemical species on the surface of graphene alters the concentration of charge carries by either increasing or decreasing it depending on the nature of the adsorbed chemical species and inducing noticeable changes in the material's electronic properties. This remarkable feature enables graphene-based sensors to detect a wide range of biomolecules, chemicals, and gas/vapors. A lot of progress has been made in this field and technologies based on reduced graphene oxide flakes have been well reviewed. Graphene grown by chemical vapor deposition has proven to be the most prominent route to large-scale production of devices. However, until now, a comprehensive review on scalable, macro-sized, chemical vapor-deposited, graphene-based field-effect transistor sensors was missing. Here we review the present status, current challenges, and future prospects for the bio/chemical sensing applications of scalable, chemical vapor-deposited, graphene field-effect transistors. We explain and examine the fabrication techniques, sensing mechanisms, and various assay strategies. We also discuss the sensing performance of graphene based on quantum mechanics simulations and theoretical calculations.

Ultraselective and Highly Permeable Polyamide Nanofilms for Ionic and Molecular Nanofiltration.

In this paper the ultraselective and yet highly water permeable polyamide nanofilm composite nanofiltration membranes developed by precisely controlling the kinetics of the interfacial polymerization reaction by maintaining the stoichiometric equilibrium at the interface is reported. The kinetically favorable stoichiometric equilibrium condition prohibits the formation of aggregate pores in the nanofilm and leads to the formation of narrow network pores with a high surface negative charge. Nanofilms are designed with a controlled degree of crosslinking and made as thin as ≈7 nm to achieve increased water permeance. The ultraselective membranes exhibit up to 99.99% rejection of divalent salt (Na2SO4) and demonstrate monovalent to divalent ion selectivity of >4000. The fabrication process is scalable for membrane manufacturing.

FnCas9-based CRISPR diagnostic for rapid and accurate detection of major SARS-CoV-2 variants on a paper strip

The Covid-19 pandemic originating in the Wuhan province of China in late 2019 has impacted global health, causing increased mortality among elderly patients and individuals with comorbid conditions. During the passage of the virus through affected populations, it has undergone mutations, some of which have recently been linked with increased viral load and prognostic complexities. Several of these variants are point mutations that are difficult to diagnose using the gold standard quantitative real-time PCR (qRT-PCR) method and necessitates widespread sequencing which is expensive, has long turn-around times, and requires high viral load for calling mutations accurately. Here, repurpose of the high specificity of *Francisella novicida Cas9* (FnCas9) to identify mismatches in the target for developing a lateral flow assay that can be successfully adapted for the simultaneous detection of SARS-CoV-2 infection as well as for detecting point mutations in the sequence of the virus obtained from patient samples. We report the detection of the S gene mutation N501Y (present across multiple variant lineages of SARS-CoV-2) within an hour using lateral flow paper strip chemistry. The results were corroborated using deep sequencing on multiple wild-type (n = 37) and mutant (n = 22) virus infected patient samples with a sensitivity of 87% and specificity of 97%. The design principle can be rapidly adapted for other mutations (as shown also for E484K and T716I) highlighting the advantages of quick optimization and roll-out of CRISPR diagnostics (CRISPRDx) for disease surveillance even beyond Covid-19.

MicroRNA exporter HuR clears the internalized pathogens by promoting pro-inflammatory response in infected macrophages.

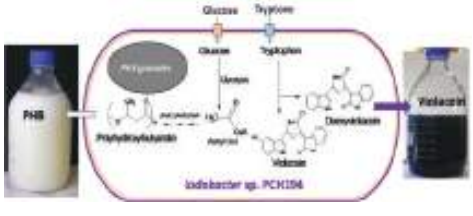
The findings elaborate the detail of the how miRNA regulator HuR and PP2A phosphatase act antagonistically to balance the inflammatory response in parasite infected macrophage cells by targeting the miRNA pathway. These findings have implications in miRNA-mediated immunoregulation process.

New approaches for antituberculosis leads from Actinobacteria

Bioactive metabolites derived from the phylum Actinobacteria represent many of the existing antimicrobial drugs. Compared with other bacterial pathogens, direct preliminary screening by diffusion assays is a limiting factor against Mycobacterium tuberculosis (Mtb) and different methodologies have been used to improve the search for new molecules. The combination of multidisciplinary approaches with new technologies could advance the discovery of new leads against Mtb like considering the unexplored Actinobacteria jointly with selective and integrative procedures.

Bioprocess for co-production of polyhydroxybutyrate and violacein using Himalayan bacterium Iodobacter sp. PCH194

The study discovers a unique bacterium Iodobacter sp. PCH194 from a high-altitude Himalayan lake sediment and employed it to develop a bioprocess for the co-production of polyhydroxybutyrate (PHB) and violacein pigment for the first time. Additionally, the application of PHB as bioplastic and violacein as an antitumor and antimicrobial agent was evaluated. In conclusion, the study provides an efficient Himalayan bioresource and develop a bioprocess for economical production of valuable bioproducts i.e., PHB and violacein.



Eco-friendly Recovery of Metals from Waste Mobile Printed Circuit boards using Low Temperature Roasting

The substantial growth of electronic waste (e-waste) in recent years has become a serious threat to environment. However, there is an excellent opportunity to recover and reuse metals present in e-waste, which eventually leads to conservation of natural resources for future generation. A greener and sustainable approach for the recovery of metals from electronic waste is the need of the hour. In this study, thermal decomposition of printed circuit boards (PCBs) was carried out in presence of nitrogen for conversion of polymers into oil and combustible gases. The metal rich pyrolysis residue was roasted in presence of ammonia chloride as chlorinating agent to recover metals. The effect of roasting parameters on the metal recovery investigated in temperature range of 200 °C to 325 °C for 1 h to 5 h while the NH4Cl dosage varied from 1 g/g to 4 g/g. Under the optimized roasting conditions, around 93% Cu, 100% Ni, 100% Zn, and 100% Pb were recovered at temperature of 300 °C, time of 4 h and NH4Cl dose of 3 g/g. The present process provides an eco-friendly solution for the recovery of metals from e-waste, which are valuable and avoid pollution.

Rhamnolipids from Planococcus spp. and their mechanism of action against pathogenic bacteria

Two bacterial species with the ability to produce biosurfactants were isolated from a pesticide contaminated soil and identified as Planococcus rifietoensis IITR53 and Planococcus halotolerans IITR55. Formation of froth indicating the surfactant production was observed when grown in basal salt medium containing 2% glucose. Both the rhamnolipids at 40 mg/mL exhibited the release of extracellular DNA and protein content. Also at one third of the MIC, a significant generation of reactive oxygen species was recorded. These rhamnolipids effectively emulsified different vegetable oils suggesting their possible utilization as antimicrobial agent.

Biofilm formation in the lung contributes to virulence and drug tolerance of *Mycobacterium tuberculosis*

Tuberculosis is a chronic disease that displays several features commonly associated with biofilm-associated infections: immune system evasion, antibiotic treatment failures, and recurrence of infection. However, although Mycobacterium tuberculosis (Mtb) can form cellulose-containing biofilms in vitro, it remains unclear whether biofilms are formed during infection in vivo. This work demonstrated the formation of Mtb biofilms in animal models of infection and in patients, and that biofilm formation can contribute to drug tolerance. First, we show that cellulose is also a structural component of the extracellular matrix of in vitro biofilms of fast and slow-growing nontuberculous mycobacteria. Then, we use cellulose as a biomarker to detect Mtb biofilms in the lungs of experimentally infected mice and non-human primates, as well as in lung tissue sections obtained from patients with tuberculosis. Mtb strains defective in biofilm formation are attenuated for survival in mice, suggesting that biofilms protect bacilli from the host immune system. Furthermore, the administration of nebulized cellulase enhances the antimycobacterial activity of isoniazid and rifampicin in infected mice, supporting a role for biofilms in phenotypic drug tolerance. The findings thus indicate that Mtb biofilms are relevant to human tuberculosis.

Transcriptome and proteome analyses reveal selenium mediated amelioration of arsenic toxicity in rice (Oryza sativa L.)

Arsenic (As), a chronic poison and non-

threshold carcinogen, is a food chain contaminant in rice, posing yield losses as well as serious health risks. Selenium (Se), a trace element, is a known antagonist of As toxicity. In present study, RNA seq. and proteome profiling, along with morphological analyses were performed to explore molecular cross-talk involved in Se mediated As stress amelioration. The repair of As induced structural deformities involving disintegration of cell wall and membranes were observed upon Se supplementation. The expression of As transporter genes viz., NIP1;1, NIP2;1, ABCG5, NRAMP1, NRAMP5, TIP2;2 as well as sulfate transporters, SULTR3;1 and SULTR3;6, were higher in As + Se compared to As alone exposure, which resulted in reduced As accumulation and toxicity. The higher expression of regulatory elements like AUX/IAA, WRKY and MYB TFs during As + Se exposure was also observed. The up-regulation of GST, PRX and GRX during As + Se exposure confirmed the amelioration of As induced oxidative stress. The abundance of proteins involved in photosynthesis, energy metabolism, transport, signaling and ROS homeostasis were found higher in As + Se than in As alone exposure. Overall, present study identified Se responsive pathways, genes and proteins involved to cope-up with As toxicity in rice.

Ultrahigh molecular weight polyethylene: catalysis, structure, properties, processing and applications

Ultrahigh molecular weight polyethylene (UHMWPE) belongs to an emerging class of high-performance specialty polymers with a unique set of properties and applications. The field has witnessed many scientific and technological advances in recent years. However, synthesis of UHMWPE is not a trivial exercise and presents several challenges. This review addresses these fundamental challenges and provides an overview of recent developments in the field of UHMWPE. The nature of catalysts, reaction conditions that favor its formation, their physical properties, methods of processing them into products, and their applications are discussed.

Assessment of cancer risk of microplastics enriched with polycyclic aromatic hydrocarbons.

Capture of carcinogens by microplastics originated from e-waste has been reported. Microplastics adsorb 236 ug L−1 of polycyclic aromatic hydrocarbons from water. Leachate from microplastics is about 1000 times hazardous than benzo[a]pyrene. Toxicity equivalent quantity of microplastics captured with PAHs was 88.21 µg. Cancer risk was 1.28 × 10−5 which is higher than the recommended value of 106.

Indi Genomes: a comprehensive resource of genetic variants from over 1000 Indian genomes

In the present study, these variants were systematically annotated using publicly available population databases and can be accessed through a browsable online database named as 'Indi Genomes' http://clingen.igib.res.in/indigen/. The Indi Genomes database will help clinicians and researchers in exploring the genetic component underlying medical conditions. Till date, this is the most comprehensive genetic variant resource for the Indian population and is made freely available for academic utility. The resource has also been accessed extensively by the worldwide community since it's launch.

Overview of the Indigenomes sample collection and data analysis.

Assessment of hydrochemical backgrounds and threshold values of groundwater in a part of desert area, Rajasthan, India

Natural background levels (NBLs) and threshold values (TVs) are crucial parameters for identification and the quantification of groundwater pollution, and the evaluation of pollution control measures. The NBLs for Na+, Cl−, SO42−, HCO3−, NO3− and F− ions were assessed and compared with the natural and anthropogenic processes. The NO3− concentration (~56% samples) above the TVs indicates extensive use of nitrate fertilizers and sewage effluent. The values of total dissolved solids (TDS) shows the suspicious scenario as about 84% of the samples in the dry period and about 89% in the wet season exceeding the drinking limit. Assessment of background concentrations and threshold values on regional and local scale assigns the basis for the identification of groundwater pollution, and helpful for better water quality guidelines to protecting of water resources.

Imprints of ancient recycled oceanic lithosphere in heterogeneous Indian Ocean mantle: Evidence from petrogenesis of Carlsberg ridge basalts from Northwest Indian Ocean

This paper reports new petrological, geochemical and isotopic data for Carlsberg Ridge Basalts (CRB) of northwest Indian Ocean and evaluates their petrogenetic aspects in the context of the geochemical and tectonic evolution of the Indian Ocean mantle. The CRB samples exhibit tholeiitic to transitional composition of precursor melts derived by high degree, shallow level partial melting of a spinel peridotite mantle source. CRB reflects distinct E-MORB affinity with selective enrichment in incompatible trace elements. Higher values of Zr/Hf (33.8–47.3) and Zr/Sm (24.9–36.4) in conjunction with lower Nb/Ta (1.7–7.3) ratio corroborate their origin from an enriched mantle source. Negative Nb anomalies with lower Nb/Y (0.04–0.11) and Zr/Y (2.5–3.5) conform to a non-plume origin of these basalts. Higher Zr/Nb (25.5–71.5) and Th/Nb (0.6–0.42) compared to OIB substantiate contributions from recycled subduction-processed components in the source mantle. Lower Nb/U (6.2–37.9) values with higher Ba/Nb (6.1–21.9), Ba/Th (27.7–147.5), Zr/Nb (25.5–71.5) and Th/Nb (0.6–0.42) compared to OIB and N-MORB attest to role of a metasomatized oceanic lithosphere that recycled into the depleted upper mantle attributing to the source heterogeneity. Sr-Nd isotopic signatures (87Sr/86Sr: 0.702668 to 0.702841 and 143Nd/144Nd: 0.512972 to 0.513068) of CRB suggest a HIMU source component preserved in the northwest Indian Ocean Ridge mantle. The compositional diversity of the Indian Ocean mantle can be translated in terms of periodic refertilization of depleted N-MORB type mantle through delamination and recycling of oceanic (HIMU component) and continental lithosphere (EM I component) concurrent with Neoproterozoic-Palaeozoic amalgamation and Jurassic dispersal of Gondwana Supercontinent respectively. This study complies with the derivation of CRB from a geochemically heterogeneous Indian Ocean mantle that experienced a protracted residence beneath the Gondwana Supercontinent prior to the opening of Indian Ocean and trapped recycled metasomatized oceanic lithosphere genetically linked with multiple stages of paleo-ocean closure and continental convergence during Gondwana assembly.

Valorization of waste powders from cement-concrete life cycle: A pathway to circular future.

Maintaining equilibrium between the three pillars of sustainability (social, economic, and environmental) is very important for the sustainable construction industry. Every phase of the cement-concrete life cycle, from the production of cement to concrete application and finally demolition,

a considerable amount of carbon dioxide (CO2) and solid waste are generated. In fact, the produced solid wastes in particular in the form of powder, for example, cement kiln dust (CKD), concrete fines, etc., are rich in Ca could be a possible source to sequestrate CO2 and use as valuable construction materials. This review focuses on the origin, physico-chemical aspects, various valorization routes as well as the potential applications of waste powders sourced from the cement-concrete life cycle. Utilization of waste powders generated in the concrete life cycle in the production of new concrete, bricks, paver blocks, and other construction applications could offer the construction industry with sustainability benefits. A number of studies also demonstrated that it is feasible to turn these wastes into artificial aggregate and produce pure calcium carbonate via mineral carbonation. However, further research on engineering performance, environmental impacts (carbon credits), and economic benefits should be systematically carried out before these products can be introduced to the construction sector.

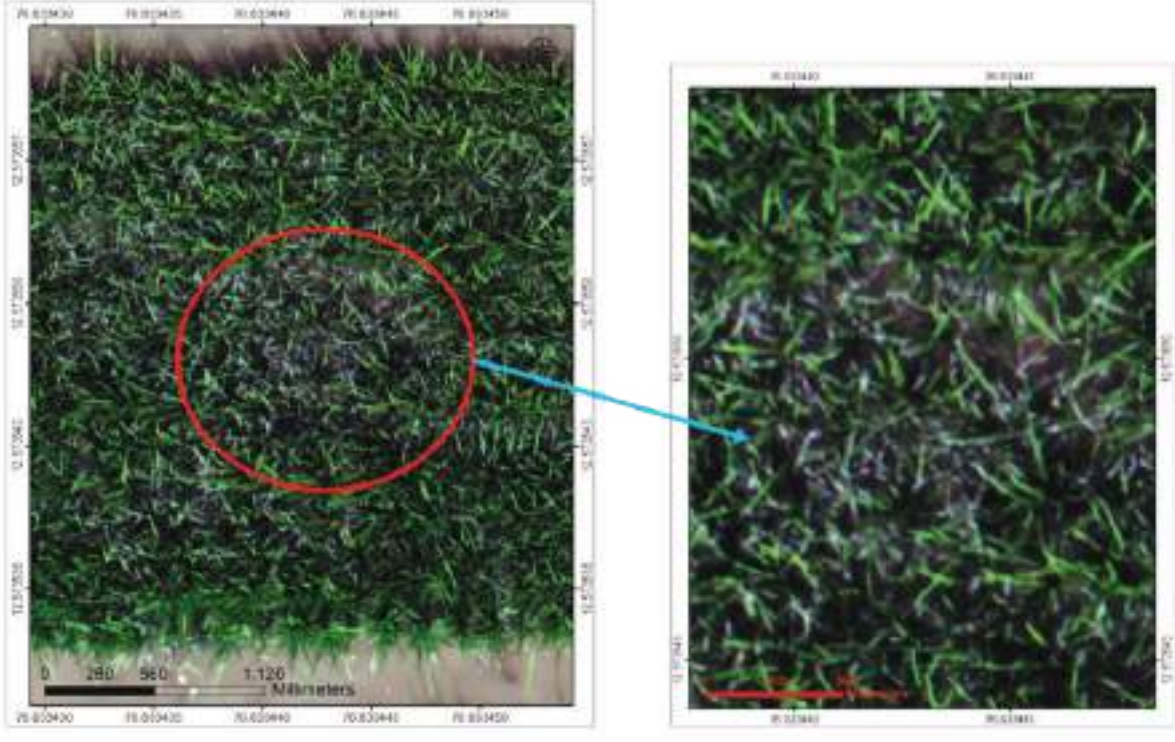
10.0
Important Services To Rural Sector

10.0

Important Services To Rural Sector

Image analytics based crop disease initiation and forecasting system

Traditional crop stress/disease forecasting models are mostly based on statistical or dynamical models, which mainly depend on whether variables. Conventional methods of identification of particular crop stress or stage monitoring are based on only one spectral pixel information. Hyperspectral images are able to convey much more spectral information than RGB or other multispectral data: each pixel is in fact a high-dimensional vector typically containing reflectance measurements from hundreds of contiguous narrow band spectral channels. Traditional learning-based approaches to hyperspectral image data interpretation rely on the extraction of hand-crafted features on which to hinge a classifier.UAVs have been used in agriculture to get high spatial resolution images to detect individual crops and weeds at sub-millimetre scale. UAV bases image analytics is used for early identification of rice blast disease in Paddy crop. The early stage of rice blast disease was clearly captured by UAV based multispectral image of 5 mm ground resolution, placing UAV at 10m height.



UAV based multispectral imaging of rice field; 5 mm resolution image taken from multi spectral camera (left), rice blast disease is visible in the enhanced image (right).

Popularization of Improved Samba Mahsuri, a bacterial blight resistant and diabetic friendly rice to increase farmers' income

CSIR-CCMB developed Improved Samba Mahsuri rice is now being spread to farmers across India.10 kg seed packets of Improved Samba Mahsuri have been distributed to about 3350 farmers in the states of Andhra Pradesh, Telangana, Karnataka, Chhattisgarh, Uttar Pradesh and Tamil Nadu. Seed distribution was done through Krishi Vigyan Kendra, State Agriculture Departments, NGOs or through progressive farmers for onward distribution to farmers. 3350 farmers were able to grow Improved Samba Mahsuri rice.

Improving the livelihood of rural entrepreneur

Helping women self-help-group with suitable CSIR-CFTRI technologies, and providing them all the necessary scientific and technical input will definitely improve the socio-economic status of the rural people. CSIR-CFTRI signed a MOU with GRAAM, a well-known local NGO, so that the identified technologies may be transferred free of cost. Accordingly, two technologies, malted ragi based weaning food, and a convenience mix suitable for stiff porridge (mudde, a traditional yet popular food), were identified. A SHG group (14 No.) near to Mysore was identified by the GRAAM, was trained for a week for two different technologies. The SHG is in the process of purchasing the machineries for setting up the plant. CSIR-CFTRI team visited the proposed building for setting up the plant. CSIR-CFTRI is also providing the technical specifications for procurement of the machineries.

Generation of Self-employment

One of the two outreach centres of CSIR-CGCRI at Khurja was involved in imparting various forms of training and technology demonstration programmes for artisans and local entrepreneurs. The Khurja Centre successfully completed training of artisans under the NBCFDC and also facilitated generation of self-employment under a KVIC project. A common facility centre at Rohtas was commissioned while steps to establish similar centres are underway at Agartala and Bhradrawati. A Digital Academy of Terracotta was established and a Centre for Excellence in Terracotta Research is on the anvil. The Black Pottery technology was selected for introduction to the North Eastern States. Skill based employment generation and entrepreneurship approach. The centre received the Corporate Environment Achievement Award 2020 from the American Ceramic Society.

Development of Leather Value Chain in Ladakh

Ladakh is renowned for its remote mountain beauty and distinct culture. Under the CSIR Ladakh initiative a webinar meeting was held on 12th October 2020 with CSIR personnel and Rigzin Samphel, IAS, Commissioner Secretary, Ladakh along with other Ladakh officials. Mr S. K. Misra, Scientist-in-Charge, RCED, Jalandhar presented on Development of Leather Value Chain in Ladakh. Further, Dr K J Sreeram, Director, CSIR-CLRI presented the initiatives of CSIR-CLRI for Ladakh in a webinar meeting organized on 16th October 2020, attended by Hon'ble Lieutenant Governor, Ladakh, Shri Radha Krishna Mathur, DG CSIR Dr Shekhar C Mande along with a few Directors from CSIR Labs. Industries & Commerce Department, UT Ladakh in collaboration with CSIR-CLRI conducted the workshops

on Entrepreneurship Development-Opportunities in Leather & Allied Products. Resulted in carrying out the Baseline Survey Activities pertaining to CSIR-CLRI initiatives towards "Development of Leather Value Chain in Ladakh".

Initiative on development of specialized footwear for salt farmers (Agarias) in Gujarat

The Rann of Kutch in Gujarat was an inland gulf whose bed was raised due to seismic disturbances and by deposits from the rivers and shores. The deposits were rich in minerals and salts and the soil is therefore highly saline. The Rann is home to a community of salt cultivators known as the Agariyas, agar meaning salt. Studies on anthropometry and foot sensitivity were taken by the CSIR-CLRI team. The age group covered was between 20 years (fresher) and 50 years (experienced for decades) of both men & women. It was observed that the salt farmers would require

two different set of footwear- one for the Pagali operation that involves stamping the clay to make it tight and another for the final operation of raking harvest (where the crystallized salt is collected).

Solar Energy Based Cooking System (Solar Chulha)

Solar energy based cooking is the simplest, safest, most convenient way to cook food without consuming fuels or heating up the kitchen. The designed Solar Chulha is Forced draft cook stove provides heating from bottom as well as from side, has longer heat retention due to proper insulation of CC, is 12V DC fan operated by solar energy for better combustion, chimney to avoid HAP, compared to Traditional Chulla CO Emission is reduced by 85% & Suspended Particulate Matter (SPM) is reduced by 38%.

Technical scrutiny of PMGSY-III DPRs from different states

CSIR-CRRI is considered as a Principal Technical Agency (PTA) by NRIDA. As per NRIDA guidelines, about 10 per cent of the PMGSY Detailed Project Reports (DPR) are to be scrutinized by PTA. Accordingly, NRIDA requested CRRI to scrutinize DPRs from Andaman & Nicobar, Pondicherry, Gujarat and Maharashtra States for technical aspects relating to both Road and CD works. DPRs received from these states were scrutinized by CRRI and comments/ observations on shortcomings noticed in these DPRs were reported to respective states and NRIDA for correction and compliance.

Rural Penetration and Pilot Trials for Divyanayan

The programme aims at Rural Intervention of Divyanayan, to the unprivileged visually

challenged people in aspirational districts of various Indian states. The Programme also aims at evaluating the socio-economic impact of the technology towards sustainability.The programme has received approximately 215 individual registrations and 25 institutional registrations from states of Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Jammu and Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar-Pradesh, and West Bengal. The device has been aimed to penetrate to a number of visually impaired through 30 dedicated Divyanayan device training workshops held so far in various states at institutional level in West Bengal, Tamil Nadu, Madhya Pradesh, Rajasthan, Bangalore, New Delhi, Chandigarh, Uttar Pradesh, Himachal Pradesh. The series of workshop resulted in approximately 500 feedbacks received from the mentioned states. A series of 35 dedicated workshops engaging more than 1000 visually impaired people were conducted based on the user registrations received via online portal, in 11 states of India to train the users, making them familiar with the device functionality and capable of using the device independently.

Decentralized solar food preservation system

Solar dryer technology is simple and therefore easily adoptable by the household, community and food processing sector. Mixed mode type of solar dryers have been designed,fabricated and tested for drying of food products like papad, potato wafers, banana wafers, grapes, onion, garlic, ginger, red chilies, methi leaves, mushrooms etc. at CSIR-CSMCRI, Bhavnagar. The capacity of the dryers can be varied from 5 -20 of kg of raw material per batch, however it depends on the nature of the food to be dried. The drying of various food products can be achieved in about half the time duration taken for open sun drying. Based on the small scale design, two solar dryer has been installed for fisherman community with help of District development officer Bhavnagar at Gogha and Gadula.

Organizing farmer's fair at CSIR-CIMAP

CSIR-CIMAP has been organizing Kisan Mela every year on 31st January. Kisan Mela is being organized for the last 17 years. The increasing number of farmers attending this Kisan Mela every year shows that the popularity of

CSIR-CIMAP Kisan Mela is increasing among the farmers. This year, Kisan mela was organized for 20 days by considering COVID-19 pandemic situation, daily 100 to 200 farmers participated in the programme by following Covid- 19 protocol.

The main function of Kisan Mela was celebrated on 31st January, 2021. On this occasion, the Chief Guest Dr. Shekhar C. Mande, Director General, CSIR joined online and said that the Kisan Mela have a special place in bringing the new experiments being done by CSIR to the general public and CSIR-CIMAP should continuously provide high quality plant material to the farmers. Farmers from all over the country participated in this Kisan Mela through daily pre-registration process. Industries associated with the aroma industry such as Ultra International Pvt. Ltd., Expo Essential Oil, Ghaziabad, Multi Commodity Exchange, Mumbai, Essential Association of India, Mumbai, BKK Specialist, Mumbai.

This year about 4000 farmers from different states of the country like Uttar Pradesh, Madhya Pradesh, Bihar, Uttarakhand, Chhattisgarh, Gujarat, Rajasthan, West Bengal, Orissa, Haryana, Punjab, Delhi, Karnataka, and Maharashtra etc. participated in the Kisan Mela. Students from 500 different universities also participated.

RET for medicinal plants

Enabled farmers of high altitude (Lahaul & Spiti) to grow high value rare endangered and threatened medicinal plants viz. Nardostachys jatamansi, Fritillaria royeli. This enabled re-establishment and sustainable utilization of rare endangered and threatened medicinal plants and helped the farmer to generated an additional source of income. A medicinal plant collector turned to grower of medicinal plants viz. Picrorhiza kurroa and Dactylorhiza hatageria at Chamba. This helped in limiting the exhaustive harvesting of medicinal plants from the environment and sustainable utilization of medicinal plant. It also gave the additional income to the grower. Farmer was helped to grow saffron at Palampur region of Distt. Kangra as an alternate source of income. It helped in generation of disease free planting material and alternate home to saffron. Farmer earned money by selling spice and planting material i.e., corm as well. Finally, this farmer was linked up with the State government for improved production of planting material.

Lavender distribution and plantation at different locations of the Doda district, J&K.

Due to the high market demand for quality planting material of Lavender, many farmers across Bhaderwah have generated nurseries of Lavender plants. They are earning reasonable amounts by selling plants to other farmers and government departments. CSIR-IIIM Jammu under CSIR Aroma Mission aims to expand its cultivation in J&K to 1500 ha in the next three years. Farmers of Doda produced 300, 500, and 800 Litres of Lavender oil in 2019, 2020, and 2021, respectively

UAV for Agriculture Applications

Precision agriculture makes use of satellite and aerial imagery to monitor crop health. With an increase in the practical application of UAV's in the agricultural industry and to provide an end to end solution in the agricultural domain (from crop monitoring to pesticide spraying) CSIR-NAL developed a modular Oct-Copter UAV system that can carry a maximum payload of 20 Kg and fly for the endurance of around 20 min.

The Oct-Copter has a provision to house either a hyperspectral camera for crop health monitoring or a fertilizer tank for fertilizer spraying. In this year one unit of Oct-Copter UAV has been delivered to CSIR-CIMAP.

First field demonstration of NAL's Oct-Copter has been demonstrated to the farmers of Alur APMC, Bangalore and the UAV has received a very positive response.

First field demonstration of NAL's Oct-Copter at Alur APMC, Bengaluru

Assessment of Water Quality Supplied by Kannad Municipal Council from Ambadi Dam to Kannad Town

To assess the water treatment plant and remedies for the reddish worm problem. Initiate survey to locate the source of water, to understand water treatment plant operations and distribution network. Collection and analysis of water samples from source, water treatment plant inlet and outlet, elevated and ground storage reservoirs and consumer end. Recommendations on water treatment and distribution network and remedy for reddish worm problem. The cause of occurrence of red worms at the consumer end was determined. Solution was given to the problem faced by a township of 40,000 people.

Training on Commercial vermicompost

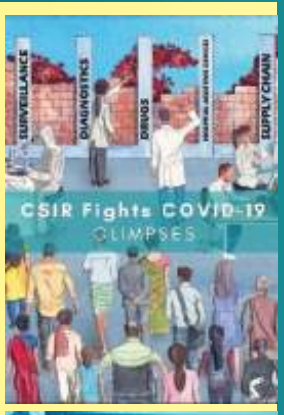
CSIR-NEIST Branch Lab Arunachal Pradesh technical guidance on establishment of commercial vermicompost production unit to local ST youth of Naharlagun, Arunachal Pradesh. About more than 10 beneficiaries started commercial production of vermicompost in different rural localities of the state with earning more than 6,000/ per month by harvesting and selling of vermicompost from their vermicompost production units.

CSIR-NRIST Branch Arunachal Pradesh Provinding Technical Guidance on Establishment of Commercial Vermicompost Production Unit to ST youth of Arunachal Pradesh

New initiatives in post-harvest value addition

CSIR-NIIST performed activities on setting up of vegetable processing unit – HORTICORP. Incubation activities in millet processing for MSMEs.Establishing processing units for millets as part of Rebuild Kerala Initiative at Millet village, Attappadi. Tie up with Kerala Industrial Department –Technical support for start-ups for post Covid economic reform. Industry linkages for product and process development.

11.0
Central Management Activities



11.0

Central Management Activities

11.1 Governing Body

The 194th and 195th meetings of the Governing Body (GB) of CSIR were held on 28.04.2020 and 27.08.2020 respectively.

In the 194th GB meeting, being the first meeting of the reconstituted GB, the Chairman, GB and DG, CSIR, Dr Shekhar C Mande welcomed and introduced all the members of the GB.

DG, CSIR made a presentation on the strategy and efforts being undertaken by CSIR towards Covid-19 mitigation. Members appreciated the efforts made by CSIR on the work undertaken regarding Covid-19 mitigation.

Agenda items taken up during 194th GB Meeting:

- Confirmation of the proceedings of the 193rd meeting of the Governing Body of CSIR held on 19th December, 2019.
- Action taken on the proceedings of the 193rd meeting of the Governing Body of CSIR.
- Review of CSIR Purchase procedure.
- CSIR Administrative Services (Recruitment and Promotion) Rules, 2020 - approval thereof.
- Amendment in Recruitment Rules for the post of Security Officer [PB-3, Rs. 9300- 34800, Grade Pay of Rs. 4600/- pre-revised] [Level -7, 7th CPC] - approval thereof.
- Policy and Guidelines for accepting and utilization of Contributions/Grants/ Donations from Corporates/ Industries under Corporate Social Responsibility (CSR) - approval thereof.
- Constitution of a High Level Committee (HLC) for Merging of CSIR Laboratories CSIR-4PI, CSIR- NISCAIR and CSIR-NISTADS as per Apex Committee proposal.

Additional item taken up with the approval of Chairman, GB:

"Proposed Amendments in Technology & Intellectual Property guidelines for Covid-19 related products developed by CSIR laboratories" – DG-CSIR explained the GB about how the novel Corona virus Covid-19 outbreak has thrown an unprecedented challenge to the humanity resulting in loss of precious lives, nationwide lockdowns in several countries, shuttering businesses, and disrupting major supply chains. In order to find some innovative solutions, CSIR has taken immediate measures to facilitate the technology licensing & knowledge transfer for products developed by CSIR labs for Covid-19. This is an extraordinary situation and the products, technologies, health devices, drugs, kits, materials, PPEs, etc., developed by CSIR laboratories needs to go for mass production to meet the growing demand of the country. To do so an empowered Committee has been constituted which proposed amendments in extant guidelines for technology transfer and utilization of Knowledgebase in September 2017.

In the 195th GB meeting, the Chairman, GB, CSIR, Dr Shekhar C Mande made a presentation on the significant progress made by CSIR on various front since the last GB meeting. He informed that recently CSIR

Hqrs was restructured to focus on Science, Technology and Innovation (STI) Management as per the recommendations of the Committee constituted by PMO for Reorientation of CSIR for extending Technological Support to Indian Industry. A brief on the newly constituted directorates including their mandates was presented. He then informed constitution of different sub-verticals under eight themes for carrying out R&D by CSIR. Dr. Mande then briefly informed the GB about the report of the committee constituted by the PMO for reorientation of CSIR for extending technological support to Indian Industry. He highlighted its major recommendations of the Committee. He then listed achievements made by CSIR for mitigation of Covid-19 pandemic. Dr. Mande then presented details about the new programmes undertaken by the Technology Management Directorates namely, Floriculture Mission, Aroma Mission and Next Generation and Insect Resistance Cotton which are being implemented by CSIR. Lastly he touched upon CSIR forging alliances with Social Vehicles like joint collaborations of CSIR, IIT, Delhi and Vijanana Bharati under Unnat Bharat Abhiyan (UBA).

The members applauded the efforts made by CSIR and gave valuable suggestions.

The Agenda items taken up during 195th GB Meeting:

- Confirmation of the proceedings of the 194th GB meeting of CSIR.
- Action taken on the proceedings of the 194th meeting of the Governing Body of CSIR.
- Merging of CSIR- NISCAIR and CSIR- NISTADS as per Apex Committee Proposal and High Level Committee Recommendations - approval thereof
- Ease of doing Science and Technology Business in CSIR - approval thereof
- Consideration and Adoption of Annual Accounts of CSIR for the Financial Year 2018-19 - approval thereof
- Amalgamation of Consultancy Development Centre (CDC) with CSIR - approval thereof
- Financial upgradation for the post of Legal Advisor, CSIR
- Consideration and Recommendation of the CSIR Annual Report for the year 2018 - 19 - approval thereof
- Proposal for extension of age relaxation to all women candidates who apply for posts of Scientists in CSIR -approval thereof
- Modifications to the CSIR Guidelines for Technology Transfer and Utilization of Knowledgebase - approval of the Committee Report

11.2 CSIR 79th Foundation Day Celebration

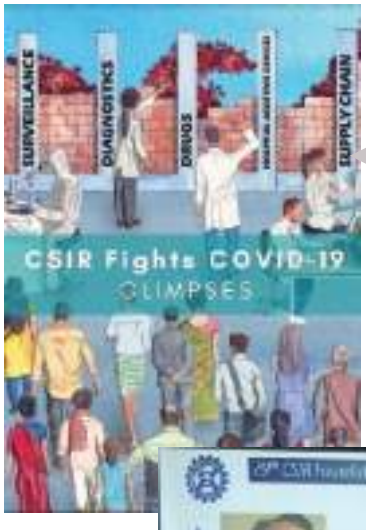
CSIR celebrated its 79th Foundation Day on 26th September 2020. In view of the Covid-19 pandemic, the event was physically attended by a small gathering at the SS Bhatnagar Sabhagar at Anusandhan Bhawan, CSIR Headquarters in New Delhi maintaining social distancing. However, CSIR staff from all CSIR labs joined the occasion virtually. Dr Harsh Vardhan, Union Minister of Science and Technology, Earth Sciences, Health and Family Welfare and Vice President, CSIR graced the occasion as the Chief Guest. Congratulating the CSIR family on its 79th Foundation Day and appreciating the efforts of CSIR, Dr Harsh Vardhan said that it is a privilege to be associated with CSIR in any capacity and he and Hon'ble Prime Minister have huge expectations and belief in the potential of CSIR and its scientists. Dr Harsh Vardhan also said that whenever there has been a challenge before the country in any form, CSIR has always been able to convert it into an opportunity delivering innumerable benefits to the society. Hon'ble Union Minister also urged CSIR to brainstorm and prepare a strategy for achieving the vision of the Hon'ble Prime Minister of an 'Atmanirbhar Bharat' through S&T.

Dr Harsh Vardhan, Hon'ble Union Minister of Science and Technology, Earth Sciences, Health and Family Welfare and Dr Shekhar C. Mande, DG, CSIR, during the lighting of the lamp

Dr Shekhar C. Mande, DG, CSIR & Secretary, DSIR (Department for Scientific & Industrial Research), in his Welcome Address, highlighted the efforts of CSIR in the fight against the pandemic and said that when the difficult time came, CSIR as a family stood up and developed innumerable technologies to mitigate the Covid-19 pandemic. He informed that more than 100 technologies developed by CSIR labs ever since the pandemic struck have been outlined in a special publication called *CSIR Technologies for Covid-19 Mitigation*. The technologies developed by CSIR have made waves not only in India but internationally also, he informed.

During the programme, Dr Harsh Vardhan also released an e-book *"CSIR Fights Covid-19 – Glimpses"* which outlines the various contributions of the CSIR laboratories during these challenging days of the pandemic. Subsequently, a short film released by Dr Harsh Vardhan was also screened. The short film paid tributes to the unstinting efforts of the CSIR family in its fight against Covid-19. The Foundation Day Lecture was virtually delivered by Prof. Ajay Kumar Sood, Physics Department, Indian Institute of Sciences, Bengaluru, on *"Science without Borders"*. Prof. Sood, FRS, Year of Science Chair Professor is one of the most distinguished physicists in the country.

During the programme, various CSIR



e-book Cover

Prof A K Sood, FRS, IISc, Bengaluru, delivering Foundation Day Lecture.

Awards were also announced virtually. Dr Shekhar Mande also announced the winners of the prestigious Shanti Swarup Bhatnagar Awards 2020.

CSIR Foundation Day Function 2020 Awards

- CSIR Young Scientist Awards 2020
- G N Ramachandran Gold Medal for Excellence in Biological S&T 2020
- CSIR Innovation Award for School Children 2020
- CSIR Technology Awards 2020
- CSIR Diamond Jubilee Technology Awards (CDJTA) 2019
- CSIR Award for S&T Innovation for Rural Development (CAIRD) 2017, 2018, 2019

Shanti Swarup Bhatnagar (SSB) Awards for Science & Technology 2020

Shanti Swarup Bhatnagar Prize for Science and Technology was instituted in the year 1957, in the memory of late Dr. (Sir) Shanti Swarup Bhatnagar, FRS, the founder director of the Council of Scientific & Industrial Research (CSIR). The SSB Prize is awarded each year on the basis of conspicuously important and outstanding contributions to human knowledge and progress, made through work done primarily in India during the five years, preceding the year of the prize.

Any citizen of India engaged in research in any field of science and technology up to the age of 45 years is eligible to be nominated. Overseas Citizen of India (OCI) and Persons of Indian Origin (PIO) working in India are also eligible. The SSB Prize, comprising a citation, a cash award of Rupees five lakh and a plaque, is given to each person selected for the award in the following disciplines:

- Biological Sciences
- Chemical Sciences
- Earth, Atmosphere, Ocean and Planetary Sciences
- Mathematical Sciences
- Medical Sciences
- Physical Sciences
- Engineering Sciences

The recipients of the Shanti Swarup Bhatnagar Prize for Science and Technology were:

Biological Sciences

- **Dr Subhadeep Chatterjee**, Laboratory of Plant-Microbe Interactions, Centre for DNA Fingerprinting and Diagnostics, Hyderabad.
- **Dr Vatsala Thirumalai**, Neural Circuits and Development Laboratory, National Centre for Biological Sciences, Bengaluru.

Chemical Sciences

- **Dr Jyotirmayee Dash**, School of Chemical Sciences, Indian Association for the Cultivation of Science, Kolkata.
- **Dr Subi Jacob George**, New Chemistry Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru.

Earth, Atmosphere, Ocean and Planetary Sciences

- **Dr Abhijit Mukherjee**, Department of Geology and Geophysics, Indian Institute of Technology Kharagpur, Kharagpur.
- **Dr Suryendu Dutta**, Department of Earth Sciences, Indian Institute of Technology Bombay, Mumbai.

Engineering Sciences

- **Dr Amol Arvindrao Kulkarni**, Chemical Engineering and Process Development, CSIR National Chemical Laboratory, Pune.

Dr Kinshuk Dasgupta, Materials Group, Bhabha Atomic Research Centre, Mumbai.

Physical Sciences

- **Dr Rajesh Ganapathy**, International Centre for Materials Science, Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru.
- **Dr Surajit Dhara**, School of Physics, University of Hyderabad, Hyderabad.

Mathematical Sciences

- **Dr Rajat Subhra Hazra,** Theoretical Statistics and Mathematics Unit, Indian

Statistical Institute, Kolkata.

- **Dr U K Anandavardhanan,** Department of Mathematics, Indian Institute of Technology Bombay, Mumbai

Medical Sciences

- **Dr Bushra Ateeq,** Department of Biological Sciences & Bioengineering, Indian Institute of Technology Kanpur.
- **Dr Ritesh Agarwal,** Department of Pulmonary Medicine Postgraduate Institute of Medical Education and Research, Chandigarh.

CSIR Young Scientist Awards 2020

CSIR introduced 'CSIR Young Scientist Awards' in 1987, a scheme of awards for Young Scientists of CSIR to promote excellence in various fields of science and technology. CSIR scientists, below 35 years of age, as reckoned on 26 September (CSIR Foundation Day) of the preceding year, are eligible for the Award. These awards are given annually in the following fields:

- Biological Sciences
- Chemical Sciences
- Earth, Atmosphere, Ocean and Planetary Sciences
- Engineering Sciences
- Physical Sciences (including Instrumentation)

Each award consists of a citation, a cash prize of rupees fifty thousand and a plaque. CSIR Young Scientist Awardees are also entitled to a research grant of rupees five lakh per annum for a period of five years and an honorarium of rupees seven thousand and five hundred per month till the age of 45 years. The award winners for 2020 were:

Physical Science (including Instrumentation) Discipline -

1. **Dr Manoj Kumar Gupta,** CSIR-AMPRI for developing novel and innovative piezoelectric, pyroelectric and triboelectric nanogenerators as a new class of renewable energy devices.

Biological Science Discipline -

1. **Dr Debojyoti Chakraborty** of CSIR-IGIB for developing a highly precise genome editing platform (FnCas9) and its application to correct the sickle cell anaemia mutation in Indian patient-derived stem cells.
2. **Dr Vandana Jaiswal,** CSIR-IHBTfor her significant contribution towards identification of genomic regions harbouring Genes/QTLs for agronomic traits in wheat and development of molecular markers for the wheat improvement programme.

Chemical Science Discipline -

1. **Dr Suraj Soman,** CSIR-NIIST for developing semi-automatic equipment for large area dye-sensitized solar module fabrication and for introducing alternate earth-abundant cobalt and copper electrolytes for Indoor Photovoltaics.

Earth, Atmosphere, Ocean & Planetary Sciences Discipline -

1. **Dr Jagadeesan Loganathan**, CSIR-NIO for his outstanding contributions to the plankton ecology in the context of marine ecosystem functioning in the Bay of Bengal, Gulf of Mannar and the Mudbank phenomena occurring along the southwest coast of India.

Engineering Science Discipline -

1. **Dr Indu Elizabeth,** CSIR-NPL for her significant contributions to the development of Lithium-ion batteries.
2. **Dr Manoj Kumar Patel**, CSIR-CSIO for developing a novel Air-Assisted Electrostatic Sprayer, which has numerous societal and industrial applications.

G N Ramachandran Gold Medal for Excellence in Biological Sciences & Technology 2020

CSIR instituted a Gold Medal in 2004 in the fond memory of Prof. G N Ramachandran, a pioneer of protein chemistry & the founding

father of structural biology in India, for recognising excellence in the interdisciplinary subject/field of Biological S&T.

The G N Ramachandran Gold Medal for Excellence in Biological Science and Technology for the year 2020 has been awarded to **Dr Jaya Sivaswami Tyagi** of All India Institute of Medical Sciences, New Delhi, for her outstanding research discoveries in Mycobacterium tuberculosis dormancy adaptation mechanisms. She has also developed novel technologies for the diagnosis of TB and drug resistance that are relevant to India's National Strategic Plan for TB elimination 2017-2025.

CSIR Innovation Award for School Children 2020

CSIR announced Diamond Jubilee Invention Award for School Children on 26 April, 2002 in order to enhance creativity amongst school children. The day is also celebrated as 'WORLD INTELLECTUAL PROPERTY DAY' throughout the world. The objectives of this competition are to capture creativity and innovativeness amongst school children and create awareness about IPR. From the year 2011 the Award is renamed as CSIR Innovation Award for School Children.

During the last sixteen years, i.e. from 2002 to 2020, 10,996 proposals were received for these Awards from various parts of the country and 136 inventions/innovations were selected for various prizes by High Level Awards Selection Committee.

In the year 2016-2020 the competition has been renewed with an intervening training cum awareness programme. This year 2020, CSIR received 4352 innovation proposals which were screened. Total eleven innovation proposals selected for award. The award comprises a cash prize, trophy and a certificate. The following 15 children awarded for their 11 innovations contain total two second prizes, three third prizes, four fourth prizes and two fifth prizes:

Second prize (Two (02) nos.) (₹ 50,000/- each)

'SUDhAAR': (Improving rural lives) through 'Udhaar' (loans):

Karan S. Soin, a student of class XII, of The Shri Ram School, Gurugram, Haryana, designed a mobile application for the rural masses for easy access to microfinance in the rural areas. This mobile app would assist rural loan applicants by providing easy access to reputable MFIs in their vicinity. It will cater to the applicants with multiple good options on their phone, and make it easier for them to get small loans from these MFIs on the best possible terms, from the comfort of their own village/ home environment, without having to leave their homes unattended or losing working hours. This will be done for one village and 3-4 MFIs as a proof of concept, and later scaled up. Thus, it will not only fulfil unmet needs and serve the rural masses, it will also fill a void in the market which lacks such platforms.

Innovative Easy Tooth Brush

Dhruvi Gupta, a student of class IX, of Amity International School, Sector-6, Ghaziabad, UP, has designed a paper toothbrush using butter paper, impregnated with herbal-formulation. It is easy to store paper tooth-brush which is herbal and cost-effective. It is perfect for travelling, camping, etc. A portable tooth-brush that can fit comfortably in toiletry bags, luggage, backpacks, purses, carry-on bags and fits just about anywhere. It is light in weight and incredibly easy to use.

Third Prize (three (03) nos.) (₹ 30,000/-each)

Bio-Degradable Pots with Groundnut Shells

A. Srija of IX class and **K. Hari Krishna** of VIII class of Zilla Parishad High School, Jogulamba Gadwal, Telangana, have manufactured biodegradable pots with groundnut shells.

These pots are very cost-effective and are a good alternative to plastic pots in nurseries. These are eco-friendly, do not cause any land pollution and take very little time to disintegrate in the soil. These ground shell pots are good for plants also act as organic manure providing macronutrients and micronutrients to the plants.

Eco-Friendly Agri Sprayer

Neha Bhat, a student of class X of Vivekavardhini English Medium High, Thenkila, Puttur, Karnataka, has manufactured an advanced multi- purpose, triple efficient, automatic spraying machine which can be used as a pesticide sprayer, weedicide, and organic insecticide sprayer. This machine neither uses fuel nor electricity. It runs on battery and is eco-friendly. This device saves time and human labour.

Reducing the Carbon Footprint through Innovative Cooking Vessels

Vibha K. Bhat, a student of class VIII of Shri Niketana School, Sirsi, Karnataka, has designed a cooking vessel which can save fuel for the sake of future generation and save time as well as money. The fuel saving cooking vessel has two vessels – an inner vessel and an outer vessel, in which the inner vessel has spirally arranged metal plate outside of it and the inner vessel is fitted in the outer vessel, the outer vessel and inner vessel joined and welded at the top so that the cooking process is made fast.

Fourth prize (four (04) nos.) (₹ 20,000/- each)

Magic Pot-Fluoride Out

P. Harshitha, a student of class X of ZP High School, Penumalli, Krishna, Andhra Pradesh, has prepared a magic pot that reduces fluoride levels in drinking water, thus avoiding the danger of Fluorosis. She has prepared a pot using freely available, eco-friendly, low cost and no- cost materials like black soil, moringa leaf powder, moringa seeds powder, and alum powder. The scientific principle involved in making it is the phenomenon of adsorption. The magic pot is made by mixing alum powder, moringa seeds, or leaf powder along with the soil. This is the simplest and easiest way of de- fluoridation. This can be a boon to the rural people who can't afford expensive filtration units at their homes.

Automatic Waste Disposal in Train

Yash B. Petkar, Sanchi, K. Hisariya, Saniya, S. Shakil students of class XI of Ranglal Kejdiwal High School & Jr. College, Pulgaon, Wardha, Maharastra, have designed an automatic waste disposal dustbin by which garbage will be extracted automatically from the coach to the dustbin. The automatic waste disposal system, wherein a passenger can put garbage into the dustbin set in the train from the berth without any effort and notify the housekeeping personnel to empty it before spilling by sending an alert message.

Post-partum Cup: A novel way to estimate the obstetric blood loss accurately and save maternal life in the golden hour

Archit Rahul Patil, a student of class VIII of Kashinath Palod Public School, Jalgaon, Maharastra, has designed a life-saving, economical, rash-free, and trash-free device made up of silicon cup that measures blood-loss post-delivery in exact and real-time. It gives a quantitative assessment of post-delivery blood-loss. In case of excessive blood loss, it is brought to the notice of the medicos and accordingly, the insertion is carried out thereby saving the lives of mothers in their golden hour.

A Multifunctional Device for Quality Monitoring and Analysis of Drinking Water

Abhijeet Kumar of class X and Arpit Kumar

of class XI of Bihar Bal Bhawan Kilkari, Patna, Bihar, have come up with a filtration device for Arsenic removal from water with zero water wastage. The filtration process uses magnets for the removal of arsenic from water sample. It is a simple and low-cost water filter that doesn't run on electricity and that can be of immense importance for the rural communities.

Fifth Prize (two (02) nos.) (₹ 10,000/- each)

Lung AI: Digital Covid-19 Detector, Lung Cancer and Other Lung Abnormalities

Aryan Gulati, a student of class XII of Delhi Public School, R. K. Puram, New Delhi, has designed a reliable web application that predominantly aims at making Covid-19 detection accessible to all the people within 3-5 seconds. The web application requires a photograph of the affected patient's lung CT Scan or X-Ray of a healthy person to be uploaded. It also aims at detecting lung cancer as well as 16 other common and dangerous lung abnormalities such as Tuberculosis, Pneumonia, Edema, etc. in an accessible manner so that the users may be able to not only diagnose whether they are positive for Covid-19 but also detect what other medical issues they have in the off chance that they have been tested Covid-19 negative.

Free-Air Temperature Increase System (FATI) in Cultivation

Revathy V. Manikandan, a student of class XI of Alphonsa Central School, Kannur, Kerala, has designed a technology to induce canopy temperature artificially without the use of the enclosure. The FATI system consists of infrared heaters. The photo-morphogenetic effects are avoided by using selective cut-off filters. The ambient canopy temperature can be tracked using an electronic control circuit task and the radiant energy can be modulated to produce desired canopy temperature.

CSIR Technology Awards 2020

The CSIR Technology awards were instituted in 1990 to encourage multidisciplinary in-house team efforts and external interaction for technology development, transfer and commercialisation. The awards are given annually and each award carries a cash prize of ₹2 lakh, a plaque and a citation. The "Most Significant CSIR Technology of the Five Year Plan Period" is awarded once in five years, previously coinciding with the erstwhile five-year plan periods, to a technology proven in the marketplace for at least five years and has a cash prize of Rs 5 lakh.

The categories of awards are:

1 Life Sciences
2 Physical Sciences including Engineering
3 Innovation
4 Business Development and Technology marketing
5 Most Significant CSIR Technology of the Five Year Plan Period

The awardees this year were:

- **Life Sciences**

  CSIR-IICT, Hyderabad for outstanding contributions to the affordable healthcare, by developing a novel and cost-effective process for the synthesis of FAVIPIRAVIR to combat Covid-19.

- **Physical Sciences including Engineering (Joint winners)**

  CSIR-NML, Jamshedpur for developing indigenous technology to extract cobalt and gold from the black cathode material of Li-Co batteries and gold-coated surface of e-waste. It is the first indigenous technology for recycling of Co, Au and for recovery of Mn, Cu, Ni, Li, graphite as by-product.

  And CSIR-CLRI, Chennai for developing Zero Formaldehyde High Performance Chromium - Melamine Synthetic Tanning Agent for Greener Leather Manufacturing.

- **Innovation**

  CSIR-NIIST and CSIR-CEERIfor developing

a low-cost multipurpose handheld Raman spectrometer for automated analytical and diagnostic application, particularly for testing of food and pharmaceutical adulteration.

- **Business Development and Technology Marketing**

  CSIR-NAL, Bengaluru for SuccessfulCommercialization of Composite Technology Towards Light Combat Aircraft(LCA) –Tejas IOC series Production.

- **Most Significant CSIR Technology of Five Year Plan**

  CSIR-CSIO, Chandigarh for developing Head Up Display Variants and Associated Test Equipment for Multiple Aircraft Platforms in association with Aeronautical Development Agency (ADA) Bengaluru and Bharat Electronics Limited (Panchkula). The developed Head Up Display variants operates in multiple operational modes while providing vital flight information to pilot in real time via interface with Mission Computer and Up-Front Control Panel.

CSIR Diamond Jubilee Technology Awards (CDJTA) 2019

CSIR launched an annual Diamond Jubilee Technology Award on 26 September 2002 in commemoration of its Diamond Jubilee celebrations to encourage scientists, engineers and technologists to develop innovative technologies and products that are amongst the best in the world and enhance India's image. The award is given to a technology that is developed in the country by Indian innovators and meets the highest global standards. Technologies leading to commercially successful products, processes and services, which give India a sustainable competitive advantage, are considered for the award. The award consists of a cash prize of ₹ 10 lakh, a citation and a shield.

The **CSIR Diamond Jubilee Technology Award for the year 2019** has been conferred on **Tata Chemicals Limited (TCL)**, Pune, Maharashtra for developing innovative technology for the production of 'Fructo-oligosaccharides' (FOS), a sugar-based prebiotic dietary ingredient. This technology cuts processing cost and provides a high yield of pure Fructo-oligosaccharides.

CSIR Award for S&T Innovations for Rural Development (CAIRD) 2017, 2018, 2019

The CAIRD Award, an annual award instituted in 2006, recognizes those outstanding S&T innovations that have helped transform the lives of rural people or generate employment. The award consists of a cash prize of Rs 10 lakh, a citation and a plaque.

- **CAIRD Award for the year 2017** was conferred on **CSIR-IICT**, for development of highly compact, low-cost water purification systems for providing safe drinking water in rural India especially the fluoride affected areas.
- The **CAIRD Award for the year 2018** was awarded to **M/s Watsan Envirotech Private Limited,** Thoraipakkam, Chennai for innovating cost-effective modular toilets to provide rural masses with better sanitation facilities.
- The **CAIRD Award for the year 2019** was given to **Indian Institute of Technology Bombay**, Mumbai for designing a low-cost portable solar study lamp with back up of 6-8 hours for rural school children.

12
Headquarter Activities

12

Headquarter Activities

12.1 Director General's Executive Directorate (DGED)

Augmenting Scientific and Technical staff by strengthening of the human resources at Scientific Directorates of CSIR Headquarters

CSIR vide OM No: No. 6-1(45)/2016-E.III dated 08.05.2020 had put in place a new science technology and innovation structure in CSIR Hq. This led to creation of 6 Directorates namely,Technology Management Directorates (TMD) - Industry Interface (II) and Socio-economic Ministry Interface (SeMI); Central Planning Directorate (CPD); Innovation Management Directorate (IMD); Science Communication and Dissemination Directorate (SCDD); DG's Executive Directorate (DGED). Thus, there was an urgent need to strengthen the Directorates by augmenting Scientific and Technical staff. DGED took initiatives and opened a call for transfer of S&T staff from labs to CSIR Hq and held interviews of the candidates both in Scientific and Technical cadres in a systematic manner. The whole activity was coordinated by DGED end-to-end which resulted in augmenting 11 Scientists and 4 Technical Officers in afore mentioned scientific directorates.

Interactive forums and participative governance through DGED monthly meetings with Directors

DG, CSIR has enumerated the concept of establishing an interactive platform for strategic discussions and participative governance. Accordingly, initiative for conducting DG's monthly meeting with CSIR lab Directors was initiated. During this period of 2020-21, DGED conducted monthly meetings of DG, CSIR with Directors. These meetings also included HOD's from CSIR Hqs, Science communicators and Scientists from labs (with age and gender balance). This activity included identification of important topics for presentation and discussions. Idea of having young scientist's presentations was also implemented during this period. A total of 13 meetings were organized during this period.

Collaborative initiatives by CSIR at various organization through Presentations, speeches etc.

In order to bridge the gaps between CSIR and other dignified universities, collages, corporate offices and eminent organizations, CSIR is always interested to develop linkages with expression of thoughts by delivering presentations, speeches, webinars, seminars, exhibitions etc. DGED assisted in drafting and delivering messages, presentation, speeches for such events/ activities in a time bound period.

India International Science Festival (IISF) 2020

The sixth edition of IISF (IISF 2020) was organized at a grand scale in virtual mode with anticipated participants of around 1 lakh jointly by Ministry of Science and

Technology, Ministry of Earth Sciences and the Ministry of Health and Family Welfare in association with Vijnana Bharati (VIBHA); and was coordinated by CSIR, with CSIR-NISTADS, New Delhi as coordinator.IISF-2020 was organized during 22-25 December 2020 in Virtual Mode withthe theme "Science for Self-reliant India and Global Welfare". Hon'ble Prime Minister Shri Narendra Modi delivered the inaugural address at IISF 2020 on 22nd Dec 2020. Hon'ble Union Minister Dr Harsh Vardhan was also present on the occasion. The event was concluded with the Valedictory address by the Hon'ble Vice President Shri M Venkaiah Naidu on 25th Dec 2020 via video conferencing. DG, CSIR was the Chairman of the Steering Committee of IISF-2020 and DGED undertook the responsibility of facilitating and coordinating IISF activities at CSIR Hqs.DGED facilitated the invitation letters to secrateries for IISF including letters to Members of Parliament (Lok Sabha and Rajya Sabha), Doordarshan, and coordinated weekly meetings and scheduled DG's lectures for various events such as Games and Toys Event, Philosophy and Science Event, Vigyanika Event, Women Scientists & Entrepreneurs Conclave and others.

12.2 Central Planning Directorate (CPD)

CSIR Budgeting and Related Planning

As its major mandate, Central Planning Directorate (CPD) carried the budgeting and related planning for CSIR for FY 2020-21. Additionally, CPD also coordinate the budget allocations as per BE/RE for CSIR for CSIR research activities under FTT/FTC/NCP/FBR and Mission Projects and allocation and release under CSIR Infra Budget Heads for all CSIR laboratories/units/ centers for carried out their infrastructure management and day to day activities.

In view of the Covid-19 pandemic situation, Department of Economic Affairs (Budget Division), Ministry of Finance vide its Office Memorandum F.No.12(13)-B(W&M)/2020 dated 8th April, 2020 and 23rd June, 2020 regarding modified exchequer control based expenditure management under Cash Management System in Central Government for the in QI (April to June, 2020) of 2020-2021 and Q2 (July to September) of FY 2020-21. DSIR / CSIR has been placed under Category (C) with the stipulation that overall expenditure of the department should be within 15% of the BE 2020-21 in both Q1 and Q2. CPD coordinated the CSIR efforts in taking up with the Department of Expenditure to shift the category of DSIR/CSIR from 'C' to "A" by placing the unavoidable expenditure due to obligatory expenses on water, taxes, electricity charges and student Fellowship. Because of this efforts, Ministry of Expenditure allowed the department to incur expenditure 18.2 % of BE in 2nd quarter of 2020-21.Further due to continuous efforts of CPD and the Budget Division, CSIR completely spent its allocations under RE 2020-21.

Detailed Demand for Grants of CSIR for FY 2021-22

CPD prepared the back ground note document for Detailed Demand of Grants (DDG) of CSIR for the year 2021-22. The document provides financial statements, major achievements of CSIR laboratories, outputs and outcomes of Schemes, Different projects and future targets. Also prepared response to Parliamentary Standing Committee on Science & Technology, Environment & Forests and Climate Change, Questionnaire-I and II on the Detailed Demand of Grants (DDG) of CSIR and submitted a consolidated response of DSIR & CSIR to Rajya Sabha Secretariat.

Action Taken Report (ATR) for Department–related Parliamentary Standing Committee on Science & Technology, Environment & Forests and Climate Change on Demands for Grants for FY 2020-21 as per their Three Hundred Thirty-Six Report

Based on the presentation of the DDG for FY 2020-21 of DSIR/CSIR before Department related Parliamentary Standing Committee On Science & Technology, Environment & Forests, Raja Sabha Secretariat gave additional set of recommendations/ observations in its 336th report. CPD prepared the Action Taken Report Note on the recommendations by the Committee.

Activity related to Department-related Parliamentary Standing Committee on Science & Technology, Environment & Forests regarding 'Preparedness to deal with Covid-19 and other Pandemics in future'

The Department-related Parliamentary Standing Committee on Science & Technology, Environment & Forests sought a background Note and a presentation on the subject 'Preparedness to deal with Covid-19 and other Pandemics in future' on 10th July, 2020. CPD prepared the background Note and draft presentation on the subject. Subsequently Verbatim received from the Rajya Sabha Secretariat were corrected and submitted.

Preparedness and Development of Covid-19 Vaccine in India

Department-related Parliamentary Standing Committee on Science and Technology, Environment, Forests and Climate Change has sought the views of DSIR/CSIR on the above mentioned subject. CPD prepared the background Note and submitted to the Rajya Sabha Secretariat.

Inputs on Examination of subject 'Affordability of Cancer treatment' by Department-related Parliamentary Standing Committee on Health and Family Welfare

Rajya Sabha Secretariat sought CSIR comments/ inputs on "Examination of subject 'Affordability of Cancer treatment' by Department-related Parliamentary Standing Committee on Health and Family Welfare". CPD prepared the inputs of CSIR for submission to the said committee.

Merging of CSIR-NISCAIR and CSIR-NISTADS and formulation of new CSIR institute CSIR- National Institute of Science Communication and Policy Research (NIScPR), New Delhi

Ministry of Finance has referred to implementation of the recommendations of Expenditure Management Commission (EMC) on Autonomous Bodies, which highlights the need for periodic reviews of the working of autonomous bodies of Ministries/ Departments with a view to examine the scope for their merger, disengagement, closure or corporatization. In order to undertake the review of CSIR, an autonomous body under DSIR, DG, CSIR and Secretary DSIR has approved a two tier review mechanism, namely at the cluster level and at an apex level. As per Apex Committee proposal and recommendation of thereafter constituted High Level Committee, CPD coordinated the meeting of CSIR-NISCAIR and CSIR-NISTADS and formulation of institute CSIR- National Institute of Science Communication and Policy Research (NIScPR), New Delhi. An Execution Committee (EC) has been constituted for merging of CSIR-Laboratories CSIR-NISCAIR and CSIR-NISTADS as per recommendations given by the High Level Committee (HLC). EC has recommended constitution of four Task Forces namely, I. Administrative Task Force; II. Financial Task Force; III.Scientific Task Force; and IV. Legal Task Force; These Task Forces are mandated to Implement recommendations of High Level Committee (HLC) as per its report and provide directions on the necessary Scientific, Administrative & Financial Resources and setup for the new institute. The agenda item for this merger was presented to the Governing Body of CSIR which in its 195th meeting approved the same. The inauguration of the institute was done by

the Hon'ble Minister of Science & Technology and Earth Sciences, Dr Harsh Vardhan on January 14, 2021.

CSIR Society Meeting

CPD made efforts to get a date for organizing the next meeting of CSIR Society during the reporting period. It also gave its inputs to SCDD for Action Taken on the last Society meeting held on 14thFebruary, 2020.

Supporting CSIR interventions for Mitigation of Covid-19

Covid-19 sample testing

CPD put forth for the proposals for approvals received from 15 laboratories of CSIR to initiate testing of the Covid-19 samples at the institute, while following the complete instructions of ICMR regarding observing strict precautions for sample handling, segregation & disposal of waste, bio-safety issues and reporting of the test results as per the instructions issues by ICMR. This was as per ICMR letter no VIR/4/2020/ECD-I dated 2nd April 2020, the laboratories under DBT,DST,DAE and CSIR were allowed to carry out testing and Secretary of the concerned Department may accord approval to the laboratory for initiation of testing. Accordingly, these laboratories were issued sanction OMs by CPD to permit them to carry out sample testing.

Funding Support to CSIR labs for Covid-19

CPD Coordinated and supported CSIR interventions for mitigation of Covid-19 during the unprecedented time. CPD was the nodal point for issuing the CPD effectively managed the approval and funding process of all such interventions by supporting such projects/ interventions from Headquarter Reserve Fund (HQRF). CSIR intervention for the mitigation of COVID19 was loudly applauded by State / Central Government as well as other stakeholders and beneficiaries. It also enabled numerous technology transfers for the effective fighting of COVID-19 at national level. Facilities like BSL2, Cell Culture and qPCR platform, state-of-the-art porta cabin based BSL-2+, IVD authorized Real Time PCR Machines and numerous other supporting facilities created under these initiatives.

Coordinating design and development of Aarogyapath: National Healthcare Supply Chain Information platform

CPD actively participated in the CSIR intervention for fighting Covid-19.CPD leaded the team under CSIR Supply Chain Vertical to design and develop web portal Aarogyapath. The portal aims to provide real-time availability of critical healthcare supplies and has been launched on June 12, 2020. It was launched by Shri Rajesh Bhushan Officer on Special Duty, Ministry of Health and Family Welfare in presence of DG CSIR, Dr Shekhar C. Mande. Shri Sudhir Garg Joint Secretary, Ministry of MSME and Dr. Vijay Chauthiawale Pharma Sector Expert were guests of honour at this event.

Timely submission of Covid updates to the Office of the Hon'ble Minister

CPD continuously updated status on genome sequencing, sample, testing, repurposing, development of new drugs, products on ventilators etc. to the Office of the Hon'ble Minister of S&T & ES. Important developments on covid sample testing viz., dry swab method developed by CSIR-CCMB, Feluda by CSIR-IGIB were informed to NITI Aayog, ICMR, and the Office of The Hon'ble Minister.

First Meeting of Advisory Board, CSIR

CPD organized the 1st meeting of reconstituted CSIR Advisory Board which was held on August 24, 2020 in a virtual mode under the Chairmanship of Prof. K. VijayRaghavan, Principal Scientific Advisor to Govt. of India. In this meeting, AB was informed about the Restructuring of CSIR headquarters: Science,

Technology and Innovation (STI) Management Structure, CSIR connect with Socio-economic Ministries through different Missions like Floriculture Mission, Aroma Mission etc., Report of Committee on "Re-orientation of CSIR for extending Technological Support to Indian Industry" and CSIR activities on Mitigation of Covid-19 pandemic were presented and discussed.

India International Science Festival (IISF)- 2020

During the sixth edition of IISF (IISF 2020) CPD was totally involved in the approval of the proposal from the Ministry of Finance and the Cabinet Secretary and allocation of funds for organisation of various events. It also coordinated with the office of the Hon'ble Minister for getting the appointments of the hon'ble Prime Minister, Vice- President of India and other important dignitaries. CPD also coordinated with the office of the Hon'ble Minister for organizing the curtain raiser events of IISF 2020 at various CSIR laboratories.

MoU between CSIR, Intel and IIIT, Hyderabad and for NDA with Intel

Country needs digital surveillance data such as camera footage, smartphone location data and credit card purchase records to help trace the recent movements of coronavirus patients and establish virus transmission chains. CSIR is taking support from Intel and TCS to come up with optimum solutions for digital surveillance. CSIR-IGIB will be lead laboratory to implement digital surveillance of coronavirus spread in association with Intel and TCS and also take other CSIR labs like CSIR-CCMB, CSIR-IMTech on board. In this regard, CPD processed a proposal of CSIR-IGIB for signing of Memorandum of Understanding (MoU) to be entered between CSIR, Intel Technology India Private Limited and IIIT Hyderabad (International Institute of Information Technology, Hyderabad with a focus on COVID19 Faster Testing & Sequencing for Research. Along with MoU, a NDA was signed between CSIR and Intel Corporation.

Coordination of CSIR projects entitled "Design, Development and Certification of HANSA-NG" and Development and Certification of 19 seater Light Transport Aircraft (SARAS Mk2)"

CPD coordinated the CSIR ambitious projects namely HANSA and SARAS Mk2. The project HANSA has been completed and has been transferred to TMD-II for ToT to the industry partners and production. SARAS Mk2 has approved for continuation in the 15 FCC and steering committee has been formulated as per the direction of former Hon'ble MoST for monitoring the progress of project under the chairmanship of DG, CSIR and Secretary DSIR.

Coordination of CSIR Units Projects

CPD coordinated projects CSIR Units (CSIR-TKDL and CSIR-URDIP) projects for its effective and timely implementation. Additionally, the CSIR initiatives entitled CSIR Jigyasa and CSIR Skill Development Programme are also coordinated by CPD.

Inputs for Draft Cabinet Notes / EFC/SFC of different Ministries/Departments

CPD acted as nodal point for preparing CSIR inputs/observations to the important Draft Cabinet Notes, Cabinet Proposals, projects/schemes/memorandum of different Ministries/Departments for the consideration of Expenditure Finance Committee (EFC) and Standing Finance Committee (SFC). This note varies in ranges and subject areas and majorly from the fields of Biological, Physical, Engineering, Information and Chemical Sciences and GoI new initiatives like National Research Foundation.

Coordination of CSIR CHAMP project

CPD is coordinating project aimed towards setting up of CSIR HPC, AI & ML Platform

(CHAMP). The project is a much ambitious CSIR with a vision towards setting up CSIR HPC facility with computing power of about 1Peta Flops (peak) from CPUs and about 10 AI Peta Flops (peak) from GPUs and a hybrid HPC and AI/ML software environment for CSIR research activities.

SoP for CSIR Facility Creation Projects

CPD prepared and notified the SoP/ Guidelines for selection, implementation and monitoring of project proposals submitted FY 2020-21 onwards for consideration for implementation and funding under Facility Creation Projects category.

Management of CSIR C-DIS Portal and Providing Data for DARPAN Portal

CPD is managing the C-DIS (CSIR Data Inforgraphics) Portal which is being used PAN CSIR as a centralized system for data collection, coordination and curation. The system is designed and developed in-house by CPD only. Apart from this, CPD is nodal for providing data for Project's / Scheme's KPI information listed on DSIR/CSIR DARPAN Portal. During the year, C-DIS was opened to all scientists and divisions.

Constitution of an Overarching Committee and eight area-wise sub-committees for CSIR Re-orientation

The Prime Minister's Office, in July 2019, had set up a Committee under the Chairmanship of Prof. K. VijayRaghavan, Principal Scientific Advisor to Government of India to look into the re-orientation of CSIR, particularly to focus on seamless industry interface and extending Technological Support to Indian Industry. The committee has made several recommendations for the desired transformation in CSIR to emerge it as a next-gen organization so as to meet the needs of new India and its global positioning in the arena of cutting edge technologies. In order to implement the recommendations of the VijayRaghavan committee, CPD constituted an Overarching Committee under the Chairmanship of Shri S. Ramadorai, Former CEO & MD, Tata Consultancy Services along with eight area-wise sub-committees headed by leading academic and Industrial experts with the approval of the Hon'ble Minister for Science & Technology and Earth Sciences and Vice President, CSIR to deliberate and make actionable and implementable transformative recommendations for desired repositioning CSIR making it a 21st century ready globally competitive organization.

Re-constitution of Research Councils (RCs) of CSIR labs/ Institutes and Introductory Meeting of DG, CSIR with Chairpersons of RCs

The Research Councils (RCs) have been constituted by CSIR for each of its constituent laboratories/ Institutes for a period of three years. Research Council acts as a high level think tank for the laboratory/institute and provides best of direction and vision and helps laboratory/institute to design a road map to achieve it. CPD coordinated the activity of re-constitution of RCs for constituent laboratories/ institutes of CSIR with effect from September 01, 2020 for a period of 3 years. Each RC comprises 10 to 12 high-level eminent scientists and technologists. An Interactive meeting of DG, CSIR with Chairpersons of Research Council of CSIR laboratories/ Institutes has also been organized for the first time by the Directorate on September 28, 2020.

Parliament Questions

Directorate has prepared the suitable responses to Parliament Questions on varied issues such as, Performance of CSIR, R&D Target for CSIR, Annual Reports of CSIR, Green Crackers, Term Loan to Various Companies for R&D, Fund allocation for R&D, State-wise grants for Scientific Research and Development, MoU for Health Research, Covid-19 Pandemic, Covid-19 Bio-repositors,

Vaccine for Covid-19, Genome sequencing test for Covid-19, Research on Medicinal Plants, Research in Ayurvedic Medicine, Herbal Garden, Research on Plant Based Diet, Research on Cow Urine and Dung, Manual Scavenging, Stem Cell Research, Hydrogen Fuel Cell Technology, Oral Antiviral Drug, , Anti-Cancer Drug Drugs as Immunity Boosters etc. During the year, around 145 questions were replied including inputs to DST, DBT, Department of Health, Ministry of Ayush and other ministries.

e-SamikSha

e-SamikSha is an online Monitoring and Compliance Mechanism to fast track the compliance of pending action-points/ proposals /issues/ projects/ schemes/ targets, etc. of various implementing agencies such as Ministries/ Departments/ Organizations of Government of India, State Governments, Autonomous Bodies, PSUs, etc. CPD coordinated e-SamikSha activity and provided CSIR inputs to update information on e-SamikSha portal in the form of ATR on Observation(s)/ Suggestion(s) made in the Cabinet Meetings.

CSIR inputs to PMO on significant events of last six years

PMO sought CSIR inputs related to important events (policy decisions, cabinet decisions, flagship programmes, announcements, foundation stone laid, significant declarations, agreements, legal enactments etc.) of last six years to prepare compendium of events. CPD prepared and complied CSIR inputs comprising details of policy decisions, flagship programmes, foundation stone laid, significant MoU/agreements executed during last six years. The response was submitted to PMO on January 15, 2021.

CSIR inputs to Department of Economic Affairs, Ministry of Finance for preparation of chapter titled 'Science and Innovation' for Economic Survey 2020-21

Department of Economic Affairs, Ministry of Finance sought CSIR Inputs for preparation of chapter titled 'Science and Innovation' in connection with the Economic Survey 2020-21. The chapter will deliberate upon the factors that determine the overall innovation environment in the country and may cover the importance of basic research and its status in the country; initiatives taken to facilitate the development of industry academia; will analyze the Global Innovation Indices of the past 5 years to identify areas where work needs to be done; examine the extant policies on promotion of R&D and compare these with the policies in other prominent economies among others. CPD prepared and complied detailed CSIR inputs related to basic research, translational research, industry connect, intellectual property rights and human resource development etc. The response was submitted to Ministry of Finance on November 16, 2020.

CSIR inputs to PMO on reforms initiated during last six years

CPD continuously interact with PMO for providing CSIR response to various queries. In this regard, CSIR inputs was sought on policy reforms initiated during last six years. CPD prepared detailed CSIR inputs comprising details of significant reforms initiated in CSIR during last six years such as Policy and Guidelines for accepting and utilization of Contributions/ Grants/ Donations from Corporates/ Industries under Corporate Social Responsibility (CSR), Guidelines for Ethics in Research and in Governance, CSIR Research Fellowships, Revisiting of CSIR Guidelines for Technology Transfer and Utilization of Knowledgebase, Procurement Reforms in CSIR: CSIR Manual for Procurement of Goods 2019 and submitted the same to PMO.

12.3 Innovation Management Directorate (IMD)

Innovation Management Directorate (IMD) is an integral component of CSIR Headquarters entrusted with the responsibility of achieving the mission and vision of CSIR through well-crafted Mission Mode Projects and New Millennium Indian Technology Leadership Initiative (NMITLI) Program.Some of the contemplated initiatives of CSIR that is being handled by the IMD include:

- Leveraging Science, Technology, and Innovation)STI(for meeting the needs of the country and economic value creation: Focused, Benchmarked R&D and Technology Development efforts through CSIR Mission-mode Projects; and
- Enhancing Industry Partnerships: Through public-private partnership projects under CSIR-NMITLI to accelerate technology deployment and commercialization at a large scale.

New Millennium Indian Technology Leadership Initiative (NMITLI) Program

As per the procedure in place, CSIR invited R&D proposals from Indian Industries through a press advertisement in National Dailies under the CSIR-Industry Originated Proposals (IOP) category. 58 R&D concept proposals were received from Indian industries. These were put through the rigorous process of screening at 4 levels. At the final level of HPC, a total of

S.No.	Title of the Project
1.	Development of a Point of Care NGS Platform for Molecular Diagnostics: M/s bigtec Pvt. Ltd., Bengaluru
2.	Development of Innovative Eco-Friendly / Formaldehyde Free Fluorescent Pigments for vast Array of Water and Solvent based Applications: M/s Aron Universal Ltd., Bangalore
3.	Development, Manufacturing, and Marketing of Micro Raman Spectrometer System with Additional Capabilities of carrying out Photo-Luminescence Spectroscopy and Optical Emission Spectroscopy: M/s TechnoS Instruments, Jaipur
4.	Novel DPP IV Inhibitors for the treatment of Diabetes – Phase III Clinical Studies: M/s Cadila Pharmaceuticals, Ahmedabad
5.	Post Clinical Trial follow up study for CSIR-NMITLI Dental Implants: MAIDS, Delhi and IIT Delhi
6.	Development of novel anti-stroke phytopharmaceutical formulation from the roots of a Ashwagandha variety, NMITLI-118:CSIR-CDRI and CSIR-CIMAP
7.	Industrially scalable Ashwagandha ***(Withania somnifera)*** charged formulation for better health:CSIR-CDRI and CSIR-CIMAP

10 project proposals (6 Project Proposals out of 58 + 4 more based on the lead received from the existing projects) were considered by the designated High Powered Committee (HPC). The HPC recommended the above 7 projects which are now at various stages of approvals and launch.

CSIR Mission Projects

CSIR has initiated and launched several Mission Mode Projects (MMPs) to put concerted and sustained efforts in an identified area by synergizing the best competencies available in various CSIR Laboratories. The time targeted effort(s) as missions are planned to enable CSIR to cross the threshold of the intellectual barrier to deliver scientific, industrial, and social goods. Within mission mode, each project has clearly defined objectives addressing the unmet need, import-substitution, timelines for milestones to be achieved, measurable outcomes and services as well as the stakeholder partnership for the commercialization of the product/technology developed.

A Top-Down approach has been adopted for the identification of new ideas/concepts under these Mission Mode Projects. The major factors considered to be addressed in these missions are national needs, ongoing national missions, the priority of the government. Here, CSIR's strength and leads available with the national laboratories of CSIR could play a significant role in realizing the goals set.

Mission projects are focused on a particular area in a concerted way with the ultimate aim of designing, developing deploying products and technologies with stakeholder's support addressing an unmet need and import substitution under the *'Atmanirbhar Bharat'* initiative of the Government of India.

Medical Instruments & Devices Mission: This CSIR-Mission Mode Program on "Medical Instruments & Devices" has been formulated to take lead in the manufacturing of high-end medical devices in the country. High-end medical devices are mainly manufactured by multinational companies and mostly imported. In present government policies, the main thrust should be on reducing the import dependency by manufacturing even high technology medical devices in India.

Indigenous Li-Ion battery production and setting up of 100 MW manufacturing Plant: CSIR in May 2020 has launched a Mission Mode Project on the "CSIR Innovation Center for Next Generation Energy Storage Solutions (ICeNGESS)". Two of its constituents' laboratories, CSIR-CECRI, Chennai Center, and CSIR-CIMFR, Dhanbad have joined hands together to come up with a manufacturing plant within a short period of 2 years. This pilot plant manufacturing facility at the Innovation Center will be the first of its kind in India. CSIR-CECRI will be able to produce LIB cells of different configurations and transfer the technology to Indian Industries to meet out the societal demand. A process for involving an interested industry is on as of now.

Bulk Chemicals: Globally, bulk chemicals are the most traded chemicals (in terms of volume) and are the building blocks for a host of products. With the increase in industrial activities, the demand for chemicals has also increased, which has resulted in higher international trade. Through the mission project on Bulk Chemicals, CSIR has pitched in with its diversified expertise and portfolio, thereby, generating a knowledgebase in the area of bulk chemical production. The project is led by CSIR-NCL, Pune, and focuses on the development of technology for production of Lithium from ores; Critical metals from used Li-ion battery; Propylene Oxide; High-Value Aromatics; Carbon Fibers from Petroleum Pitch Precursors and Coal Resin; DCDA; Cyclohexanone Oxime from Cyclohexanone; and Bisphenol-A.

Development of Advanced Materials

and Devices for Opto-electronic, Biomedical, and Strategic Applications: The mission project aims to develop new materials and undertake the associate research required to mature their application in the deliverable device/prototype/product for cutting edge applications, by the cohesive multidisciplinary R&D efforts of CSIR laboratories. It is specifically focused on advanced optoelectronic materials, meta-materials, bio-implants, and un-conventional composite materials and their device development, which are expected to make a big technological intervention and their outcome can set forth the translational outcome in the subsequent years to come.

The multifaceted outcome of the project will lead to many technologies for optoelectronic, healthcare (e-skin), bio-implant, armor, automobile, and other applications. All of these technologies will immensely contribute to the self-reliance of the nation and have good market potential. The project is led by CSIR-IMMT, Bhubaneswar.

Aerospace Materials and Technologies: The Mission comprise 3 major work components that include: 1) Advanced Aerospace Materials; 2) Advanced Functional Coatings; and 3) Structural Health Monitoring of Composite and Metallic Structures the mission project aims to develop Light Weight aerospace materials, Ceramic and Metal Matrix Composites, Thermoplastic Composites, Multifunctional Smart Materials and Composite Structures, and Special Coatings. The research on aerospace materials is primarily focused on weight reduction, performance improvement, reduced cost, and newer efficient processing technologies. Under the aerospace technologies, it is envisaged to develop technologies for health management of metallic and composites structures. There is a huge potential for aerospace materials and SHM technologies. All of these technologies will immensely contribute to the self-reliance of the nation and have good market potential. The outcome of this project will lead to aerospace materials and technologies. The project is led by CSIR-NAL.

Contributions to Covid-19 Mitigation

The unprecedented situation arisen due to the Covid-19 pandemic has posed multifarious S&T challenges. CSIR has responded to the situation with a well-coordinated and integrated approach in cooperation with all relevant stakeholders. Innovation Management Directorate (IMD) at CSIR has been contributing to the fight against coronavirus through projects under NMITLI, Mission Project, Direct funding of laboratories with MLPs, and a unique Public-Private-Partnership project for indigenization of reagents manufacture used in RT-PCR tests.

Contribution through New Millennium Indian Technology Leadership Initiative (NMITLI) Projects

Considering the gravity of the situation posed by coronavirus, CSIR had given a special call for projects from the Indian Industry to provide multi-pronged interventions. The proposals were invited in any one of the following areas related to the coronavirus:

(i) Faster and Cost-effective Diagnostics;

(ii) Ventilators and other assistive devices related to treatment; and

(iii) Fast Track Clinical trial of Repurposed Drugs.

CSIR received about 230 proposals. After rigorous scrutiny and assessment at multiple levels, the following 6 projects have been sanctioned for implementation:

S. No	Title of Project
1.	Generation of neutralizing human monoclonal antibodies against the SARS-Cov2 virus as a therapeutic strategy to contain the Covid-19 pandemic

2.	Development of Mycobacterium W for Covid-19: Safety and Efficacy Trial in critically ill hospitalized and at-risk patients
3.	Development of Ayurveda based botanical drugs for prophylaxis and management of the New Corona Virus Disease (Covid-19)
4.	Dev. of an inactivated SARS-CoV2 vaccine for Covid-19 (ICoV2Vac)
5.	Design and Development of a portable personal Air Purifying Respiratory Device
6.	Development of an accurate, affordable point-of-care diagnostic kit for Covid-19

Truenat for Point of care Covid-19 detection

CSIR-NMITLI had supported the development of the Truenat (MicroPCR) device which is used for the diagnosis of many diseases. The device now tests the presence of corona infection. A multiplex assay combining E-gene screening and Orf1a-gene confirmatory assay has been developed by the company and validated by ICMR. This assay exhibited 100% sensitivity and specificity, and positive and negative predictive value when compared with the gold-standard RT-PCR test. A total of 2530 Truelab workstations are currently operational at 1008 sites in 530 districts of India. More than 3 million tests have been run on Truelab workstations so far. This innovative affordable Covid-19 testing platform has been a game-changer for testing in primary health care facilities of the country and quick testing in emergency departments of health-care facilities in India.

Mycobacterium W for Covid-19- Clinical Trial

CSIR and Cadila Pharmaceuticalshave received regulatory approval for conducting clinical trials to evaluate the efficacy of an existing gram-negative sepsis drug, called Sepisvac for COVID19 patients. The drug contains heat-killed Mycobacterium (Mw) and is found to be extremely safe in patients and no systemic side effects are associated with its use. Sepsivac has been clinically developed and approved for gram-negative sepsis, a severe infection under one of the earlier NMITLI Project. The drug has been shown to reduce the mortality of critically ill patients by more than half. It also leads to faster recovery of organ dysfunction seen in this condition. It is now approved for marketing in India and is available commercially as Sepsivac® from Cadila Pharmaceuticals Ltd. The drug now is being tested in three different trials to combat Covid-19, i. on critically ill Covid-19 patients, ii. hospitalized (but not critically ill) Covid-19 patients, and iii. high-risk contacts of Covid-19.

Human Monoclonal Antibodies for Covid-19 Therapy

Hyderabad based Bharat Biotech International Ltd., leads a CSIR-NMITLI supported project to develop human antibodies for Covid-19 therapy. CSIR has sanctioned a project led by Bharat Biotech International Ltd, to develop human monoclonal antibodies as therapy for Covid-19 infections. The project brings together both academia - National Centre for Cell Science (NCCS), Pune, and Indian Institute of Technology, Indore and industry - PredOmix Technologies Pvt. Ltd, Gurgaon and Bharat Biotech International Ltd., Hyderabad in a collaborative mode for a public cause.

Several efforts are underway for the development of drugs and vaccines for controlling the Covid-19 pandemic. However, an alternate therapeutic regimen for early deployment is critical. The present project aims at an alternate therapeutic regimen

by generating highly effective and specific human monoclonal antibodies that are capable of neutralizing the SARS-CoV2 virus. Such virus-neutralizing antibodies can block the spread of infection by binding to the virus and rendering it ineffective. Monoclonal antibody therapy is a highly effective and safe method.

The company is fast-tracking the development process, to make the antibodies available within the next 6 months and intends to develop it as a nasal spray to deliver directly to the respiratory tract, which is the primary site of SARS-CoV2 infection and thus improve the treatment efficacy.

Contribution through Mission Mode Projects

CSIR is implementing Covid API Mission for a short duration of nine months. The main objective of the mission is to make available the cost-effective process know-hows for APIs to treat Covid-19. As a deliverable of the project, practical and scalable processes for selected APIs are being developed. These processes shall be licensed/transferred to pharmaceutical industries to ensure access to these pharmaceuticals at affordable prices. The list of APIs being developed is Centhaquin, Umifenovir, Tilorone, Baloxavir, Saquinavir, Remdesivir, Dalargin, KSMs-Hydroxychloroquine, Ribavirin, EIDD-1931, Phosphonate Fragment of Remdesivir, Barcitinib, Ruxolitinib, Lopinavir-KSM, Ritonavir -KSM, EIDD 2801, and Galidesvir. CSIR laboratories participating in the Mission are CSIR-CDRI, CSIR-IICB, CSIR-IICT, CSIR-IIIM, CSIR-NCL, CSIR-NEIST, and CSIR-NIIST.

Contribution through MLP Projects

With a view to further strengthen its efforts for mitigation of coronavirus, proposals were invited from CSIR labs for achieving breakthrough innovation. The initiative was aimed at addressing the challenge by restricting and controlling the spread of coronavirus on one hand and treating and curing those infected on the other. The call was in the area of Diagnostics, Protective Gears, Drugs and APIs, and vaccine for Covid-19. In response to the call and with special efforts of CSIR Strategic Group, the following 36 projects are under implementation.

S.No.	Vertical name	Number of projects
1	Rapid and Economical Diagnostics	13
2	Digital and Molecular Surveillance	04
3	Hospital Assistive Devices and PPEs	06
4	Repurposing of Drugs	13

A long-term longitudinal observational cohort study of health outcomes-Preparatory Phase

The objective of the project was to ascertain the burden of Covid-19 using a serology-based assay that can distinguish SARS-CoV2 from other similar viral infections and to determine the antibody titers at various time intervals.

CSIR-IGIB conducted the studies and analyzed 10,029 samples collected from across the CSIR laboratories for the presence of Covid Antibody. City wise and lab wise seroprevalence was conducted. It was observed that the maximum number of CSIR labs and centers had seropositivity greater than 10 percent which is still insufficient to account for herd immunity and anticipated fall of cases shortly because of herd immunity. The densely populated cities had seropositivity from 12 percent to ~18 percent, while, low-density cities were observed to have minimum seropositivity.

Results of neutralization assay for 29 labs are in confirmation of the seropositivity. It was also observed that while antibody titers rise with time, neutralizing antibody levels fall. This is an important insight concerning the current pandemic situation in monitoring and surveillance strategy and policymaking.

INtegrative GENomics of Covid-19 (INGEN-CoV2)

The objective of the project was to analyze the genome sequence of Indian SARS-CoV-2 isolates to understand the virulence, transmission, and infectivity of Covid-19, Understanding the host genetic variants and their role in progression, severity, and prognosis of Covid infection, studying the host response through whole Transcriptomics Analysis by RNA sequencing and metagenomic analysis to study co-infections as co-morbidity factors during Covid infection.

Under the RT-PCR activity, 4000 additional samples have been tested by RT-PCR and are continuing. With regards to the sequencing of viral isolates, sequencing of 200 samples have been done by CSIR-IGIB from re-infection cases, where 2 pairs have been identified and published, 6 pairs are in collaboration with Mumbai hospital, and is under review & 1 pair in collaboration with NCDC. CSIR-CCMB has to date sequenced 221 viral genomes & deposited 536 SARS-CoV2 genomes in GISAID.

Transcriptomes of individuals from various groups of susceptibility/prognosis including those which are Covid positive and negative sequenced by IGIB (50 transcriptomes done) and CCMB (70 transcriptomes done). Additional control samples awaited to complete the analysis through transcriptome sequencing under CSIR-IGIB.

Under Metagenomic studies for comorbidity factors, CSIR-IGIB is working on to identify the role of co-infection in delineating Covid-19 clinical outcome. The analysis is at an advanced stage with a manuscript target in 2 weeks. Holo-transcriptome analysis for coinfections completed. CSIR-CCMB performed 90 RNA metagenomes on swab samples of patients with relevant clinical data. CSIR-CCMB has sequenced 57 host genomes so far from a mix of asymptomatic and symptomatic individuals.

This study also reports two viral lineages B.1.112 and B.1.99 for the first time in India. It has also revealed 1,143 unique single nucleotide variants and added a total of 73 novel variants identified for the first time. Whole-genome sequencing of the eight SARS-CoV-2 viral samples generated a genome coverage ranging from 82.55 to 98.23%. Phylogenetic analysis revealed that sequences belonged to the L clade and within this major clade; they clustered into India-specific A2a and A4 clades.

Testing for Covid-19 in wastewater as a community surveillance measure

The objective of the project is to establish a viable protocol for Surveillance and Wastewater based Epidemiological Studies of Covid-19 in Hyderabad as a model urban setting. Institute has prepared SOP for sample collection and storage. The raw sewage samples were collected from inlet and outlet points from the STPs with total coverage of 712 million liters per day (MLD), which receive wastewater from all parts of the city (80% coverage of the existing STPs). All the required analyses to detect SARS-CoV-2 RNA were performed, such as the effect of the addition of Sodium Hypochlorite, Kit efficiency, estimation of viral RNA copies, and an approximate number of people infected from the total population of Hyderabad. Based on the detected viral gene copies per liter and average viral particle shedding per individual, the total number of individuals exposed to SARS-CoV-2 (in a window of 30 days) is estimated to be about 3% to 17% of the total population. Based on the study it is suggested that sewage-based surveillance is an effective approach to study the infection dynamics, which helps in the efficient management of the SARS-CoV-2 spread.

SwasthVayu: Non-Invasive BiPAP Ventilator on Covid-19 Patients

CSIR-National Aerospace Laboratories (CSIR-NAL), Bangalore has indigenously developed the "SwasthVayu" Non-Invasive BiPAP Ventilation Device in a record time of 36 days. The device is an ideal bridging solution for patients of moderate to severe respiratory distress who may be amenable to management with non-invasive ventilation outside ICU to avoid load on already resource scare ICU health care infrastructure.

The device has completed clinical trials to treat mild to moderate Covid-19 patients at Command Hospital, Bangalore; Mysore Medical College & Research Institute, Mysore and Jubilee Hospitals, Hyderabad. The device has been used on more than 50 Covid-19 patients successfully and patients maintained SpO2 97-98% on SwasthVayu. The device has completed all the safety calibration and performance trials at NABL accredited Laboratories. The clinical trials report has been submitted to DGHS for evaluation by Expert Committee and the Expert Committee Chaired by DGHS has approved the use of SwasthVayu device for the mild Covid-19 patients. CSIR-NAL has transferred the technology to M/s. Apollo Computing Laboratory under a license agreement and they can produce about 500 units per week.

Convalescent Plasma Therapy

The U.S. Food and Drug Administration has approved the use of convalescent plasma therapy as an experimental treatment in clinical trials, and for critically ill Covid-19 patients without other treatment options. The therapy, which takes antibodies from the blood of a person who has recovered from a virus and transfuses those antibodies into a person sick with that virus, has long been used as a way to help kick start a person's immune system.

CSIR-IICB, Kolkata is working on plasma therapy. The trial is registered with the Clinical Trial Registry of India (CTRI/2020/05/25209). The trial has been approved by CDSCO. Convalescent plasma (COVID Plasma) was collected from 50 recovered Covid-19 patients at the Department of Blood Transfusion, Medical College Hospital, Kolkata. A dedicated 'Epidemic Immune Monitoring Lab' has been set up at the Salt Lake Campus of CSIR-IICB. Biological samples, rendered non-infectious at source by the investigators themselves, were brought in for flow cytometric analysis, antibody titer analysis, multiplex cytokine analysis, peripheral blood gene expression analysis, fecal DNA isolation, and bio-banking of nasal swab samples in Trizol. 40 patients have been recruited in the control arm and treatment arm each. The results are awaited.

Development of Drug-target based Assay platforms and screening against Covid-19

Considering the pandemic situation due to Covid-19, enormous efforts are being made to identify lead drug candidates either through drug repurposing or by the identification of new chemical entities. This important activity requires the establishment of Drug-target based Assay platforms and screening against Covid-19. Presently, among the participating laboratories (CSIR-CDRI, CSIR-IICT, CSIR-NCL, CSIR-IMTech, and CSIR-IICB), purified targets like m-pro, PL-pro, RNA-dependent RNA polymerase, and Spike-ACE2 are available. The purification of the proteins and assays are being standardized across the laboratories. The participant laboratories are further establishing platforms to address host-pathogen interaction and immune-modulatory functions, in addition to other targets, to screen new compounds & approved drugs to accelerate the development of therapeutics against Covid-19. Thousands of compounds are being screened using the assay systems for the development of new antiviral chemical entities as well as for drug repurposing as anti-virals and host-pathogen interactions including immunomodulation.

CSIR Call in PPP mode to make India self-reliant in RT-PCR and Serological Testing for Coronavirus

Real-time reverse transcription-polymerase chain reaction (RT-PCR) assay is used to rapidly detect the SARS-CoV. RT-PCR assay requires several reagents to do the tests. Most of these reagents are imported and are available in limited quantities in India. There is also a need for substitutes for RT-PCR-based detection of nucleic acids as a diagnostics approach. Besides, there is a great need for serological testing. Such tests will be useful for late and post-infection status at population/ area scale for surveillance and monitoring which will help in key decision making by the government.

Extending support to the Indian industry to make these reagents in India, CSIR has launched a project in PPP mode to make India self-reliant in RT-PCR and Serological Testing for Coronavirus. CSIR-CDRI, Lucknow and Biotech Desk Pvt. Ltd., Hyderabad have entered into an agreement on 27th October 2020 for jointly working on a project entitled "Production of Indigenous qRT-PCR (INDI-FluorAMP) kit for testing COVID-19 with Make-in-India ingredients".

The company plans to develop a multiplexing qRT-PCR based kit for the detection of Covid-19 using all the components of the kit being manufactured in India. The kit could be used as a single reaction multiplexing or a combination of different singleplex reactions. CSIR-CDRI is developing its own fluorophore/ quencher technology, which can be used in TaqMan probes used in the Covid-19 qRT-PCR kit. The quencher technology being developed under the project is unique and being tried for the first time.

12.4 Technology Management Directorates - Industry Interface (TMD-II)

CSIR Technology Award (CTA) 2020

CSIR Technology Awards (CTA), instituted in 1990, seek to foster and encourage multi-disciplinary in-house team efforts and external interaction for technology development, transfer and commercialization. These awards are in the categories of Life Sciences, Physical Sciences including Engineering, Innovation, Business Development and Technology Marketing; and Most Significant CSIR Technology of the Five Year Plan Period. The awards under the first 4 categories are annual and carry the cash prize of Rs. 2 lakh each, Award for the "Most Significant CSIR Technology of the Five Year Plan Period" is awarded once in five years and carries a cash prize of Rs. 5 lakh. In case of joint winners, both receive the cash prize in full. The nominations are sought from constituent CSIR laboratories under above mentioned categories. The selection of the Winners is done by Technology Award Selection Committee constituted by DG, CSIR. TASC comprises Members from CSIR Advisory Board and subject experts (outside CSIR). This year the call for receiving nominations was made in April 2020. About 30 nominations were rceived which were evaluated by TASC at its meeting held on September 8,2020. The details of Winners of CTA for the Year 2020 in various categories are provided in Chapter 11, Section 11.2.

Indian Oil CSIR Research Fellowships

Besides its flagship NET scheme, CSIR has taken steps to partner with industry to start Industry supported research fellowship (Ph.D. level). The objective of the initiative is to co-create/ co-develop Ph.D. level manpower with expertise / skill sets needed by industry/ industry relevant issues. Under the partnership, CSIR and industry will jointly

identify research areas / topics of mutual interest and fellows required. The selected fellow(s) will carry out work both at CSIR lab as well as industry under Guide / Co-Guide art respective places. The financial support will be provided by the Industry to such selected fellows. In this regard, CSIR has entered into an MoU with Indian Oil on May 4, 2020 for supporting Research fellowships (Ph.D.level) from Academic year 2021-22. The initiative, being implemented as a GAP project, will support up to 10 fellows annually.

On similar lines, CSIR is exploring partnership with other leading Indian organisations to co-create/ co-develop Ph.D. level manpower in different areas of S&T.

Societal Portal

CSIR Societal Portal was launched by Honorable Minister of Science & Technology on 4th March 2021. The objective behind the portal launch is that expectations of the society from scientists are ever growing and rightly so given the transformative power of S&T. CSIR is committed to utilize its scientific strength and meet the expectations of the country. While India has made commendable progress thus far, there are still many challenges facing the country which could be solved through S&T interventions. CSIR would like to identify such problems / challenges and find a solution. This portal is the first step in that direction to seek inputs on challenges and problems from different stake holders in society.

CDJTA Awards

CSIR launched an annual Diamond Jubilee Technology Award on 26th September 2002 in commemoration of its Diamond Jubilee celebrations. It was launched in recognition that mere investments in creating enabling infrastructure and support systems are not sufficient for achieving cutting-edge technological breakthroughs but also continuous encouragement need to be provided to potential inventors and innovators to unleash and realize their creative potential. The award details are available in Chapter 11, Section 11.2.

Headquarter Coordinated Project (HCP)

Headquarter coordinated projects (03 Nos) in area of Cancer and Drug IND Mission. The projects were screened by screening committee.

Details of Projects

1)Indian Breast Cancer Genome Atlas

Nodal Lab: CSIR - IGIB

Participating Labs/ Hospitals: CSIR - CCMB, CSIR – IMTech, CSIR – IICB

The work proposed here shall help in understanding the multidisciplinary roles of genomic, epigenomic and immunological factors in Indian breast cancer patients. The work, in segments shall open up new avenues for identification of new biomarkers and therapeutic development.

2) Progressing CSIR molecules for filing Investigational New Drug (IND) Application

Nodal Lab: CSIR-IICT

Participating Lab: CSIR-IICT, CSIR-CDRI, CSIR-IIIM, CSIR-NIO. New CSIR laboratories may participate in future once new molecules enter in the drug discovery pipeline.

The following outcomes are envisaged in the proposal

- Three IND applications will be filled.
- CSIR's drug discovery pipeline will be strengthened by progressing more molecules towards IND and pre-IND category.
- Drug discovery is very dynamic process and is governed by "go/no-go decisions". The progress of molecules will be monitored regularly and go/ no-go decisions from expert committee will guide the further progression of

molecule towards the IND filing.

- The new molecules will appear in 2nd or 3rd year and new CSIR laboratories will be added to this programme.

3) PAN CSIR Cancer Research Program; Making Cancer CareAffordable

Empowering Women's Health: Focusing on Breast and Gynaecological

Cancers of Indian Relevance

Nodal Laboratory: CSIR – CDRI

Participating Laboratories: CSIR – IICB, CSIR – IIIM, CSIR – IICT, CSIR – IMTech, CSIR – IGIB, CSIR – NCL

12.5 Technology Management Directorates - Socio-economic Ministry Interface (TMD-SeMI)

The **Technology Management Directorate – Socio Economic Ministries Interface (TMD-SeMI)** aims at streamlining organization, coordination, and management of all such dynamic technology management activities of CSIR laboratories which requires coordination and interaction with socio economic ministries. All activities of TMD-SeMI converge towards socio economic development of the country.

The Directorate interfaces and helps form organic linkages between CSIR laboratories and different ministries for technology development and deployment of the developed technologies on the ground even in remotest areas. By doing so, TMD-SeMI strives to leverage developed technologies to provide high quality technology based products/ solutions/ services as well as competitive advantage to citizens of the country.

The technology roadmap of TMD-SeMI is dynamic, in keeping with the change in market needs and on-ground requirements. TMD-SeMI is working on sector-specific Technology Projects portfolio (technology projects under development) and technology portfolio (technologies in use) for use by Ministries in the socio-economic sector.

TMD-SeMI is thus mandated for end-to-end networking with Socio-Economic Ministries and Other Relevant Organizations on the one hand; and implement Missions of Societal Relevance, CSIR-Harnessing Appropriate Rural Interventions and Technologies (HARIT), Niche Creating High Science/ High Technology Projects (NCP) and Focused Basic Research (FBR) Projects (planning, financial management, implementation, monitoring, and closing), lab centric projects, CSIR Award for S&T Innovations for Rural Development (CAIRD), vital activities pertaining to CSIR Theme Directorates, Themes and Sub-verticals, including new assignments, on the other hand.The Directorate works in conjunction with Technology Management Directorate - Industry Interface.

12.6 Intellectual Protection Unit (IPU)

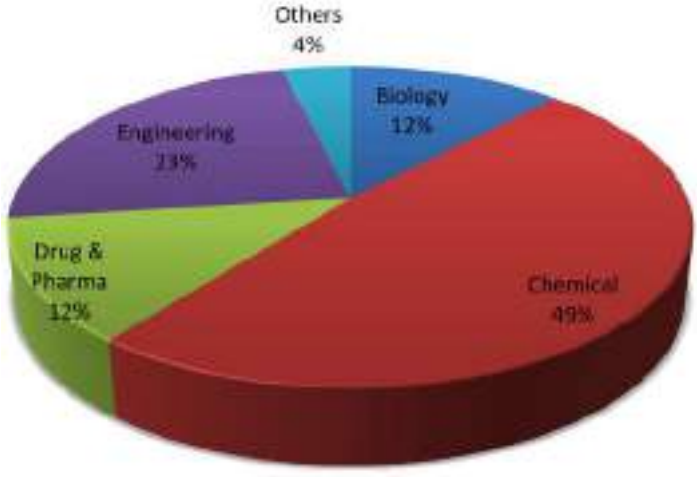
CSIR is pioneer in India's intellectual property movement. CSIR is strengthening its patent portfolio to carve out global niches for the country in select technology domains. Since inception, CSIR has filed 12218 Patent Applications in India and 11794 Patent Applications abroad including PCT, USA, Europe, China, Japan, Australia, Canada, South Africa, South Korea etc. CSIR is a leader in terms of filing and securing patents worldwide.The IPU is a centralised facility of CSIR to protect the intellectual property rights at national and international level for the results of important R&D carried out in the various CSIR Laboratories. The activities encompass protection of all types of intellectual property generated in CSIR that include patents, trademarks, design, copyrights, plant patent, plant varieties, software patents, etc. IPU plays a critical role

in providing valuable inputs to the IP clauses for the MoU/Agreements. IPU has also played a significant role in creating the IP awareness across CSIR Laboratories through Seminar, Symposium and webinars in association leading IP firms and Patent Office India.

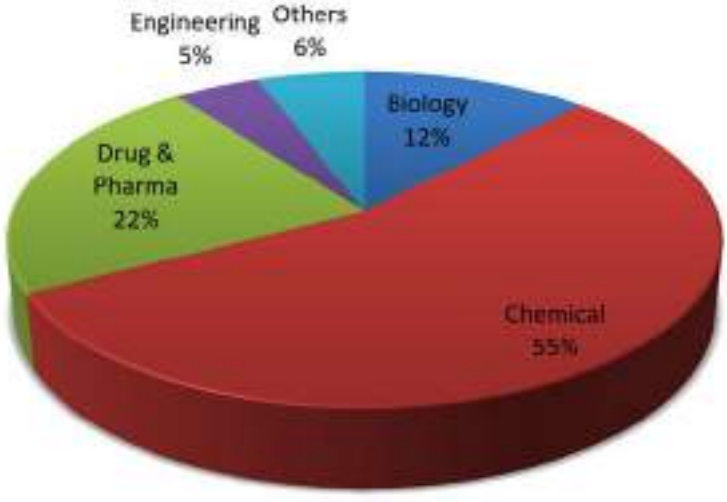
CSIR Patent Applications Filing and Grant of Patents

CSIR has been actively involved in filing, prosecuting and obtaining patents in India and abroad. CSIR has filed 174 patent applications in foreign countries and 208 patent applications in India in various technical fields during 2020-21.

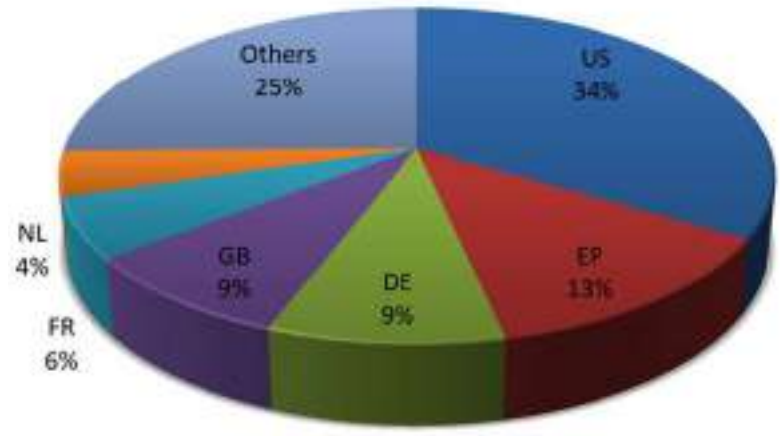
CSIR Patent Applications filed in India (2020-21)



CSIR Patent Applications filed Abroad (2020-21)



CSIR Patents Granted abroad (2020-21)

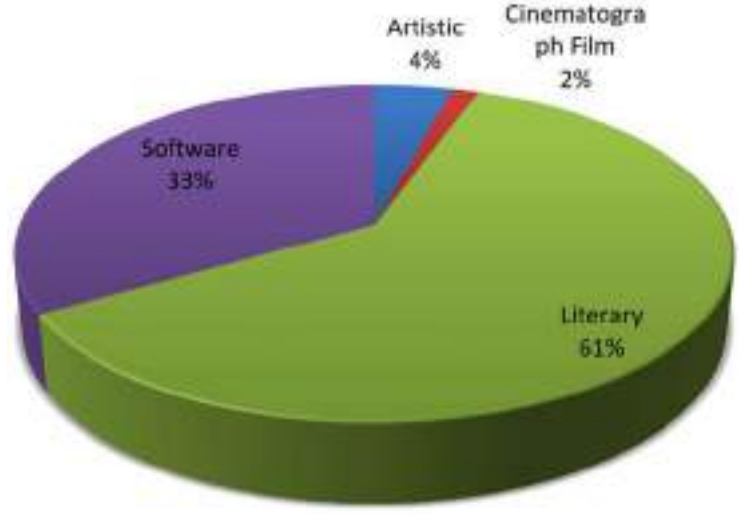


CSIR is granted 206 patents in foreign countries and 318 patents in India in various technical fields during 2020-21. The patents are broadly filed in US, Europe with maximum filing in the area of Chemical Technology.

Other IP Rights

CSIR has filed 72 Copyright applications during 2020-21. The Copyright applications filed by CSIR subsist in different categories such as literary work, software and artistic work. The copyright applications were filed for various classes of works generated by various laboratories of CSIR.

CSIR Copyright Applications filed (2020-21)



CSIR also filed 11 Trademark applications and had successfully registered 7 trademarks; further CSIR has filed 13 Design Applications and had received the grant to 10 Designs.

CSIR Innovation Award for School Children-2020

CSIR announced Diamond Jubilee Invention Award for School Children on 26 April, 2002 in order to enhance creativity amongst school children. The day is also celebrated as 'World Intellectual Property Day' throughout the world. The objectives of this competition is to capture creativity and innovativeness amongst school children and create awareness about IPR. From the year 2011 the Award is renamed as CSIR Innovation Award for School Children. During the last sixteen years, i.e. from 2002 to 2020, 10,996 proposals were received for these Awards from various parts of the country and 136 inventions/innovations were selected for various prizes by High Level Awards Selection Committee.In the year 2016-2020 the competition has been renewed with an intervening training cum awareness programme. In year 2020, CSIR received 4352 innovation proposals. After screening eleven innovation proposals were selected for award. The award comprises a cash prize, trophy and a certificate. 15 children were awarded for their 11 innovations contain total two 2nd prizes, three 3rd prizes, four 4th prizes and two 5t h prizes. The detailed list of the prizes and the awardees are provided in Chapter 11, Section 11.2.

12.7 Unit for Research and Development of Information Products (URDIP)

Clinical and pre-clinical data related to heptoprotection and Tuberculosis

Provided full report on clinical and pre-clinical data related to heptoprotection and Tuberculosis on the various plants to the CSIR Team who may further collaborate with Ministry of Ayush.

Aroma Mission

Value added informatics services and IP support are being extended to the CSIR-Aroma mission. The activities carried out by CSIR URDIP provided a commercial overview on trade and pricing of essential oils.State of the art and patentability reports helped partner labs in R&D planning and filing of patents.

Bulk Chemicals Mission

- State–of–the–Art patent landscape as per the requirement from each of the Bulk mission work package (WP1–W9).
- Patentability assessments of the proposed process/products highlighting any patent protection opportunities.
- Freedom–to–Operate (FTO) evaluation of the product/final process, based on the information shared by inventor(s).
- Market overview information based on the available secondary data for each of the work package components of the mission.
- Market overview information completed and shared with the labs included Provided the following details for WP1/2, WP5/6, WP7/8/9.Application Specific Segments, Segment by source type,Production /Consumption details, Market–Region Specific, Market size by Application, Key Market Players,Existing cost details, where available, Recent Trends & Developments, Challenges.

Patent Landscape & FTO Reports

The clients have used the report submitted to them while planning their research activity and taking decision on patent filing. Some of the report received feedback and further research planning related information carried out are:-

- Patent Landscape-Desalination Plant on Wheels.

- FTO analysis-Hybrid Adsorption-Membrane Separation System.
- Patents report - Red Mud & Glass Ceramic Foam.
- FTO-Procedure for Making Superabsorbent Polymer.
- Patents report - Nano-Engineered Optical Fibers for OCT Applications.

Development of Portals & Data Updation

- CSIR Technology Portal (https://techindiacsir.anusandhan.net): It is a single Point Window to showcase CSIR's Technical acumen. It provides information on CSIR's Intellectual Property, Technologies, Knowledgebase, Social Intervention and Success Stories. Kept close communication with CSIR laboratories to collect Technology data and regularly updated the same on Technology Portal.
- NiRBASE (https://nirbase.anusandhan.net/): An Online searchable Database of CSIR Laboratories Water Technologies .

Major Covid 19 Contributions 2020-21:

CSIR Supply Chain Management - Pre-emptive identification of supply chain issues in new launches of CSIR products and services for Covid-19 management

The objective of this channel is to identify and pre-empt issues in the launch of CSIR products that could affect their scalable deployment. A careful study of the bill of materials and identifying potential issues prior to the launch of the products was done. The products or technologies were studied to identify the key components, whether they are single or multiple source and whether the components are available in India or have to be imported. The study results in the smooth launch of competitive and cost-effective products with no infringement or supply chain issues.

Patentability Assessment, Freedom to Operate and Prior Art Reports

URDIP suggested to have technical advancements on the following areas:

- Method for oxygen enrichment in terms of the way of arrangement of the system & use
- Effect of pressure/vacuum swing adsorbents on concentration and purity of end product.

URDIP FTO report on ""Hybrid Adsorption-Membrane Separation System for Enriching Medical Grade Oxygen from Air"" has found that, the technology disclosed by CSIR-IIP/NCL has not been found in claims of any active high and medium relevant Indian patents. Hence this technology may be practiced in India.

Provided an overview on the closest prior art references and assessed the patentability aspects for "The process for preparing the active pharmaceutical ingredient EIDD 1931" which CSIR-NIIST aims to reposition and use for treating Covid-19.

Clinical Trial Information and regular weekly updates

Provided details on the ongoing clinical trials on small molecule therapeutics and combination products against COVID-19.The information from worldwide as well as from India are being enlisted.

Weekly update on Clinical trial data for 25 molecules for Covid-19: Weekly update on Clinical trial on Drugs of Interest to CSIR - 25 molecules for repurposing. Clinical trial data was useful for CSIR Scientists in the Covid19 mission and Antiviral mission.

Development of Portal

CSIR Covid-19 Portal (https://covid19csir.urdip.res.in/): To showcase CSIR India's contributions towards fight against Covid-19, CSIR-URDIP had developed a dedicated portal. This provides information about CSIR India's

strategy, products, technologies and other social initiatives in fight against Covid-19.

12.8 Science Communication and Dissemination Directorate (SCDD)

The Science Communication and Dissemination Directorate (SCDD) plays a very critical role for furthering favourable public image of CSIR. Several image building activities were carried out to achieve the overall objective. The SCDD has the responsibility of communicating CSIR's S&T developments to the public at large. This is done through the social media platforms. Several activities were organized by SCDD during the year.

Weekly News Bulletin: SCDD scans many newspapers from across the country and selects relevant news items pertaining to CSIR labs. The selected news items are compiled and widely circulated widely across the CSIR laboratories in the country.

CSIR on social media: CSIR has a vibrant social media presence. The CSIR-SCDD has the responsibility of the social media communications and campaigns. The Directorate uses social media platforms extensively for its communications and streams many of its events live on its social media pages on Twitter, Facebook and YouTube.

www.twitter.com/CSIR_IND

www.facebook.com/INDIA.CSIR

www.youtube.com/CSIRINDIA1942

Annual Report 2019-2020: The CSIR Annual Report is a mandatory and important publication of CSIR that is approved by the CSIR Society and tabled in the Parliament. The CSIR-SCDD compiled the English and Hindi versions of the CSIR Annual Report 2019-2020.

Daily and Monthly Reports: SCDD prepared daily reports for the Office of the Hon'ble Minister of Science and Technology. The Directorate also prepares the monthly reports of CSIR. These reports are prepared in a time bound manner by gathering inputs from all the CSIR laboratories.

CSIR COVID Compendium: The Directorate put together the ***CSIR Technologies for COVID-19 Mitigation***. The compendium includes details of about 100 Covid-19 technologies categorized under diagnostics, drugs and vaccines, hospital assistive devices and PPEs, supply chain and other Covid-19 technologies. Salient technical features of each of the technologies, uses, the laboratory, and industry partner details are given. The compendium also has an index of all the CSIR laboratory and industry contacts. Two versions of the compendium, one in June 2020 and another in January 2021 (updated) were brought out.

Webinars and online Events: During the year, SCDD organized a number of webinar and other online events. They can be categorized as:

- Covid related Webinars
- Shanti Swarup Bhatnagar Awardees Webinars
- CSIR Success Stories Webinars
- Other Webinars and Events

Covid webinars: To communicate CSIR's Covid-19 research to the public and dispel fake news, misinformation and disinformation, several webinars were held in in many Indian languages. The webinars were streamed on the CSIR social media platforms and were widely attended. The Covid-19 webinar organized during the year were:

Date	Title
23 June 2020	Plasma Therapy & Vaccines
18 July 2020	The Making of a Swadeshi Suit [***Kannada***]
25 July 2020	Unravelling the Coronavirus: Why? How? What? When? of Genome
01 August 2020	COVID-19 Testing and Treatment Initiatives [***Telugu***]
22 August 2020	Contributions of CSIR during COVID-19 pandemic [***Assamese***]
05 September 2020	CSIR Fights COVID-19: Computation to Testing and beyond
18 September 2020	Testing, Prevention & Makeshift Hospitals: CSIR's COVID-19 [***Tamil***]
21 September 2020	**कोविड१९- के निवारण में सीएसआईआर की संचार भूमिका**
12 December 2020	The What, Why and How of COVID-19 Vaccines
16 January 2021	Webinar on New Variants of SARS-CoV-2
05 February 2021	Decentralised Wastewater Treatment - The Need of the Hour
20 March 2021	Global Economic Effects of Coronavirus

Shanti Swarup Bhatnagar Awardees Webinars: SCDD organized the webinar series, ***Exploring Science with Shanti Swarup Bhatnagar Prize Winners-2020***. All the Prize Winners were invited to share their prize-winning research work.

Date	Title
31 October 2020	Exploring Science with Shanti Swarup Bhatnagar Prize Winners-2020 [Biological Sciences]
07 November 2020	Exploring Science with Shanti Swarup Bhatnagar Prize Winners-2020 [Chemical Sciences]
21 November 2020	Exploring Science with Shanti Swarup Bhatnagar Prize Winners-2020 [Physical Sciences]
28 November 2020	Exploring Science with Shanti Swarup Bhatnagar Prize Winners-2020 [Engineering Sciences]
05 December 2020	Exploring Science with Shanti Swarup Bhatnagar Prize Winners-2020 [Medical Sciences]
12 December 2020	Exploring Science with Shanti Swarup Bhatnagar Prize Winners-2020 [Mathematical Sciences]

CSIR Success Story Webinars: With CSIR entering its 80th year and the nation celebrating the 75th Year of Independence, SCDD launched a CSIR Success Stories Webinar series. The #80Years_80SuccessStories webinar series, aims at showcasing 80 impact making technologies, research and interventions of CSIR. During the period January to March 2021, the following success stories webinars were held:

Date	Title
12 February 2021	Appropriate Rural Housing in Odisha: A CSIR Success Story
19 February 2021	Centochroman: A CSIR success story
26 February 2021	Integrated Municipal Solid Waste disposal system (i-MSWDS): A CSIR Success Story
01 March 2021	Webinar on Leather for Employment: A CSIR Success Story
22 March 2021	TERAFIL Water Filter: An Efficient Affordable and Sustainable Solution for drinking water
22 March 2021	From Many to One: Saga of the Indian Calendar

Other webinars: CSIR-SCDD also organized the following other webinars during the year.

10 December 2020	#VocalForLocal: The Heeng Story
11 February 2021	Launch of Theses Portal: Vigyangranth and Webinar on International Day of Women and Girls in Science
08 March 2021	International Women's Day: Invited Special Lecture
24 March 2021	World TB Day

India International Science Festival 2020: The India International Science Festival 2020 was held in the online mode during 22 to 25 December 2020. The SCDD took part in the Mega Science, Technology and Industry Expo.

12.9 International S&T Affairs Directorate (ISTAD)

International S&T Networking

ISTAD continued playing a vital role in fostering and expanding CSIR's international partnerships by initiating new cooperation tools with leading international agencies across the globe, managing / supporting collaborative projects, joint / international workshops and conferences and coordinating scientific visits of CSIR delegations / scientists abroad and of foreign delegations / distinguished researchers to CSIR and its research institutes.

Developed HQs level New Collaboration Linkages with some World Class Institutes

A. Following two CSIR HQs level cooperation MoUs with a RTO from Russia and USA concluded during the FY 2020-2021:

1) MoU between CSIR and Skolkovo Institute of Science and Technology (Skoltech) Russia (concluded on Dec 11 2020)

To promote mutually beneficial cooperation activities in mutually agreed areas including (a) Aerospace, Electronics and Instrumentation; (b) Engineering S&T; (c) Ecology, Environment, Earth & Ocean Sciences and Water; (d) Mining, Minerals, Metals and Materials; (e) Chemicals and Petrochemicals; (f) Energy technologies and devices; g) Biotechnology and Healthcare S&T; and h) Big Data and Artificial Intelligence.

2) MoU between CSIR and Mayo Clinic (concluded on 9 April 2021)

To promote and further develop the possibilities of S&T cooperation in the areas of common interest and synergy inlcuding Healthcare, Cancer and Targeted Medicinal Drug Dlivery Systems). CSIR-IGIB requested to be the nodal point.

B. Projects funded under ongoing collaborative programmes

1) Three (3) projects approved under CSIR - Czech Academy of Sciences (CAS) programme for a period of two years with support from ISTAD towards exchange visits costing upto Rs 6 lakhs per year:

- CSIR-IMMT – Institute of Physics of CAS – Noval Electrodes for Electrochemical Studies
- CSIR-NEERI - Institute of Inorganic Chemistry of CAS – Drinking Water Purification (Materials)
- CSIR-CIMFR - Biology Centre of CAS – Ecosystem Development – Mining Sites in India

2) A Consortium Project entitled "Urban wastewater, fecal sludge and septage problem in Indian cities" for implementation by CSIR-NEERI and CSIR-NIIST, Bauhaus-Universität, Weimar and M/s Tilia GmbH, Leipzig, under CSIR-BMBF (Germany) programme was funded for two years.

Bilateral Networking Meetings Supported/Organised by CSIR

Russia

Following Indo-Russian Web workshops were organised by Indian Embassy Moscow in collaboration with CSIR-ISTAD:

a) Workshop titled 'Gas Hydrates and Gas Fluxes in the Indian and Russian Continental Margins: Experience, Activity and Proposals' held on May 28, 2020 with participation of domain experts from CSIR-NIO, CSIR-NGRI and POI FEB RAS.

b) Workshop on 'Marine Technology Developed at NIO and future plans for deep sea robots' held on June 3, 2020 with participation of CSIR-NIO and IMTP FEB - RA S.

c) Workshop and interactive meeting on 'Marine Biodiversity and Marine Ecosystem' held on July 2, 2020 and July 23, 2020 with participation of CSIR-NIO and NSC FEB - RAS.

d) India-Russia Scientific Webinar on Agriculture coordinated by CSIR-NBRI held on 11-12 November 2020.

e) Webinar on Ecology and Environmental Protection coordinated by CSIR-NBRI on 25-26 November 2020.

f) CSIR - Skolkovo Institute of Science and Technology (Skoltech) Interactive meeting held on December 18, 2020 with participation of 11 CSIR scientists (IIP, 4PI, CEERI, IGIB, NEIST, CSIR HQs) and 5 Russian experts.

Belarus

An Interactive meeting with Belarus National Academy of Sciences was organized on February 17, 2021 to explore potential opportunities for synergistic collaboration. Presentation were made from both sides on topics including a) Radio & Space Physics, b) Information technology; c) Chemicals, Drugs, Biotechnology; d) Nanotechnology, Materials; e) Unmanned systems; and f) Mining. Participation of 85 persons was recorded online which included experts from 13 CSIR

Institutes and CSIR-HQ, 1 from IRS, ISRO and 9 institutes and NAS HQs from Belarus.

USA

An interactive meeting was held on March 1, 2021 between CSIR and Biomedical Advanced Research and Development Authority (BARDA), Office of the Assistant Secretary for Preparedness and Response, U.S. Department of Health and Human Services, to explore potential collaboration in Health sector, particularly for vaccine development / manufacturing in India. The meeting was led by DG, CSIR with participation of Covid-19 technology vertical Directors from CSIR and Head, BARDA with his international cooperation head and the Science Attaché of India and the USA.

Engagement with the Global Indian S&T Community for Societal Goods

To implement the directives of Hon'ble Prime Minister to connect with Indian S&T Diaspora through virtual mode to address societal challenges, Two Fold Action was initiated and implemented.

A. Vaishvik Bhartiya Vaigyanik (VAIBHAV) Summit

Deliberations on different topics/areas of national importance, CSIR-ISTAD engaged in coordination and planning for organization of "VAIBHAV"; (2nd October – 31st October 2020). ISTAD contribution in the VAIBHAV Summit:

- Engaged in Planning and Execution through (a) Advisory Committee, (b) Steering Committee, (c) CSIR Champion Institutes
- Shared validated (through individual interactions) database of Diaspora and encouraged them to participate in VAIBHAV
- Identified Champion Institutes (Conceptualizing, Coordinating, Planning and Execution) for 12 out of 18 Verticals of VAIBHAV
- Identified Elite and world renowned Diaspora and communicated to all CSIR Champions and VAIBHAV Committee (over 15% of non resident experts from CSIR Diaspora Database are the panellists

B. Pravasi Bharatiya Academic and Scientific Sampark (PRABHASS) Portal aiming to Serve as National Digital Platform to continuously engage with Global Indian S&T Community for Societal Good. Effort was mounted to develop a database and a virtual platform to bring on board the Global Indian S&T Community to address the Indian societal challenges / problems. ISTAD contribution:

- Awarded CSIR-NISCAIR project to develop Portal; Close coordination towards Conceptualization and development of the portal PRABHASS 1.0 (Structure, Trademark, Logo, Engagement mechanisms (Societal Challenges; Collaborative R&D; Lectures & Webinars; Trainings; Hosting Indian Researchers; Any other Engagements), Adding details of registered experts (in India and Abroad), Disclaimer, Privacy Policies, Domain name registration and Security Audit etc) Available at (www.prabhass.gov.in);
- The main objective of the portal was targeted to attract and encourage Indian diaspora to come forward and join hands with GOI to help & solve challenges being faced by the common man in India thereby making an impact on society at large. This is a digital mode to engage Indian diaspora, particularly engaged in scientific and technological work, on various matters related to S&T interventions to address India centric issues. PRABHASS provides Diaspora a platform to collaborate with Indian scientists based in India on value proposals and contribute towards nation building. It is a one-stop solution for the S&T Diaspora and to unite similar

efforts and experience of other major S&T departments/ministries and to collectively promote inclusive growth in India, strengthen Indian innovation ecosystem and contribute towards nation building, an Inter-Ministerial Working Group was constituted for PRABHASS initiative under the chairmanship of Dr Dnyaneshwar Mulay, Member, National Human Rights Commission and Former Secretary, Government of India (MEA), that comprises a senior representative each from DST, DBT, CSIR, ICMR, ICAR, DAE, DOS, MoES and MEA.

- PRABHASS 1.0 (www.prabhass.gov.in) was launched jointly by Prof. K. Vijay Raghavan, Principal Scientific Advisor and Dr V.K. Saraswat, Member NITI Aayog, on 31st October 2020 during VAIBHAV and is now being used for connecting corresponding experts.

PRABHASS is an interactive platform accessible to both Indian as well as Diaspora S&T experts for match making, collaborating and browsing through scientific profiles - No such Indian Scientific CONNECTING/ NETWORKING platform existed before.

PRABHASS in Statistics

- A database of over 6000 Diaspora from 47 countries.
- Around 360 registered Diaspora and 380 India based S&T experts for collaborating and working towards this mission.
- Presents 50 societal challenges and 10 national programs/projects (specific R&D projects) inviting participation form registered experts.
- 266 Indian R&D Institutions categorized in 20 Specific areas/Domains aligned to National Missions

Networking done so far

- Connected the diaspora with different S&T departments for scientific discussions in specific areas for preparing and recommending a road map and way ahead for Indian R&D and societally relevant interventions.

(i) Vaishvik Bhartiya Vaigyanik (VAIBHAV) Summit (October 2020)

(ii) Global Indian Scientist and Technocrats (GIST) Meet (December 2020)

(iii) CSIR Area-specific Brainstorming Meetings in 2020

a. Structural Health Monitoring (31.07.2020);

b. Atma Nirbhar Bharat: Personal Care, Flavour and Fragrance (31.08.2020);

c. Energy Management and Energy Storage Devices (16.09.2020);

d. Utilization of Agro/Biomass Waste: Roadmap & Strategy' scheduled (28.10.2020);

e. Liquid Waste Management (27.11.2020).

- Experience sharing Webinar on Global Economic Effects of Corona Virus (10.03.2021)
- Exploratory topical interactions: Several Virtual Meetings were conducted and have been scheduled to connect the Diaspora with different S&T departments for topical scientific discussions for preparing and recommending a road map and way ahead for Indian R&D and societal relevant interventions.

Facilitating Lab Level International Collaborations

a) Seventeen (17) institute to institute levels MoUs were approved for signing during 2020-2021 between CSIR institutes and the research and academic institutions from nine (9) countries (Ethiopia, Japan, Mozambique, Switzerland, UK, USA, Vietnam and Russia) for cooperation in the broad areas of Marine S&T, Engineering, Materials, Transport Systems, Safety and Environment, Leather, Constructions, Food technologies and Healthcare.

b) Approvals coordinated for over 28 collaborative projects of 16 CSIR Labs for implementations implemented with partners from 14 Countries. These are in the areas of Bio-medical Instrumentation; Membranes; Geophysical Measurement Systems; Ocean Sciences; Waste CO2 to fuel; Bio-polymers; Machine Learning; Plastic Waste Reduction; Electrodes, Materials, Antibiotics Monitoring using MoF, IOT –Agricultural Systems, Healthcare Technologies, 3D Printing, Carbon Capture Technologies, Syn-Gas Conversion; Waste Water and Fecal Sludge Treatment.

Multilateral Cooperation

CSIR was represented in the International WAITRO Summit (WAITRO://50 Virtual Innovation Summit (28-30 October 2020) for the live interactive sessions and in the General Assembly of WAITRO for approving a) the Strategic Plan 2030 and the Work Program for 2021-2022 of WAITRO; b) Electing the Returning Officer & the Nominating Committee and the WAITRO Executive Board 2021-2022; and c) Proposal for Membership Fee, Proposal for Amendment of the Constitution and the Topic for the Innovation Award 2021

Human Resource Development

Capacity building through CSIR-TWAS Fellowship (For researchers and scholars from developing countries – CSIR-TWAS Fellowships (PG and Postdoc))

i) With an aim to provide training and advanced exposure / award higher educational degrees to researchers from developing countries, thereby enhancing CSIR brand, CSIR, in association with TWAS, CSIR offered 17 fellowships (9 Postgraduate (leading to Ph.D.) and 8 Postdoctoral) for the year 2020, to foreign nationals from Cameroon, Côte d'Ivoire, Egypt, Ethiopia, Iran, Kenya, Madagascar, Mongolia, Mozambique, Nigeria, Rwanda, and Sudan enabling them to carry out research at CSIR-CDRI, CSIR-CECRI, CSIR-CFTRI, CSIR-CSIO, CSIR-CSMCRI, CSIR-CLRI, CSIR-IICT, CSIR-IIP, CSIR-IMMT, CSIR-NEIST, CSIR-NIIST, CSIR-NIO, CSIR-NISTADS, CSIR-NML and CSIR-NCL in different areas S&T (i.e. Biological Sciences, Chemical Sciences, Engineering Sciences, Food Sciences & Technology, Health Sciences, Materials Science & Engineering, Physical Sciences etc.).

ii) Ministerial Clearances for TWAS Fellows 2019 obtained and the Award letters issued to 17 selected Fellows (10 PG and 7 Postdoc) selected for the 2019 award. Due to the pandemic, the date of start of fellowship was extended to 2nd September 2021. a few TWAS Fellows 2019 joined the respective CSIR labs and initiated their research work.

12.10 Information Technology Division (ITD)

Establishment and techncial support for Online collobartion platform for CSIR & its labs for conducting Online/ virtual meetings of various working groups of intra labs / Inter labs for development of techncologies related to Covid-19.

eOffice Lite (eFile) implementation at CSIR Hqrs and its unit

Operational and functional support for creation of eOffice accounts for DG CSIR, JS(Admin), CVO, Head of divisions and other senior officials of CSIR Headquarters. eOffice account creation and support for all Directorate/ Division/ Section/ Units of CSIR Headquarters, New Delhi through Sri Abhishek Kumar Gupta, Nodal Officer eOffice with help of DSIR and NIC. Access of eOffice thorugh WebVPN are functional in CSIR Headquarters.

Setup, Installation, Configuration, Monitoring and Operationalization of IT Infrastructure

Operational and functional support, monitoring for functioning of IT

infrastructure (Data Center, Servers, LAN Network and infrastructure, WAN, Active directory, DNS, UTM, Antivirus, Coordination with ISP/National Knowledge Network links, DIGI board, eProcurement (CPPP Portal), Coordination with ERP team and setup of ERP staging servers. Important web application like CSIR Website, C-DIS, Oasis, CSIR-Grievance portal, CSIR-HRDG Help Desk etc are hosted in server room and web hosting facility of CSIR Headquarters, New Delhi.

Central Nodal Officer/ CSIR Coordinator at CSIR Hqrs

Functional support for NIC E-Mail, NKN and VPN services in the CSIR Headquarters, New Delhi. Sri Abhishek Kumar Gupta, Nodal Officer has authorization for creation/ deletion/ updation of CSIR users email account. He has also authorization for posting of bulk emails using distribution lists to the all CSIR staffs in the country and CSIR Hqrs staffs.

NKN realted activities

Various technical activities relaited to National Knowledge Network are taken care by IT Division, CSIR Headquarters.

Functional and Technical support to All CSIR Laboratories/ Institute/units

Functional and technical support for IT related activities to All CSIR Laboratories/ Institute/units are taken care by IT Division, CSIR Headquarters.

12.11 Human Resource Development Centre (HRDC)

CSIR-HRDC has the objectives of promoting a professional and holistic human resource development for professionalizing R&D management and support functions in CSIR. During the period, the Centre was engaged in organizing online programmes due to spread of Covid-19 pandemic. The Centre has conducted 27 online programmes on MS Teams platform during the period for CSIR and non-CSIR participants and also organized three residential programmes. Centre organized one residential programme for newly joined Directors on “Excellence in Leadership” and two residential “Induction Programme for Newly Recruited Scientists”. Centre organized several online programmes on usage of Microsoft Teams for effective team work. Other significant achievements of the Centre during the period are given here under:

New initiative undertaken

CSIR-HRDC has been nominated as nodal agency of DSIR for ‘Accelerate Vigyan Programme of Science and Engineering Research Board (SERB)’ to bring all the training programmes, high-end workshops/seminars, winter/summer schools, other scientific outreach activities, research internship programmes under the umbrella programme DSIR Accelerate Vigyan Programme(DAVP).

Coordination of Brainstorming Session

CSIR society in its meeting held on 14.02.2020 instructed CSIR to conduct Brainstorming meetings/discussions on societally relevant and globally impacting topics with global leaders and industry experts on different thematic areas, on which CSIR is working with priority. The activity was assigned to HRDC to coordinate and conduct brainstorming sessions.

The Center has started coordinating brainstorming session on various societally and industry relevant topics in collaboration with CSIR labs. Centre has coordinated following sessions during the year:

- CSIR-HRDC and CSIR-SERC jointly organized brainstorming session on “StructuralHealth Monitoring”

- CSIR-HRDC, CSIR-IIP and CSIR-IICT jointly organized brainstorming session on "AtmanirbharBharat: Personal Care, Flavour and Fragrance",
- CSIR-HRDC and CSIR-CECRI jointly organized the brainstorming session on "Atmanirbhar Bharat: Energy Management and Energy Storage Devices"
- Brainstorming session on "Utilization of Agro/Biomass waste: Roadmap & Strategy"
- Brainstorming session on 'Liquid Waste Management'
- Brainstorming session on "Linkage of Climate Change and Oceans with Water Availability and Human Health CSIR Theme - Earth, Ecology, Environment, Ocean and Water (E3OW)"

Major online Training & Development Programmes for Scientist & Technical personnel:

The major programmes organized to develop skills and competencies of the scientists & technical personnel:

- Programme on Leadership Transition for Woman Scientists
- Online Programme on Technology Readiness Levels for the Scientists of Chemical Cluster of CSIR labs/ Instts
- Programme on Research & Development: Industry 4.0
- Programme on Planning, Monitoring and Evaluation of R&D Projects for Scientists
- Programme on Intellectual Property Rights and Related Issues
- Outreach Programme for India International Science Festival 2020
- Outreach Programme for IISF
- ISO/IEC-17025:2017 - General Requirements for the Competence of Testing and Calibration Laboratories

Other online Programmes on Administration and General Management:

- Programme on RTI and transparency audit
- Roles & Responsibilities of Inquiring Officer (IO) and Presenting Officer (PO) in disciplinary proceedings
- Reservations and Rosters for the Common Cadre Officers Managing self and others for higher performance
- Recruitment of Technical and Support Staff (Gr I, II and III)
- General Financial Rules (GFRs) for Common Cadre Officers
- Drafting Request for Proposal (RFP)/ Tenders for Procurement of Services for Common Cadre Officers
- Reservation and Maintenance of Rosters
- Programme on Vigilance and Related Matters
- Capacity Development Programme for Finance Officers of CSIR
- Hands-on Programme on Government e-Marketplace (GeM)
- Programme on Work Life Balance

Special Programme

CSIR-HRDC organized one special programme on "Sensitization and Training Program of Basic Indian Sign Language (ISL) for Deaf and Dumb Employees of CSIR" in association with Haryana Welfare Society for Persons with Speech and Hearing improvement Institute to facilitate basic communication skills and awareness for the persons belonging to the deaf community working in CSIR.

Third Party Audit under RTI Act

CSIR-HRDC has been entrusted to carryout third party audit of the 46 Public Authorities under DSIR [ie **DSIR(1), CSIR(41), AcSIR(1), CDC(1), NRDC(1) and CEL(1)**] for proactive disclosures under RTI Act.

The main objective of the audit is to make a thorough assessment of voluntary disclosures of the information on public domain for more transparency. Specifically, the major objectives of the audit are as under:

- to audit ***Suomotu*** disclosure of more items under section IV
- to check guidelines for digital publication of proactive disclosure under section IV
- to provide guidance for certain clauses of section 4(1)(b) to make disclosure more effective
- to ascertain for compliance with provisions of ***Suomotu*** disclosure.

The Centre has conducted Third Party Audit of 43 Public Authorities of DSIR, 6 public authorities under DST, Ministry of Science & Technology and **Pharmacopoeia Commission for Indian Medicine & Homoeopathy (PCIM&H),** Ministry of Ayush for proactive disclosures under RTI Act.

CSIR Integrated Skill India initiative

Various CSIR labs are engaged in conducting industry-oriented training/ skilling programmes and developing high quality human resources in trans-disciplinary areas effectively utilizing its R&D knowledgebase and infrastructure including manpower for addressing the nation's major thrust towards Skill Development. CSIR labs provides high-end skilling/reskilling trainings in different domains of industrial/service sectors and their respective trades of specialization – engineering services, agriculture, chemical, mining/mineral technology, leather technology, bio-technology, pharma industry, environmental, water technology and rural based applications and strategic sector to

2nd Programme in Series of Online Programme on the use of Microsoft Teams for Effective Team Work, 11 June, 2020

CSIR-HRDC, CSIR-IIP & CSIR-IICT jointly organized #Brainstorming on #AtmanirbharBharat: Personal Care, #Flavour and #Fragrance, 31stAugust, 2020

Residential Programme on Excellence in Leadership, 15-16 January 2021

make India ***Aatmanirbhar***and driving the country to become HR Capital of the world.

The second phase of CSIR Integrated Skill Initiative has been initiated in April 2020 which will continue upto March 2021. The measurable outcomes of the project activities during the first year i.e. 2020-21 was around 31,490 trainees trained in 327 no. of skilling & reskilling training programmes.

Capacity Development Programme for Finance Officers of CSIR, 09-26 February, 2021

Induction Programme for newly Recruited Scientists, 1-10 March, 2021

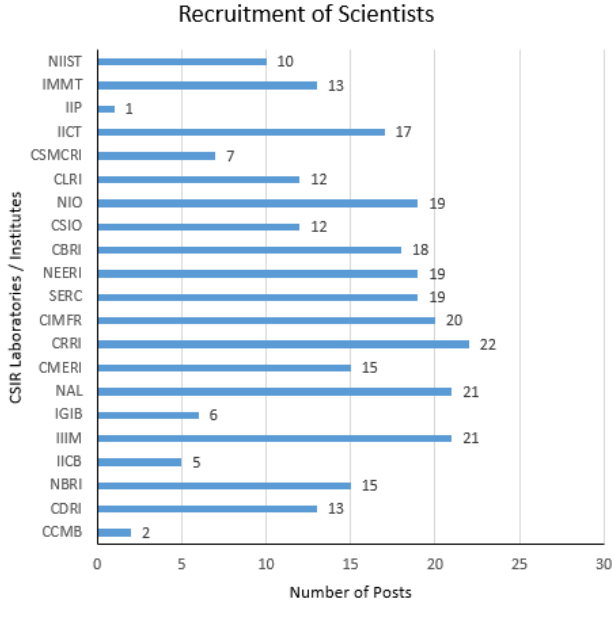
12.12 Recruitment & Assessment Board (RAB)

Recruitment process completed during 2020-21:

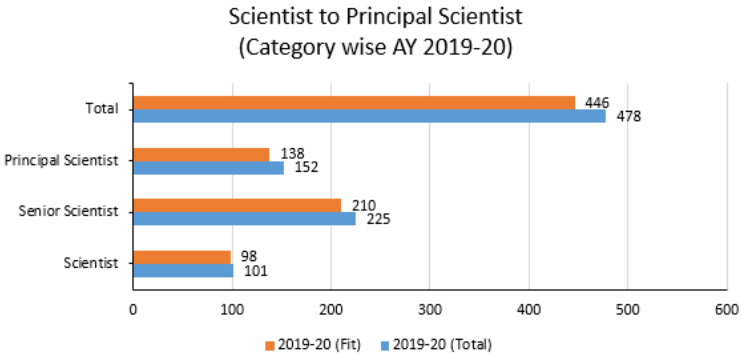
Recruitment & Assessment Board (RAB) facilitated a total of 287 posts of Group IV scientists have been advertised at lab/institute level by 21 CSIR Laboratories / Institutes.

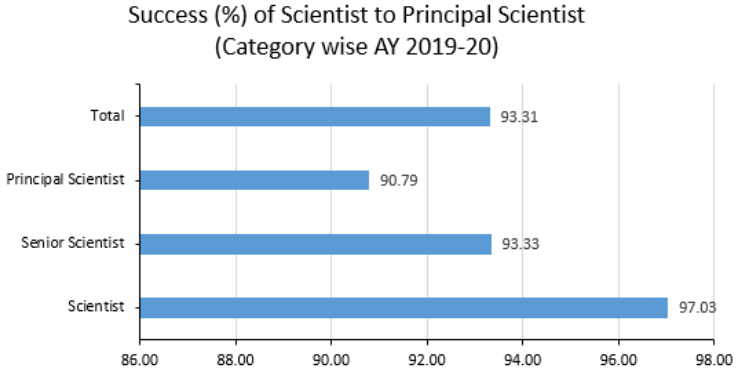
Assessments done by RAB during 2020-21:

a) Assessment of Scientists to Principal Scientists due for promotion during 2019-20, covering all the areas were conducted.

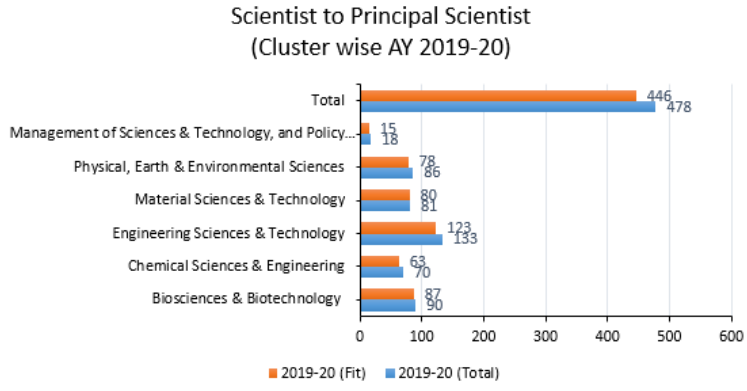


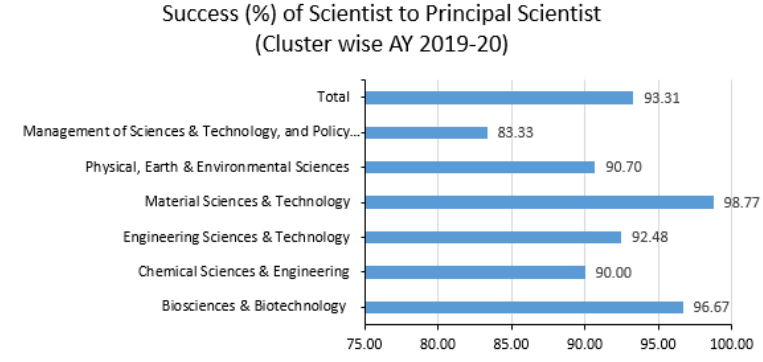
b) The category wise scientist's success rates to the next higher grades during 2019-20 are 97.03 %, 93.33 % and 90.79 % w.r.t. Scientist, Senior Scientist and Principal Scientist respectively. A total of 478 candidates (Scientists to Principal Scientists) were assessed by CSIR-RAB in six different broad Core areas of R&D.



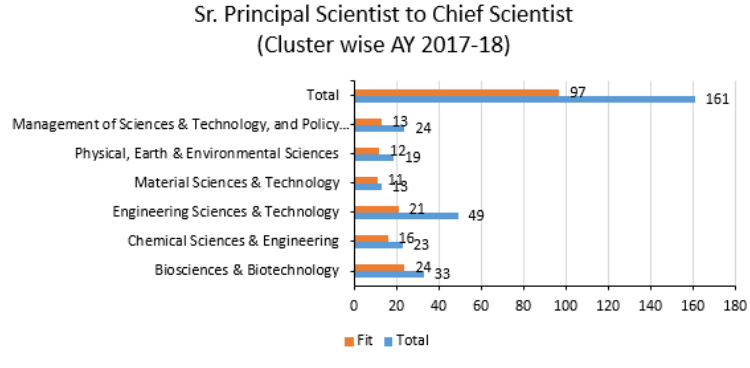


c) For all six clusters of CSIR; for the assessment of **Scientist to Pr. Scientist**, 96.67% in Biosciences & Biotechnology, 90% in Chemical Sciences & Engineering, 92.48% in Engineering Sciences & Technology, 98.77% in Material Sciences & Technology, 90.70% in Physical, Earth & Environmental Sciences, and 83.33% in Management of Sciences & Technology, and Policy Studies were successfully promoted to their next higher grades for the assessment cycle of the assessment year 2019-20.





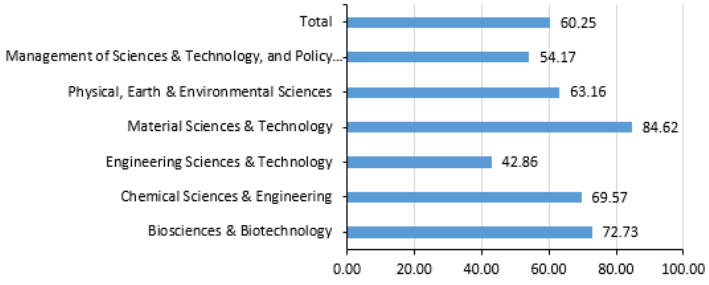
d) The centralized assessment of 161 Senior Principal Scientists through 'Peer Review' process for the period 2017-18 was also successfully conducted. A total of 97 Sr. Principal Scientists were promoted to the level of Chief Scientists (success rate 60.25%).



e) Whereas, for the assessment of **Sr. Pr. Scientist to Chief Scientist**, 72.73% in Biosciences & Biotechnology, 69.57% in Chemical Sciences & Engineering, 42.86% in Engineering Sciences & Technology, 84.62% in Material Sciences & Technology, 63.16% in Physical, Earth & Environmental

Sciences, and 54.17% in Management of Sciences & Technology, and Policy Studies were successfully promoted to their next higher grades for the assessment cycles of the year 2017-18.

Success (%) of Sr. Principal Scientist - Chief Scientist (Cluster wise AY 2017-18)



12.13 Human Resource Development Group (HRDG)

CSIR is pioneer in supporting R&D activities in the country. The Human Resource Development (HRD) Group of CSIR has a mandate to develop and nurture S&T manpower at the national level. It also promotes, guides and co-ordinates scientific & industrial research through research grants to scientists/professors working in universities / R & D institutes.

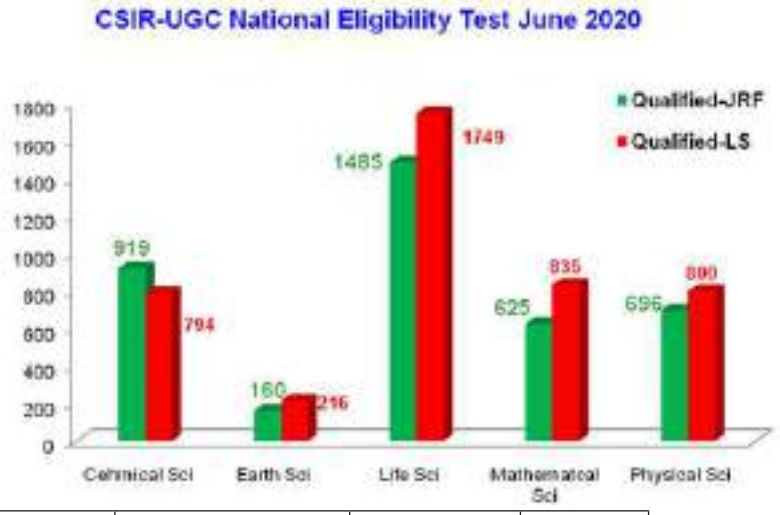
The activities of the HRD Group include: Award of Junior Research Fellowships (JRF) through National Eligibility Test (NET); award of Senior Research Fellowships (SRF), Research Associateships (RA), Senior Research Associateships (SRA) and Shyama Prasad Mukherjee Fellowships (SPMF) to benefit students to pursue their research interests in various areas of science & technology; Award of Shanti Swarup Bhatnagar Prizes (SSB), CSIR Young scientist Awards (YSA) and GN Ramachandran Gold Medal for "Promotion and Recognition of Excellence"; Funding of Extra Mural Research (EMR) Schemes at universities/ R&D organizations for their capacity building; Travel / Conference / Symposium grants for Promoting Knowledge Sharing.

Significant achievements of HRD Group for the period from April 2020 to March 2021 are as follows:

1. National S & T Manpower Development :

1.1 Junior Research Fellowship(NET)

The CSIR-UGC NET June examination was conducted online on 19th, 21st, 26th and 30th November 2020 at 576 centres in 236 cities across the country. 2,62,292 candidates registered and 1,71,273 candidates appeared for the examination. The result was declared on 5th February 2021. A total number of 3885 candidates qualified for CSIR/UGC Junior Research Fellowship & lectureship and 4394 qualified for lectureship only.



Subject	Chemical Sciences	Earth Sciences	Life Sciences	Mathematical Sciences	Physical Sciences	Total
Qualified-JRF	919	160	1485	625	696	3885
Qualified-LS	794	216	1749	835	800	4394

Out of 3885 candidates qualified for JRF, 2247 are to be supported by CSIR and rest by UGC.

The Covid-19 pandemic in early 2020 affected the JRF-NET examination schedule and due to the prevailing conditions and lockdown across the country, CSIR could hold only one NET Exam during financial year 2020-21. The Covid-19 not only affected JRF-NET but also affected other fellowship schemes as a result of which, the number of fellowships awarded is low compared to previous financial years.

1.2 Senior Research Fellowship (SRF) and Research Associate-ship (RA)

The expert committee meetings for the selections of SRFs and RAs in 11 disciplines were held during 2020-21. Out of total 2940 candidates called for interview, the candidates selected for SRF and RA were 234 and 138, respectively.

1.3 Senior Research Associate-ship (SRA) / Scientist's Pool Scheme

The Senior Research Associate-ship (SRA-ship) is primarily meant to provide temporary placement to highly qualified Indian scientists, engineers, technologists, and medical personnel who are not in regular employment in the country and including those returning from foreign countries. During the year 2020-21, sixty nine (69) Senior Research Associates were selected and their total number as on 31st March 2021 was 176.

1.4 Junior Research Fellowship for GATE qualified engineering and pharmacy graduates (JRF-GATE)

CSIR introduced a research fellowship known as the Junior Research Fellowship (JRF)-GATE in 2002 for the GATE qualified candidates with BE/ BTech/ BArch/ BPharm degree to pursue research leading to PhD in engineering and pharmaceutical sciences. JRFs selected under this scheme get an excellent opportunity to work with CSIR scientists with state-of-art R&D facility. During 2020-21, fifty-five (55) JRF-GATE fellowships were awarded and around130 JRF-GATE Fellows are working at present in different CSIR laboratories.

2. Promotion and Recognition of Excellence

2.1 CSIR Young Scientist Awards

CSIR introduced the CSIR Young Scientist (YS) Awards scheme in 1987 in order to promote in-house excellence in various fields of science and technology. These awards are given annually in the fields of (i) Biological Sciences (ii) Chemical Sciences (iii) Earth, Atmosphere, Ocean and Planetary Sciences (iv) Engineering Sciences; and (v) Physical Sciences (including instrumentation). The CSIR Young Scientists awards are given for outstanding contributions made by young CSIR scientists of below 35 years of age, as reckoned on 26 September (CSIR Foundation Day) of the preceding year, based on the work done primarily in India.

The CSIR Young Scientist Award, comprising a citation, a cash prize of Rs.50,000/- (Rupees fifty thousand only), and a plaque, is given to each scientist selected for the award every year on 26 September, the CSIR Foundation Day. The awardees working in CSIR, are entitled to get a special honorarium of Rs.7,500/- (Rupees seven thousand five hundred only) per month till they attain the age of 45 years. The detailed list of awardees for the year 2020 is provided in Chapter 11, Section 11.2.

2.2 Shanti Swarup Bhatnagar Prize for Science & Technology

CSIR instituted in 1957 the Shanti Swarup Bhatnagar (SSB) Prize for Science and Technology in the memory of late Dr (Sir) Shanti Swarup Bhatnagar, FRS for recognizing outstanding Indian work in science & technology. The SSB Prizes are awarded annually to scientists for their outstanding scientific contributions made primarily in India during last 5 years preceding the year

of the Prize. Scientists/ Engineers, who are not more than 45 years of age, as reckoned on 31st December of the year preceding the year of the Prize, are eligible. From the year 2010, Overseas citizen of India (OCI) and Persons of Indian Origin (PIO) working in India are also eligible.

The SSB Prize, comprising a citation, a cash award of Rs.5,00,000/- (Rupees five lakh only) and a plaque, is given to each person selected for the award in the following disciplines: (1) Biological; (2) Chemical; (3) Earth, Atmosphere, Ocean and Planetary; (4) Engineering; (5) Mathematical; (6) Medical; and (7) Physical Sciences. The awardees, currently serving the nation in public funded organizations are entitled to get a special honorarium of Rs.15000/- (Rupees fifteen thousand only) per month in addition to the salary drawn by the awardees and shall be admissible till he/she attains the age of 65 years. The detailed list of awardees is provided in Chapter 11, Section 11.2.

2.3 GN Ramachandran Gold Medal for Excellence in Biological Sciences & Technology

CSIR instituted a Gold Medal for excellence in Biological Sciences and Technology in the fond memory of Prof G N Ramachandran, pioneer in protein chemistry and the founding father of structural biology in India from the year 2004. The award comprises a Gold Medal, a citation and is presented every year to the recipient on 26 September, the CSIR Foundation Day. Any citizen of India, overseas citizen of India (OCI) and persons of Indian origin (PIO) working in India are eligible to be nominated. The recipient of G N Ramachandran Gold Medal for the year 2020 is Prof. Jaya Sivaswami Tyagi, All India Institute of Medical Sciences, New Delhi.

3. Funding of Extra Mural Research Schemes to promote R & D

CSIR provides financial assistance to promote research in the field of Science and Technology including Agriculture, Engineering and Medicine. It is given in the form of research grants to Professors/ Scientists working in Universities/ Academic Institutes/ IIT's etc. The number of research schemes recommended and renewed during 2020-2021 are as given below:

Schemes	No. of Proposals Considered	Proposals Recommended	Proposals Renewed
General	203	59	676
Emeritus Scientist	62	31	82
Sponsored	19	10	13

4. Travel / Conference Grants

Travel grant is provided by CSIR to young researchers for presenting research papers at International Conferences abroad. The Covid-19 pandemic in early 2020 affected the scheme as travel bans were imposed all across the globe and mass gatherings were not allowed by the respective governments across India and globally. As result of Covid-19 pandemic no application was received under Travel Grants to Research Scholars and PFA to scientists to attend the seminar/symposia/ conferences abroad. For organizing national/

Schemes	Total Considered	Total Recommended
Travel Grant to students	Nil	Nil
Travel Grant to regular employees	1	Nil
Symposia Grant	252	25

international conferences/ symposia/ workshops etc., a total of 252 proposals from universities/institutes/scientific societies etc were considered and 25 cases were recommended for support.

5. Jigyasa: Scientist- Student connect programme:

The objective of the Jigyasa Programme is to engage students in practical activities to get a flavour of research through visit in laboratories and interaction with scientists of one the premier national laboratories. It aims to extend classroom learning to research and laboratory-based learning at early age through Jigyasa Programme. Further, Scientists will be encouraged to visit schools and impart their knowledge to students as part of the programme. Teachers will also be provided with hands on experimentation at state-of-art facilities of CSIR.

Implementation Mechanism:

CSIR synergize its efforts with KVS, NVS, and other State Schools with the objective of popularizing Science, Technology, and Innovation to inculcate scientific temper among school students. For this some of the possible models of engagement that are articulated below, which can be expanded with mutual consultations between school and laboratory:

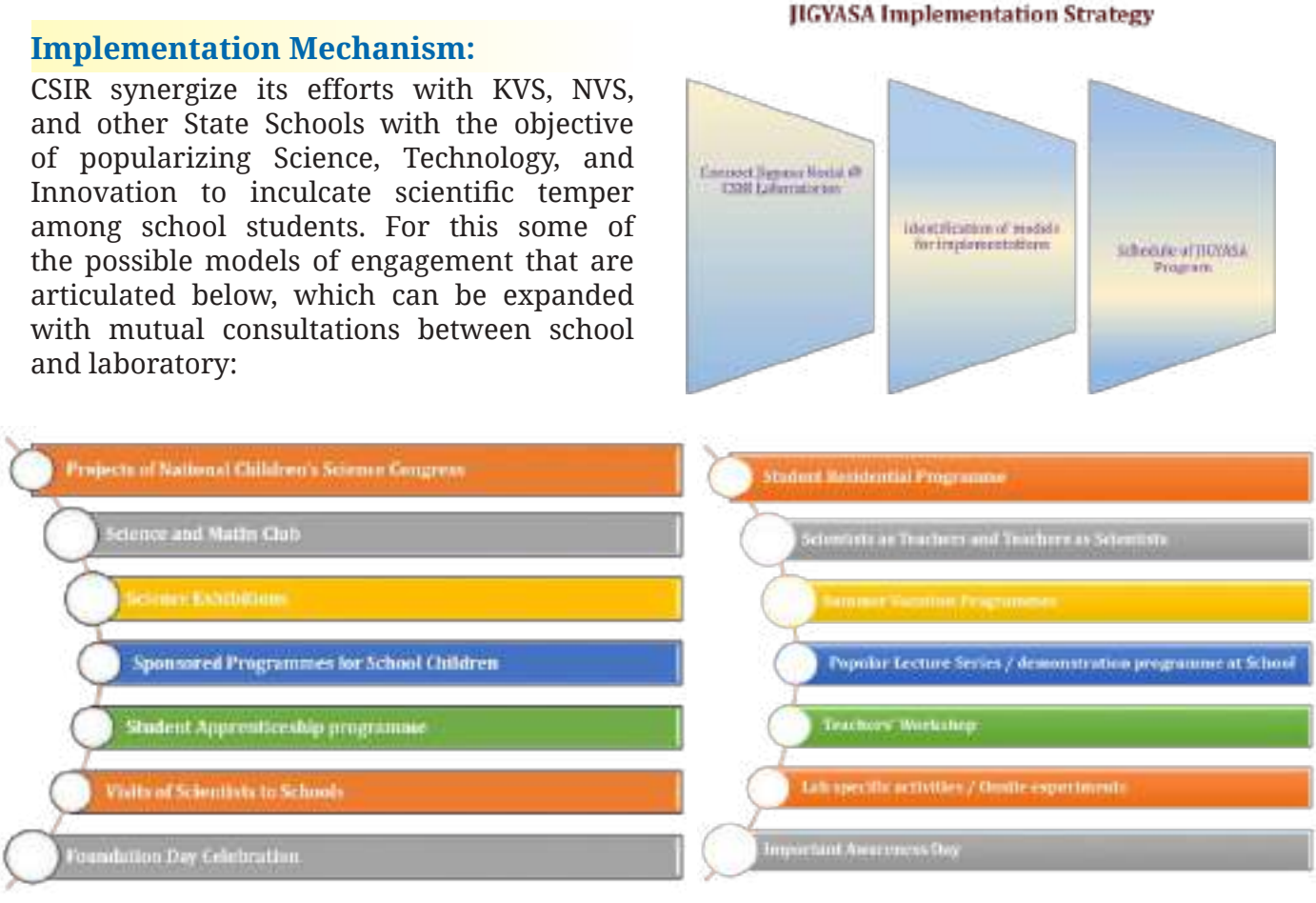
The programme will be implemented by CSIR laboratories in consultation with the schools. A calendar of activities will be prepared for implementation by the laboratory. All Schools and CSIR Lab (Jigyasa coordinator) are engaged in preparing yearlong Calendar of Activity in consultation with Principals as follows.

Some major highlights/Pictures of Jigyasa program during the FY 2020-21 are as follows:

During the financial year 2020-21, due to the Covid-19 pandemic, more thrust was placed on online activities.

More than 120 webinars were organized by different laboratories

CSIR- SUMMER RESEARCH TRAINING PROGRAMME 2020 conducted online by CSIR-NEIST during 16th to 22nd August 2020.



More than 2 lakh students attended the webinar on CSIR Jigyasa youtube channel.

CSIR Jigyasa Program in collaboration with Atal Tinkering Lab (ATL), NITI Aayog:

MoU on Jun 05, 2020 between CSIR and AIM NITI Aayog

- 22 Webinar Series organized under CSIR-ATL collaboration
- Nearly 295 ATL schools are going to be adopted by CSIR labs
- One Resource person for each adopted school with a tentative time commitment of 4-5 hours per month
- Cooperation in VL Content development
- Popularizing CJVL among ATL/AIM community

In the CSIR Society meeting, that was held on 14th February 2020, Hon'ble Prime Minister of India and President, CSIR, Shri Narendra Modi, among many directions to CSIR, appreciated the student outreach Jigyasa program and stressed on the importance of developing Virtual Labs (VL) so that science can further be taken to all segments of the students in every corner of the country.

This challenge was taken up by CSIR and thus Jigyasa 2.0 was initiated. To develop the virtual lab platform CSIR had signed an MoU with IIT Bombay on January 29, 2021.

CSIR-IITB MoU on Jan 29, 2021

The objective of the MoU are:

- Development of a JVL deployment platform that facilitates access on computers, mobile devices and similar devices.
- Cloud-based and offline deployment architecture (communication protocol to setup the offline deployment)
- Pedagogy and technology support for storyboards, interactive simulators,
- animations etc.
- Training workshops for developers
- Outreach including workshops, bootcamps, events etc. for popularsing CSIR Jigyasa VL across India.
- Technical help throughout building of Platform
- Maintainance and technical support as required

- ArMoR is designed to trigger scientific curiosity & awareness, particularly among the citizens of tomorrow, as all game levels are based on sound scientific principles

12.14 Traditional Knowledge Digital Library (TKDL)

The Traditional Knowledge Digital Library (TKDL) as prior art database was established in response to growing instances of misappropriation of Indian traditional knowledge across the globe via grant of intellectual property rights. The TKDL database currently containing information of Indian traditional medicine knowledge from over 390 classical/ traditional books of Ayurveda, Unani, Siddha & Sowa Rigpa as well as Yoga practices in a digitized format is available in five international languages (English, French, German, Spanish and Japanese).

Over 7500 medicinal formulations from different Indian systems of medicine and Yoga were transcribed into the TKDL database in the year 2020-21 with associated creation of appropriate traditional knowledge resource classification (TKRC) codes. The total number of formulations currently transcribed in the TKDL database is about 3.9 lakh.

During this period, over 20 patent applications were identified for submission of third party or pre-grant submissions against grant of patent applications based on Indian systems of medicine. As a result of the submission of evidences and the use of TKDL as a prior art database by Patent Offices, as on date 241 patent applications have been either amended, withdrawn, abandoned or rejected.

ANNEXURES

ANNEXURE I

Awards and Recognition

During the year numerous awards and recognitions have been received by CSIR staff, as below:

Awards/Recognition	Name of the Awardees	Lab Name
National Meritorious Invention Awards from National Research Development Corporation (NRDC)	Dr.T.S. Shabi , Dr.S.K. Sanghi, Dr. Deepti Mishra, Dr. Rini Paulose, Ms. Varsha Agrawal, Mr. Rahul Arya, Mr. Akshay Singh Tomar, Dr. Sanjai Kumar Singh Rathore, Dr. Avanish Kumar Srivastava	CSIR-AMPRI
CSIR-Young Scientist Award-Physical Sciences 2020	Dr. Manoj Kumar Gupta	CSIR-AMPRI
Infosys Prize for Life Sciences 2020	Dr Rajan Sankaranarayanan	CSIR-CCMB
NASI Reliance Industries Platinum Jubilee Award 2020	Dr. Ritu Trivedi	CSIR-CDRI
SERB Women Excellence Award 2020	Dr. Niti Kumar	CSIR-CDRI
Fellow of the Indian National Science Academy, New Delhi	Dr. Saman Habib	CSIR-CDRI
Fellow of the Indian Academy of Sciences, Bengaluru	Dr. Atul Goel	CSIR-CDRI
Fellow of the Royal Society of Biology.	Dr. Prakash M. Halami	CSIR-CFTRI
Fellow of the Royal Society of Biological Sciences.	Dr. Rajagopal K	CSIR-CFTRI
Life-Time Achievement Award by The Society of Tropical Agriculture, 11th ICAHPS 2020, New Delhi, India.	Dr. Prabhasankar P	CSIR-CFTRI
Young Scientist Award by The Society of Tropical Agriculture, 11thICAHPS 2020, New Delhi, India.	Dr. Aashitosh A. Inamdar	CSIR-CFTRI

Awards/Recognition	Name of the Awardees	Lab Name
C K Somany Award for Innovation and Technology from All India Glass Manufacturer's Federation (AIGMF)	Dr. Mukul Chandra Paul	CSIR-CGCRI
Deokaran Award by Indian Ceramic Society	Dr. Ashis Kumar Mandal, Avik Halder, Biswajit Mandal, Sourindra Mahanty, Ranjan Sen	CSIR-CGCRI
CSIR Technology Award 2020 for Physical Sciences for its technology Zero Formaldehyde High Performance Chromium – Melamine Synthetic Tanning agent for Greener Leather Manufacturing		CSIR-CLRI
INAE Young Engineer Award 2020 by for "Cleaner Greener Chemicals for Leather" during September 2020	Dr. M. Satish	CSIR-CLRI
Fellow of Academy of Sciences by The Academy of Sciences, Chennai	Dr K J Sreeram, Dr A Sivasamy and Dr Debasis Samanta	CSIR-CLRI
'Rajbhasha Vishist Puraskar-2019' from the representative of TOLIC, Durgapur	Prof. (Dr.) Harish Hirani	CSIR-CMERI
CIDC Vishwakarma Achievement Award 2021	Dr. Ambika Behl	CSIR-CRRI
IGS Delhi Chapter Leadership Award 2020 (Trophy & Citation)	Dr. A K Sinha	CSIR-CRRI
CIDC Viswakarama Award 2021	Dr Ravindra Kumar	CSIR-CRRI
INAE Young Engineer Award 2020	Dr. Pooja Devi	CSIR-CISO
CSIR Young Scientist Award 2020 in Engineering Sciences	Dr. Manoj K Patel	CSIR-CISO
IETE-Hari Ramji Toshniwal Award	Dr. Manoj K Patel	CSIR-CISO
IETE-CEOT (94) Award for 2020	Dr. Umesh Kumar Tiwari	CSIR-CISO
APMP Award for Developing Economies for year 2020 by APMP Secretariat, Japan	Dr Sanjay Yadav	CSIR-NPL
DBT-Biotech Product, Process Development and Commercialisation Award 2020		CSIR-CSMCRI

Awards/Recognition	Name of the Awardees	Lab Name
National Award for Technology Innovation in the category of "Innovations in Polymeric Materials"	Dr Ketan Patel	CSIR-CSMCRI
DBT- Ramalingaswami Fellowship	Dr. Ratnasekhar	CSIR-CIMAP
CSIR Young Scientist Award for 2020 in Biological Sciences	Dr. Vandana Jaiswal	CSIR-IHBT
NASI-Young Scientist Platinum Jubilee Award, 2020 in the field of Bio-medical, Molecular Biology and Biotechnology	Dr. Rohit Sharma, INSPIRE Faculty	CSIR-IHBT
Fellow of Indian National Science Academy	Dr. Suvendra Nath Bhattacharyya	CSIR-IICB
SERB POWER fellowship2021	Dr Upasana Ray	CSIR-IICB
Young Scientist Award of Indian National Science Academy	Dr. Kamalika Mukherjee	CSIR-IICB
Fellow of the Royal Society of Chemistry (FRSC)	Dr R Parthasarathi	CSIR-IITR
Jagadish Chandra Bose (JC Bose) National Fellowship Award (2021)	Dr. Sanjeev Khosla	CSIR-IMTECH
Fellow The National Academy of Sciences, India (NASI), (2020)	Dr. Manoj Raje	CSIR-IMTECH
DBT/Wellcome Trust India Alliance Fellowship (2021)	Dr. Ashwani Kumar	CSIR-IMTECH
CSIR Technology Award in the category of Business Development and Technology Marketing 2020 for		CSIR-NAL
Fellow of the Indian National Academy of Engineering	Dr. S Raja	CSIR-NAL
Fellow of the National Academy of Engineering	Dr. Harish Barshilia	CSIR-NAL
CSIR-Young Scientist Award in Engineering Sciences	Dr. Indu Elizabeth,Scientist	CSIR-NAL
IEEE-Women Technologist Award Award by IEEE Bangalore Chapter	Dr. Hema Singh	CSIR-NAL

Awards/Recognition	Name of the Awardees	Lab Name
INSA Fellowship-2020	Dr. P. K. Singh	CSIR-NBRI
Fellow of The Linnaean Society (FLS), London	Dr. T. S. Rana	CSIR-NBRI
Shanti Swarup Bhatnagar Award 2020 in the Engineering Sciences and A V Rama Rao Chair Professorship	Dr. Amol Kulkarni	CSIR-NCL
Professor Kaushal Kishor Memorial Award and 10th National Award for Technology Innovation	Dr. Samir Chikkali	CSIR-NCL
SERB POWER Fellowship	Dr. Manjusha Shelke	CSIR-NCL
The INAE Young Entrepreneur Award 2020	Dr. Anuya Nisal	CSIR-NCL
CSIR Technology Award 2020 for Restoration of Nallah with Ecological units (RENEU)		CSIR-NEERI
Fellow of The National Academy of Sciences, Allahabad-2020	Dr. Prantik Mandal	CSIR-NGRI
NASI Platinum Jubilee Young Scientist Medal 2020 in the field of Earth science, Mathematics and Physics	Dr. Shib Sankar Ganguli	CSIR-NGRI
CSIR Young Scientist Award for the year 2020 in Chemical Sciences; Kerala State Youth Icon Award in Science for the year 2020; and INSA Medal for Young Scientist in the area of Chemical Science for the year 2020	Dr. Suraj Soman	CSIR-NIIST
CSIR-Technology Award for the best innovation for the year 2020	Dr. Yoosaf Karuvath, Dr. Narayanan Unni, Dr. Kaustabh Kumar Maiti, Dr. Elizabeth Jacob, Robert Philip.	CSIR-NIIST
Raman Research Fellowship	Dr C Vijayakumar	CSIR-NIIST
Kerala State Young Scientist Award	Dr Sreejith Shankar	CSIR-NIIST
Fellow of Indian Chemical Society	Dr B S Sasidhar	CSIR-NIIST
Senior Scientist Award for the year 2020, by the Microbiologists Society, India.	Dr. Samir Damare	CSIR-NIO

Awards/Recognition	Name of the Awardees	Lab Name
K.K.Menon Award for the year 2020 by the Geological Society of India.	Dr. Firoz Badesab	CSIR-NIO
CSIR Young Scientist Award for the Year 2020 in Earth, Atmosphere, Ocean and Planetary Sciences	Dr. Jagadeesan Loganathan	CSIR-NIO
Dr. Anna Mani National Award for Woman Scientist for the year 2020	Dr. Lidita Khandeparker	CSIR-NIO
National Award in the field of Ocean Science and Technology for the year 2020	Dr. V.V.S.S. Sarma	CSIR-NIO
CSIR-Best Technology Award 2020 in Physical Sciences		CSIR-NML
SKOCH Order of Merit 2020		CSIR-NML
MASCOT National Award by The Electrochemical Society of India		CSIR-NML
Scroll of Honour 2020 from the Institution of Engineers (India)		CSIR-NML
CSIR-Raman research Award for 2020-2021.	Dr. Pratima Meshram	CSIR-NML
Institution of Engineers (India) Young Engineers Award 2020-21	Dr. Prabhat Ranjan Prem and Dr. A. Kanchana Devi	CSIR-SERC
PIUG 2020 Brian Stockdale Memorial Award by PIUG, Inc., The International Society for Patent Information Professionals.	Mr. Guruprasad Posugade	CSIR-URDIP

ANNEXURE II

CSIR Patent Applications Filed and Patents Granted during 2020-21

	India		Abroad*	
	Filed	Granted	Filed	Granted
AMPRI	7	4	9	0
CBRI	0	1	0	0
CCMB	1	1	5	5
CDRI	11	11	0	4
CECRI	1	9	1	0
CEERI	1	1	0	0
CFTRI	2	11	0	0
CGCRI	6	5	0	7
CIMAP	4	3	0	0
CIMFR	11	3	0	0
CLRI	5	27	13	14
CMERI	12	3	1	1
CRRI	1	4	0	0
CSIO	6	0	4	2
CSIR(SCH)	0	2	0	1
CSMCRI	13	22	7	20
FPI	0	0	0	0
IGIB	3	0	4	1

	India		Abroad*	
IHBT	10	3	8	1
IICB	2	1	10	2
IICT	10	18	15	5
IIIM	1	4	14	10
IIP	5	23	5	7
IITR	10	1	1	0
IMMT	5	6	0	0
IMTECH	5	1	8	9
NAL	3	7	0	2
NBRI	2	3	0	1
NCL	30	110	50	101
NEERI	7	3	0	0
NEIST	4	6	1	4
NGRI	0	0	1	1
NIIST	10	3	17	3
NIO	0	1	0	0
NMITLI	0	0	0	1
NML	16	15	0	0
NPL	2	6	0	4
SERC(M)	2	0	0	0
Total	**208**	**318**	**174**	**206**

* Data may change later during national phase entries

ANNEXURE III

Foreign Patents Granted to CSIR during 2020-2021

CSIR-CCMB				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
1	Australia	2018202963	Biomarkers useful for detection of grades of human breast cancer	Dinesh Kumar Lekha, Verma Vinod Kumar, Appukuttan Nair Rekha, Jem Prabhakar, Katoor Jayasree
2	Canada	2852384	Biomarkers useful for detection of grades of human breast cancer	Dinesh Kumar Lekha, Verma Vinod Kumar, Appukuttan Nair Rekha, Jem Prabhakar, Katoor Jayasree
3	United Kingdom	2558494	Protein nanostructures for the delivery of therapeutic agents to the anterior segment of the eye	Saad Mohammad Ahsan, Chintalagiri Mohan Rao
4	United States Of America	10625343	Production of metal nanoparticles in aqueous slution	Sankalp Vinod Agarwal, Shyam Sunder Reddy, Marshal
5	United States Of America	10640539	Recombinant protein-based method for the delivery of silencer rna to target the brain	Gopal Vijaya, Ghulam Hassan Dar
CSIR-CDRI				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
6	Germany	3200770	A formulation useful for delivery of neuro protecting agent	Anil Kumar Dwivedi, Hafsa Ahmad, Kiran Khandelwal, Rajender Singh Sangwan, Neelam Singh Sangwan, Jiaur Rahaman Gayen, Sarika, Smrati Bhaduaria, Sps Gaur, Vivek V Bhosale, Srikanta Kumar Rath, Sharad Sharma, Rakesh Shukla

7	European Patent Office	3200770	A formulation useful for delivery of neuro protecting agent	Anil Kumar Dwivedi, Hafsa Ahmad, Kiran Khandelwal, Rajender Singh Sangwan, Neelam Singh Sangwan, Jiaur Rahaman Gayen, Sarika, Smrati Bhaduaria, Sps Gaur, Vivek V Bhosale, Srikanta Kumar Rath, Sharad Sharma, Rakesh Shukla
8	France	3200770	A formulation useful for delivery of neuro protecting agent	Anil Kumar Dwivedi, Hafsa Ahmad, Kiran Khandelwal, Rajender Singh Sangwan, Neelam Singh Sangwan, Jiaur Rahaman Gayen, Sarika, Smrati Bhaduaria, Sps Gaur, Vivek V Bhosale, Srikanta Kumar Rath, Sharad Sharma, Rakesh Shukla
9	United Kingdom	3200770	A formulation useful for delivery of neuro protecting agent	Anil Kumar Dwivedi, Hafsa Ahmad, Kiran Khandelwal, Rajender Singh Sangwan, Neelam Singh Sangwan, Jiaur Rahaman Gayen, Sarika, Smrati Bhaduaria, Sps Gaur, Vivek V Bhosale, Srikanta Kumar Rath, Sharad Sharma, Rakesh Shukla
CSIR-CGCRI				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
10	Germany	2958866	Energy efficient soda lime silicate glass compositions using borax pentahydrate	Karmakar Basudeb, Molla Atiar Rahaman, Tarafder Anal, Sen Ranjan
11	European Patent Office	2411340	A new codopant for fabricating rare earth doped optical fiber	Sen Ranjan, Dhar Anirban, Paul Mukul Chandra, Maiti Himadri Sekhar

12	European Patent Office	2958866	Energy efficient soda lime silicate glass compositions using borax pentahydrate	Karmakar Basudeb, Molla Atiar Rahaman, Tarafder Anal, Sen Ranjan
13	France	2411340	A new codopant for fabricating rare earth doped optical fiber	Sen Ranjan, Dhar Anirban, Paul Mukul Chandra, Maiti Himadri Sekhar
14	United Kingdom	2411340	A new codopant for fabricating rare earth doped optical fiber	Sen Ranjan, Dhar Anirban, Paul Mukul Chandra, Maiti Himadri Sekhar
15	Malaysia	MY-175349-A	Novel soda lime silicate glass composition comprising colemanite and a process for the preparation thereof	Kalyandurg Annapurna, Biswas Kaushik, Sontakke Atul Dnyaneshwar, Sen Ranjan
16	Turkey	2958866	Energy efficient soda lime silicate glass compositions using borax pentahydrate	Karmakar Basudeb, Molla Atiar Rahaman, Tarafder Anal, Sen Ranjan
CSIR-CLRI				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
17	Argentina	AR105795B1	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
18	China	ZL201680004680.1	A dispersing agent composition for tanning of hides/skins and a process for the preparation thereof	Chellappa Muralidharan
19	Germany	3430174	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao

20	European Patent Office	3430174	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
21	France	3430174	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
22	United Kingdom	3430174	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
23	Indonesia	IDP000072818	A novel fluidized bed reactor for treatment of waste water	Ganesan Sekaran, Sekar Karthikeyan, Ramasamy Boopathy, Asit Baran Mandal
24	Indonesia	IDP000072810	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
25	Iran	101459	An improved dispersing agent composition for application in tanning and a process for the preparation thereof	Chellappa Muralidharan
26	Italy	3430174	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao

27	Netherlands	3430174	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
28	Portugal	3430174	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
29	Turkey	3430174	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
30	Vietnam	27257	A zero water chrome tanning process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
CSIR-CMERI				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
31	United States Of America	10962333	Vehicle mounted sliding type retractable mobile protective shield	Palash Kumar Maji, Harish Hirani, Avik Chatterjee
CSIR-CSIO				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
32	United States Of America	10699415	A method for automatic volumetric segmentation of human upper respiratory tract	Neelapu Bala Chakravarthy, Sardana Harish Kumar, Kharbanda Om Prakash, Sardana Viren, Gupta Abhishek, Vasamsetti Srikanth

33	United States Of America	10661288	Manually controlled variable coverage high range electrostatic sprayer	Patel Manoj Kumar, Ghanshyam C, Kapur Pawan
CSIR-CSIR(SCH)				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
34	United States Of America	10639274	Carbamoylethyl katira eye lubricant solution and a process for preparation thereof	Rana Vikas, Sharma Radhika, Kamboj Sunil, Singh Kuldeep, Suresh Sarasija
CSIR-CSMCRI				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
35	Bulgaria	2616168	High flux hollow fiber ultrafiltration membranes and process for the preparation thereof	Alamuru Venktarami Reddy, Paramita Ray, Puyam Sobhindro Singh, Kallem Parashuram, Sandipkumar Maurya, Jitendra Jaydevprasad Trivedi
36	China	ZL201580039857.7	Preparation of functionalized castor oil derivatives using solid acid and base catalysts	Kannan Srinivasan, Sivashunmugam Sankaranarayanan
37	Germany	2675879	Improved process for the preparation of fatty acid alkyl esters (biodiesel) from triglyceride oils using eco-friendly solid base catalysts	Kannan Srinivasan, Sivashunmugam Sankaranarayanan, Churchil Angel Antonyraj
38	European Patent Office	2922617	Low fouling thin film composite reverse osmosis membranes with improved chlorine resistance and a process for preparation thereof	Alamuru Venkata Rami Reddy, Saha Nirmal Kumar, Jewrajka Suresh Kumar, Jitendra Jaydevprasad Trivedi, Paramita Ray, Nagendra Pathak, Gaurang Shambuprasad Trivedi, Temubha Bhupatsinh Gohil, Rahul Shubhash Patil

39	European Patent Office	2616168	High flux hollow fiber ultrafiltration membranes and process for the preparation thereof	Alamuru Venktarami Reddy, Paramita Ray, Puyam Sobhindro Singh, Kallem Parashuram, Sandipkumar Maurya, Jitendra Jaydevprasad Trivedi
40	European Patent Office	2675879	Improved process for the preparation of fatty acid alkyl esters (biodiesel) from triglyceride oils using eco-friendly solid base catalysts	Kannan Srinivasan, Sivashunmugam Sankaranarayanan, Churchil Angel Antonyraj
41	Spain	2922617	Low fouling thin film composite reverse osmosis membranes with improved chlorine resistance and a process for preparation thereof	Alamuru Venkata Rami Reddy, Saha Nirmal Kumar, Jewrajka Suresh Kumar, Jitendra Jaydevprasad Trivedi, Paramita Ray, Nagendra Pathak, Gaurang Shambuprasad Trivedi, Temubha Bhupatsinh Gohil, Rahul Shubhash Patil
42	Spain	2675879	Improved process for the preparation of fatty acid alkyl esters (biodiesel) from triglyceride oils using eco-friendly solid base catalysts	Kannan Srinivasan, Sivashunmugam Sankaranarayanan, Churchil Angel Antonyraj
43	France	2675879	Improved process for the preparation of fatty acid alkyl esters (biodiesel) from triglyceride oils using eco-friendly solid base catalysts	Kannan Srinivasan, Sivashunmugam Sankaranarayanan, Churchil Angel Antonyraj
44	United Kingdom	GB2534090	A facile synthesis of seaweed polysaccharides based hydrophobic biocompatible crosslinked composite porous materials for energy-efficient separation	Ramavatar Meena, Naresh Dharmashibhai Sanandiya, Jai Prakash Chaudhary, Dibyendu Mondal, Nataraj Sanna Kotrappanavar

45	United Kingdom	GB2539862	Robust, bulk conducting moulded polymer composite - the polymer chip electrode - an improved next generation off-laboratory electrode	Divesh Narayan Srivastava, Mosarrat Perween, Rajeev Gupta, Dilip Bhimjibhai Parmar
46	Hungary	2616168	High flux hollow fiber ultrafiltration membranes and process for the preparation thereof	Alamuru Venktarami Reddy, Paramita Ray, Puyam Sobhindro Singh, Kallem Parashuram, Sandipkumar Maurya, Jitendra Jaydevprasad Trivedi
47	Indonesia	IDP000072069	Integrated process for potash recovery from biomethanated spent wash with concomitant environmental remediation of effluent	Pratyush Maiti, Krishna Kanta Ghara, Soumya Haldar, Neha Pratap Patel, Subarna Maiti, Prasanta Das, Charola Samirkumar Kanjibhai
48	Japan	6779863	Robust, bulk conducting moulded polymer composite - the polymer chip electrode - an improved next generation off-laboratory electrode	Divesh Narayan Srivastava, Mosarrat Perween, Rajeev Gupta, Dilip Bhimjibhai Parmar
49	Philippines	1/2018/500512B1	Integrated process for potash recovery from biomethanated spent wash with concomitant environmental remediation of effluent	Pratyush Maiti, Krishna Kanta Ghara, Soumya Haldar, Neha Pratap Patel, Subarna Maiti, Prasanta Das, Charola Samirkumar Kanjibhai
50	Portugal	2922617	Low fouling thin film composite reverse osmosis membranes with improved chlorine resistance and a process for preparation thereof	Alamuru Venkata Rami Reddy, Saha Nirmal Kumar, Jewrajka Suresh Kumar, Jitendra Jaydevprasad Trivedi, Paramita Ray, Nagendra Pathak, Gaurang Shambuprasad Trivedi, Temubha Bhupatsinh Gohil, Rahul Shubhash Patil

51	United States Of America	10954185	An eco-friendly process for hydrogenation of organic molecules using hydrous ruthenium oxide catalyst	Kannan Srinivasan, Sreedhar Gundekari
52	United States Of America	10690569	A device for collecting water sample to concentrate diversified bacteria from different water depth	Binod Kumar Sweta, Haldar Soumya, Bhattacharya Amit, Manna Paramita
53	United States Of America	10688446	Seaweed polysaccharide based superhydrophilic foam membrane for energy-efficient oil-water separation	Ramavatar Meena, Naresh Dharmashibhai Sanandiya, Jai Prakash Chaudhary, Dibyendu Mondal, Nataraj Sanna Kotrappanavar
54	United States Of America	10683211	Integrated process for potash recovery from biomethanated spent wash with concomitant environmental remediation of effluent	Pratyush Maiti, Krishna Kanta Ghara, Soumya Haldar, Neha Pratap Patel, Subarna Maiti, Prasanta Das, Charola Samirkumar Kanjibhai
CSIR-IGIB				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
55	United States Of America	10925929	Method to modulate pigmentation process in the melanocytes of skin	Gokhale Rajesh Sudhir, Natarajan Vivek Turunelveli, Ganju Parul
CSIR-IHBT				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
56	United States Of America	10808259	A method for enhancing status of carbon, nitrogen, biomass and yield of plants	Anish Kaachra, Surender Kumar Vats, Paramvir Singh Ahuja, Sanjay Kumar

CSIR-IICB				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
57	Canada	2831933	Inhibitors of il-4 and il-5 for the treatment of bronchial asthma	Santu Bandyopadhyay, Balaram Ghosh, Parasuraman Jaisankar, Bikas Chandra Pal, Siddhartha Roy, Bholanath Paul, Arjun Ram, Ulaganathan Mabalirajan, Nahid Ali, Arun Bandyopadhyay, Aditya Konar, Jayashree Bagchi Chakrabotry, Indrani Chaudhury Mukherjee, Jaydeep Chaudhuri, Sanjit Kumar Mahato, Anirban Manna, Roma Sinha, Pradyot Bhattacharya, Jayaraman Vinayagam, Deba Prasad Jana, Sushovan Chowdhury
58	United States Of America	10662177	Blocking toll-like receptor 9 signaling with small molecule antagonist	Arindam Talukdar, Dipyaman Ganguly, Barnali Paul, Ayan Mukherjee, Shounak Roy, Swarnali Roy, Amrit Raj Ghosh, Roopkatha Bhattacharya, Oindrila Rahaman, Biswajit Kundu
CSIR-IICT				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
59	United States Of America	10752585	Process for the preparation of zafirlukast and analogs thereof	Srivari Chandrasekhar, Prathama Satyendra Mainkar, Paladugu Srinu, Togapur Pavan Kumar

60	United States Of America	10947248	Synthesis and biological evaluation of 4?-amidotriazole linked podophyllotoxin derivatives as potential anticancer agents	Ahmed Kamal, Velma Ganga Reddy, Ayinampudi Venkata Subbarao, Syed Riyaz, Vadithe Lakshma Nayak, Shaik Taj
61	United States Of America	10806715	Gold nanoparticles-based new formulation useful for cancer therapy	Rajesh Kotcherlakota, Sudip Mukherjee, Chitta Ranjan Patra, Vijaya Gopal
62	United States Of America	10611796	A method for regressing pancreatic tumor by a liposomal formulation along with dna vaccines	Madamsetty Vijay Sagar, Chaudhuri Arabinda, Mukhopadhyay Debabrata
63	United States Of America	10947249	Nimbolide analogs as anti-cancer agents and preparation thereof	Srivari Chandrasekhar, Prathama Satyendra Mainkar, Karre Nagaraju, Togapur Pavan Kumar, Ummanni Ramesh, Kanchanapally Tejaswini, Jerald Mahesh Kumar, Katragadda Suresh Babu, Boggavarapu Subrahmanya Sastry, Debabrata Mukhopadhyay
CSIR-IIIM				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
64	Canada	2913281	Tetrahydro-2h-pyrano [3,2-c] isochromene-6-ones and analogs for the treatment of inflammatory disorders	Jain Shreyans Kumar, Sidiq Tabasum, Meena Samdarshi, Khajuria Anamika, Vishwakarma Ram Asrey, Bharate Sandip Bibishan
65	Canada	2867452	Design, synthesis and biological evaluation of isoform selective analogs of liphagane scaffold as anticancer agents: p13k-alpha/beta inhibitors	Ram A Vishwakarma, Sanghapal Damodhar Sawant, Parvinder Pal Singh, Abid Hamid Dar, Parduman Raj Sharma, Ajit Kumar Saxena, Amit Nargotra, Kolluru Anjaneya Aravind Kumar, Mudududdla Ramesh, Asif Khurshid Qazi, Aashiq Hussain, Nayan Chanauria

66	Canada	2909280	New chromone alkaloid dysoline for the treatment of cancer and inflammatory disorders	Vishwakarma Ram Asrey, Jain Shreyans Kumar, Bharate Sandip Bibishan, Dar Abid Hamid, Khajuria Anamika, Meena Samdarshi, Bhola Sunil Kumar, Qazi Asif Khurdhid, Hussain Aashiq, Sidiq Tabasum, Uma Shaanker Ramanan, Ravikanth Gudasalamani, Vasudeva Ramesh, Mohana Kumara Patel, Ganeshaiah Kotiganahalli Narayanagowda
67	Canada	2960455	A pharmaceutical composition for the treatment of multi-drug resistant infections	Vishwakarma Ram, Kumar Ajay, Khan Inshad Ali, Bharate Sandip Bibishan, Joshi Prashant, Singh Samsher, Satti Naresh
68	European Patent Office	3380476	Fused pyrimidines as isoform selective phosphoinositide-3-kinase-alpha inhibitors and process for preparation thereof	Bharate Sandip Bibishan, Bhushan Shashi, Mohammed Shabber, Guru Santosh Kumar, Bharate Sonali Sandip, Kumar Vikas, Mahajan Girish, Mintoo Mubashir Javed, Mondhe Dilip Manikrao, Vishwakarma Ram
69	European Patent Office	3209638	Polyalkylated acyl and benzoyl-phloroglucinols as potent p-glycoprotein inducers	Bharate Sandip, Kumar Ajay, Bharate Jaideep, Joshi Prashant, Wani Abubakar, Mudududdla Ramesh, Sharma Rohit, Vishwakarma Ram
70	United Kingdom	3209638	Polyalkylated acyl and benzoyl-phloroglucinols as potent p-glycoprotein inducers	Bharate Sandip, Kumar Ajay, Bharate Jaideep, Joshi Prashant, Wani Abubakar, Mudududdla Ramesh, Sharma Rohit, Vishwakarma Ram

71	United Kingdom	3380476	Fused pyrimidines as isoform selective phosphoinositide-3-kinase-alpha inhibitors and process for preparation thereof	Bharate Sandip Bibishan, Bhushan Shashi, Mohammed Shabber, Guru Santosh Kumar, Bharate Sonali Sandip, Kumar Vikas, Mahajan Girish, Mintoo Mubashir Javed, Mondhe Dilip Manikrao, Vishwakarma Ram
72	United States Of America	10941096	A process for thr preparation of natural crystallized thymol from monarda citriodora (jammu monarda) oil	Shankar Ravi, Chandra Suresh, Meena Siya Ram, Verma Mahendra Kumar, Bindu Kushal, Vij Bhavna, Dheer Divya, Jyoti, Vishwakarma Ram Asrey
73	United States Of America	10696688	Fused pyrimidines as isoform selective phosphoinositide-3-kinase-alpha inhibitors and process for preparation thereof	Bharate Sandip Bibishan, Bhushan Shashi, Mohammed Shabber, Guru Santosh Kumar, Bharate Sonali Sandip, Kumar Vikas, Mahajan Girish, Mintoo Mubashir Javed, Mondhe Dilip Manikrao, Vishwakarma Ram
CSIR-IIP				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
74	Germany	3328830	An improved process for the selective production of n-methyl-2-pyrrolidone (nmp)	Ghosh Indraji Kumar, Jain Suman Lata, Khatri Praveen Kumar, Ray Siddharth Sankar, Garg Madhukar Onkarnath
75	European Patent Office	3328830	An improved process for the selective production of n-methyl-2-pyrrolidone (nmp)	Ghosh Indraji Kumar, Jain Suman Lata, Khatri Praveen Kumar, Ray Siddharth Sankar, Garg Madhukar Onkarnath
76	United Kingdom	3328830	An improved process for the selective production of n-methyl-2-pyrrolidone (nmp)	Ghosh Indraji Kumar, Jain Suman Lata, Khatri Praveen Kumar, Ray Siddharth Sankar, Garg Madhukar Onkarnath

77	Japan	6827031	An improved process for the selective production of n-methyl-2-pyrrolidone (nmp)	Ghosh Indraji Kumar, Jain Suman Lata, Khatri Praveen Kumar, Ray Siddharth Sankar, Garg Madhukar Onkarnath
78	South Korea	10-2153764	A single step catalytic process for the conversion of naphtha to diesel range hydrocarbons	Nagabhatla Viswanadham, Peta Sreenivasulu, Saxena Sandeep Kumar, Panwar Rajiv, Nandan Devaki, Jadgish Kumar
79	United States Of America	10857532	Preparation method of slurry phase organic-inorganic fused hybrid catalyst use for residue hydroprocessing	Ravindra Prajapati, Kirtika Kohli, Samir Kumar Maity, Madhukar Onkarnath Garg
80	United States Of America	10745629	A process for upgradation of heavy crude oil/residue using waste plastic as hydrogen donating agent	Kiritika Kohli, Ravindra Prajapati, Samir Kumar Maity, Madhukar Onkarnath Garg
CSIR-IMTECH				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
81	Australia	2019246661	A method to screen cancer	Ashish, Sagar Amin, Badmalia Maulik D, Dhiman Kanika, Yadav Shiv Pratap Singh
82	Brazil	112013003725-3	Novel laccase enzyme and its application	Vijay Chintaman Sonawane
83	European Patent Office	3545299	Method for mycobacterium tuberculosis dection using small angle x-ray scattering profile of hair	Ashish, Ashwani Kumar, Amin Sagar
84	European Patent Office	3423587	A method for o- and s- glycosylation of peptides or polypeptides using a multifunctional glycosyltransferase	Alka Rao, Rupa Nagar

85	United Kingdom	3545299	Method for mycobacterium tuberculosis dection using small angle x-ray scattering profile of hair	Ashish, Ashwani Kumar, Amin Sagar
86	Mexico	379928	Aptamers for purifying and quantifying gelsolin and its variants	Ashish, Renu Garg, Nagesh Peddada
87	Netherlands	3423587	A method for o- and s- glycosylation of peptides or polypeptides using a multifunctional glycosyltransferase	Alka Rao, Rupa Nagar
88	Romania	3545299	Method for mycobacterium tuberculosis dection using small angle x-ray scattering profile of hair	Ashish, Ashwani Kumar, Amin Sagar
89	United States Of America	10738292	Cellulase derived from metagenomics	Roma Garg, Vijaya Brahma, Lata Verma, Girish Sahni
CSIR-NAL				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
90	Australia	2016210539	An improved process for the preparation of corrosion resistant sealed anodized coatings on aluminum alloy	Jayam Nagabushan Balaraju, Govindaraj Yoganandan
91	United States Of America	10920332	An improved process for the preparation of corrosion resistant sealed anodized coatings on aluminum alloy	Jayam Nagabushan Balaraju, Govindaraj Yoganandan

CSIR-NBRI				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
92	United States Of America	10934556	Novel reversible expression system for transgene expression in plants	Sawant Samir Vishwanath, Singh Surendra Pratap
CSIR-NCL				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
93	Belgium	3303445	An efficeint process for production of high molecular weight poly-l-latic acid and production of pellets thereof.	Ashish Kishore Lele, Abhijit Pravin Shete, Karan Vivek Dikshit
94	Brazil	BR112012003276-3	Process for producing fatty acids	Srinivas Darbha, Jitendra Kumar Satyarthi, Raja Thirumalaiswamy, Shilpa Shirish Deshpande
95	Brazil	BR112012030397-0	Lactic acid-isosorbide copolyesters and process for preparation thereof	Bhaskar Bhairavnath Idage, Susheela Bhaskar Idage, Sivaram Swaminathan
96	Canada	2735411	A process for deacidification using membranes	Ulhas Kanhaiyalal Kharul, Ramchandra Vitthal Gadre, Vithal Venkatrao Jogdand, Yogesh Jayasing Chendake
97	Switzerland	3209639	Novel anti-malarial agents	Ashis Kumar Bhattacharya, Eswar Kumar Aratikatla, Kumkum Srivastava, Ashan Manhas
98	Switzerland	3392240	Engineering of organic molecules for terahertz tagging applications	Ashootosh Vasant Ambade, Bala Pesala, Kavita Joshi, Nitin Bapurao Basutkar, Shaumik Ray, Jyotirmayee Dash, Kaware Vaibhav Vilasrao

99	Germany	3352805	A novel pharmaceutical wound healing composition	Asmita Ashutosh Prabhune, Snehal Vijay More, Sachin Bharat Agawane
100	Germany	3039062	Abpbi co-polymers and their synthesis thereof	Ulhas Kanhaiyalal Kharul, Kurungot Sreekumar, Harshal Dilip Chaudhari, Vinaya Bhagwat Ghodake
101	Germany	3274326	Improved process for synthesis of dialkyl carbonates	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Savita Kiran Shingote, Lalita Sanjib Roy
102	Germany	3268126	Novel configuration and its use in process for synthesis of alkyl carbamates from alkyl alcohol and urea in a tubular reactor	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Dhananjay Ravindra Mote, Savita Kiran Shingote, Lalita Sanjib Roy
103	Germany	3303445	An efficeint process for production of high molecular weight poly-l-latic acid and production of pellets thereof.	Ashish Kishore Lele, Abhijit Pravin Shete, Karan Vivek Dikshit
104	Germany	3307428	Microcapsules modified with nano materials for desired release pattern/ rate and preparation thereof	Parshuram Gajanan Shukla
105	Germany	3551637	A novel compound for the detection of hno in biological systems	Amitava Das, Firoj Ali, Anila Hoskere Ashok, Samit Chattopadhyay, Nandaraj Taye
106	Germany	3138627	A process for preparation of self healing microcapsules	Parshuram Gajanan Shukla, Arun Savalaram Jadhav
107	Germany	3307817	Novel spiropyram based compounds and preparation thereof	Nithyanandhan Jayaraj, Ananthan Alagumalai, Pooja Ramesh Kayasth

108	Germany	3491031	Self- assembled catalysts and use thereof in olefin polymerization	Samir Hujur Chikkali, Nilesh Rajesh Mote
109	Germany	3377880	Apparatus for vapour-liquid-equilibrium (vle) data measurement	Nilesh Atmaram Mali
110	Germany	3256250	A one pot process for the preparation of methanol from carbon dioxide	Ekambaram Balaraman, Vinod Gokulkrishna Landge, Siba Prasad Midya, Manoj Kumar Sahoo, Garima Jaiswal
111	Germany	3392240	Engineering of organic molecules for terahertz tagging applications	Ashootosh Vasant Ambade, Bala Pesala, Kavita Joshi, Nitin Bapurao Basutkar, Shaumik Ray, Jyotirmayee Dash, Kaware Vaibhav Vilasrao
112	European Patent Office	3307817	Novel spiropyram based compounds and preparation thereof	Nithyanandhan Jayaraj, Ananthan Alagumalai, Pooja Ramesh Kayasth
113	European Patent Office	3256250	A one pot process for the preparation of methanol from carbon dioxide	Ekambaram Balaraman, Vinod Gokulkrishna Landge, Siba Prasad Midya, Manoj Kumar Sahoo, Garima Jaiswal
114	European Patent Office	3138627	A process for preparation of self healing microcapsules	Parshuram Gajanan Shukla, Arun Savalaram Jadhav
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116	European Patent Office	3268126	Novel configuration and its use in process for synthesis of alkyl carbamates from alkyl alcohol and urea in a tubular reactor	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Dhananjay Ravindra Mote, Savita Kiran Shingote, Lalita Sanjib Roy

117	European Patent Office	3274326	Improved process for synthesis of dialkyl carbonates	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Savita Kiran Shingote, Lalita Sanjib Roy
118	European Patent Office	3303445	An efficeint process for production of high molecular weight poly-l-latic acid and production of pellets thereof.	Ashish Kishore Lele, Abhijit Pravin Shete, Karan Vivek Dikshit
119	European Patent Office	3307428	Microcapsules modified with nano materials for desired release pattern/ rate and preparation thereof	Parshuram Gajanan Shukla
120	European Patent Office	3551637	A novel compound for the detection of hno in biological systems	Amitava Das, Firoj Ali, Anila Hoskere Ashok, Samit Chattopadhyay, Nandaraj Taye
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122	European Patent Office	3377880	Apparatus for vapour-liquid-equilibrium (vle) data measurement	Nilesh Atmaram Mali
123	European Patent Office	3039062	Abpbi co-polymers and their synthesis thereof	Ulhas Kanhaiyalal Kharul, Kurungot Sreekumar, Harshal Dilip Chaudhari, Vinaya Bhagwat Ghodake
124	European Patent Office	3209639	Novel anti-malarial agents	Ashis Kumar Bhattacharya, Eswar Kumar Aratikatla, Kumkum Srivastava, Ashan Manhas
125	European Patent Office	3392240	Engineering of organic molecules for terahertz tagging applications	Ashootosh Vasant Ambade, Bala Pesala, Kavita Joshi, Nitin Bapurao Basutkar, Shaumik Ray, Jyotirmayee Dash, Kaware Vaibhav Vilasrao

126	Spain	3268126	Novel configuration and its use in process for synthesis of alkyl carbamates from alkyl alcohol and urea in a tubular reactor	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Dhananjay Ravindra Mote, Savita Kiran Shingote, Lalita Sanjib Roy
127	Spain	3274326	Improved process for synthesis of dialkyl carbonates	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Savita Kiran Shingote, Lalita Sanjib Roy
128	Spain	3303445	An efficeint process for production of high molecular weight poly-l-latic acid and production of pellets thereof.	Ashish Kishore Lele, Abhijit Pravin Shete, Karan Vivek Dikshit
129	France	3303445	An efficeint process for production of high molecular weight poly-l-latic acid and production of pellets thereof.	Ashish Kishore Lele, Abhijit Pravin Shete, Karan Vivek Dikshit
130	France	3307428	Microcapsules modified with nano materials for desired release pattern/ rate and preparation thereof	Parshuram Gajanan Shukla
131	France	3138627	A process for preparation of self healing microcapsules	Parshuram Gajanan Shukla, Arun Savalaram Jadhav
132	France	3039062	Abpbi co-polymers and their synthesis thereof	Ulhas Kanhaiyalal Kharul, Kurungot Sreekumar, Harshal Dilip Chaudhari, Vinaya Bhagwat Ghodake
133	France	3352805	A novel pharmaceutical wound healing composition	Asmita Ashutosh Prabhune, Snehal Vijay More, Sachin Bharat Agawane

134	France	3491031	Self- assembled catalysts and use thereof in olefin polymerization	Samir Hujur Chikkali, Nilesh Rajesh Mote
135	France	3392240	Engineering of organic molecules for terahertz tagging applications	Ashootosh Vasant Ambade, Bala Pesala, Kavita Joshi, Nitin Bapurao Basutkar, Shaumik Ray, Jyotirmayee Dash, Kaware Vaibhav Vilasrao
136	United Kingdom	3039062	Abpbi co-polymers and their synthesis thereof	Ulhas Kanhaiyalal Kharul, Kurungot Sreekumar, Harshal Dilip Chaudhari, Vinaya Bhagwat Ghodake
137	United Kingdom	3209639	Novel anti-malarial agents	Ashis Kumar Bhattacharya, Eswar Kumar Aratikatla, Kumkum Srivastava, Ashan Manhas
138	United Kingdom	3352805	A novel pharmaceutical wound healing composition	Asmita Ashutosh Prabhune, Snehal Vijay More, Sachin Bharat Agawane
139	United Kingdom	3551637	A novel compound for the detection of hno in biological systems	Amitava Das, Firoj Ali, Anila Hoskere Ashok, Samit Chattopadhyay, Nandaraj Taye
140	United Kingdom	3307817	Novel spiropyram based compounds and preparation thereof	Nithyanandhan Jayaraj, Ananthan Alagumalai, Pooja Ramesh Kayasth
141	United Kingdom	3307428	Microcapsules modified with nano materials for desired release pattern/ rate and preparation thereof	Parshuram Gajanan Shukla
142	United Kingdom	3491031	Self- assembled catalysts and use thereof in olefin polymerization	Samir Hujur Chikkali, Nilesh Rajesh Mote

143	United Kingdom	3392240	Engineering of organic molecules for terahertz tagging applications	Ashootosh Vasant Ambade, Bala Pesala, Kavita Joshi, Nitin Bapurao Basutkar, Shaumik Ray, Jyotirmayee Dash, Kaware Vaibhav Vilasrao
144	Italy	3274326	Improved process for synthesis of dialkyl carbonates	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Savita Kiran Shingote, Lalita Sanjib Roy
145	Italy	3268126	Novel configuration and its use in process for synthesis of alkyl carbamates from alkyl alcohol and urea in a tubular reactor	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Dhananjay Ravindra Mote, Savita Kiran Shingote, Lalita Sanjib Roy
146	Italy	3392240	Engineering of organic molecules for terahertz tagging applications	Ashootosh Vasant Ambade, Bala Pesala, Kavita Joshi, Nitin Bapurao Basutkar, Shaumik Ray, Jyotirmayee Dash, Kaware Vaibhav Vilasrao
147	Japan	6717849	Process for regeneration and recovery of catalysts used for dialkyl carbonate synthesis	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Savita Kiran Shingote, Lalita Sanjib Roy, Dhananjay Ravindra Mote
148	Netherlands	3491031	Self- assembled catalysts and use thereof in olefin polymerization	Samir Hujur Chikkali, Nilesh Rajesh Mote
149	Netherlands	3256250	A one pot process for the preparation of methanol from carbon dioxide	Ekambaram Balaraman, Vinod Gokulkrishna Landge, Siba Prasad Midya, Manoj Kumar Sahoo, Garima Jaiswal

150	Netherlands	3268126	Novel configuration and its use in process for synthesis of alkyl carbamates from alkyl alcohol and urea in a tubular reactor	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Dhananjay Ravindra Mote, Savita Kiran Shingote, Lalita Sanjib Roy
151	Netherlands	3274326	Improved process for synthesis of dialkyl carbonates	Vivek Vinayak Ranade, Ashutosh Anant Kelkar, Vilas Hari Rane, Anil Kisan Kinage, Savita Kiran Shingote, Lalita Sanjib Roy
152	Netherlands	3307428	Microcapsules modified with nano materials for desired release pattern/ rate and preparation thereof	Parshuram Gajanan Shukla
153	Netherlands	3303445	An efficeint process for production of high molecular weight poly-l-latic acid and production of pellets thereof.	Ashish Kishore Lele, Abhijit Pravin Shete, Karan Vivek Dikshit
154	Netherlands	3138627	A process for preparation of self healing microcapsules	Parshuram Gajanan Shukla, Arun Savalaram Jadhav
155	Thailand	81055	Process for the preparation of l-lactide of high chemical yield optical purity	Bhaskar Bhairavnath Idage, Sivaram Swaminathan
156	United States Of America	10774073	Novel glycolactams derivative and process for preparation thereof	Asish Kumar Bhattacharya, Hemender Rami Chand
157	United States Of America	10843179	Self- assembled catalysts and use thereof in olefin polymerization	Samir Hujur Chikkali, Nilesh Rajesh Mote
158	United States Of America	10774060	Oxone-acetone mediated metal free preparation of syn-diols	Chepuri Venkata Ramana, Ravindra Suresh Phatake

159	United States Of America	10875011	Temperature tunable mesoporous co oxidation catalysts	Chinnakonda Subramanian Gopinath, Edwin Solomon Raja Gnanakumar
160	United States Of America	10618819	Novel p-amino benzoic acid sensitization of laf3:tb3+ nanoparticles and its applications	Meitram Niraj Luwang, Debasish Ghosh
161	United States Of America	10656515	Photochromic metal organic frameworks for inkless and erasable printing	Rahul Banerjee, Bikash Garai, Arijit Mallick
162	United States Of America	10941155	Furo[2,3-b]pyran-2-one compounds, preparation and composition thereof	Ravindar Kontham, Sagar Sudam Thorat
163	United States Of America	10717072	Water splitting activity of organic conducting ligand functionalized semiconductor nanoparticles	Radhamonyamma Nandini Devi, Leena George
164	United States Of America	10723883	Novel spiropyram based compounds and preparation thereof	Nithyanandhan Jayaraj, Ananthan Alagumalai, Pooja Ramesh Kayasth
165	United States Of America	10801033	Nucleotide sequences encoding enzymes for lactone synthesis	Vidya Shrikant Gupta, Ashish Balwant Deshpande, Pranjali Sidhir Oak, Ashok Prabhakar Giri
166	United States Of America	10658690	Phytic acid based metallogel and applications thereof	Sreekumar Kurungot, Rahul Banerjee, Harshitha Barike Aiyappa, Subhadeep Saha, Pritish Wadge
167	United States Of America	10842165	A membrane filtration device	Harshavardhan Vishavanath Adikane, Mahendra Devram Jagtap
168	United States Of America	10639615	Water oxidation catalyst having low overpotential for oxygen evolution reaction	Rani Mohan Ramsundar, Pattayil Alias Joy

169	United States Of America	10683317	Novel compounds and process for preparation of the same from cashew nut shell liquid (cnsl)	Samir Hujur Chikkali, Swechchha Pandey
170	United States Of America	10787418	Palladium (ii)-catalyzed y c(sp)3-h alkynylation of amines	Ekambaram Balaraman, Vinod Gokulkrishna Landge, Akash Mondal
171	United States Of America	10730820	A new solid porous form of trimesic acid and a process for preparation thereof	Srinu Tothadi, Rahul Banerjee
172	United States Of America	10945957	A biodegradable theranostic nano-composite and uses thereof	Selvaraj Kaliaperumal, Rajendra Prasad
173	United States Of America	10781220	Boronic acid derivatives, a process for preparation and use thereof	Santhosh Babu Sukumaran, Vivek Chandrakant Wakchaure
174	United States Of America	10703714	A process for the synthesis of aromatic carbamates	Ashutosh Anant Kelkar, Nayana Tushar Nivangune, Vilas Hari Rane
175	United States Of America	10808118	Novel epoxy novolac composites and preparation thereof	Manohar Virupax Badiger, Rajeshwari Shyamji Gour, Prakash Purushottam Wadgaonkar
176	United States Of America	10709743	A novel pharmaceutical wound healing composition	Asmita Ashutosh Prabhune, Snehal Vijay More, Sachin Bharat Agawane
177	United States Of America	10730891	Selective determination of free cyteine	Amitava Das, Firoj Ali, Upendar Reddy Gandra, Anila Hoskere Ashok, Samit Chattopadhyay, Nandaraj Taye
178	United States Of America	10827695	A process for in-vitro production of saffron	Chovumpurathu Kurian John, Mrudul Vijay Shirgurkar, Ashok Bhimrao Dhage

179	United States Of America	10711012	Novel pyridinium oxazole dyad scaffold and a process for preparation thereof	Nitin Tukaram Patil, Aslam Chandbhai Shaikh, Prasad Padmakar Kulkarni, Dnyanesh Sadanand Ranade
180	United States Of America	10633572	A process for dissociation of hydrates in presence of hydrate dissociation promoters	Rajnish Kumar, Sudip Roy, Gaurav Bhattacharjee, Nilesh Choudhary, Asheesh Kumar, Raj Kumar Kashyap, Parivesh Chugh, Nawal Kishore Pande
181	United States Of America	10653134	Microcapsules containing water-soluble amine and a process for the preparation thereof	Parshuram Gajanan Shukla, Arun Savalaram Jadhav
182	United States Of America	10646827	Non noble metal based diesel oxidation catalyst	Shubhangi Bhalchandra Umbarkar, Mohan Keraba Dongare, Pavan Manohar More, Ankush Venkatrao Biradar
183	United States Of America	10815256	Novel dithiophene compound, preparation and its application in organic photovoltaics therof	Santosh Babu Sukumaran, Vivek Chandrakant Wakchaure
184	United States Of America	10940468	Novel nickel catalysts, process for preparation and use thereof for alkylation, benzylation, arylation of heteroarenes	Benudhar Punji, Vineeta Soni
185	United States Of America	10774019	Novel improved process for conversion of alkanes to alkenes	Thirumalaiswamy Raja, Ashok Kumar Venugopal, Aswathy Thareparambil Venugopalan, Marimuthu Prabu
186	United States Of America	10865174	A one step process for the hydroformylation of olefins	Samir Hujur Chikkali, Swechchha Pandey
187	United States Of America	10722462	Preparation and use of surfactant particles with internal mesomorphic structure	Guruswamy Kumaraswamy, Manoj Kumar, Ashootosh Vasant Ambade

188	United States Of America	10866199	Apparatus for vapour-liquid-equilibrium (vle) data measurement	Nilesh Atmaram Mali
189	United States Of America	10613098	Selective detection and analysis of small molecules	Dipankar Ghosh, Venkateswarlu Panchagnula, Deepika Dhaware
190	United States Of America	10656165	An in vitro process for the identification and quantification of carboxymethyl and carboxyethyl level of albumin in a sample	Mahesh Jagdishrao Kulkarni
191	United States Of America	10628720	Remote monitoring and controlling physical parameters of a device	Muthukumarasamy Karthikeyan, Renu Vyas
192	United States Of America	10857508	Continuous micro mixer	Amol Arvind Kulkarni, Vivek Vinayak Ranade
193	United States Of America	10758896	A one pot process for the preparation of methanol from carbon dioxide	Ekambaram Balaraman, Vinod Gokulkrishna Landge, Siba Prasad Midya, Manoj Kumar Sahoo, Garima Jaiswal
CSIR-NEIST				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
194	Germany	3204346	A novel process for extraction and separation of oxyresveratrol from artocarpus lakoocha roxb	Swapnali Hazarika, Dilip Konwar, Hirokjyoti Borah, Somiron Borthakur, Pranab Barkakati, Modon Mohan Bora, Ram Nath Das
195	European Patent Office	3204346	A novel process for extraction and separation of oxyresveratrol from artocarpus lakoocha roxb	Swapnali Hazarika, Dilip Konwar, Hirokjyoti Borah, Somiron Borthakur, Pranab Barkakati, Modon Mohan Bora, Ram Nath Das

196	France	3204346	A novel process for extraction and separation of oxyresveratrol from artocarpus lakoocha roxb	Swapnali Hazarika, Dilip Konwar, Hirokjyoti Borah, Somiron Borthakur, Pranab Barkakati, Modon Mohan Bora, Ram Nath Das
197	United States Of America	10655061	A process for the preparation of blue-fluorescence emitting carbon dots (cdts) from sub-bituminous tertiary high sulfur indian coals	Binoy Kumar Saikia, Tonkeswar Das, Sonali Roy, Bardwi Narzary, Hari Prasanna Deka Boruah, Manobjyoti Bordoloi, Jiumoni Lahkar, Dipankar Neog, Danaboyina Ramaiah
CSIR-NGRI				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
198	Norway	344925	Development of a technique utilising natural carbon-13 isotope for identification of early breakthrough of injection water in oil wells	Balbir Singh Sukhija, Donti Reddy Venkat Reddy, Pasupuleti Nagabhushanam, Dattatray Jaiwant Patil, Syed Hussain
CSIR-NIIST				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
199	Brazil	BR 112012021846-8	Process for the production of violacein and its derivatives containing bioactive pigment from chromobacterium sp. Niist-ckk-01	Krishnakumar Bhaskaran
200	Japan	6700200	New inorganic blue pigments from cobalt doped magnesium having transition element oxides and a process for the preparing the same	Padala Prabhakar Rao, Saraswathy Divya

201	United States Of America	10661265	Semiconductor-oxides nanotubes-based composite particles useful for dye-removal and process thereof	Shukla Satyajit Vishnu, Padinhattayil Hareesh, Narayani Harsha, Jose Manu, Karunakaran Remya
CSIR-NMITLI				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
202	Pakistan	143575	Detection of pathogens using dna macroarrays	Chintalagiri Mohan Rao, Kunchala Sridhar Rao, Puppala Venkat Ramchander, Hajib Naraharirao Madhavan, Savitri Sharma, Gita Satpathy, Ravi Kumar Venkata Banda
CSIR-NPL				
S.No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
203	United States Of America	10633257	A process for the preparation of uniform sized phosphor aerogel	Divi Haranath, Singh Nahar, Chawla Sneha
204	United States Of America	10752515	Lithium substituted magnesium ferrite as hydroelectric cell and processing method thereof	Ravinder Kumar Kotnala, Jyoti Shah
205	United States Of America	10782212	Design and development of a high-volume pm2.5 impactor	Aggarwal Shankar G, Patel Prashant, Tsai Chuen Jinn, Soni Daya, Singh Khem, Kotnala Ravinder Kumar, Tomoaki Okuda, Gupta Prabhat Kumar, Ojha Vijay Narain, Aswal Dinesh Kumar
206	United States Of America	10811546	Preparation of anti-reflection and passivation layers of silicon surface	Pathi Prathap, Kalpana Rani, Vandana, Srivastava Sanjay Kumar, Rauthan Chandra Mohan Singh, Singh Parakram Kumar

ANNEXURE IV

Publications (Area-wise Research Publications (TOP 25 Papers) by CSIR Labs)

BIOLOGICAL SCIENCES				
Sr. No.	**Lab**	**First Three Authors**	**Journal Details**	**IF-2020**
1.	IGIB	Abbafati, C; Abbas, KM; Abbasi, M	LANCET, 2020, Vol. 396, Iss. 10285, pp. 1135-1159	79.323
2.	IGIB	Abbafati, C; Abbas, KM; Abbasi, M	LANCET, 2020, Vol. 396, Iss. 10285, pp. 1204-1222	79.323
3.	IGIB	Lozano, R; Fullman, N; Mumford, JE	LANCET, 2020, Vol. 396, Iss. 10285, pp. 1250-1284	79.323
4.	IGIB	Kinyoki, DK; Ross, JM; Lazzar-Atwood, A	NATURE MEDICINE, 2020, Vol.26,Iss. 5,pp. 750-759	53.44
5.	IITR	Graetz, N; Woyczynski, L; Wilson, KF	NATURE, 2020, Vol. 577Iss. 7789,pp. 235-238	49.962
6.	IGIB	Agrawal, A	SCIENCE, 2020, Vol. 369, Iss. 6507, pp. 1050-1052	47.728
7	IHBT	Medina-Puche, L; Tan, H; Dogra, V	CELL, 2020, Vol. 182,Iss. 5, pp. 1109	41.584
8.	IGIB	Soriano, JB; Kendrick, PJ; Paulson, KR	LANCET RESPIRATORY MEDICINE, 2020, Vol. 8,Iss. 6, pp. 585-596	30.7
9.	IGIB	Yurdagul, A; Subramanian, M; Wang, XB	CELL METABOLISM, 2020, Vol. 31, Iss. 3, pp. 518	27.287
10.	IIIM	Balgotra, S; Verma, PK; Vishwakarma, RA	CATALYSIS REVIEWS-SCIENCE AND ENGINEERING, 2020, Vol. 62, Iss. 3, pp. 406-479	20.217

11.	CCMB	Avvaru, AK; Sharma, D; Verma, A	NUCLEIC ACIDS RESEARCH, 2020, Vol. 48, Iss. D1, pp. D155-D159	16.971
12.	CDRI, IMTECH	Khanam, T; Afsar, M; Shukla, A	NUCLEIC ACIDS RESEARCH, 2020, Vol. 48, Iss. 8, pp. 4325-4343	16.971
13.	IGIB	Upadhyay, SK; Mackereth, CD	NUCLEIC ACIDS RESEARCH, 2020, Vol. 48, Iss. 8, pp. 4538-4550	16.971
14.	IGIB	Jatana, N; Ascher, DB; Pires, DEV	AUTOPHAGY, 2020, Vol. 16, Iss. 2, pp. 239-255	16.016
15.	IMTECH	Pahari, S; Negi, S; Aqdas, M	AUTOPHAGY, 2020, Vol. 16, Iss. 6, pp. 1021-1043	16.016
16.	CIMAP, NBRI	Sharma, A; Badola, PK; Bhatia, C	NATURE PLANTS, 2020, Vol. 6, Iss. 10, pp. 1262	15.793
17.	CDRI	Garg, A; Foinquinos, A; Jung, MR	EUROPEAN JOURNAL OF HEART FAILURE, 2020, Vol. 22, Iss. 8, pp. 1366-1377	15.534
18.	IGIB, NCL	George, JT; Azhar, M; Aich, M	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 2020, Vol. 142, Iss. 32, pp. 13954-13965	15.419
19.	IITR	Awasthi, MK; Sarsaiya, S; Patel, A	RENEWABLE & SUSTAINABLE ENERGY REVIEWS, 2020, Vol. 127	14.982
20.	IITR	Usmani, Z; Sharma, M; Karpichev, Y	RENEWABLE & SUSTAINABLE ENERGY REVIEWS, 2020, Vol. 131	14.982
21.	CCMB	Dutta, P; Talenti, A; Young, R	NATURE COMMUNICATIONS, 2020, Vol. 11, Iss. 1	14.919
22.	CDRI	Tiwari, R; Manzar, N; Bhatia, V	NATURE COMMUNICATIONS, 2020, Vol. 11,Iss.1	14.919
23.	IGIB, NCL	Verma, K; Saxena, K; Donaka, R	NATURE COMMUNICATIONS, 2020, Vol. 11,Iss.1	14.919
24.	IITR	Kidiyoor, GR; Li, QS; Bastianello, G	NATURE COMMUNICATIONS, 2020, Vol. 11,Iss.1	14.919
25.	IITR	Serhan, CN; Gupta, SK; Perretti, M	MOLECULAR ASPECTS OF MEDICINE, 2020, Vol. 74	14.235

CHEMICAL SCIENCES				
Sr. No.	**Lab**	**First Three Authors**	**Journal Details**	**IF-2020**
1.	IIP	Murugesan, K; Senthamarai, T; Chandrashekhar, VG	CHEMICAL SOCIETY REVIEWS, 2020, Vol.49, Iss. 17, pp. 6273-63	54.564
2.	CECRI	Ohayon, D; Nikiforidis, G; Savva, A	NATURE MATERIALS, 2020, Vol.19, Iss. 4, pp. 456	43.841
3.	IICT	Yuan, JY; Hazarika, A; Zhao, Q	JOULE, 2020, Vol. 4 Iss. 6 pp. 1160-1185	41.248
4.	CECRI	Li, CY; Duan, S; Wen, BY	NATURE NANOTECHNOLOGY, 2020, Vol. 15, Iss. 11, pp. 922	39.213
5.	CECRI	Thangavel, P; Ha, MR; Kumaraguru, S	ENERGY & ENVIRONMENTAL SCIENCE, 2020, Vol. 13, Iss. 10, pp. 3447-3458	38.532
6.	CSMCRI	Tiwari, K; Sarkar, P; Modak, S	ADVANCED MATERIALS, 2020, Vol. 32, Iss. 8	30.849
7	CSMCRI, NCL	Patel, K; Chikkali, SH; Sivaram, S	PROGRESS IN POLYMER SCIENCE, 2020, Vol. 109	29.19
8.	CLRI	Periasamy, H; Gnanamani, A	LANCET INFECTIOUS DISEASES, 2020, Vol. 20, Iss. 12, pp. 1362-1363	25.071
9.	NCL	Sudarsanam, P; Ruijten, D; Liao, Y	TRENDS IN CHEMISTRY, 2020, Vol. 2, Iss. 10, pp. 898-913	24.081
10.	NIIST	Praveen, VK; Vedhanarayanan, B; Mal, A	ACCOUNTS OF CHEMICAL RESEARCH, 2020, Vol. 53, Iss. 2, pp. 496-507	22.384
11.	NCL	Enjamuri, N; Darbha, S	CATALYSIS REVIEWS-SCIENCE AND ENGINEERING, 2020, Vol. 62, Iss. 4, pp. 566-606	20.217
12.	IICT	Kim, B; Mohan, SV; Fapyane, D	TRENDS IN BIOTECHNOLOGY, 2020, Vol. 38, Iss. 6, pp. 667-678	19.536
13.	IICT	Sreeharsha, RV; Mohan, SV	TRENDS IN BIOTECHNOLOGY, 2020, Vol. 38, Iss. 8, pp. 873-887	19.536

14.	CSMCRI	Advani, JH; Singh, AS; Khan, NU	APPLIED CATALYSIS B-ENVIRONMENTAL, 2020, Vol. 268	19.503
15.	CSMCRI	Samikannu, A; Konwar, LJ; Rajendran, K	APPLIED CATALYSIS B-ENVIRONMENTAL, 2020, Vol. 272	19.503
16.	NCL	Soni, Y; Pradhan, S; Bamnia, MK	APPLIED CATALYSIS B-ENVIRONMENTAL, 2020, Vol. 272	19.503
17.	NCL	Landaburu, LU; Berenstein, AJ; Videla, S	NUCLEIC ACIDS RESEARCH, 2020, Vol. 48, Iss. D1, pp. D992-D1005	16.971
18.	NCL	Maris, C; Jayne, S; Damberger, FF	NUCLEIC ACIDS RESEARCH, 2020, Vol. 48, Iss. 8, pp. 4521-4537	16.971
19.	NEIST	Tan, MWY; Sng, MK; Cheng, HS	CELL DEATH AND DIFFERENTIATION, 2020, Vol. 27, Iss. 9, pp. 2668-2680	15.828
20.	NCL	Mohammed, AK; Usgaonkar, S; Kanheerampockil, F	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 2020, Vol. 142, Iss. 18, pp. 8252-8261	15.419
21.	IICT	Chilivery, R; Begum, G; Chaitanya, V	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 2020, Vol. 59, Iss. 21, pp. 8160-8165	15.336
22.	NCL	Dey, K; Kunjattu, HS; Chahande, AM	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 2020, Vol. 59, Iss. 3 pp. 1161-1165	15.336
23.	NCL	Hema, K; Gonnade, RG; Sureshan, KM	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 2020, Vol. 59, Iss. 7, pp. 2897-2903	15.336
24.	NCL	Vijayakanth, T; Ram, F; Praveenkumar, B	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 2020, Vol. 59, Iss. 26, pp. 10368-10373	15.336
25.	NCL	Nidhankar, AD; Goudappagouda; Kumari, DSM; Chaubey, SK	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 2020, Vol. 59, Iss. 31, pp. 13097-13085	15.336

26.	NIIST	Mal, A; Vijayakumar, S; Mishra, RK	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 2020, Vol. 59, Iss. 22, pp. 8713-8719	15.336
27.	NIIST	Bhattacharya, B; Roy, D; Dey, S	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, 2020, Vol. 59, Iss. 45, pp. 19878-19883	15.336
ENGINEERING SCIENCES				
Sr. No.	Lab	First Three Authors	Journal Details	IF-2020
1.	IMMT	Feldmann, S; Macpherson, S; Senanayak, SP	NATURE PHOTONICS, 2020, Vol. 14, Iss. 2, pp. 123	38.771
2.	AMPRI	Aili, D; Henkensmeier, D; Martin, S	ELECTROCHEMICAL ENERGY REVIEWS, 2020, Vol. 3, Iss. 4, pp. 793-845	28.905
3.	AMPRI	Bharti, DK; Gupta, MK; Kumar, R	NANO ENERGY, 2020, Vol. 73	17.881
4.	CMERI	Saha, S; Basak, B; Hwang, JH	TRENDS IN MICROBIOLOGY, 2020, Vol. 28, Iss. 12, pp. 968-984	17.079
5.	IMMT	Sarkar, S; Mathew, S; Chintalapati, S	ACS NANO, 2020, Vol.14, Iss. 12, pp. 16761-16769	15.881
6.	CMERI	Basak, B; Jeon, BH; Kim, TH	RENEWABLE & SUSTAINABLE ENERGY REVIEWS, 2020, Vol. 133	14.982
7	IMMT	Senanayak, SP; Abdi-Jalebi, M; Kamboj, VS	SCIENCE ADVANCES, 2020, Vol. 6, Iss.	14.143
8.	IMMT	Ramasamy, B; Pratihary, N; Sekar, K	CHEMICAL ENGINEERING JOURNAL, 2020, Vol. 399	13.273
9.	NAL	Menon, AV; Choudhury, B; Madras, G	CHEMICAL ENGINEERING JOURNAL, 2020, Vol. 382	13.273
10.	IMMT	Srinivasulu, YG; Yao, QF; Goswami, N	MATERIALS HORIZONS, 2020, Vol. 7, Iss. 10, pp. 2596-2618	13.266
11.	IMMT	Mondal, S; Mohanty, B; Nurhuda, M	ACS CATALYSIS, 2020, Vol. 10, Iss. 10, pp. 5623-5630	13.084

12.	IMMT	Mohanty, B; Wei, YD; Ghorbani-Asl, M	JOURNAL OF MATERIALS CHEMISTRY A, 2020, Vol. 8, Iss. 14, pp. 6709-6716	12.732
13.	CGCRI	Bullen, JC; Torres-Huerta, A; Salaun, P	WATER RESEARCH, 2020, Vol. 175	11.236
14.	AMPRI	Dwivedi, N; Patra, T; Lee, JB	NANO LETTERS, 2020, Vol. 20, Iss. 2, pp. 905-917	11.189
15.	IMMT	Bourelle, SA; Shivanna, R; Camargo, FVA	NANO LETTERS, 2020, Vol. 20, Iss. 2, pp. 5678-5685	11.189
16.	AMPRI	Tiwari, JK; Mandal, A; Sathish, N	ADDITIVE MANUFACTURING, 2020, Vol. 33	10.998
17.	CGCRI, NEERI	Roy, S; Majumdar, S; Sahoo, GC	JOURNAL OF HAZARDOUS MATERIALS, 2020, Vol. 399	10.588
18.	IMMT	Srivastava, P; Abbassi, R; Yadav, AK	JOURNAL OF HAZARDOUS MATERIALS, 2020, Vol. 387	10.588
19.	NEERI	Sharma, MD; Elanjickal, AI; Mankar, JS	JOURNAL OF HAZARDOUS MATERIALS, 2020, Vol. 398	10.588
20.	NEERI	Anshul, A; Moinuddin, AA; Azad, AM	JOURNAL OF HAZARDOUS MATERIALS, 2020, Vol. 398	10.588
21.	NML	Nath, SK	JOURNAL OF HAZARDOUS MATERIALS, 2020, Vol. 387	10.588
22.	CMERI	Basak, B; Saha, S; Chatterjee, PK	BIORESOURCE TECHNOLOGY, 2020, Vol. 299	9.642
23.	NEERI	Kumar, A; Singh, E; Khapre, A	BIORESOURCE TECHNOLOGY, 2020, Vol. 297	9.642
24.	NEERI	Rani, A; Negi, S; Hussain, A; Kumar, S	BIORESOURCE TECHNOLOGY, 2020, Vol. 297	9.642
25.	NEERI	Awasthi, SK; Sarsaiya, S; Awasthi, MK	BIORESOURCE TECHNOLOGY, 2020, Vol. 299	9.642
26.	NEERI	Wainaina, S; Awasthi, MK; Sarsaiya, S	BIORESOURCE TECHNOLOGY, 2020, Vol. 301	9.642
27.	NEERI	Chandrasekhar, K; Kumar, S; Lee, BD	BIORESOURCE TECHNOLOGY, 2020, Vol. 302	9.642

28.	NEERI	Rena; Bin Zacharia, KM; Yadav, S; Machhirake, NP	BIORESOURCE TECHNOLOGY, 2020, Vol. 309	9.642
INFORMATION SCIENCES				
Sr. No.	Lab	First Three Authors	Journal Details	IF-2020
1.	NISCAIR	Lata, C	SCIENCE, 2020, Vol. 370, Iss. 6512, pp. 30-30	47.728
2.	NISTADS	Aggarwal, R; Sumran, G	EUROPEAN JOURNAL OF MEDICINAL CHEMISTRY, 2020, Vol. 205	6.514
3.	NISTADS	Raina, RS; Dey, D	SUSTAINABILITY SCIENCE, 2020, Vol. 15, Iss. 3, pp. 975-984	6.367
4.	CSIR-HQ	Shaw, R; Madan, S; Tiwari, S	ADVANCED MATERIALS INTERFACES, 2020, Vol. 7, Iss. 23	6.147
5.	CSIR-HQ	Singh, RP; Nimbalkar, S; Singh, S	GEOTEXTILES AND GEOMEMBRANES, 2020, Vol. 48, Iss. 3, pp. 275-283	5.292
6.	CSIR-HQ	Chopra, K; Burdak, B; Sharma, K	BIOMOLECULES, 2020, Vol. 10, Iss. 6	4.879
7	CSIR-HQ	Madan, S; Shaw, RC; Tiwari, S	COLLOIDS AND SURFACES A-PHYSICOCHEMICAL AND ENGINEERING ASPECTS, 2020, Vol. 607	4.539
8.	CSIR-4PI	Jade, S; Mir, RR; Vivek, CG	SCIENTIFIC REPORTS, 2020, Vol.10, Iss. 1	4.38
9.	CSIR-4PI	Varghese, SJ; Surendran, S; Rajendran, K	CLIMATE DYNAMICS, 2020, Vol. 54, Iss. 03-Apr, pp. 1315-1328	4.375
10.	NISTADS	Manonmani, G; Sandhiya, L; Senthilkumar, K	ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH, 2020, Vol. 27, Iss. 11, pp. 12080-12095	4.223
11.	NISTADS	Sandhiya, L; Senthilkumar, K	PHYSICAL CHEMISTRY CHEMICAL PHYSICS, 2020, Vol. 22, Iss. 46, pp. 26819-26827	3.676
12.	NISCAIR	Dhatarwal, P; Choudhary, S; Sengwa, RJ	MATERIALS LETTERS, 2020, Vol. 273	3.423

13.	NISCAIR	Sengwa, RJ; Dhatarwal, P; Choudhary, S	MATERIALS TODAY COMMUNICATIONS, 2020, Vol. 25	3.383
14.	CSIR-HQ	Parihar, K; Telang, M; Ovhal, A	WORLD JOURNAL OF MICROBIOLOGY & BIOTECHNOLOGY, 2020, Vol. 36, Iss. 12	3.312
15.	NISTADS	Bhattacharya, S; Kumar, R; Singh, S	SCIENTOMETRICS, 2020, Vol. 125, Iss. 1, pp. 361-384	3.238
16.	CSIR-4PI	Joshi, S; Gouda, KC; Goswami, P	THEORETICAL AND APPLIED CLIMATOLOGY, 2020, Vol. 139, Iss. 01-Feb, pp. 237-250	3.179
17.	CSIR-4PI	Sahoo, SK; Ajilesh, PP; Gouda, KC	THEORETICAL AND APPLIED CLIMATOLOGY, 2020, Vol. 140, Iss. 03-Apr, pp. 915-926	3.179
18.	CSIR-4PI	Bhimala, KR; Rakesh, V; Prasad, KR	THEORETICAL AND APPLIED CLIMATOLOGY, 2020, Vol. 142, Iss. 03-Apr, pp. 987-1001	3.179
19.	CSIR-HQ	Rao, VD; Choudhury, D	NATURAL HAZARDS REVIEW, 2020, Vol. 21, Iss. 4	3.169
20.	CSIR-4PI	Neethu, C; Ramesh, KV; Shafeer, KB	NATURAL HAZARDS, 2020, Vol. 102, Iss. 2, pp. 673-688	3.102
21.	CSIR-4PI	Mir, RR; Parvez, IA	NATURAL HAZARDS, 2020, Vol. 103, Iss. 2, pp.1989-2007	3.102
22.	CSIR-4PI	Raj, EE; Kumar, RR; Ramesh, KV	JOURNAL OF APPLIED METEOROLOGY AND CLIMATOLOGY, 2020, Vol. 59, Iss. 4, pp. 651-664	2.923
23.	NISTADS	Yao, YX; Lakshmanan, SY; Pratihar, SH	JOURNAL OF PHYSICAL CHEMISTRY A, 2020, Vol. 124, Iss. 9, pp. 1821-1828	2.781
24.	NISCAIR	Nanda, T; Rathore, A; Sharma, D	FRONTIERS OF MATERIALS SCIENCE, 2020, Vol. 14, Iss. 4, pp. 387-401	2.765

25.	NISTADS	Manonmani, G; Sandhiya, L; Senthilkumar, K	INTERNATIONAL JOURNAL OF QUANTUM CHEMISTRY, 2020, Vol. 120, Iss. 11	2.444
PHYSICAL SCIENCES				
Sr. No.	Lab	First Three Authors	Journal Details	IF-2020
1.	CSIO	Son, S; Kim, JH; Wang, XW	CHEMICAL SOCIETY REVIEWS, 2020, Vol. 49, Iss. 11, pp. 3244-3261	54.564
2.	NIO	Saraswat, R; Saraswat, DA	SCIENCE, 2020, Vol. 368, Iss. 6491, pp. 594-595	47.728
3.	NPL	Ramanujam, J; Bishop, DM; Todorov, TK	PROGRESS IN MATERIALS SCIENCE, 2020, Vol. 110	39.58
4.	NPL	Krishnamurthi, V; Khan, H; Ahmed, T	ADVANCED MATERIALS, 2020, Vol. 32, Iss. 45	30.849
5.	NGRI	Panda, D; Kundu, B; Gahalaut, VK	NATURE COMMUNICATIONS, 2020, Vol. 11, Iss. 1	14.919
6.	NPL	Sunko, V; Mazzola, F; Kitamura, S	SCIENCE ADVANCES, 2020, Vol. 6, Iss. 6	14.143
7	CSIO	Thakur, A; Ghosh, D; Devi, P	CHEMICAL ENGINEERING JOURNAL, 2020, Vol. 397	13.273
8.	CSIO	Younis, SA; Lim, DK; Kim, KH	ADVANCES IN COLLOID AND INTERFACE SCIENCE, 2020, Vol. 277	12.984
9.	CSIO	Matai, I; Kaur, G; Seyedsalehi, A	BIOMATERIALS, 2020, Vol. 226	12.479
10.	CSIO	Xu, YL; Zhang, Y; Li, J	BIOMATERIALS, 2020, Vol. 259	12.479
11.	NGRI	Krapez, B; Sarma, DS; Mohan, MR	EARTH-SCIENCE REVIEWS, 2020, Vol. 201	12.413
12.	NGRI	Raju, PVS; Mazumder, R	EARTH-SCIENCE REVIEWS, 2020, Vol. 202	12.413
13.	CSIO	Jain, R; Thakur, A; Kaur, P	TRAC-TRENDS IN ANALYTICAL CHEMISTRY, 2020, Vol. 123	12.296

14.	CSIO	Sarkar, K; Devi, P; Kim, KH	TRAC-TRENDS IN ANALYTICAL CHEMISTRY, 2020, Vol. 130	12.296
15.	CSIO	Sinha, A; Kumar, R; Kaur, R	IEEE TRANSACTIONS ON CYBERNETICS, 2020, Vol. 50, Iss. 7, pp. 3254-3263	11.448
16.	CSIO	Garg, M; Chatterjee, M; Sharma, AL	BIOSENSORS & BIOELECTRONICS, 2020, Vol. 151	10.618
17.	NPL	Verma, S; Arya, P; Singh, A	BIOSENSORS & BIOELECTRONICS, 2020, Vol. 165	10.618
18.	NIO	Akhil, VP; Vialard, J; Lengaigne, M	REMOTE SENSING OF ENVIRONMENT, 2020, Vol. 248	10.164
19.	NPL	Kabir, S; Nirantar, S; Zhu, LC	APPLIED MATERIALS TODAY, 2020, Vol. 21	10.041
20.	CSIO	Sarkar, K; Devi, P; Lata, A	ADVANCED OPTICAL MATERIALS, 2020, Vol. 8, Iss. 13	9.926
21.	CEERI	Parthiban, A; Reddy, KS; Pesala, B	ENERGY CONVERSION AND MANAGEMENT, 2020, Vol. 205	9.709
22.	CEERI	Chandan; Dey, S; Kumar, PS; Reddy, KS	ENERGY CONVERSION AND MANAGEMENT, 2020, Vol. 220	9.709
23.	CSIO, NPL	Dubey, P; Shrivastav, V; Maheshwari, PH	CARBON, 2020, Vol. 170 pp. 1-29	9.594
24.	NPL	Shankar, U; Gupta, CR; Oberoi, D	CARBON, 2020, Vol. 168, pp. 485-498	9.594
25.	CEERI, NIIST	Agarwal, PB; Sharma, R; Mishra, D	ACS APPLIED MATERIALS & INTERFACES, 2020, Vol. 12, Iss. 36, pp. 40901-40909	9.229
26.	CSIO	Ghosh, D; Devi, P; Kumar, P	ACS APPLIED MATERIALS & INTERFACES, 2020, Vol. 12, Iss. 12, pp. 13797-13804	9.229
27.	CSIO	Ghosh, D; Roy, K; Sarkar, K	ACS APPLIED MATERIALS & INTERFACES, 2020, Vol. 12, Iss. 25, pp. 28792-28800	9.229

28.	CSIO	Roy, K; Ghosh, D; Sarkar, K	ACS APPLIED MATERIALS & INTERFACES, 2020, Vol. 12, Iss. 33, pp. 37218-37226	9.229
29.	CSIO	Gupta, A; Garg, M; Singh, S	ACS APPLIED MATERIALS & INTERFACES, 2020, Vol. 12, Iss. 42, pp. 48198-48205	9.229
30.	NPL	Paul, SJ; Sharma, I; Elizabeth, I	ACS APPLIED MATERIALS & INTERFACES, 2020, Vol. 12, Iss. 14, pp. 16946-16958	9.229
31.	NPL	Goswami, L; Aggarwal, N; Verma, R	ACS APPLIED MATERIALS & INTERFACES, 2020, Vol. 12, Iss. 41, pp. 47038-47047	9.229

ANNEXURE V

Summary of important audit observations

(Position as on 31.03.2021)

S.No.	No. & Year of the Report	Number of Paras/PA Reports on which ATNs have been submitted to Monitoring Cell. Ministry of Finance	Details of the Paras /PAC Reports on which ATNs are pending		
			Number of ATNs not sent by the Ministry even for the first time	Number of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	Number of ATNs which have been finally vetted by Audit but have not been submitted by the Ministry
1.	NIL	NIL	NIL	NIL	NIL
	Total = NIL				

ANNEXURE VI

Members of CSIR Governing Body

1.	**Dr. Shekhar C Mande** Director General Council of Scientific & Industrial Research (CSIR) Anusandhan Bhawan 2, Rafi Marg New Delhi - 110 001.	Chairman (ex- officio)
2.	**Secretary (Expenditure)** (Dr. TV Somanathan) Ministry of Finance North Block New Delhi - 110 001.	Member - Finance (ex- officio)
3.	**Shri Jitendra J. Jadhav** Director, CSIR- National Aerospace Laboratories Post Bag No. 1779 Bengaluru – 560 017 (Karnataka)	Member
4.	**Dr. Anurag Agrawal** Director CSIR- Institute of Genomics and Integrative Biology North Campus, Mall Road Delhi - 110 007.	Member
5.	**Shri Baba A. Kalyani** Chairman and Managing Director Kalyani Group Bharat Forge Limited Mundhwa, Pune - 411 036 (Maharashtra)	Member
6.	**Shri Gurdeep Singh** Chairman and Managing Director National Thermal Power Corporation Limited NTPC Bhawan, SCOPE Complex Institutional Area Lodhi Road New Delhi - 110 003	Member

7.	**Prof. K. VijayRaghavan** Principal Scientific Advisor to the Government of India and Chairman, Scientific Advisory Committee to the Cabinet and Chairman, Advisory Board, CSIR Vigyan Bhavan Annexe Dr. Maulana Azad Road New Delhi - 110 011	Member
8.	**Prof. Ajay Kumar Sood** Honorary Professor Department of Physics Indian Institute of Science Bengaluru - 560 012 (Karnataka)	Member
9.	**Dr. Vijay Bhatkar** Eminent Scientist 34 A, Vrindavan Society, 2 Panchvati Pashan Road, Pashan Gaon Pune - 411 021 (Maharashtra)	Member
10.	**Shri K. N. Vyas** Secretary Department of Atomic Energy; and Chairman Atomic Energy Commission, Anushakti Bhawan, CSM Marg Mumbai - 400001 (Maharashtra)	Member
11.	**Dr. G. Satheesh Reddy** Secretary Department of Defence Research and Development (DDRD) and Chairman, Defence Research and Development Organisation (DRDO) Ministry of Defence New Delhi - 110 001.	Member

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ANNEXURE VII

List of Approved Projects

A: List of FTT-FTC 3rd Tranche Projects

S. No	Lab	Project Title	Project Code	Theme	Category
1	CSIR-CDRI	IND enabling studies and development of CDRI-4655 as anti-hyper-triglyceridemic formulation	MLP 2024	HTC	FTT
2	CSIR-CDRI	Development of new Smac Mimetic against chemotherapy resistant colon cancer	MLP 2025	HTC	FTT
3	CSIR-IICT	Developing a novel effective therapeutic agent targeting pancreatic Cancer	MLP 0061	HTC	FTT
4	CSIR-IMTECH	Preclinical studies and process development for production of Tridecaptin M, an antibiotic against colistin resistant Gram negative bacterial infections	MLP 38	HTC	FTT
5	CSIR-IHBT	Preclinical Efficacy Validation In Non-Human Primate Stroke Model Of Anti-Thrombin-Clot Specific Streptokinase (ACSSK), With Dual Properties Of Fibrin Specific Clot Dissolution And Prevention Of Arterial Re-Occlusion, For The Treatment Of Acute Myocardial Infarction And Ischemic Stroke	MLP 0155	HTC	FTC
6	CSIR-NIIST	Customized Portable Raman spectrophotometric device for multiplex detection of breast cancer biomarkers	MLP0039	HTC	FTT

7	CSIR-CSMCRI	Homocysteine Specific Novel Sensor for Diagnostic Use	MLP 0047	HTC	FTT
	CSIR-CCMB		MLP 0137		
	CSIR-CECRI		MLP0308		
8	CSIR-IGIB	Development and Pilot Implementation of a Genetic Information Access and Analysis System for Genetic Diseases	MLP 2001	HTC	FTT
9	CSIR-IGIB	Radiological AI system for Parallel Informatic Detection of Clinical Triage emergencies (RAPID-CT): Phase 2	MLP 2002	HTC	FTT
10	CSIR-NBRI	A Novel Herbal Product for Vulvovaginal Candidiasis	MLP 0033	HTC	FTT
11	CSIR-AMPRI	Development of Bamboo Composite Beams and their specifications for engineering applications	MLP 210	ANB	FTT
12	CSIR-CFTRI	A cost-effective process of preparation of arabinoxylan from wheat bran and its incorporation in low dietary fiber food products for their commercial application	MLP 0278	ANB	FTC
13	CSIR-CFTRI	Development of export protocol (sea route) for fresh pineapples	MLP 0279	ANB	FTC
14	CSIR-CFTRI	Minimally processed fruits with extended shelf life	MLP 0280	ANB	FTC
15	CSIR-CFTRI	Production of Isomaltooligosaccharides (IMO) using indigenous transglucosidase from primary and secondary starch sources	MLP 0281	ANB	FTT
16	CSIR-CIMAP	Commercialization of 'CIM-Pushti': Withanolide-A rich, Leaf Blight tolerant high yielding variety of Ashwagandha (Withania somnifera) with good root textural quality	MLP 08	ANB	FTC

17	CSIR-CIMAP	Scale-up process for isolation of ricinoleic acid from castor oil and its biotransformation to food-flavor perspective (+)-ɣ-decalactone using Candida strain	MLP 09	ANB	FTT
18	CSIR-CIMFR	Pilot scale demonstration of "silica composite "Si-Bps- HAs" (Silica-Botanical pesticides-Humic acid) from coal ash/biomass ash/ biogenic silica rich resources as bio-pesticide for agricultural/store grain pests control	MLP 142	ANB	FTT
19	CSIR-CMERI	Design and Development of Retractable-Roof Poly House	MLP 231712	ANB	FTT
20	CSIR-CSMCRI	Cost effective sustainable process for microalgal based ɣ-linolenic acid production from microalgae through biorefinery approach	MLP 0049	ANB	FTT
21	CSIR-IHBT	Development of botanical formulation using Artemisia maritima extract for the control of aphids in cabbage/cowpea	MLP 0169	ANB	FTT
22	CSIR-IHBT	Development of microalgae based protein and micronutrient rich animal feed	MLP 0173	ANB	FTT
23	CSIR-IHBT	Development of processes for edible and industrial dyes from plant sources for enhanced income	MLP 0166	ANB	FTT
	CSIR-NBRI		MLP 0053		
	CSIR-NEIST		MLP 1018		
24	CSIR-IHBT	Up-scaled production of disease free corms of saffron (Crocus sativus)	MLP 0165	ANB	FTC
25	CSIR-IIP	Techno-economic analysis of xylitol production from lignocellulosic biomass using whole-cell biocatalyst	MLP 1172	ANB	FTT
	CSIR-NCL		MLP 101926		
26	CSIR-IICT	Agri-waste Biorefinery for Microcrystalline cellulose, Reducing Sugars and Lignin Recovery	MLP 0075	ANB	FTT

27	CSIR-IMMT	Production of Potash, Sulfur And Phosphorus Enriched Biochars Utilising Biomass And Fertiliser Industries Waste	MLP 75	ANB	FTT
28	CSIR-NBRI	Bioefficacy and Toxicity data generation for CIB registration of microbial formulations applicable for the biological control of Fusarium diseases in different crops	MLP 0050	ANB	FTT
29	CSIR-NBRI	Field trial for early maturity of cotton using Anacardic Acid formulation and CIB registration of the product	MLP 0051	ANB	FTT
30	CSIR-NBRI	Preparation of Certified Reference Material of important phytomolecules	MLP 0052	ANB	FTT
31	CSIR-NIIST	Design & development of prototype solar dehumidified drier for cost effective drying of agricultural products	MLP 0057	ANB	FTT
32	CSIR-CSIO	Electrostatic dust mitigation and environment protection device	MLP-2011	E3OW	FTC
33	CSIR- CSMCRI	Technology for Single Stage Seawater anti-fouling RO Membrane Module and the Rejuvenation of the same at the end of their Life	MLP-58	E3OW	FTC
34	CSIR-CSMCRI	Advanced Water Treatment System of Anti-Fouling Hollow Fibre and Nano Filtration Membranes	MLP-59	E3OW	FTC
35	CSIR-NEERI	RISK-PiNET- Contaminant Infusion Point Detection Tool for Water Distribution System- Field Implementation and Commercialization	MLP-179	E3OW	FTC
36	CSIR-CSMCRI	Development of indigenous high performance membrane separator for redox flow batteries	MLP-61	E3OW	FTT

37	CSIR-CSMCRI	Development of electro-deionization (EDI) system for continuous production of different grade ultrapure water with fine tuning	MLP-60	E3OW	FTT
38	CSIR-NIIST	Reactive Gel-Curing Process for Transforming Environmentally Threatening Industrial Solid Wastes into High Value Building Materials	MLP-60	E3OW	FTT
39	CSIR-CIMFR	Investigation into permeable liner for disposal of coal ash in ash disposal ponds	MLP-141	E3OW	FTT
40	CSIR-AMPRI	Development of Advanced Non - Toxic Radiation Shielding Material from Tailored Brine Sludge	MLP 0213	4M	FTT
41	CSIR-AMPRI	Light Weight Aluminium Alloy Matrix composites for automobile, defence and Engineering Applications	MLP 0212	4M	FTT
42	CSIR-CECRI	Indigenous Development of Phosphors for Image Intensifier Tubes	MLP 0310	4M	FTT
43	CSIR-CECRI	Super Hard Nanocomposite Coatings by PVD onto Automotive Chain Pins/Cutting Tools	MLP 0309	4M	FTT
44	CSIR-CGCRI	Development of high-power optical amplifier (1.0 -5.0 W)	MLP0112	4M	FTT
45	CSIR-CGCRI	High piezoelectric coefficient composites for application as flank array sensors	MLP0309	4M	FTT
46	CSIR-IMMT	Development of process for reduction roasting of low and lean grade iron ores using fluidized bed roaster (in pilot scale) to maximize the recovery of iron values	MLP-79	4M	FTT
47	CSIR-IMMT	Pilot Scale Study of Reduction of Phosphorous Content in High Phosphorus Indian Iron Ore	MLP-76	4M	FTT

48	CSIR-IMMT	Processing of spent liquor for improvement of alumina productivity in Bayer process	MLP-77	4M	FTT
49	CSIR-IMMT	Development and scale up studies for Cu incorporated Zn/Al layered double hydroxide antimicrobial material as protective cement additive	MLP-78	4M	FTT
50	CSDIR-NML	Development of advanced giant magneto-impedance (GMI) based sensor for structural health monitoring of engineering structure with enhanced area coverage	MLP- 3112	4M	FTC
51	CSDIR-NML	Production of Fe-Ni/Co-Mo metallic alloy & alumina rich slag from Ni-Mo/Co-Mo spent catalysts	MLP- 3113	4M	FTT
52	CSDIR-NML	Development and commercialization of Eco-friendly reagents for limestone and sillimanite flotation	MLP- 3114	4M	FTC
53	CSDIR-NML	Development of CS Analytical and Charpy Impact Toughness Physical Standard (CRM) in Steel	MLP- 3115	4M	FTT
54	CSDIR-NML	Development of the close loop pilot process for recycling of metals/ materials from e-waste	MLP- 3116	4M	FTC
55	CSDIR-NML	Industrial Hot Rolling Run Out Table and Continuous Annealing Line Simulations for developing Advanced High Strength Steels (AHSS)	MLP- 3117	4M	FTT
56	CSIR-CRRI	Microscopic Traffic Network Simulation Model for Mixed Traffic Conditions (MiTraNS)	MLP 0628	CIE	FTT
57	CSIR-CMERI	Batch Scale Production of High Quality Activated Carbon from Biomass Wastes for Waste Water Treatment – An Initiative Towards Waste to Wealth	MLP 230012	CIE	FTT

58	CSIR-CMERI	Design & Development of Self Sustainable Integrated Municipal Solid Waste Disposal System (iMSWDS) for Bulk Waste Generator	MLP 230412	CIE	FTT
59	CSIR-CBRI	Development of Technology for High Strength Binder/Value Added Building Products Using Flue Gas Desulphurization (FGD) Gypsum-a By-Product of Coal Based Thermal Power Plants	MLP 012002	CIE	FTT
60	CSIR-CBRI	Technology Package for Eco-Friendly Burnt Clay Bricks with Low Carbon Footprints		CIE	FTT
61	CSIR-CBRI	Valorization of lime sludge through development of environmental friendly building products	MLP 0320	CIE	FTT
62	CSIR-CBRI	Utilization of marble waste to develop cost-effective sustainable building products		CIE	FTT
63	CSIR-SERC	Development of simple low cost flexible heating module for assessing fire rating of steel structural components	MLP 206	CIE	FTT
64	CSIR-SERC	Dissipative fuse link beam-column connection for seismic resilient steel moment frames	MLP 207	CIE	FTT
65	CSIR-SERC	Folded Textile Reinforced Concrete Fencing Panels for Highway and Other Infra Project Applications	MLP 208	CIE	FTC
66	CSIR-NCL	Synthesis of bio-derived 2,5-furan dicarboxlic acid (FDCA) as analogue to Purified terephthalic acid (PTA)	MLP100326	CLP	FTT
67	CSIR-NCL	Process for the catalytic dehydration of methanol (MeOH) to dimethyl ether (DME)	MLP100426	CLP	FTC

68	CSIR-CECRI	Design and development of electrodes to generate hydrogen peroxide	MLP 0301	CLP	FTT
69	CSIR-CLRI	Translation of technology on preservation-cum-unhairing of hides and skins	MLP 2001	CLP	FTT
70	CSIR-CLRI	Translation of technology on "Manufacturing organic supplement and compost from hair waste"	MLP 2002	CLP	FTT
71	CSIR-CSMCRI	Greener process for the synthesis of perfumery chemicals alpha-Campholenic aldehyde and carveol at 1 Kg level in ~85% yield and >95% purity	MLP 0046	CLP	FTT
72	CSIR-CSMCRI	Development of integrated process for enhancement of brine evaporation rate @30-40% to improve yield of solar salt in existing areas	MLP 0050	CLP	FTT
73	CSIR-CSMCRI	Multi-locational commercial deployment of CSIR-CSMCRI's 'Zero Waste' spent wash management technology-Potash fertilizer & Regulatory compliance	MLP 0048	CLP	FTC
74	CSIR-IICT	Development of vapour phase catalytic ammoxidation processes for the synthesis of aromatic nitriles	MLP 0063	CLP	FTT
75	CSIR-IICT	Development of process for pharmaceutical grade Hydroxyl Propyl Methyl Cellulose (HPMC)	MLP 0062	CLP	FTT
76	CSIR-IICT	Development of process for production of 4-methoxy acetophenone in a continuous single-step process	MLP 0064	CLP	FTT
77	CSIR-NEIST	Development of an efficient and cost-effective process for production of Caffeine and Tannis from Tea Waste	MLP 1012	CLP	FTT

78	CSIR-NIIST	Fluorescent pigments for currency application	MLP 0040	CLP	FTC
79	CSIR-CECRI	Design and Development of indigenous smart battery management system for energy storage and E-vehicle applications	MLP 0304	EED	FTT
80	CSIR-CECRI	Development of 250 W direct methanol fuel cell stack with in-house Nafion based hybrid membranes for portable and strategic applications	MLP 0307	EED	FTT
81	CSIR-CECRI	Fabrication of 12V, 500F supercapacitor device assembly	MLP 0306	EED	FTT
82	CSIR-CECRI	Refurbished cathode material from spent lithium-ion batteries: a direct approach towards renewable feed stock	MLP 0305	EED	FTT
83	CSIR-NIIST	Indigenous Fabrication of Transparent Conducting Oxide (TCO) Coatings by spray pyrolysis for dye sensitized solar cell application	MLP 0038	EED	FTT
84	CSIR-NIIST	Translating electrochromic deices to 1'x1' dynamic windows: Towards industrial smart glass technologies	MLP 0037	EED	FTC
85	CSIR-CIMFR	Pilot scale demonstration of coal mine water usage for commercial algal production for food-fertilizer in hybrid photo-bioreactor for combating malnutrition	MLP 119/20-21	EED	FTT
86	CSIR-IIP	Vacuum Swing Adsorption (VSA) process for up-gradation of Bio-gas to Biomethane meeting BIS Specification for Bio-PNG and CBG Applications	MLP 1150	EED	FTC

87	CSIR-AMPRI	Lightweight Aluminium hybrid foam core multi-layer sandwich panels with metal / 3D Carbon Fibre / Kevlar as face sheets for aerospace, blast resistance and transportation applications	MLP 211	AEISS	FTT
88	CSIR-CECRI	Aerogel based thermal protection systems for nozzle surfaces in space and aerospace applications	MLP 0302	AEISS	FTT
89	CSIR-CECRI	Development of eco-friendly trivalent chromium plating process	MLP 0303	AEISS	FTT
90	CSIR-CEERI	Development of High Power Thyratrons for Fast Switching Applications	MLP 00118	AEISS	FTT
91	CSIR-CEERI	i) Development of rapid honey adulteration detection system	MLP 00117	AEISS	FTT
	CSIR-CFTRI	ii)Development of rapid honey adulteration detection system	MLP 0265	AEISS	FTT
	CSIR-IIIM	iii)Development of rapid honey adulteration detection system	MLP110010	AEISS	FTT
92	CSIR-CSIO	Batch digital microscopy with marker-specific auto-scoring for high-throughput analytics	MLP 2002	AEISS	FTC
93	CSIR-CSIO	Development of force-distance curve based Atomic Force Microscope for multi-parametric Imaging of Biological Systems	MLP 2001	AEISS	FTT
94	CSIR-CSIO	Energy Management using Non-Intrusive Load Monitoring (NILM) Technique	MLP 2003	AEISS	FTT
95	CSIR-CSIO	Marine Bearing Sight for Indian Naval Ships and Submarines	MLP 2005	AEISS	FTT
96	CSIR-CSIO	Postural Stability Assessment System (Dynamic)	MLP 2010	AEISS	FTC
97	CSIR-CSIO	Visual Landing Aids for Naval Operations	MLP 2004	AEISS	FTT

98	CSIR-IMMT	i) Stealth Technologies: Development of carbon- Ferrite composites materials for microwave absorbing	MLP 073	AEISS	FTT
	CSIR-NAL	ii)Stealth Technologies: Development of carbon- Ferrite composites materials for microwave absorbing	MLP 2002	AEISS	FTT
99	CSIR-NAL	Development of spin valve GMR based current sensor	MLP 2001	AEISS	FTC
100	CSIR-NPL	Broadband Rydberg Atom-based Quantum Sensor	MLP191132	AEISS	FTT

4M: Mining Minerals Metals & Materials
CIE: Civil Infrastructure and Engineering
AEISS: Aerospace Electronics Instrumentation & strategic Sectors
ANB: Agriculture Nutrition & Biotechnology
E3OW: Ecology, Environment, Earth & Ocean Sciences and Water
HTC: Healthcare
EED: Energy (conventional and non-conventional) and Energy devices
CLP:Chemical (including Leather) and Petrochemical

B: Details of NCP/ FBR Projects

S. No	Lab	Project Title	Theme	Category
1	CSIR-NGRI	Probing the Structure and Kinematics of the NW Himalaya for Assessment of Earthquake Hazard Potential	E3OW	FBR
2	CSIR-NGRI	Geodetic measurements for crustal deformation Along a N-S Transect in India	E3OW	FBR
3	CSIR-NGRI CSIR-NEIST	Earthquake Hazard Studies in Moderate and Severe Seismic Zones	E3OW	FBR
4	CSIR-4PI	Integration of GNSS and Broadband data for high resolution velocity structure and crustal deformation in Jammu, Kashmir and Ladakh Himalaya	E3OW	FBR
5	CSIR-NGRI	Structure, Anatomy and Geological Evolution of the Singhbhum Mobile Belt, Singhbhum Craton, East India (SIMO)	E3OW	FBR
6	CSIR-NGRI	Hydro- Mechanical Modelling in Seismically active Koyna- Warna region, Maharashtra, India	E3OW	FBR
7	CSIR-NGRI	Electrical Vector Resistivity Imaging (EVRI): a novel method for 3D subsurface mapping	E3OW	NCP
8	CSIR-NGRI	To Develop Capability in Multicomponent, Long-Offset Seismic Data Acquisition with increased seismic bandwidth 10 to 200Hz	E3OW	NCP
9	CSIR-NIO	Focused Research on specialized ecosystems in the South Eastern Arabian Sea for sustainable utilization and management of resources (FoRSEAS)	E3OW	FBR
10	CSIR-NIO	Long-term evolution of monsoon and associated processes	E3OW	FBR
11	CSIR-NIO	Influence of methane/methane hydrate on ecology and biodiversity at the methane seep locations in Indian EEZ	E3OW	FBR
12	CSIR-NIO	Study on the nature and formation of Ramsethu & its surrounding environment	E3OW	FBR

13	CSIR-NIO	Tectonic and magmatic processes along the slow-spreading mid-oceanic ridges and subduction zone in the Indian Ocean	E3OW	FBR
14	CSIR-NIO	Interactions between trace metals and marine biota in the Indian Ocean	E3OW	FBR
15	CSIR-NEERI	Assessing influence of open and closed drain system on ecosystem services using meta-omics approach	E3OW	FBR
16	CSIR-NEERI	Mapping of the impacts of Climate Change (Extreme weather events) on critical health and social care systems in Aspirational Districts (ADs)	E3OW	NCP
17	CSIR-NEERI CSIR-NBRI CSIR-NGRI	Understanding Food-Energy-Water Nexus in Dynamics of Critical Zone: WRJ-1 Critical Zone Observatory	E3OW	NCP
18	CSIR-NGRI	Development of new technologies for Seismic Image Enhancement and fine scale Subsurface VELocity structure	E3OW	FBR
19	CSIR-NIO CSIR-IIIM CSIR-IMTECH CSIR-CGCRI CSIR-NCL CSIR-CFTRI	Synergizing marine ecology with bioprospecting: Harnessing marine living resources for products and bioprocesses “BIOPROSmar”	E3OW	NCP
20	CSIR-NIO	Ecological processes and prediction of coastal pollution in Mumbai waters	E3OW	FBR
21	CSIR-4PI	Development of a modelling platform for Hydro-meteorological Disaster early Warning System for major metro cities in India	E3OW	NCP
22	CSIR-NEERI CSIR-CSMCRI CSIR-IICT CSIR-NCL CSIR-NEIST CSIR-AMPRI CSIR-CECRI CSIR-IITR CSIR-NIIST	Water and Water Consolidated Project AMPRI, CECRI, CSMCRI, IICT, IITR, NCL, NEERI, NEIST, NIIST	E3OW	FBR/NCP

23	CSIR-CCMB	An integrated structural biology approach to unravel a unique fatty acid activation mechanism in eukaryots	HTC	NCP
24	CSIR-CCMB	Biology of aging and age related disorders	HTC	NCP
25	CSIR-CCMB	Organoid models for biomedical research applications	HTC	NCP
26	CSIR-CCMB	Understanding the biology of bacterial cell walls	HTC	NCP
27	CSIR-CDRI	Chemical biology approaches towards dissecting non-canonical protein functions and novel targets in the Malaria, Leishmania and Filaria parasites	HTC	NCP
28	CSIR-CDRI	Discovery of selective KOR ligands for the treatment of resistant depression and neuropathic pain	HTC	NCP
29	CSIR-CDRI	Multipronged studies on persistence and drug resistance in mycobacteria	HTC	NCP
30	CSIR-CDRI	Novel and integrative approaches towards discovery of small molecule therapeutics for healthy ageing	HTC	NCP
31	CSIR-CDRI	Understanding the mechanism of osteopreia and aberrant bone formation, and discovery of new targets for skeletal medicine (Osteo Target)	HTC	NCP
32	CSIR-IGIB	Regenerative experimental approaches for cell-based therapies	HTC	NCP
33	CSIR-IGIB	Therapeutic gene targeting by CRISPER-Cas system: advancement of editing platforms and proof-of-concept disease correction in patient derived cells	HTC	NCP
34	CSIR-IICB CSIR-IGIB	Deriving a pan-omics diagnostic pipeline for systems level immune health and therapeutic targeting in systemic autoimmunity	HTC	NCP
35	CSIR-IICB	Leishmaniasis: target specific approaches to affect host-pathogen interaction and disease process	HTC	NCP

36	CSIR-IICB CSIR-IGIB CSIR-CDRI CSIR-NEERI CSIR-CIMFR	Modern innovative solutions for environmental/ occupational lung health challenges using clinical and pre -clinical strategies	HTC	NCP
37	CSIR-IICB CSIR-IGIB	Non-alcoholic fatty liver disease (NAFLD): Novel pathogenic mechanism and therapeutic development	HTC	NCP
38	CSIR-IICB CSIR-IGIB CSIR-CCMB	Targeting RNA driven processes: Novel chemical biology approaches to identify new classes of RNA modulators	HTC	NCP
39	CSIR-CCMB	Molecular basis of evolutionary divergence in RNAi initiation	HTC	FBR
40	CSIR-CCMB	Quality control of regulatory complex biogenesis	HTC	FBR
41	CSIR-CCMB	Investigating interactions at the host-pathogen interface in the pathogenesis of Mycobacterium tuberculosis	HTC	FBR
42	CSIR-CCMB	Mechanistic insights into bacterial growth and morphogenesis	HTC	FBR
43	CSIR-CCMB	Membrane lipids and the actin cytoskeleton in GPCR endocytosis: Implications in health and disease	HTC	FBR
44	CSIR-CCMB	Development of META1 as a druggable target against Leishmaniasis	HTC	FBR
45	CSIR-CCMB	Functions and adaptive reconfiguration of autophagy in malaria parasites	HTC	FBR
46	CSIR-CCMB	Transcriptional regulation of cellular quiescence	HTC	FBR
47	CSIR-CCMB	Understanding molecular mechanism in depression and fast acting antidepressants	HTC	FBR
48	CSIR-CDRI	Identification of diagnostic targets and therapeutic methods for infertility	HTC	FBR
49	CSIR-CDRI	Mechanisms of Autophagy-mediated cell survival in TNBC: implications in therapeutics and diagnostics	HTC	FBR

50	CSIR-CDRI	Research in ASTHI: Pre-clinical development of CDRI optimized lead molecules as dual osteogenic and muscle anabolic agents	HTC	FBR
51	CSIR-CDRI	Structural and functional characterization of potential drug target proteins from ESKAPE pathogens	HTC	FBR
52	CSIR-CDRI	Unravelling cognitive impairments due to ageing and neurodegeneration	HTC	FBR
53	CSIR-CFTRI CSIR-CDRI CSIR-IICT	SREBP inhibitors as novel therapeutics for non-alcoholic fatty liver disease: Insights on CRISPER-Cas9 inhibition of SREBPs targeting activated hepatic stellate cells	HTC	FBR
54	CSIR-CSMCRI CSIR-IMTECH	Anti-virulent therapy and nutraceutical formulation from edible microalgae *Chlorella varaibilis* (ATCC PTA 12198) against toxigenic *Vibrio cholerae*	HTC	FBR
55	CSIR- IGIB	Identifying modifiers of genetic diseases for preventive and prognostic interventions: focus on hematological and neurological diseases (GATII, Genomics Assisted target Identification and Intervention	HTC	FBR
56	CSIR-IGIB	In vivo RNAi mediated intervention in neuro-inflammation pathway for development of therapuetic strategy	HTC	FBR
57	CSIR-IGIB	Intercepting host immunometabolism with granuloma adapted tubercle bacilli	HTC	FBR
58	CSIR-IGIB	Molecular mechanisms of how non-coding RNAs impact epigenetic regulation	HTC	FBR
59	CSIR-IGIB	Transgenerational effect of paternal and maternal vitamin B12 deficiency	HTC	FBR
60	CSIR IICB	Exploring role of mechanical cues in immunocellular regulation	HTC	FBR
61	CSIR IICB	Mechanistic understanding of role of human ZMYND8 in tumor microenvironment-dependent transcriptional reprogramming leading to metastasis in colorectal cancer	HTC	FBR

62	CSIR IICB	Restoration of p53 and Rb through targeting their post-translational modifiers (PTM) HAUSP and 00MDM2 in glioma and stepping towards development of novel inhibitory peptide designing from interacting interface	HTC	FBR
63	CSIR IICB	Theranostic approach in Glioblastoma Multiforme (GBM) using engineered oncolytic Virus derived particles (VDPs)	HTC	FBR
64	CSIR-IICT	Chemically induced degradation of proteins using proteolysis targeting chimera (PROTAC) molecules	HTC	FBR
65	CSIR-IICT	Strategies to ameliorate neurodegenerative disorders: mitochondria targeting agents for disease modifying role	HTC	FBR
66	CSIR-IIIM	Development of b-hairpin peptidomimetics and self-assembled untrashort hybrid peptide nanostructures as anti-infective agents	HTC	FBR
67	CSIR-IIIM	Discovery of cannabinoids and their derivatives from *Cannabis sativa* for the management of chronic disease conditions like rheumatoid arthritis/neuropathic pain	HTC	FBR
68	CSIR-IIIM	Non-infringing routes for the synthesis of FDA approved life saving drugs	HTC	FBR
69	CSIR-IIIM	Nucleoside as biofilm inhibitors of bacteria and to understand the underlying mechanism of action	HTC	FBR
70	CSIR-IIIM	Preclinical development of small molecules promoting hair regeneration and studying mechanism of hair regeneration	HTC	FBR
71	CSIR-IITR	Dissection of specialized transcription coordinating mechanisms during DNA damage response: Implications on genome stability	HTC	FBR
72	CSIR-IMTECH	Harnessing myxobacterial diversity for bioactives	HTC	FBR
73	CSIR-IMTECH	Investigating the role of tyrosine kinase signalling pathways in *Acinetobacters* genetic plasticity and competence	HTC	FBR

74	CSIR-IMTECH	Mechanism of action of spermidine in pathogenesis of Salmonella, Shigella and Staphylococcus	HTC	FBR
75	CSIR-IMTECH CSIR-NIO	Profiling of phages having implications in combating drug resistant microbes	HTC	FBR
76	CSIR-IMTECH	Study on the effect of a novel quorum sensing inhibitor isolated from Streptomyces sp. as an adjunct therapy molecule against latent and persisters in Mycobacterium tuberculosis	HTC	FBR
77	CSIR-IMTECH	Understanding the cell death pathways induced by *Mycobacteria* infections	HTC	FBR
78	CSIR-IMTECH	PhoP regulated other factors influencing transcription-mycobacterial virulence regulation	HTC	FBR
79	CSIR-IMTECH	Role of Eis protein of Mtb in stringent response	HTC	FBR
80	CSIR-NCL	Development and functional characterization of glycation resistant insulin for diabetic therapy	HTC	FBR
81	CSIR-NCL	Phagocytosis of full-length Tau oligomers by actin-remodelling of activated microglia	HTC	FBR
82	CSIR-NCL	The potential use of eugenol and its derivatives in diabetic management and glycation inhibition	HTC	FBR
83	CSIR-NIIST	Development of mitochondrial antioxidant for geriatric well being	HTC	FBR
84	CSIR-NIIST CSIR-CFTRI	Exploration of diet (plant) derived exosomal miRNAs for inhibiting key metastatic targets in breast cancer cells	HTC	FBR
85	CSIR-NIIST CSIR-IHBT	Trapping glycation intermediates for the modulation of diabetes and its complications: a natural product derived therapeutic approach	HTC	FBR
86	CSIR-AMPRI CSIR-NBRI	Synthesis of Zeolites from Flyash for Agriculture Applications	ANB	FBR
87	CSIR-CCMB	Apomixes and Hybrid Seed Technologies for Increasing Agricultural Production – Phase -II	ANB	FBR

88	CSIR-CFTRI	Non-digestible carbohydrates as functional mimics of human milk oligosaccharides	ANB	FBR
89	CSIR-CFTRI	Development of chito-conjugates of spice bioactives and clove oil nano-encapsulated polymeric films for enhanced bio-functionality and anti-inflammatory activity	ANB	FBR
90	CSIR-CFTRI	Characterization of nutraceuticals from Ulva lactucaand their utilization in functional food	ANB	NCP
91	CSIR-CFTRI	Development of a prototype of Machine Learning based Ripening Classifier for selected mango varieties	ANB	FBR
92	CSIR-CIMAP	Development of Functional food: Ocimum basilicum derived line (Tukmaria) to be released as plant variety yielding “functional food” for weight management	ANB	FBR
93	CSIR-CIMAP	Utilization of Ocimum Genome for production of industrially important medicinal and aromatic compounds	ANB	FBR
94	CSIR-CIMAP	Understanding essential oil biosynthesis in commercially important aromatic grasses (Cymbopogon sp.) and Davana (Artemisia pallens) for crop improvement	ANB	FBR
95	CSIR-CIMAP	Induction, identification, characterization. And selection of polyploidy in Stevia rebaudiana to increase biomass, stevioside, and rebaudioside-A yield.	ANB	FBR
96	CSIR-CIMAP CSIR-CDRI	Metabolic engineering of Bacopa monnieri by redirecting the flux towards triterpenoid biosynthesis for enhanced bacosides production	ANB	FBR
97	CSIR-CLRI	Developing a Bio- fabricated Leather	ANB	FBR
98	CSIR-CMERI CSIR-IHBT	Development of bare-root seedling simulations system and automatic seedling transplanted for stevia	ANB	FBR
99	CSIR-CMERI CSIR-IHBT	AI based methodology for grading machine Harvested tea leaves	ANB	FBR

100	CSIR-CSMCRI	Process development for the production of phytol and lutein from microalgae through valorization of agro-wastes.	ANB	NCP
101	CSIR-CSMCRI CSIR-CCMB	Genome sequencing of Recretohalophyte Aeluropus	ANB	NCP
102	CSIR-IHBT	Next generation genomics for genetic improvement of Stevia rebaudiana Bert	ANB	FBR
103	CSIR-IHBT	Functional characterization of the host (plant) and vector (whitefly) proteins in systemic immunity and transmission of virus and virus-like pathogens	ANB	NCP
104	CSIR-IHBT	Genetic improvement of high value medicinal plants	ANB	NCP
105	CSIR-IHBT	Introduction, characterization and cultivation of Ferula assa-foetida (Heeng) in cold desert regions of Indian Himalayas	ANB	NCP
106	CSIR-IHBT	High resolution NextGen remote sensing for medicinal, aromatic and commercially important crops	ANB	NCP
107	CSIR-IHBT	iPRESS: Integrated Plant REgulomics Software & Server	ANB	FBR
108	CSIR-IICB	Classification and characterization of Phytophthora capsici effectors in understanding the early, late onset of pathogenesis and developing inhibition strategies	ANB	NCP
109	CSIR-IICT	Isolation and characterization of epothilone production strain and identification of yield improvement factors	ANB	FBR
110	CSIR-IIIM	Understanding the physiological role of forskolin in Coleus forskohlii	ANB	FBR
111	CSIR-IIIM	A essential oil based formulation for Post-harvest storage of fruits	ANB	FBR
112	CSIR-IIP	The engineering/omics potential of Rhodotorulamucilagenosa IIPL32 (MTCC 25056) as a workhorse for biotechnological applications	ANB	FBR

113	CSIR-IIP	Techno-economic evaluation, nutritional mapping, and toxicity profiling of MUFA rich yeast lipid production from biodiesel plant derived glycerin targeted to be used as edible oil blend	ANB	FBR
114	CSIR-IMMT	Shelf-life enhancement of seeds/grains by plasma treatment(PTS)	ANB	FBR
115	CSIR-IMTECH	Development of glycocins as “clean label” Food Preservative	ANB	NCP
116	CSIR-IMTECH	Iron Deficiency Anemia Solutions via Microbial Engineering Technology	ANB	NCP
117	CSIR-NBRI	Unraveling molecular details of drought tolerance in cotton.	ANB	FBR
118	CSIR-NBRI	Epigenetic modifications in Rhizoctoniasolani during interaction with Bacillus amyloliquefaciens and its implication for biotic stress management in rice	ANB	FBR
119	CSIR-NBRI	Regulation of pectin methylesterase inhibitor for enhancing plant-generated methanol for broad spectrum insect resistance.	ANB	FBR
120	CSIR-NBRI	Deciphering the role of sRNAs during synergistic interaction between two Trichoderma spp	ANB	FBR
121	CSIR-NBRI	Fe and Zn bio-fortification in rice through integrated microbial and soil nitrogen management in crop field	ANB	FBR
122	CSIR-NBRI	Arsenic (As) risk assessment in vegetable crops in arsenic affected areas and mitigation through microbial consortia containing AsMT activity	ANB	NCP
123	CSIR-NBRI CSIR-IHBT CSIR-NEIST	Conservation of threatened plant species of India	ANB	FBR
124	CSIR-NBRI	Plant Resource Mapping of Chambal Ravines	ANB	FBR
125	CSIR-NBRI	Leveraging genetic resources for accelerated genetic improvement of grain amaranth using genomics and phenotyping approaches	ANB	FBR

126	CSIR-NBRI	To identify the potential Aloe species for cultivation in salt affected soils	ANB	FBR
127	CSIR-NBRI	Conservation, Agronomics, Metabolomics and genomics of Indian Lotus (KAMAL)	ANB	NCP
128	CSIR-NBRI	Targeted metabolite genetics in two underutilized narcotic crops (Cannabis and Opium poppy) for Cannabinoids and Oripavine improvement	ANB	FBR
129	CSIR-NBRI	Characterization of Boll-Weight (BW) QTL Hotspots for Cotton Yield Improvement	ANB	FBR
130	CSIR-NCL	Developing microRNA-based strategies to control fungal plant-pathogens	ANB	FBR
131	CSIR-NCL	Screening of elite genotypes, elucidation of biosynthetic pathway and extraction process improvisation for colchicine in Gloriosa superba	ANB	FBR
132	CSIR-NCL	Gels (micro/macro) for pheromone release	ANB	FBR
133	CSIR-NCL	Phyto-inspired peptides derived from plant protease inhibitor for crop protection	ANB	NCP
134	CSIR-NEIST	Understanding the Rhizobacteria-Induced Resistance in Bhut Jolokia (Capsicum chinense Jacq.) against Fungal Diseases	ANB	FBR
135	CSIR-NEIST	Edible biocatalyst for the sensory alteration of essential oils	ANB	FBR
136	CSIR-NIIST	Investigation on the separation, composition andutilization of deoiled microalgal biomass as valueadded nutraceuticals	ANB	FBR
137	CSIR-NIIST	Food additive based on exopolysachharides (EPS) of lactic acid bacteria – Process development, structural modifications and functional characterization	ANB	FBR
138	CSIR-NIIST	Process development for enzymatic production of Ascorbic acid 2 glucoside	ANB	FBR

139	CSIR-NIO CSIR-CFTRI CSIR-IMTECH CSIR-CSMCRI CSIR-IIP	Valorisation of Fishery Waste for Development of Biofertiliser, Biorefinery, Biofeed & Recovery of Biopolymers (VALBBBB)	ANB	
140	CSIR-CCMB	Towards product development in rice using mutants that have traits of agronomic importance: Phase-II	ANB	FBR
141	CSIR-CIMAP CSIR-NBRI	Small RNAs and Associated factors for enhanced post-harvest Life (sRNA-life) Phase-II	ANB	FBR
142	CSIR-CFTRI	Understanding structure-function relationships in enzymes critical for the survival of bacterial food Pathogens. Phase-II	ANB	FBR
143	CSIR-IHBT	Exploration of Himalayan Plants for Novel Antimalarial Agents: Characterization of potential molecules (Phase-II)	ANB	FBR
144	CSIR-IMTECH	Development Of A Microbial System For The Production Of Neo-Glycopeptides/ Neo-Glycoproteins For Useful Applications-Phase-II	ANB	NCP
145	CSIR-NBRI	Characterization and value addition of plant-based resins, gums and waxes	ANB	NCP
146	CSIR-NBRI	Pathway elucidation and identification of genes involved in guggul stereos biosynthesis in Commiphora sps.	ANB	FBR
147	CSIR-NBRI	Sub-genome dominance in end reduplication and its implication in heterotic benefits to F1-hybrids for biomass and their adaptation	ANB	FBR
148	CSIR-NCL	Design and Development of Indigenous Strain Portfolio for the Production of Penicillin V (PenV-IP)	ANB	FBR
149	CSIR-CIMAP CSIR-CCMB CSIR-CFTRI CSIR-IIIM CSIR-IHBT CSIR-IMTECH CSIR-NBRI CSIR-NEIST	Deciphering the mechanism(s) of host-entophytes' coevolution, enhanced secondary metabolite production and crop productivity	ANB	FBR

150	CSIR-CIMAP CSIR-NBRI CSIR-IIIM CSIR-NEIST CSIR-NCL CSIR-IHBT CSIR-CFTRI CSIR-CCMB	Genome-editing for crop improvement (GE-Crop)	ANB	FBR
151	CSIR-AMPRI CSIR-CIMAP CSIR-CSMCRI CSIR-IHBT CSIR-NIIST CSIR-NBRI	Bio stimulants for stress amelioration, enhanced plant productivity and soil health	ANB	FBR
152	CSIR-CECRI	Tailored 2D supramolecular self-assembled architectures for investigating on-surface catalysis	CLP	FBR
153	CSIR-CECRI	Sustainable Electrochemical Conversion of CO2 to Methanol using Highly Selective Catalytic Electrode/GDE	CLP	FBR
154	CSIR-CLRI	Spatial regulation of collagen orchestrated protein dynamic exposition in skin	CLP	FBR
155	CSIR-CLRI	Innovative Fundamental Research for attaining Sustainability in Leather Sector	CLP	FBR
156	CSIR-CLRI	Chemicals for Low Temperature Applications of Leather in Strategic sector	CLP	NCP
157	CSIR-CSMCRI	Development of CO2 selective membrane and adsorbents for biogas purification and flue gas treatment	CLP	FBR
158	CSIR-CSMCRI	Fundamental studies on designing & synthesis of multinucleating ionophores towards high lithium loading and extraction from various sources	CLP	FBR
159	CSIR-IICT	Practical Organic Synthesis Harnessing Light	CLP	FBR
160	CSIR-IICT	Extremozymes: Studies on enzymes from extreme environments and their Industrial applications	CLP	FBR

161	CSIR-IICT	Stereoselective synthesis of all carbon stereocenters bearing C-CF3 bond via CF3-Pd-π-benzyl intermediate under transition metal catalysis	CLP	FBR
162	CSIR-IICT	Stimulus-Driven Molecular-Motors for Asymmetric Synthesis (SDMMAS)	CLP	FBR
163	CSIR-IICT	Presenting Metallated Porous-Organic-Polymer as Next Generation Photocatalyst for Solar-Fuel Production	CLP	FBR
164	CSIR-IIP CSIR-IICT	Photochemical carboxylation of naphtha feed with carbon dioxide	CLP	FBR
165	CSIR-IIP	Development of PANI-Graphene Based Composites As Functional Fillers to Conventional Coatings for Enhancement of Corrosion Inhibition Properties	CLP	FBR
166	CSIR-IIP	Recovery of aromatics from cracked naphtha	CLP	FBR
167	CSIR-IIP	Development of a Process for Catalytic Cracking of Phenolics Tar to Phenols	CLP	NCP
168	CSIR-IIP	Feasibility study for the vapour phase conversion of glycerol to acrylic acid in a fixed bed reactor setup	CLP	FBR
169	CSIR-NCL	Rheology and structural investigations of the flow of polymer functionalized particles	CLP	FBR
170	CSIR-NCL	To develop scale-up guidelines for continuous flow solvent free synthesis platforms using mechanochemistry	CLP	NCP
171	CSIR-NCL	Exploiting Frustration in Activation of N2 and CO2	CLP	FBR
172	CSIR-NIIST	Chromogenic Materials and Inks for Smart Coating and Printable Applications	CLP	NCP
173	CSIR-NIIST	Development of cardanol based colourless functional superhydrophobic coating	CLP	FBR
174	CSIR-NPL	Design Development and Establishment Of Optical Interferometer Manometer: A Primary Quantum Pressure Standard at CSIR-NPL	AEISS	FBR

175	CSIR-NPL	Realization and Dissemination of Boltzmann constant based new kelvin (K)	AEISS	NCP
176	CSIR-CSIO	Development of Precision Optical Coatings for Beam Manipulation in Airborne Infrared Search & Track Systems	AEISS	FBR
177	CSIR-CSIO	Design and Development of precision Infrared optical elements for Thermal imagining	AEISS	FBR
178	CSIR-CSIO	Development of holographic systems for 3D dynamic displays	AEISS	NCP
179	CSIR-IMMT	Rare earth phosphate TBCs for high temperature insulation and hot corrosion protection applications	AEISS	FBR
180	CSIR-NAL	Development of corrosion protective coatings for AA 2024 and AA 2014 by low pressure cold spray	AEISS	FBR
181	CSIR-NAL	Enhanced Flight Vision System for Civil Aircraft Simulator	AEISS	FBR
182	CSIR-NAL	Multi-Sensor Data Fusion Concepts for Condition Monitoring and Diagnosis of Rotating Machinery	AEISS	FBR
183	CSIR-NAL	Design and analysis of structurally integrated antennas over manned and unmanned aircraft	AEISS	FBR
184	CSIR-NAL	High Strain Rate Characterization of Structural Materials used in a Transport Aircraft	AEISS	FBR
185	CSIR-NAL	Development of Micro Gas turbine Engine	AEISS	FBR
186	CSIR-NAL	Development of Technologies for Indigenous Wankel Rotary Combustion Engine	AEISS	FBR
187	CSIR-NAL	Development of Smart Electro -Rheological Fluid system with hybrid Inclusions for Damping Applications	AEISS	FBR
188	CSIR-CEERI	Development of Cold Plasma Technologies	AEISS	FBR
189	CSIR-CEERI	Development of high emission density nanotechnology based scandate cathode for high power mm wave devices	AEISS	NCP

190	CSIR-CEERI	Task l: High Power Sub-THz Compact Source Applicable for Security screening and Non-destructive evaluation (HP-SCAN)	AEISS	NCP
		Task 2: Compact photonic crystal (PhC) based W-Band source	AEISS	NCP
191	CSIR-CECRI	Tailoring the graphene reinforced PEEK composite based filament for 3D printable aerospace structuralcomponents	AEISS	FBR
192	CSIR-CSMCRI	Electro- and photo- lysis of water for cost-effective production of pure H2 utilizing renewable energy	EED	FBR
193	CSIR-CECRI CSIR-CSMCRI	Organic radical energy storage devices	EED	FBR
194	CSIR-CECRI	Development of electrodes and electrolytes for water electrolysis to generate hydrogen	EED	FBR
195	CSIR-CECRI	High energy density, low cost and environmentally benign redox flow batteries for bulk storage of electricity	EED	FBR
196	CSIR-CECRI	Development of Precious Metal Single-Atom Catalyst and Its Theoretical Validation for Low-Cost Polymer Electrolyte Fuel Cells	EED	FBR
197	CSIR-CECRI	Extreme Fast Charging of Lithium Ion Battery for E-Mobility Application	EED	FBR
198	CSIR-IIP	Development of Adsorption based Process for the Up-gradation of Coal Bed Methane	EED	FBR
199	CSIR-NIIST	Two Electrons by One Photon: Exploring the Singlet Fission Dynamics for Photovoltaic Applications	EED	FBR
200	CSIR-NIIST	Development of Piezo-Tribo-Hybrid Electric Generator for Self-Powered Electronics	EED	FBR
201	CSIR-CECRI CSIR-NIIST	Perovskite Materials for Light Emitting Diode (LED) and Solar Cell (PSC) Applications	EED	FBR

202	CSIR-NCL	A Strategic Design of PEM Fuel Cell Carbon-free Electrocatalysts with Oxygen Buffering Effect – A Step to Improve Corrosion Resistance and Performance Under Oxygen Lean Conditions	EED	NCP
203	CSIR-AMPRI	Development of 3-D printer for additive construction of scaled model of building and construction material optimization	CIE	NCP
204	CSIR-AMPRI	Development of polymer / geopolymer based nanocomposites for antimicrobial coating applications	CIE	FBR
205	CSIR-CBRI CSIR -CIMFR	Geotechnical Novel Solutions for Underground Infrastructures	CIE	NCP
206	CSIR-CBRI	Spalling-mitigation solution of self-compacting high-strength concrete at elevated temperature condition using recycled tire's polymer fiber	CIE	FBR
207	CSIR-CBRI	Development of Innovative cool roof with improved thermal & energy performance	CIE	FBR
208	CSIR-CBRI	Structural Performance Assessment of Connections in Bamboo Structures	CIE	FBR
209	CSIR-CBRI	Multi-temporal Optical Imaging Drone based Landslide Monitoring and Warning	CIE	NCP
210	CSIR-CIMFR	Roof rock reinforcement system (R3S) for mine roadways intersection under varying geomining conditions.	CIE	FBR
211	CSIR-CMERI	Development of Ultra-precision Co-ordinate Measuring Machine (UCMM) with sub-micron range uncertainty	CIE	NCP
212	CSIR-CRRI	Development of prefabricated plastic panels for road construction	CIE	FBR
213	CSIR-NPL	Development of prefabricated plastic panels for road construction-NPL	CIE	FBR
214	CSIR-CRRI	Development of Trip Generation Manual for Indian Cities	CIE	FBR

215	CSIR-SERC	Performance Based Retrofitting of Ageing Infrastructure (Existing Bridges, Power Plant Structures & Transmission Line Towers)	CIE	FBR
216	CSIR-SERC	Engineering of Large Floating Offshore Structures and Systems for Renewable Energy Farming (Projects woth NAL, NIO)	CIE	NCP
217	CSIR-SERC	Advanced Cementitious Composites for 3D printing	CIE	NCP
218	CSIR-SERC	Nondestructive Testing and Evaluation of Submerged Concrete Structures	CIE	NCP
219	CSIR-SERC	Phase-Field Approach for Prediction of Crack Initiation and Growth in Structural Components	CIE	NCP
220	CSIR-SERC	Methodologies for prediction of Fatigue damage and remaining life assessment of Latticed Transmission line towers due to wind loads	CIE	NCP
221	CSIR-SERC	Development of novel Electrically Conductive concrete utilizing high carbon content industrial solid wastes	CIE	NCP
222	CSIR-AMPRI	Development of special radiation shielding materials	4M	NCP
223	CSIR-AMPRI	Bio-Inspired Surface Functionalization of Carbon Nanostructures with Catecholamine/Catechol Rich Polymers: Novel Approach to Develop Advance Biosensors	4M	FBR
224	CSIR-AMPRI	High strength creep and corrosion resistance Magnesium – RE-TE Alloy, composite and foams for Engineering and strategic sectors	4M	FBR
225	CSIR-AMPRI	Advanced Protecting of Magnetic Storage and Bio-Medical Systems using Smart Thin Film Materials	4M	FBR
226	CSIR-AMPRI	Design and development of Smart, Hybrid Polymer Composites and Structures For Advanced Engineering Applications	4M	NCP

227	CSIR-CECRI	Functional bio-degradable polymers with antibacterial properties for tissue engineering applications	4M	FBR
228	CSIR-CECRI	Computationally aided synthesis of artificial receptors: Biomimetic molecularly imprinted polymers (MIPs)	4M	FBR
229	CSIR-CECRI	Reclamation of spent platinum group metals utilizing hazardous exhaust from plating baths	4M	FBR
230	CSIR-CGCRI	Advanced Manufacturing of Nanofinished Ceramics and Hard Alloy Components by Laser Assisted Ductile Mode Machining	4M	NCP
231	CSIR-CGCRI	Multicomponent glass based optical fibers for Vis-MIR photonic applications	4M	FBR
232	CSIR-CGCRI	Microwave melting of glass: A potential method for tailoring glass properties.	4M	FBR
233	CSIR-CGCRI	Demonstration of Pulsed Fiber Laser Sources for Additive Manufacturing and Precision Material Processing	4M	NCP
234	CSIR-CGCRI CSIR-CDRI	Development of a biodegradable and biocompatible nano ceramics/bioactive glass-polymer composite material with anti-bacterial properties for use in female sanitary hygiene products.	4M	NCP
235	CSIR-CGCRI	Development of an array based low temperature sensing device for early detection of multiple diseases by monitoring exhaled breath	4M	NCP
236	CSIR-CGCRI	Development of Low Carbon MgO-C Refractory for Clean Steel Production	4M	NCP
237	CSIR-CGCRI CSIR-IICB	Development of thermally stable and antimicrobial bioactive glass based bone graft material	4M	FBR
238	CSIR-CGCRI	Efficient Supercontinuum Sources in the Mid-IR and Visible-NIR using Photonic Crystal Fibers: Innovative Solutions for Deep-Penetration and Ultrahigh-Resolution OCT	4M	FBR

239	CSIR-CGCRI	Development of ultra-low expansion glass-ceramic from low Cost resources for application in cooktop panel of LPG gas Oven	4M	NCP
240	CSIR-CGCRI CSIR-CBRI	Development of Fiber Bragg Grating long gauge sensors for Structural Health Monitoring	4M	NCP
241	CSIR-CIMFR	Assessment of Rock Bolting in –situ by Ultrasonic Guided Waves for Human Safety in Underground Mines	4M	FBR
242	CSIR-CMERI	Development of Scanning Laser Epitaxy (SLE) process	4M	FBR
243	CSIR-CMERI	Development of Compressed Hydrogen Composite Storage Tank for Fuel Cell Electric Vehicles	4M	NCP
244	CSIR-CSIO	Advanced Functional Nanosurfaces For Optical Sensing of Emerging Pollutants and Their Removal	4M	FBR
245	CSIR-CSIO CSIR-NAL	Dielectric and Magnetic Material based Composite for Microwave Absorption Applications	4M	FBR
246	CSIR-CSMCRI	Development of efficient synthetic protocol of high temperature (≥ 1200 °C) stable anatase TiO2: A technological challenge for self-cleaning ceramic tiles industries	4M	FBR
247	CSIR-CSMCRI	New material & strategy for recognition and removal of toxic Polyaromatic hydrocarbons (PAH4) and “Dirty dozen” Persistent organic pollutant	4M	FBR
248	CSIR-IIP	Development of Graphene-Based Materials as Booster Dose Additives to Fully Formulated Engine oil for Enhancement of Lubrication Properties	4M	FBR
249	CSIR-IIP	Design and development of nanostructured hybridmaterials comprising a semiconductor light harvester and molecular complex for photo-electrochemical reduction of CO2 to methanol	4M	FBR

250	CSIR-IMMT	Development of ferro alloys using alternate reductants: syn gas/producer gas, methane, and hydrogen through pyrometallurgical route	4M	FBR
251	CSIR-IMMT	Recovery of metal values from FeCr slag en route to zero waste	4M	FBR
252	CSIR-IMMT	Feasibility study on combustion of Petcoke-coal fuel mix in a Fluidized bed reactor (FBR) and reduction of emission through appropriate dosages of chemical reagents during combustion.	4M	FBR
253	CSIR-IMMT	Recovery of Mn as EMD from low grade ores and secondaries for energy application	4M	FBR
254	CSIR-IMMT	Nanometal engrained Agro waste based Dielectric materials for Embedded Capacitors (NanoDEC)	4M	FBR
255	CSIR-IMMT	Liquid - Liquid - Liquid Extraction and Stripping of Metal Ions in Multi-Helical Flow Reactor	4M	FBR
256	CSIR-IMMT	Value addition of bauxite mining waste rocks for refractory applications	4M	NCP
257	CSIR-IMMT	Development of Green Surfactants for Mineral Flotation and Flocculation: Molecular Level Design, Characterization, and Synthesis (GSMF)	4M	FBR
258	CSIR-IMMT	Design of Novel Luminescent Materials For White Light-Emitting Devices Application	4M	NCP
259	CSIR-IMMT	Development of Flexible Piezocomposite Materials for Self-Powered Electronics	4M	FBR
260	CSIR-IMMT	Multiscale modeling and computational design of high-performance materials for remediation of polluted water	4M	FBR
261	CSIR-IMMT	Synthesis of Calcium sulfo-aluminate: An Eco-cementing material alternate of Portland cement	4M	FBR
262	CSIR-NCL	Understanding Reaction Mechanism of Ethylene Epoxidation	4M	FBR
263	CSIR-NCL	Development of MXene based Composite 2D Nanoengineered Materials for charge storage	4M	FBR

264	CSIR-NEIST	Nanozyme Decorated Paper-Based Analytical Devices (μPADs) for Detection of Pathogens and Pesticides	4M	FBR
265	CSIR-NEIST	Development of Microbial based process for Bio-cement, Bio-brick and self-healing concrete using locally available resources.	4M	FBR
266	CSIR-NEIST	Design and Synthesis of Extended Carbon Materials for Photonic Applications	4M	FBR
267	CSIR-NIIST	Eco-friendly process for making anatase grade TiO2 from Low grade ilmenite	4M	FBR
268	CSIR-NIIST	Exploring biodegradable and biocompatible Magnesium based alloys and coatings for temporary implants	4M	FBR
269	CSIR-NIIST	Conductive Copper Ink for Inkjet Printable Flexible Electronics	4M	NCP
270	CSIR-NIIST	Aluminium-Magnesium-Scandium Alloy and Product Development for Aerospace and Strategic Applications.	4M	NCP
271	CSIR-NIIST	Development of lightweight aluminum alloy and functionally graded components for automotive Category and strategic applications	4M	NCP
272	CSIR-NML	Development of fire resistant lightweight structural materials by hybridization of Inorganic - Organic polymers low grade ilmenite	4M	NCP
273	CSIR-NML	Process development of high quality layered transition metal carbides/ nitrides/ carbonitrides (MAX)	4M	FBR
274	CSIR-NML	Development of Tin-Selenide (SnSe) based thermoelectric thin films for waste heat recovery in metallurgical amd other industries	4M	NCP
275	CSIR-NML	Development of dry beneficiation process technology for low grade iron ore for Iron and steel making	4M	NCP
276	CSIR-NML	Big Data Assimilation and Synthesis for Materials Creep Degradation	4M	FBR

277	CSIR-NML	Thermodynamic and kinetic assessment of Interfacial equilibrium conditions in multi-component based bulk nano-pearlitic steels	4M	FBR
278	CSIR-NML	Development of high ballistic strength armour steel with 2GPa tensite strength and min 50MP am 1/2 fracture toughness	4M	NCP
279	CSIR-NML	Preparation of Coke from Non-Coking Coal	4M	NCP
280	CSIR-NPL	Establishment of parameters for certain ferrous and nonferrous Alloys and Specialized Polymers for developing their standards & Life Cycle Extension	4M	NCP

C: Other Laboratory based Projects

S.No	Lab	Project Title	Theme	Category
1	CSIR-CIMAP CSIR-IHBT CSIR-IIIM CSIR-NBRI CSIR-NEIST CSIR-URDIP	CSIR Aroma Mission- Phase-II,	Mission	Mission
2	CSIR-NBRI CSIR-IHBT CSIR-IIIM CSIR-NEIST CSIR-CFTRI	CSIR Floriculture Mission;	Mission	Mission
3	CSIR-CCMB	Discerning the Eastern Ghats for improving conservation outcomes	Others	MLP Project
4	CSIR-CSMCRI CSIR-CEERI CSIR-NEERI CSIR-CMERI CSIR-CSIO	Jal Jeevan Mission	Others	MLP Project
5	CSIR-NBRI CSIR-IICT CSIR-CMERI	Development of next generation transgenic Cotton for broad-spectrum resistance to field pests for yield protection	Cotton Mission	Mission
6	CSIR-IMTECH	Multi-temperature crystallography to probe conformational switching in FtsZ	CSIR-FIRST	Basic Project
7	CSIR-CSIO	Development of optical multilayer mirrors with enhanced Laser Induced Damage Threshold (LIDT) for high power continuous wave fiber laser	CSIR-FIRST	Basic Project
8	CSIR-IGIB	Increasing the protein folding arm of proteostasis using evolutionary strategies	CSIR-FIRST	Basic Project
9	CSIR-CCMB	The origin of multiple Dicers and dsRNA Binding proteins in the RNAi initiation pathway of A. thaliana and D. melanogaster	CSIR-FIRST	Basic Project

10	CSIR-CCMB	Dynamic regulation of structure and function of respiratory complexes	CSIR-FIRST	Basic Project
11	CSIR-CLRI	Sequence Axial periodicity and exploring telo-peptide assembly in collagen: Rediscovery of biomedical treasury	CSIR-FIRST	Basic Project
12	CSIR-IHBT	Characterization of reverse transcriptase (RNA dependent DNA polymerase) activity from greenhouse whitefly Trialeurodes vaporariorum	CSIR-FIRST	Basic Project
13	CSIR-CCMB	Mechanisitic and functional role of a 'Chiral Proofreading' variant in Animalia	CSIR-FIRST	Basic Project
14	CSIR-CGCRI	In-situ and synergistic Magneto-Acoustic regenrative treatment (i-SMART)	CSIR-FIRST	Basic Project
15	CSIR-CDRI	Elucidation of neonatal cardiac regenrative potential following angoitensin II/isoproterenol mediated injury	CSIR-FIRST	Basic Project
16	CSIR-IGIB	Role of unusual secondary structures in IncRNA functions	CSIR-FIRST	Basic Project
17	CSIR-IHBT	Biopropecting kinetically stable lytic polysacchariede monooxygenase (s) (LPMOs) for accelerated degradation of lignocellulosic biomass	CSIR-FIRST	Basic Project
18	CSIR-NIIST	Engineering Next Generation Low Cost and Highly Efficient Copper Hole Conductor Based Hybrid Dye Cells for Outdoor/Indoor Photovoltaics	CSIR-FIRST	Basic Project
19	CSIR-CSIO	Design and Development of Augmented Reality Display for Use in Aviation Maintenance	CSIR-FIRST	Basic Project
20	CSIR-CSIO	Design and Development of Precision Silicon Optics for Soft X-Rays by Micro-Machining process Chain	CSIR-FIRST	Basic Project

21	CSIR-IHBT	Investigating mechanisms underlying transgenerational heat stress adaptation in plants	CSIR-FIRST	Basic Project
22	CSIR- CSMCRI	Biomimetic design and application of chiral bifunctional ligands for asymmetric?- functional reactions	CSIR-FIRST	Basic Project
23	CSIR- IGIB	Study of the potential role of parentally inherited non-coding RNA as cell division counters during early embryonic development in zebrafish.	CSIR-FIRST	Basic Project
24	CSIR- CLRI	SAM (self-assembled monolayer) on collagen and related surfaces	CSIR-FIRST	Basic Project
25	CSIR- CCMB	Defining PP1 phosphatase function in the preservation of cellular quiescence	CSIR-FIRST	Basic Project
26	CSIR- IMTECH	Functional and molecular characterization of gut microbiota mediated modulation of immune response with age.	CSIR-FIRST	Basic Project

ANNEXURE VIII

CSIR Establishments

BIOLOGICAL SCIENCES	
CSIR-CCMB	Centre for Cellular and Molecular Biology, Hyderabad
CSIR-CDRI	Central Drug Research Institute, Lucknow
CSIR-CFTRI	Central Food Technological Research Institute, Mysore
CSIR-CIMAP	Central Institute of Medicinal & Aromatic Plants, Lucknow
CSIR-IGIB	Institute of Genomics & Integrative Biology, Delhi
CSIR-IHBT	Institute of Himalayan Bioresource Technology, Palampur
CSIR-IICB	Indian Institute of Chemical Biology, Kolkata
CSIR-IIIM	Indian Institute of Integrative Medicine, Jammu
CSIR-IMTECH	Institute of Microbial Technology, Chandigarh
CSIR-IITR	Indian Institute of Toxicology Research, Lucknow
CSIR-NBRI	National Botanical Research Institute, Lucknow
ENGINEERING SCIENCES	
CSIR-AMPRI	Advanced Materials and Processes Research Institute, Bhopal
CSIR-CBRI	Central Building Research Institute, Roorkee
CSIR-CGCRI	Central Glass and Ceramic Research Institute, Kolkata
CSIR-CMERI	Central Mechanical Engineering Research Institute, Durgapur
CSIR-CRRI	Central Road Research Institute, New Delhi
CSIR-IMMT	Institute of Minerals and Materials Technology, Bhubaneshwar
CSIR-NAL	National Aerospace Laboratories, Bengaluru

CSIR-NEERI	National Environmental Engineering Research Institute, Nagpur
CSIR-NML	National Metallurgical Laboratory, Jamshedpur
CSIR-SERC	Structural Engineering Research Centre, Chennai
PHYSICAL SCIENCES	
CSIR-CEERI	Central Electronics Engineering Research Institute, Pilani
CSIR-CSIO	Central Scientific Instruments Organisation, Chandigarh
CSIR-NIO	National Institute of Oceanography, Goa
CSIR-NPL	National Physical Laboratory, New Delhi
CSIR-NGRI	National Geophysical Research Institute, Hyderabad
INFORMATION SCIENCES	
CSIR-NIScPR	National Institute of Science Communication and Policy Research, New Delhi
CSIR-4PI	Fourth Paradigm Institute, Bengaluru
CHEMICAL SCIENCES	
CSIR-IICT	Indian Institute of Chemical Technology, Hyderabad
CSIR-IIP	Indian Institute of Petroleum, Dehradun
CSIR-NCL	National Chemical Laboratory, Pune
CSIR-NEIST	North-East Institute of Science and Technology, Jorhat
CSIR-NIIST	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram
CSIR-CLRI	Central Leather Research Institute, Chennai
CSIR-CECRI	Central Electrochemical Research Institute, Karaikudi
CSIR-CSMCRI	Central Salt & Marine Chemicals Research Institute, Bhavnagar
CSIR-CIMFR	Central Institute of Mining & Fuel Research, Dhanbad

Units	
CSIR-HRDC	Human Resource Development Centre, Ghaziabad
CSIR-TKDL	Traditional Knowledge Digital Library, Ghaziabad
CSIR-URDIP	Unit for Research and Development of Information Products, Pune
Innovation Complexes	
Innovation Complex, Mumbai	

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