ANNUAL REPORT 2022-2023

सीएसआईआर
CSIR
भारत का नवाचार इंजन
The Innovation Engine of India

Council of Scientific & Industrial Research
New Delhi

Annual Report

2022-23

Council of Scientific & Industrial Research (CSIR)
Ministry of Science & Technology
Government of India

Prepared by

Science Communication and Dissemination Directorate (SCDD), CSIR

Designed & Printed by

CSIR-National Institute of Science Communication and Policy Research (CSIR-NIScPR)

Contents

Resource Base **2022-23**

37
Laboratories

39
Outreach Centres

1
Innovation Complex

3
Units

Staff Strength

(as on 01.03.2023)

3476	4000	2538	10014
Scientists Gr. IV	Technical and Support Staff	Administrative Staff	Total Staff

Budget (Rs. in Crore)

Grant-in-Aid (GIA) General	2976.10
GIA for Capital Assets	595.00
GIA General Research Scheme#	564.06
GIA Salary*	1738.93
Total	**5874.09**

Rs. 50.00 Crore surrendered under Capacity Building & Human Resource Development (EMR).

* Rs. 10.00 Crore supplementary Grants received under GIA-Salaries.

Performance Indicators

Publications and Patents

- More than **5800** Research Publications during 2022
- **250** Patents Applications Filed in India
- **225** Patents Granted in India
- **213** Patent Applications Filed Abroad (Unique Patents filed Abroad - 121)
- **99** Patents Granted Abroad (Unique Patents granted Abroad - 70)

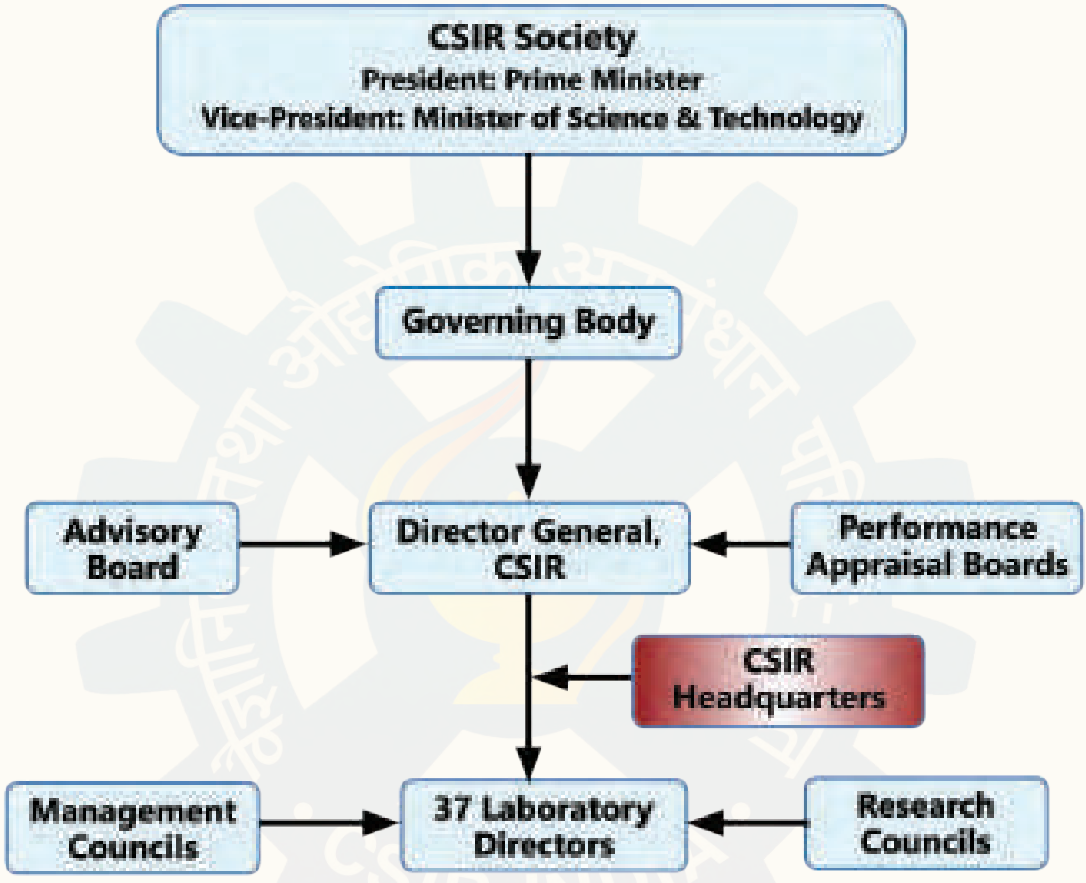
National S&T Human Resource Development

- Junior Research Fellows/Senior Research Fellows/SPM Fellows/Research Associates Supported: **9389**
- Senior Research Associates (SRAs) in position: **111**
- Research Schemes supported: **699**
- Emeritus Scientists in position: **78**

Preamble

- The Council of Scientific & Industrial Research (CSIR) was established as an autonomous body in September 1942, to address the needs of industrial research in the country. Further, evolving the scope and range of activities in several domains, CSIR is today 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 focused basic and applied research in diverse fields of S&T. CSIR has also established 39 outreach centres, one innovation complex and three units. CSIR's R&D expertise and experience is embodied in about 3476 scientists supported by about 4000 technical and support personnel.
- CSIR has been playing a significant role in mentoring the scientific and technological advancement in the country. CSIR addresses national needs through its innovative research, strong fundamental science, industry partnerships, entrepreneurship, translation research, capacity building, and policy making. Through its technological interventions, CSIR has provided solutions and innovations for the industry and has also proved to be a catalyst in improving the quality of life of millions of people across the country.
- Various S&T domains in which CSIR has focused its R&D activities over the years include 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 tool to address unethical commercial exploitation of Indian Traditional Knowledge. CSIR also 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 5846 papers in SCI Journals during 2022 with an average impact factor of 4.9.
- CSIR through its various constituent laboratories is also placing major focus upon creating incubation facilities for spin offs and start-ups. 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.

CSIR Organizational Structure



CSIR Vision and Mission

Vision

Enhance the quality of life of the citizens of India through innovative science and technology, globally competitive R&D, development of sustainable solutions and capacity building to fulfil the dream of *Atmanirbhar Bharat*.

Mission

It is essential for CSIR and important for the country that it continues to be as relevant as it was in the past, but even more so in the future particularly India's vision for 2047. The guiding beacon for CSIR would continue to be its mission across various socio-economic sectors as below:

- Technology innovation and translational research and commercialization of technology and know-how to align with national goals,
- Development of national strengths through advanced technology solutions for national aerospace programs, design and development of small and medium sized civil aircraft to promote a vibrant Indian civil aviation,
- Synergizing diverse expertise to solve the grand challenges of new age science, industry and society,
- Creation and demonstration of scalable and sustainable green technologies in the energy sector, contributing to real-time applications towards long-term energy security of the country.
- Meeting international benchmarks and societal needs
- Improving wellness indices and health outcomes through a synthesis of biology, chemistry, engineering and computation
- To be a leader in civil and infrastructural engineering domain for the growth of sustainable civil infrastructure
- Provide globally benchmarked sustainable processes for chemicals leading to reduction in trade deficits
- Catalyze & optimize sustainable production and processing of metals and materials, their use and reuse for local and global benefits
- Ensuring sustainable agriculture and nutritional security through biotechnological research and innovation
- Management and rejuvenation practices for the environment and natural resources
- Capacity building to enable globally competitive R&D
- Developing technologies for Carbon neutrality and achieving net zero plan across various industries
- Providing value-added services to the industry, and society at large.

Director General's Message

CSIR stepped into a new decade this year. With a long and rich legacy of 80 years behind us, we are committed to continue serving the nation through cutting-edge technologies.

In the CSIR Society Meeting chaired by the Hon'ble Prime Minister and President, CSIR, Shri Narendra Modi, CSIR was asked to undertake several technological challenges. We have initiated action on all of them in earnest, and I am sure that in the times to come, CSIR will play a vital role in realizing the Hon'ble Prime Minister's vision of a developed India by 2047.

The year witnessed a flurry of activities, including signing several important MoUs with industry partners, creating and dedicating facilities, transferring technologies, developing products and so on. The Hon'ble Prime Minister, Shri Narendra Modi, inaugurated the scaled-up plant to produce 10,000 tonnes per year of Hydrazine Hydrate, established by GACL at their Dahej complex based on the CSIR's technology.

Among other notable achievements during the year were the CSIR's HANSA-NG aircraft completing the in-flight engine relight test, opening the access of the two-decade-old Traditional Knowledge Digital Library (TKDL) database to users besides the patent offices, development of the first indigenously developed Hydrogen Fuel Cell bus, laying of India's first steel slag road, and so on. The CSIR Aroma Mission Phase II progressed well during the year. High-value aromatic/medicinal plants have been introduced in new areas, and about 30,000 hectares have been brought under cultivation.

CSIR is well known for high-quality research publications and robust patent portfolios. I am pleased to state that during 2022, CSIR published 5846 research papers in SCI journals of repute, the highest ever in a year by CSIR. We also filed the most number of 250 patent applications in a year in the last five years.

Dr Jitendra Singh, Hon'ble Minister of Science and Technology and Vice President, CSIR, is an inspiration to CSIR. The Hon'ble Minister, while addressing the CSIR Leadership Meet on the 81st CSIR Foundation Day on 26th September 2022, mooted the idea of a 'One Week, One Lab (OWOL) Campaign'. The campaign's objective is to enhance the visibility of CSIR among its stakeholders, especially the public, and engage with start-ups and industry in a focused manner.

I am happy to inform you that the Hon'ble Minister launched the campaign on 6th January 2023, and the first three months have seen tremendous participation by the CSIR labs' stakeholders. The OWOL will culminate on the CSIR Foundation Day 2023, and I am sure we shall have an exciting and productive 'One Week, One Lab' campaign.

We have lined up several plans that align with the SDGs, CSIR Vision 2030, and National Vision 2047. As advised by the Hon'ble PM and President of CSIR Society, we also focus on a vision for CSIR@100 in 2042.

Dr. N. Kalaiselvi

Significant Events

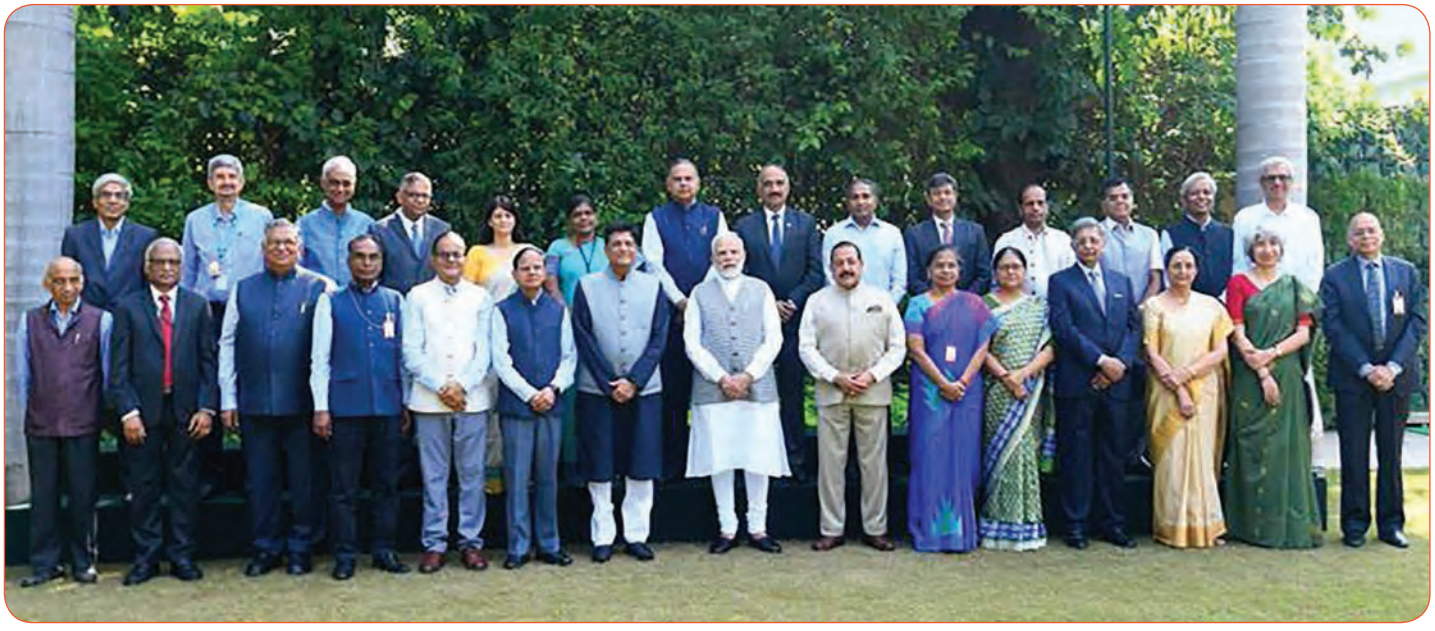
1.0 Significant Events

Hon'ble PM Chairs the CSIR Society Meeting

The Hon'ble Prime Minister of India and President, CSIR Society, Shri Narendra Modi, chaired the meeting of CSIR Society on October 15th, 2022.

The Hon'ble Minister of State (Independent Charge) Science & Technology and Vice President, CSIR, Dr Jitendra Singh, and the Hon'ble Minister of Commerce & Industry, Shri Piyush Goyal also participated in the meeting along with other CSIR Society members who include eminent scientists, industrialists and Secretaries of scientific and other Ministries. The Director General, CSIR, Dr N Kalaiselvi presented the recent achievements and contributions of CSIR to the Nation and also presented the road map of CSIR Vision 2030 which is aligned to national ambitions and Vision@2047.

The Hon'ble PM appreciated the efforts of CSIR in the past 80 years and urged the CSIR to develop a new vision for 2042 when CSIR will turn 100 years. He also highlighted the significance of documenting the journey of the past 80 years, which can help review CSIR's progress and identify lacunae, which can be addressed.



MoU between CSIR, India and BCSIR, Bangladesh

In an important milestone in S&T Cooperation between India and Bangladesh, an MoU between CSIR, India and Bangladesh Council of Scientific and Industrial Research (BCSIR) was concluded on September 6th, 2022 to establish a broad framework to promote scientific and technological cooperation. The MoU, signed by Dr N Kalaiselvi, DG, CSIR and Dr Md Aftab Ali Shaikh, Chairman, BCSIR, was exchanged at New Delhi in the presence of the Hon'ble Prime Minister of India, Shri Narendra Modi and the Hon'ble Prime Minister of Bangladesh, Ms Sheikh Hasina.

CSIR participated in Centre–State Science Conclave

The Hon'ble PM, Shri Narendra Modi, virtually inaugurated the Centre-State S&T Conclave organized by DST along with Government of Gujarat held at Vigyan Bhavan, Science City, Ahmedabad, on September 10th & 11th, 2022. Dr N Kalaiselvi, Secretary, DSIR & DG, CSIR presented an overview of recent projects implemented in coordination with several states. The success stories of CSIR including Hydrogen Mission, E-mobility, and the development of a diabetic-friendly and bacterial blight–resistant Samba Mahsuri rice were highlighted. CSIR also participated in the Expo organized during the event. Thirteen CSIR laboratories showcased their technologies along with relevant posters & products.

Inauguration of scaled-up plant for production of Hydrazine Hydrate

The Hon'ble Prime Minister, Shri Narendra Modi, inaugurated the scaled-up plant for production of Hydrazine Hydrate (HH) developed in collaboration of CSIR-Indian Institute of Chemical Technology (IICT), Hyderabad and Gujarat Alkalies and Chemicals Ltd (GACL), Gujarat on October 10th, 2022, as an initiative towards *'Atmanirbhar Bharat'*.

The plant is based on CSIR-IICT's and GACL's jointly patented technology for production of 10,000 tonnes per year of Hydrazine Hydrate. The collaboration of CSIR-IICT and GACL led the process development from laboratory scale to pilot scale, and then to a commercial scale. The scale up ratio from pilot scale to commercial scale has been up to 100 times.

Inauguration of CSIR-IIIM's BioNEST-Bioincubation Centre in Jammu

CSIR-IIIM Jammu's BioNEST-Bioincubator was inaugurated by the Hon'ble Minister of State

(Independent Charge) Science & Technology, Dr Jitendra Singh, on April 23rd, 2022. The objectives of this incubator is to ignite the entrepreneurship mind set and to nurture start-ups culture among youth, local farmers and entrepreneurs of Jammu & Kashmir.

The Bio-NEST incubation centre has been financially supported by DBT-BIRAC to foster the biotech innovation ecosystem in the country. Bio-NEST program provides support to establish bio-incubators either as a standalone entity or as a part of academia. Sixty-four start-ups have already registered with CSIR-IIIM, Jammu and a fresh impetus has been given to promote start-up as an alternative source of livelihood, with financial, technical and logistic support being provided by the Union Ministry of Science & Technology through its different agencies and departments. Out of the Sixty-four start-ups, 14 have developed products and 4 have already reached the market.

CSIR and iCreate sign MoU to harness India's tech strength

With the objective to foster rapid economic development and help create world-class start-ups, CSIR signed an MoU with the Government of Gujarat's flagship technology incubator - iCreate (International Centre for Entrepreneurship and Technology) on April 25th, 2022. The MoU signing was presided by the Chief Minister of Gujarat, Shri Bhupendra Patel. Under the MoU, CSIR and iCreate intend to establish a collaborative support system for promising tech start-ups by making combined resources available for entrepreneurs and innovators in the country. The partnership will also catalyse scientific

innovation and the marketability of high-tech start-ups. Further, iCreate will help set up new incubators at identified CSIR labs. Such start-ups will access CSIR's equipment, facilities, and scientific manpower. CSIR will provide intellectual property support and explore methods of financially supporting innovative start-ups from India to boost emerging entrepreneurs.

Inauguration and launch of CSIR's Patch Fill Machine for Pothole Repair and Mobile Cold Mixer cum Paver Machine

A programme to dedicate to the public two equipment of CSIR-CRRI in road construction and highways was organized on May 9th, 2022 at CSIR-CRRI, New Delhi. Dr Jitendra Singh, Hon'ble Minister of S&T; Shri Nitin Gadkari, Hon'ble Minister of Road Transport & Highways; and General (Dr) Vijay Kumar Singh, Hon'ble Minister of State for Road Transport & Highways and Civil Aviation participated in the launch of 'Mobile Cold Mixer Cum Paver' for constructing black top layer using bitumen emulsion and 'Patch Fill Machine' for pothole repair along the road.

Industry Connect ('i' Connect) event inaugurated at CSIR-NEIST, Jorhat

The Hon'ble Minister of S&T, Dr Jitendra Singh, inaugurated the Industry Connect ('i' Connect) event at CSIR-NEIST, Jorhat, Assam. In the inaugural event held on May 12th, 2022, Dr Jitendra Singh said, the innovative start-ups by the young entrepreneurs have to shoulder responsibility for the next 25 years of glorious journey, when we celebrate 100 years of India's independence as a frontline nation in the world.

The 75 Industry Connect ('i'-connect) events were aimed at forging partnership with industry in 10 thematic /focus areas. The 'i'-connect events were the consolidated efforts of DSIR/CSIR, DBT, DST, MoES and other scientific departments of the Government of India to reach out to industry.

Shri Keshab Mahanta, Minister for Health and Family Welfare, Science & Technology and IT, Assam Government and Dr V K Saraswat, Member NITI Aayog were other dignitaries present during the inaugural function. On the occasion, Dr Jitendra Singh also released CSIR Compendium of Technologies for Entrepreneurship of Relevance in North East India.

HANSA-NG successfully completes Engine Relight test in Air

HANSA-NG, the two-seater flying trainer aircraft, designed & developed by CSIR-NAL, successfully completed in-flight engine relight test at DRDO's Aeronautical Test Range (ATR) facility, Challakere on May 17th, 2022. Flight test was carried out at an altitude of 7000-8000 feet with the speed range of 60 to 70 knots by Test Pilots from Aircraft and Systems Testing Establishment (ASTE), Indian Air force (IAF).

In-flight engine relight capability of the aircraft was demonstrated with wind milling propeller and starter assisted start. The aircraft handling characteristics & flight parameters were found to be normal during these test flights. The in-flight engine relight test is most critical and important milestone towards certification of the aircraft by DGCA.

"TechBharat" inaugurated at CSIR-CFTRI in Mysuru

The third edition of "TechBharat" on the theme "Transforming India's FoodTech, AgriTech & Agronomic Landscape" was held at CSIR-CFTRI, Mysuru and was inaugurated by the Hon'ble Minister of S&T, Dr Jitendra Singh on May 20th, 2022. Addressing the Conclave-cum-Exhibition on Agri-Tech and Food-Tech at CSIR-CFTRI in Mysuru, Dr Jitendra Singh said, a new wave of Agri-tech start-ups has risen in India in the last few years.

Dr N Kalaiselvi, Director, CSIR-CECRI takes over as the DG-CSIR

Dr N Kalaiselvi, Director, CSIR-CECRI, took over as the Director General, CSIR on August 8th, 2022. After taking charge, Dr N Kalaiselvi discussed the status of ongoing research projects in cutting edge and futuristic technologies with the Hon'ble Minister of S&T, Dr Jitendra Singh on August 8th, 2022.

Dr Jitendra Singh congratulated Dr Kalaiselvi for being the first woman DG of CSIR in its rich history and legacy of over 80 years.

Dr Kalaiselvi apprised Dr Jitendra Singh about her research experience spanning over two decades in areas like electrochemical power systems, energy storage devices, lithium technologies and electric mobility. The discussion focused on emerging innovations in areas like Hydrogen in the energy transition, carbon capture and storage, accessible solar power, plastic recycling and inexpensive energy storage. Recent and novel CSIR technologies were discussed such as CSIR-NAL's High Altitude Performance (HAP) Vehicle and Drone technology; Aroma Mission of CSIR and The Purple Revolution; State-of-the-art Heli-borne survey technology of CSIR for groundwater management on a wider scale with cooperation and coordination from Jal Shakti Ministry fulfilling the Hon'ble Prime Minister Shri Narendra Modi's Vision and Mission of "*Har Ghar Nal Se Jal*".

Widening access of the TKDL database

The Cabinet chaired by the Hon'ble Prime Minister, Shri Narendra Modi on August 17th, 2022, approved the widening access of the Traditional Knowledge Digital Library (TKDL) database to users, besides patent offices. The opening up of the TKDL database to users is an ambitious and forward-looking action by the Government of India. The TKDL will drive research & development, and innovation based on India's valued heritage across diverse fields. The opening up of the TKDL is also envisaged to inculcate thought and knowledge leadership through *Bharatiya Gnana Parampara*, under the New Education Policy 2020.

Inauguration of new Institutional Building of CSIR-URDIP

The New Institutional Building of CSIR-URDIP located in CSIR-NCL Campus in Pune was inaugurated by the Hon'ble Minister of S&T, Dr Jitendra Singh on August 20th, 2022.

As a specialized services unit of CSIR, catering to the niche knowledge–based services sector, CSIR–URDIP is into its 22nd year of existence, dedicated to continuous Analytics and Informatics services activities supporting pre–research and pre–development phases of regular,

Mission–mode and Theme–based CSIR R&D projects, besides support services to research institutions, start-ups, SMEs, Indian corporates and also multinational corporations. The inauguration was marked by a mini exhibition with selected 30 start-ups working on themes of health, energy, environment, digitalization and automation.

India's first indigenously developed Hydrogen Fuel Cell Bus unveiled

The Hon'ble Minister of S&T, Dr Jitendra Singh launched India's first indigenously developed Hydrogen Fuel Cell Bus developed by CSIR and KPIT Technologies Ltd. in Pune on August 21st, 2022. The Hydrogen Fuel Cells utilize Hydrogen and Air to generate electricity to power the bus. Addressing the gathering, Dr Jitendra Singh said that PM Modi's Hydrogen Vision is important for India to ensure *Atma Nirbhar* means of affordable and accessible clean energy, meeting climate change goals, and creating new entrepreneurs and jobs. He said that green hydrogen is an excellent clean energy vector that enables deep decarbonization of difficult-to-abate emissions from the refining industry, fertiliser industry, steel industry, cement industry and also from the heavy commercial transportation sector. He lauded the joint development efforts of KPIT and CSIR-NCL and pointed out that the technology prowess of Indian scientists and engineers is no less than the best in the world and also at much lower costs. Dr Jitendra Singh also inaugurated the Bisphenol-A pilot plant in CSIR-NCL.

Cooperation between the *Institut National de la Propriété Industrielle*, France and CSIR on access to TKDL

The *Institut National de la Propriété Industrielle* (INPI; the National Industrial Property Institute), France, and CSIR entered into a cooperation on the Traditional Knowledge Digital Library (TKDL) access through an Agreement in the gracious presence of Dr N Kalaiselvi, Secretary,

DSIR & DG, CSIR on Sept 16th, 2022. The Agreement was exchanged by Mr Sebastien Connan, Regional IP Counsellor for India and Dr. Viswajanani J Sattigeri, Scientist-H and Head, CSIR-TKDL Unit. The signing of the TKDL Access Agreement with the INPI, France marked the beginning of a new partnership and mutual cooperation in the domains of Intellectual Property Rights as well as traditional knowledge between France and India.

Royal Society of Chemistry (RSC) and CSIR to jointly support chemistry in schools

The Royal Society of Chemistry and CSIR have partnered to support an outreach programme designed to promote the chemical sciences in schools and universities. The two organizations signed an MoU on September 22nd, 2022, committing to work together on the CSIR's Jigyasa programme. The MoU will be a non-financial one and will be time-bound for at least three years with an option of renewal.

As a part of the event, the collaboration organized a global experiment including all the CSIR's laboratories. About 2,000 school children, 150 teachers, and 350 volunteers took part in the 'RSC's Global Coin' experiment organised across over 30 CSIR laboratories, in which participants were asked to compare batteries made from different types of coins.

Hon'ble Minister of S&T, Dr Jitendra Singh addresses CSIR Leadership Meet

The first-ever CSIR Leadership Meet was held on September 26th, 2022 and was attended by the Directors and Heads of Labs/Units of all the 37 CSIR labs across the country and CSIR Headquarters Directorates.

Addressing the Leadership Meet, Dr Jitendra Singh said, the legacy of CSIR is built on the cumulative contributions of its several national laboratories and institutes. He said, each laboratory of CSIR is unique and specialise in as diverse areas as genomics to geology, material technology to microbial technology and food to fuel. The Hon'ble Minister also announced "One Week One Lab" theme-based campaign to showcase the technological breakthroughs and innovations in each of the 37 CSIR laboratories/institutes spread across the country.

The DG, CSIR, Dr N Kalaiselvi addressed the leaders of CSIR and said that the 21st century is going to be the century of India and for India, and the Science & Technology fraternity must rise to the occasion and work hard to make India a respected name in the global arena.

Dr Jitendra Singh said that the Prime Minister's call for "Start-Up India Stand Up India" in his Independence Day address of 2015 resulted in the number of start-ups in India increasing from mere 350 in 2014 to over 77,000 in 2022 with more than 100 unicorns, and India stands third in the world in the start-up ecosystem.

Inauguration of first-of-its-kind Start-Ups Expo in Jammu

The Hon'ble Minister of S&T, Dr Jitendra Singh inaugurated the first of its kind Start-Ups Expo organized in Jammu by CSIR-IIIM on September 30th, 2022. During the inaugural event, the Hon'ble Minister said, the government job mind-set is proving an impediment to start-up culture.

Swachh Sagar Surakshit Sagar Campaign

The Hon'ble Minister of S&T, Dr Jitendra Singh, chaired the review meeting of the "*Swachh Sagar, Surakshit Sagar*/Clean Coast Safe Sea" campaign on October 6th, 2022. The 75-day citizen-led campaign for improving ocean health through collective action started on July 5th, 2022 with strategic underlying goals that target transformation and environmental conservation through behavior change. CSIR and its laboratories SERC, CLRI, NIIST, NIO and IICB participated in the campaign and observed coastal clean-up drives at various parts of the country.

CSIR Directors' Conference at CSIR-IHBT

CSIR Directors' Conference was held at CSIR-IHBT, Palampur during October 28-29, 2022, chaired by Dr N Kalaiselvi, Secretary, DSIR & DG, CSIR. Directors and Heads of all CSIR laboratories, Units and Directorates of CSIR Headquarters attended the conference and discussed the Vision 2030 & Action Taken Reports of labs.

Flag off of the Steel Slag Aggregates railway rack from Tata Steel, Jamshedpur to Border Road Organization Project at Arunank, Itanagar

The Hon'ble Minister S&T, Dr Jitendra Singh, virtually flagged off the dispatch of processed Steel Slag Aggregates railway rack from Tata Steel Jamshedpur to Border Road Organization Project, Arunank, Itanagar, Arunachal Pradesh on November 2nd, 2022.

In the first of its kind initiative of technology for development of road using processed steel slag aggregates by CSIR-CRRI, steel slag aggregates of TATA Steel Plant will be utilised in construction of steel slag road stretch in strategic areas under Border Roads Organization Project at Arunank, Itanagar.

200th Governing Body Meeting of CSIR

The Hon'ble Minister of Science & Technology, Dr Jitendra Singh, who is also the Vice President of CSIR, addressed the 200th Governing Body Meeting of CSIR at the CSIR Science Centre in New Delhi on December 17th 2022, where he also announced the launching of "One Week, One Lab" campaign of CSIR.

At the 200th Governing Body Meeting of CSIR, Dr Jitendra Singh announced a Special Call for Research Grant Proposals for Women Scientists. The call for research grant proposals is for women scientists including those who have taken a career break and are interested in returning to research and reestablishing their careers. Keeping in tune with the transformations happening in CSIR, the Minister of Science and Technology also released the new tagline, "CSIR — The Innovation Engine of India".

Dr N Kalaiselvi, DG, CSIR, gave a presentation on CSIR activities and achievements from the 199th to the 200th GB meetings.

Members of the GB included Prof Ajay Sood, PSA to the Government of India; Dr Samir V Kamat, Secretary, DoD and Chairman, DRDO; Shri Gurdeep Singh, Chairman and Managing Director, NTPC; Dr Srinivasa Reddy, Director, CSIR-IICT; Dr N Anadavalli, Director, CSIR-SERC; Finance Secretary and Secretary (Expenditure); Shri Baba A Kalyani, Chairman & MD, Kalyani Group; Prof K VijayRaghavan, Former PSA to GoI; Dr Vijay Bhatkar; Dr K N Vyas, Secretary, DAE and Chairman, AEC and Dr N Kalaiselvi, DG, CSIR.

The first meeting of CSIR Governing Body was held on March 9th, 1942 that framed the Bye-Laws for the Council amongst other agenda items.

CSIR participates in 108th Indian Science Congress (ISC) – 2023

CSIR and its laboratories participated in the 'Pride of India Mega Expo' in 108th Indian Science Congress – 2023 organised at RTMNU, Nagpur, Maharashtra, during January 3-7, 2023. The Expo was inaugurated by the Hon'ble Minister of State (I/C) S&T, Dr Jitendra Singh, along with Deputy CM, Maharashtra, Shri Devender Fadnavis.

The Secretary DSIR & DG, CSIR, Dr N Kalaiselvi, visited CSIR Pavilion at the 'Pride of India Mega Expo' and interacted with delegates, students, start-ups and beneficiaries. CSIR bagged the 'Best Exhibitor of the Year' Award at ISC 2023.

'One Week, One Lab' campaign of CSIR

The 'One Week, One Lab' campaign of CSIR was launched to focus on the utmost need of the present day for establishing a resourceful connect of stakeholders (scientists/entrepreneurs/students/industries/start-ups/society) for the advancement of the technologies and the progress of the society. The objective of the campaign is to showcase the diverse legacies, exclusive innovations and technological breakthroughs of the network of 37 CSIR labs situated across the Nation, working in diversified domains of S&T.

Highlighting the global excellence in technology, innovation and start-ups of the Nation, the 'One Week, One Lab' campaign of CSIR was launched by the Hon'ble Minister of State (I/C) S&T, Dr Jitendra Singh, on January 6th, 2023. Dr N Kalaiselvi, Secretary, DSIR & DG, CSIR, called the campaign, a celebration of Science & Technologies for CSIR labs and new initiative in the *Amrit Kaal*, to leverage the technologies of CSIR.

The Hon'ble Minister, Dr Jitendra Singh, on January 6th, 2023 also inaugurated the Workshop and Exhibition on "Innovation and Sustainable Construction Materials & Technologies" with an aim of moving towards Net Zero Emission and Zero Waste. The CSIR-CBRI was the first lab to organise the 'One Week, One Lab' (OWOL) campaign. Ten (10) CSIR labs organised their OWOL campaign till end of March 2023.

CSIR commemorates the International Year of Millets

CSIR-CFTRI organised an exclusive event, "CSIR Innovations on Millets" commemorating the International Year of Millets on January 10th, 2023. The event was inaugurated by the Hon'ble Minister of State (I/C) S&T, Dr Jitendra Singh. He said that the United Nations declared 2023 as the "International Year of Millets" at the initiative of the Indian Government last year and was backed by 72 other countries. An exhibition on millet products and a Desktop Calendar 2023 on millets was also released as part of the celebrations of "International Year of Millets-2023". The Exhibition had a display of products and technologies developed in CSIR-CFTRI, Mysuru, CSIR-NIIST, Thiruvananthapurm and CSIR-IHBT, Palampur, and showcased the capabilities of CSIR laboratories in Millets R&D and reach out to various stakeholders on the institute's Millet-based Technologies at national Level.

CSIR participates in IISF 2022

CSIR and its laboratories participated in the 'Mega Science & Technology Expo' of India International Science Festival (IISF) 2022, held at Maulana Azad National Institute of Technology (MANIT), Bhopal, Madhya Pradesh during January 21-24, 2023. The aim of the 'Mega Science & Technology Expo' of IISF 2022 was to showcase India's prideful achievements, advancements, and success stories in the field of Science, Technology, Engineering, and Mathematics.

The Mega S&T Expo was inaugurated by the Hon'ble Minister of State (I/C) S&T, Dr Jitendra Singh, along with the Hon'ble CM of Madhya Pradesh Shri Shivraj Singh Chouhan and the Hon'ble Minister S&T of Madhya Pradesh, Shri Om Prakash Saklecha. The Hon'ble Ministers along with Dr N Kalaiselvi, Secretary, DSIR & DG, CSIR visited CSIR Pavilion at the 'Mega S&T Expo'. CSIR Pavilion won the 'Best Pavilion in the Expo' Award at the Mega S&T Expo of IISF 2022.

CSIR organises G20 RIIG Conference on Materials for Sustainable Energy

CSIR organized the Research and Innovation Initiative Gathering (RIIG) Conference on "Materials for Sustainable Energy" during March 2-3, 2023 at Ranchi under India's G20 Presidency. Various facets of 'Materials for Sustainable Energy' were discussed under three sessions, viz., (i) 21st Century Challenges Related to Energy Materials & Devices, (ii) Solar Energy Utilisation and Photovoltaic Technology, and (iii) Materials and Processes for Green Energy. Leading experts were drawn from institutions such as IITs, IISERs, CSIR Labs, Industries, think tanks including NITI Aayog, and Indian Energy Storage Alliance.

Dr Srivari Chandrasekhar, Secretary, Department of Science and Technology (DST) and Chair of the RIIG events in India, welcomed the G20 delegates and special invitees. Well known energy experts and policy makers including Dr V K Saraswat (Member NITI Aayog), Dr G Satheesh Reddy (Scientific Adviser to Raksha Mantri), Prof Ashok Jhunjhunwala (IIT Madras), Dr N Kalaiselvi, (Secretary, DSIR & DG, CSIR), Prof Vijayamohanan K. Pillai (IISER, Tirupati), Dr Rahul Walawalkar (Indian Energy Storage Alliance), Dr Ashish Lele (Director, CSIR-NCL, Pune), Dr Anjan Ray (Director, CSIR-IIP, Dehradun), Mr Saba Kalam (ISA) and many others deliberated on the main theme and sub-themes of the Conference.

Twenty foreign delegates from ten G20 member countries, six invited guest countries and an international organisation joined the two-day conference. From India, 38 delegates and special invitees from scientific departments, research and academic institutions and industry participated in the RIIG Conference.

MoU signing between CSIR, India and AMEXCID, Mexico on research, technology and innovation collaborations

In a landmark milestone in S&T Cooperation between India and Mexico, an MoU on Research, Technology & Innovation cooperation was signed between CSIR, India and the Mexican Agency for International Development Cooperation (AMEXCID) of the Ministry of Foreign Affairs of the United Mexican States on March 4th, 2023.

The MoU shall facilitate cooperation in the areas of research, technological development/deployment, innovation and capacity building, with an objective to expand knowledge and strengthen Institutional capacities in both the countries. The collaboration would focus in the areas of Aerospace, Electronics Instrumentation & Strategic Sectors; Civil, Infrastructure & Engineering; Ecology, Environment, Earth, Ocean Sciences & Water; Mining, Minerals, Metals & Materials; Chemicals & Petrochemicals; Energy & Energy Devices; Agriculture, Nutrition & Biotechnology; and Healthcare. Special focus on technology and industry collaboration has been structured in the MoU (supporting start-up ecosystem and existing industry through technology partnerships, tailor-making each other's technologies/ products and demonstration/deployment, establishing joint outreach centres and capacity building centres).

International Women's Day celebrations at CSIR

The CSIR family celebrated International Women's Day on March 9th, 2023, to honour the Pride of Women in CSIR contributing directly or indirectly in the progress of science & society. The celebration had Mrs Manju Singh, an educationist and Dr Jitendra Singh, Hon'ble Minister of State (I/C) S&T, gracing the occasion as the Chief Guests. Ms Nivruti Rai, VP, Intel Foundry Services, Intel Corporation & Country Head, Intel India, joined the celebration as the Guest of Honour and addressed the audience by delivering special talk on "Breaking Barrier: Advancing Women in Science & Technology".

The celebration was also graced by the presence of the Principal Scientific Advisor (PSA) to the Govt. of

India, Prof A K Sood and Dr M Ravichandran, Secretary, MoES & Dr Rajesh Gokhale, Secretary, DBT, too joined together with their families. Directors of CSIR laboratories and Heads of CSIR Headquarter Directorates along with their spouses; and many CSIR staffs joined physically as well as online for the celebration. In one of its kind celebrations, a segment on Spouse Forum Meet was organised as an interactive session with the special invited guests along with their families.

Golden Peacock Eco-Innovation Award – 2022

CSIR won 'The golden Peacock Eco-Innovation Award' for the year 2022 for 'Environmental Surveillance for SARS-CoV-2 Virus in Wastewater for Effective Management. The prestigious award is a recognition of the comprehensive and extensive work done by CSIR labs IIICT, CCMB, NCL and NEERI in surveillance during COVID-19 outbreak.

National Intellectual Property Awards 2021 & 2022

CSIR bagged the National IP Award for the year 2021 & 2022 under the category "Top R&D institution/organization for Patents Filing, Grant & Commercialization". The award was conferred by the Hon'ble Minister of Commerce & Industry, Shri Piyush Goyal.

Tata Innovista 2022 Award

Tata Innovista 2022 Award in the category of "Most Innovative Partner" was awarded to CSIR-NML, Jamshedpur as a partner of Tata Steel for the work on "Intelligent Billet Caster: Improve Quality & Productivity".

Significant S&T Achievements

2.0 Significant S&T Achievements

Technology of Nucleic Acid Staining Dye GreenR™

The dye GreenR™ has been developed by CSIR-CDRI in joint collaboration with industry partner Biotech Desk Pvt. Ltd (BDPL), Hyderabad. The product GreenR™ provides an economical alternative to commercially available dyes that are used to stain DNA/RNA, which are currently imported. It binds to all nucleic acids including genomic DNA, PCR products, plasmids and RNA and fluorescence under blue light or UV exposure. This dye has varied applications in molecular diagnostics and life sciences research. The chemical synthesis of GreenR™ was standardized by CDRI team and the BDPL team studied its biological applications in real-time PCR and DNA binding. CSIR-CDRI has transferred the technology of the nucleic acid staining dye GreenR™ to GenetoProtein Pvt. Ltd (GPPL), a start-up registered in Uttar Pradesh, and the company has already started sampling the product amongst researchers both in academia and industry. The development of this indigenous dye will offer the Indian researcher an alternative to expensive imported dyes and take India a step closer to '*Atmanirbhar Bharat*'.

CO_2 Capture Technology

CSIR-CECRI has developed a process to capture the polluting carbon-di-oxide (CO_2) from thermal power plant flue gas, and emerged successfully with a technology matching with the Department of Energy (DoE), USA targets.

The novelty of CSIR-CECRI's process lies on the synthesis process to produce an adsorbent capable of adsorbing more than 3 millimoles per gram of CO_2 at flue gas conditions. The process know-how has been transferred to M/s. Summits Hygronics Pvt Ltd, Coimbatore. The technology finds application in multiple areas like thermal power plants, submarines, biogas enrichment, automotive sector and direct air capturing in highly polluted cities thereby minimizing CO_2 concentration towards reducing global warming. The captured CO_2 can also be converted into value added industrially important chemicals like methanol, formic acid, adipic acid, etc. leading to a circular economy.

The technology aligns to one of the United Nation's "Sustainable Development Goals on Climate Action" (SDG 13) and Government of India's mission on "Carbon Capture, Utilization and Storage (CCUS)". Transfer of this technology paves way for a joint working of research institute with industry to address one of the global mandates by fulfilling India's commitment in realizing "net-zero" emission by 2070.

Li-ion Battery Fabrication Pilot Plant

CSIR has launched a Mission Mode Project, "CSIR Innovation Centre for Next Generation Energy Storage Solutions (ICeNGESS)", that is being implemented at CSIR-CECRI's Chennai Centre. The project aims at establishing a National Facility for the fabrication of Lithium-ion cells with the following objectives:

Phase I - Establishing an assembly line for 18650 cylindrical cells (1000 cells/day) by augmenting the existing facility

Phase II – Establishing a dedicated assembly line for 21700 cylindrical cells

The facility would demonstrate

a) Lithium-ion batteries (LIB) fabrication,

b) Impart training & nurture Indian industries, offer handholding business opportunities to private sector/ industries through Technology Transfer apart from the creation of avenues through Technical Incubation to encourage investors to start-up with new LIB enterprises.

c) Building Indian eco-system and indigenous supply chain apart from offering skill development training programs, relevant to Battery Researchers and start-ups.

As part of ICeNGESS project, Phase I facility to make 1000 nos. of 18650 Li-ion Cylindrical Cells, first of its kind in India, has been established. M/s Godi India Pvt Ltd, Hyderabad has been identified as industrial partner to fabricate and penetrate the Indian market.

Steel Slag Valorization Technology for Conversion of Steel Slag as Road Making Aggregates

India is the world's second largest steel producer. India generates around 19 million tons of solid steel slag waste annually. CSIR-CRRI under a major research study sponsored by Ministry of Steel and four major steel industries in India, namely, JSW Steel, AMNS India, TATA Steel and Rashtriya Ispat Nigam Limited has developed the steel slag valorization technology to convert waste steel slag as road making aggregates. Processed steel slag aggregates as developed through waste steel slag has been successfully utilized in the construction of India's First Steel Slag Road at Hazira, Surat. Around one lakh ton processed steel slag aggregates were utilized as 100% substitute of natural aggregate in steel slag road construction. For its unique design features Steel Slag Road built through CRRI technology has been inducted in INDIA BOOK OF RECORDS and ASIA BOOK OF RECORDS as First Steel Slag Road.

The Hon'ble Minister of Steel, Shri R.C.P Singh inaugurated the steel slag road at Hazira, Surat on June 15th, 2022. MoUs have been signed with different steel industries such as JSW Steel, AMNS India, and Rashtriya Ispat Nigam Limited for Technology Transfer.

Bio Ceramic application

CSIR-CGCRI successfully demonstrated in-vitro differentiation capability of the human mesenchymal stem cells (hBMSCs) towards cartilage tissues under normoxic conditions with and without supplement under a CSIR FIRST project. Further, a series of borosilicate bioactive glasses with given specifications were designed with increasing the substitution of B_2O_3 for SiO_2. These have potential applications as a scaffold material in bone tissue engineering. Significant progress has taken place towards development of bioactive glasses and glass composites.

Novel Piezo based Multipurpose Non Destructive Evaluation Vibro-integrity Sensing Device (VInSD)

CSIR-CRRI developed piezoelectric based sensor especially for Non Destructive Testing (NDT) of concrete and steel structures, provide a system and method for sensing the dynamic response and the integrity of a concrete structure (such as a bridge) through the measurement of the vibration response of a piezoelectric based sensor. This is a very light weight, battery operated and portable sensor which can be either used as a standalone sensor or as an attachment for the Unmanned Aerial Vehicles for inspection of concrete and steel structures. This is designed in a way that it can generate

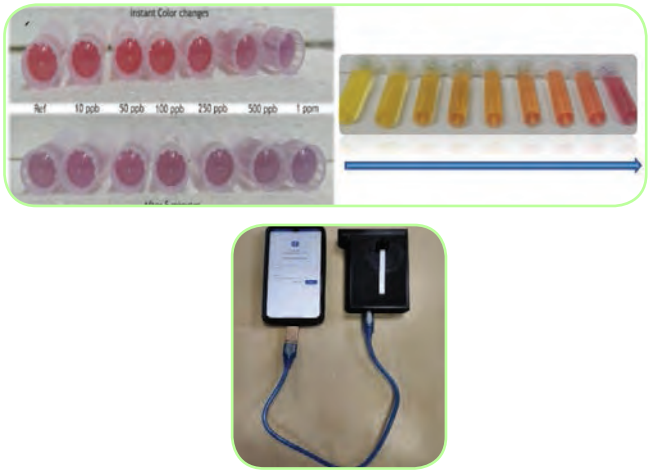
waves in the concrete structure by producing an impact force and then measure the velocity of these waves travelling inside the concrete. Further, this sensor can estimate the depth of the defects (in form of cracks etc.) by studying the dynamic response of the concrete structure.

Multi-source Edible Vegetable Oil with an Ideal Ratio of SFA: USFA (omega3 and omega6)

Fats and oils are important dietary components in our diet. Diet provides mixtures of three types of fatty acids-saturated (SFA), monounsaturated (MUFA, w-6), and polyunsaturated (PUFA, w-3). Each fatty acid has unique metabolic facts and potentially independent physiological functions. Hence it should be consumed in a balanced manner to avoid the adverse effect. Accordingly, FSSAI revised the regulation of vegetable oil blending and introduced a new term called "Multi-Source Edible Oil (MSEO; blending of three oils) to ensure the w-3 fatty acids intake and the other w-6 and saturated fatty acids in the recommended ratio in our diet. Multi-Source Edible Oil (MSEO) has been developed at CSIR-CFTRI with a balanced fatty acid ratio by both enzymatic and non-enzymatic processes as per FSSAI guidelines.

Indigenous Colorimetric Test Kits and Device for Water Quality Testing

Water in several Indian states have high level contamination of heavy metals including arsenic, selenium, chromium, cadmium, etc. It is therefore required to have end-to-end detection platform for their detection before water consumption as well as utilization in agriculture in affected regions. The work initiated at CSIR-CSIO integrates successfully accepted colorimetric approach for heavy metals detection in water with mobile phone-based image processing to quantify the contamination level using affordable paper/membrane based disposable sensor strip. The developed mobile app ensures elimination of subjectivity of the colometric sensor, which limits their application to true extent by users in resource limited regions especially rural sector.

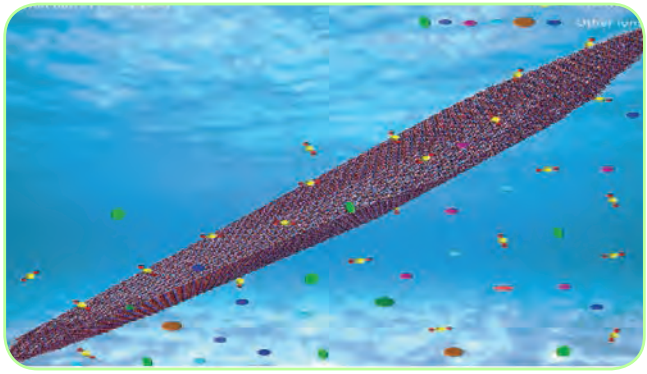


Development of Battery Warmer Unit for Cold Weather Applications

A Thick Film hot-plate integrated battery warmer unit with controllable temperature has been developed. The unit operates at 12V DC supply to provide optimum temperature for battery operation of 25-35˚C inside the battery box. Developed prototypes have been successfully tested at CSIR-CEERI, Pilani at room temperature as well as at cold temperatures. In extreme cold weathers (during winters and in high altitude areas like Himalayas). Thick film LTCC based hotplates have been utilized as energy efficient solution. The prototype unit was handed over to the DRDO-Defence Institute of Bio-Energy Research for testing in actual deployment environment.

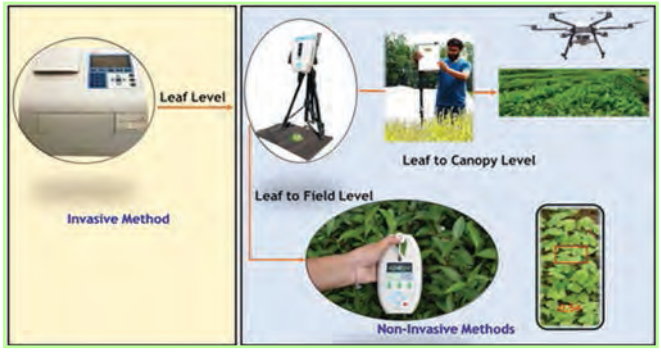
Uranium Extraction from Seawater

Uranium extraction from seawater is an emerging paradigm of the Blue economy towards harnessing the ocean resources for sustainable development of clean energy. The large area thin films of permanently porous Hydrogen-bonded Organic Frameworks (HOFs) have been prepared at CSIR-CSMCRI for efficient Uranium Extraction from Seawater (UES).



Migrating from Invasive to Non-invasive Techniques for Enhanced Leaf Chlorophyll Content Estimations Efficiency

Leaf chlorophyll is vital for plants because it helps them get energy through the process of photosynthesis. CSIR-IHBT has developed a non-invasive technique based on hyperspectral remote sensing along with Artificial Intelligence (AI) and Machine Learning (ML) for efficient and rapid estimations of leaf chlorophyll content on local and regional scales.



Food grade xylitol from biomass

A process for production of crystalline xylitol from biomass has been established at CSIR-IIP with corncob and sugarcane bagasse as the feedstock. The xylan fraction of the biomass was hydrolyzed with dilute acid and steam treatment and the resulting xylose rich fraction was converted into xylitol with high yield by a mesiophilic yeast. The final product after recovery has a purity of ~97.5%, shows no traces of heavy metals or pesticides and has a shelf life of >3 months. Also, the product has been found to have no adverse effect on animal cell lines at a dosage of >10000 mg/kg of the product.

CSIR-NAL's Octa-Copter

CSIR-NAL has developed a medium-class BVLOS (Beyond Visual Line of Sight) multi-copter Unmanned Aerial Vehicle (UAV). The UAV is made out of a lightweight carbon fiber foldable structure for ease of transportation and has unique features like autonomous guidance through dual redundant MEMS-based digital Autopilot with advanced flight instrumentation systems. The DGCA, Ministry of Civil Aviation, Govt. of India, has granted conditional permission to CSIR-NAL for conducting BVLOS flight trials. Subsequently, the NAL drone has completed about 50 hrs of flying to verify the performance parameters and the report is being submitted to MoCA for type approval.

NAL's Octa-copter Drone is capable of carrying payload of 20 kg for a duration of 20 minutes. However, for longer duration applications, the payload is reduced suitably. It can fly at an operational altitude of 500m AGL and a maximum flying speed of 36 kmph. Its regulatory compliance includes DGCA-NPNT, Geo-fencing, and digital sky with 360 degrees collision avoidance making it one of the best UAVs in its class. The uniqueness of this UAV is its higher payload and higher endurance which is perfect for last-mile delivery, floriculture mapping, geo exploration, precision agriculture pesticide spraying and medical transport at remote places. These drones have been configured to suit multiple applications for societal needs. The three

applications envisaged are (a) Emergency Medical/ Vaccine Delivery (b) Agricultural Spraying and (c) for Geophysical Survey applications. The technology has been transferred to 4 MSMEs during the Wings India 2022.

Cost Effective Refractory Lining in Steel making

A cost effective refractory lining material for induction furnace suitable for production of quality steel has been developed at CSIR-CGCRI. A ramming mass composition suitable for removal of sulphur and phosphorus effectively from steel composition has been developed. Six tonnes of material has been supplied for industrial trial after the furnace availability confirmation from the industrial partner M/s Ispat India, Raipur.

Design & Development of a Vertical Slurry Transport System for Lifting of Minerals/ Ores in Heterogeneous Regime

Limestone samples were collected from Lanjiverna mines, Dalmia Cement, Rajgangpur (Sundergarh), Odisha. Characterization studies comprising of particle size analysis, material density, settling characteristics of the limestone samples were carried out at CSIR-IMMT. In order to transport the limestone samples in vertically upward direction, the settling velocities of lime stone particles in size ranges of 4-6 mm, 8-10 mm, 12-15 mm & 18-20 mm were evaluated experimentally through visual observations at the transparent sections (Perspex tube) using the vertical test loop facility. A 2-4 ton/hr capacity rotary feeding system has been designed, developed & successfully installed by CSIR-IMMT with the vertical lifting system. Experiments have been conducted with a maximum mixture slurry concentration of 12.52% & the pressure drops were evaluated using the vertical slurry test setup. A 4-10 ton/hr capacity feeding system to handle 4-20 mm size particles has been designed to increase the slurry concentration. A mechanical pulsar mechanism has been designed and installed with the system to induce pulsation in a variable frequency.

Design and Development of Remotely Operated Vehicle (ROV) for Underwater Inspection and Intervention upto a Depth of 100mm

A Remotely Operated Vehicle (ROV) operational upto 100m of water depths with inspection and intervention tools has been designed and developed at CSIR-CMERI. The ROV has been designed based on modeling of dynamics and hydrodynamic interactions. The developed ROV has been interfaced with a manipulation system and designed with a suitable control strategy for navigation of ROV from surface to site. The developed ROV incorporates image processing (de-hedging technique based) & SONAR data mapping algorithms and facilitates real-time report generation through collection and interpretation of NDE based data.

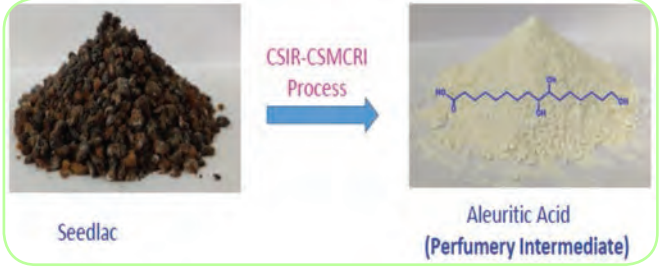
Process Development for VOC and Odour Emissions Control

Large amounts of organic solvents are used in automotive painting booths. On an average, more than 6 kg of volatile organic compounds (VOCs) are used as paint solvents per vehicle in typical automotive plants with solvent-based coatings. The paints used contain organic polymers and solvents. These compounds can be photo-chemically reactive and negatively affect local air quality. Automobile spray painting units causes VOC and odour emission in several parts of the state. Biological waste air treatment is best for this as it is cost effective as well as environment friendly in comparison with conventional techniques such as chemical or thermal. Therefore, a hybrid bio-physico-chemical process termed as “Gas Bio-trickling filter” has been developed at CSIR-NIIST through R&D project

financially supported by Central Pollution Control Board (CPCB) and Kerala State Pollution Control Board (KSPCB). The biological treatment utilizes microbial consortia to treat contaminants emitted in the air.

Recovery of Aleuritic Acid from Seedlac

Aleuritic acid is an intermediate mainly used in the perfumery industry, for the preparation of "musk" aroma compounds as well as medicinal and bioactive compounds. Aleuritic acid is a natural product obtained by the alkaline hydrolysis of seedlac and purification by various steps including recrystallization and charcoal treatment. The existing process for the recovery of aleuritic acid is very tedious and it needs 15-20 days per batch production. Also the recovery of aleuritic acid is 12-14% yield w.r.t. seedlac, results less profit for the manufacturers.



CSIR-CSMCRI developed a process for the recovery of aleuritic acid from the seedlac that reduces the reaction time from 10-15 days to 2-5 days. Pure product obtained was without recrystallization and improvement in the yield (20-24%). One Indian patent has been filed and the technology has been transferred to industry with limited exclusivity.

Medha Plus - A Novel Polyherbal Formulation for Alzheimer's Disease

Available synthetic drugs only provide symptomatic reliefs targeting single molecule, hence, are unable to address the multi-factorial aspects in Alzheimer's disease (AD) pathogenesis. It is imperative to develop combinatorial drugs that address the multiple molecular targets in AD. Parker Robinson Pvt. Ltd. (India) approached CSIR-IICB for experimental studies on a herbal medicinal formulation 'Medha Plus' (MP) which is a unique combination of aqueous extracts of six therapeutic plants indigenous to South-East Asia and hugely propagated across India - *Brahmi*, *Mandukaparni*, *Sankhapusphi*, *Yastimadhu*, *Kokilaksha* and *Shunthi*. Experimental studies performed at CSIR-IICB showed that MP is an incredible combinatorial drug that targets multiple molecular targets with exemplary neuroprotective properties. An array of behavioral studies showed that MP was able to recover AD-associated memory deficits in both sporadic and familial AD models. MP treatment reduced Amyloid plaques deposits and decreased apoptotic cell death in the hippocampus. Enzymatic assays demonstrated anti-oxidative and anti-acetyl cholinesterase properties of MP. An underlying improvement in synaptic plasticity was observed with MP treatment as well. The ability of multi-constituent MP in reversing cognitive deficits and underlying synaptic health in rodent models of sporadic and familial forms of AD promote it as a frontline candidate drug for clinical trials in AD.

Water Security for Arid Regions of India

With an annual rainfall of less than 100 to 400 mm in the arid areas in the North-Western India, spread over parts of states of Rajasthan, Gujarat, Haryana and Punjab covering nearly 12% of the country's total geographical area and home to more than 8 crore people, this area faces acute shortage of water throughout the year. CSIR-NGRI, with approval of Ministry of Jal Shakti, Govt of India, carried out high resolution aquifer mapping and management to augment the groundwater resources in

these areas. Under Phase-I, an area of ~1,00,000 sq. km covered which comprised of 41,375 sq. Kms.

Industrial Solid Wastes Utilization

CSIR-NIIST has developed a process for creating innovative building materials, IR reflective ceramic colorants and light weight CLC blocks from industrial wastes generated from the mining, mineral and metallurgical wastes. Industry wastes such as jarosite, fine silica sand, foundry sand waste, red gypsum, iron oxide sludge, rock dust, etc. were utilised for developing bricks and blocks for low-cost housing. The processing need no firing and product is manufactured by simple gel-bonding technique.

India's First Indigenously Developed Laser-cooled Caesium Atoms Based Primary Frequency Standard

CSIR-NPL indigenously developed India's first laser-cooled Caesium (Cs) atoms based primary frequency standard NPLI-CsF1. Only a handful of (less than 10) such primary frequency standards, developed worldwide, contribute to the maintenance of international reference time UTC. Apart from international timekeeping, such accurate standard will provide self-reliance in the field of precise Time and Frequency measurement which has measurable economic and strategic implications in the areas of navigation (ISRO's NavIC), telecommunication, smart grids, financial security etc. Millions of Caesium atoms were laser cooled to a few micro kelvin temperature, inside the vacuum chamber of NPLI-CsF1 after many years. Efforts were made to launch the cold atoms, detect them and realize the fountain operation and trademark Ramsey Fringes. Work is underway to make it contribute to International Reference Time (UTC) after a long hiatus. The figure below shows Image of laser-cooled cloud of Caesium atoms, trapped in a magento-optical trap (MOT), captured with an Infrared CCD camera mounted on one of the viewports on the vacuum chamber. In the bright spot (atomic cloud), more than 10 million Caesium atoms trapped at few micro kelvin temperatures. The cold Caesium atomic cloud is used to realize SI Second in India's first and only indigenously developed Caesium Fountain Primary Frequency Standard.

Laboratory Scale Facility creation of 3D printing (3DP)

Extrusion-based research scale 3D concrete printer, installed at CSIR-SERC, was used for development of 3D printable concrete mixes. About 30 trial mixes were prepared to arrive at a successful 3D printable mix which satisfies flowability, buildability, and open time. Various mixes were developed using different industrial by-products (fly ash, silica fume, GGBS) and different types of fine aggregates such as standard sand, river sand and copper slag. Flowability of these mixes were determined by conducting slump test and flow table tests in accordance with ASTM C 1437. Further, extrudability of 3D printable mixes were evaluated by

visual inspection method; extruding filaments without clogging, breaking segregating or bleeding. For the determination of buildability, cylindrical/ rectangular specimens for height up to 500 mm (maximum printable height using the printer) was printed; the total number of printed layers were counted and by measuring the vertical strain the buildability was checked. Structural build up behaviour was evaluated using penetration test. Initial setting time and final setting time of printed sample was less compared to companion cast-in-place samples. Grade of the concrete was achieved as M30.

Development of Bamboo Diversity (*Bambusetum*) using Eco-Rejuvenation Technology

Development of bamboo diversity on degraded land was achieved effectively with the help of Eco-rejuvenation Technology (ERT). Using ERT, the fertility of the land is increased by incorporating the land with bio-manure, microbial consortia and specific bamboo species to survive in harsh environment and develop rhizosphere biodiversity in the degraded land area.

Implementation of bamboo diversity on degraded land also meet various environmental issues. Issues like flood in agricultural land are prevented by using bamboo bio-fencing on the border of the field. Bamboo plantation on fly ash contaminated land has not only reduced air pollution in the area, but have also helped in reducing the carbon foot print of the area by sequestering carbon dioxide and other greenhouse gases. In addition to the environmental advantages, these initiatives have also provided social advantages like women empowerment in rural areas. In majority of the ERT project sites, the bamboo plantation work is done by rural women and CSIR-NEERI has upskilled them. The output of this ERT could be converted into self-sustainable bamboo-based industry. Along with meeting the environmental problems arising due to fly ash, it also helps to provide livelihood to many families surrounding the thermal power plant and promote the development of bamboo based technologies & wooden art forms with local artists of the area.

CSIR Aroma Mission Phase II

In order to increase the income of farmers, Aroma Mission (Phase I: 2017-2020 and Phase II: 2020-2023) of CSIR has played an important role in introducing high value aromatic/medicinal plants into new areas and about 30,000 hectares (ha) land has been brought under cultivation. Sixty-four agro technologies and fifty superior varieties have been developed. Further, 384 distillation units have been installed and about 4000 tonnes of essential oil has been produced. So far, about 81,000 people have been trained of which 15,000 are women. Farmers income has increased up to ₹ 70,000/ha/year and around 71 lakh man-days of rural employment have been generated.

CSIR Floriculture Mission

CSIR Floriculture Mission Phase I was launched in March 2021 with the aim to utilize knowledgebase available in CSIR Institutes and help Indian farmers and industry. So far, 1250 hectares have been brought under floriculture. Apiculture has been integrated with floriculture in collaboration of KVIC forming 49 clusters benefiting 2000 farmers and covering 4880 hectors. CSIR is implementing Phase II of Floriculture Mission with the aim to overcome the lack of indigenously produced quality planting materials (QPM).

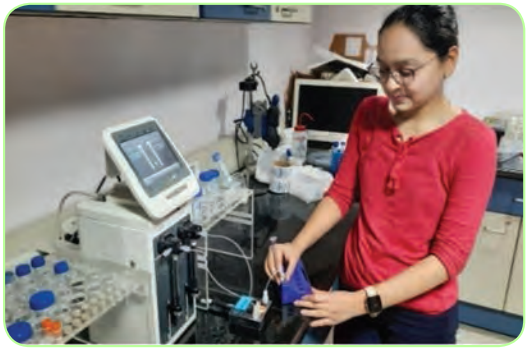
Ancient DNA research

DNA and radioisotope analyses by scientists from CSIR-CCMB, BHU, Birbal Sahni Institute of Paleosciences and Panjab University have traced the origin of human skeletons found in a well in Ajnala, Punjab to East of India in 2014. Their findings suggest the skeletons match people of Eastern India. Historical records corroborate this to the British killing of Indian soldiers from the 26th Native Bengal Infantry Battalion during the freedom struggle of 1857 at Ajnala.

Significant COVID-19 Activities

mRNA Vaccine Development Platform

CSIR-CCMB has set-up a working platform to develop mRNA vaccines, starting with identifying a candidate for COVID-19 vaccine. The mRNA vaccines are modular. In principle, the mRNA can be inserted to make a protein of a pathogen of concern in human cells. This can be used to train the recipient's immune system to evade the real pathogen, if it infects.



Tablets and Syrup of Umifenovir for Clinical Trials

Tablets of Umifenovir, an inhibitor of virus entry into host cells, have been developed at CSIR-CDRI for clinical trials. A syrup formulation was also developed for administration to children. The technologies have been transferred to M/s. Medizest, Goa for production of the dosage forms employing Good Manufacturing Practices. Currently, M/s. Medizest is carrying out large-scale Phase III clinical trials at multiple locations in India.

Dry Powder Inhalation of Favipiravir

A powder containing Favipiravir (a directly-acting antiviral), intended for inhalation through the mouth, without using any propellant or spraying valve, has been developed at CSIR-CDRI. This technique supplies medicine directly to the throat, airways and lungs. The technology has been transferred to M/s. Windlas Biotech, Dehradun.

Phenome India - CSIR Health Cohort Knowledgebase (PI-CHeCK)

One of the holy grails of preventive precision medicine is to predict the health trajectories of individuals to allow early intervention and prevent onset or complications of the disease. Such prediction of health outcomes has traditionally been accomplished by the development of risk scores based on limited data from prospective cohort studies. The advent of multi-omics data and artificial intelligence-based big-data analytical tools has opened an unprecedented opportunity for developing novel personalized risk matrix to predict health outcomes.

This was evident during the recent pandemic of COVID-19 when CSIR in its laboratories and centres spread all over the country, representing a wide range of ethnicity subclasses, geo-social habitats and occupational exposures, initiated a longitudinal cohort study (Phenome-India Cohort) to estimate the burden of COVID-19 and to assess antibody stability. In a first-of-its-kind study from India, this cohort enabled to ascertain the sero-positivity across the country and identify variable susceptible associations for contacting infection. The longitudinal design enabled to follow up sero-positive individuals and provide insights on the stability of these antibodies.

This multi-centric program involved longitudinal collection and biobanking of biological samples from about 5,000 CSIR employees, pensioners and their family members with concurrent collection of multi-parametric data and included clinical questionnaire, lifestyle and dietary habits, anthropometric parameters, imaging/scanning, biochemical data, and molecular data including genomics, plasma proteomics, and metabolomics. The data, archived in a central data server, was analyzed to develop robust individual and pathway-based observations which then using artificial intelligence-based tools will help to identify risk factors and develop risk matrix for various communicable (COVID-19) and non-communicable (CVD, Diabetes) that will be applicable to the Indian population. When combined with prospective collection of biological samples and analysis of the phenome using big-data approach, it can yield a wealth of information in establishing causation and development of diagnostic and prognostic biomarkers especially for chronic non-communicable metabolic diseases, which is an emerging health crisis in India.

V-Treat: A Wearable Pressurized Air-breathing and SARS CoV-2 Scavenging Device

COVID-19 was declared an air borne virus and spreads through aerosols. The frontliners were at high risk working in COVID environment as well as attending thousands of patients in COVID wards, OTs, OPDs, etc.

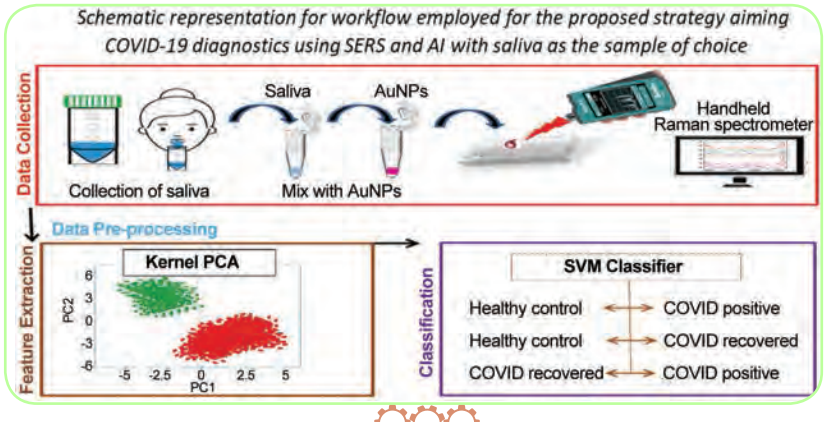
The mask used creates an un-comfort for wearing 24X7 due to negative pressure and CO_2 build up. Also, despite of using mask several doctors got infected with COVID. To overcome this and provide a more comfortable solution, a wearable pressurized air-breathing and SARS-CoV-2 scavenging device called as V-Treat was developed under collaborative project between CSIR-CSIO, Chandigarh and Ideamines Pvt. Ltd., Noida. The device works on three-level deactivation of virus and is tested for UVC safety by CSIR-NPL and SARS-CoV2 viricidal activity by CSIR-IMTECH. The device provides SARS-CoV-2 free air while wearing PPE kits in COVID wards/OPDs.

Benchmarking the Ability of Novel Compounds to Inhibit SARS-CoV-2 Main Protease using Steered Molecular Dynamics Simulations

To explore the potential binding mechanisms of 1,2,3-triazole scaffolds in comparison to co-crystallized inhibitors 11a and 11b towards Mpro, CSIR-IHBT utilized molecular dynamics and enhanced sampling simulation studies. All the 1,2,3-triazole scaffolds interacted with catalytic residues (Cys145 and His41) and binding pocket residues of Mpro involving Met165, Glu166, Ser144, Gln189, His163, and Met49. Furthermore, the adequate binding free energy and potential mean force of the topmost compound 3h was comparable to the experimental inhibitors 11a and 11b of Mpro. Overall, the current analysis could be beneficial in developing the SARS-CoV-2 Mpro potential inhibitors.

Non-invasive Ultrasensitive Diagnostic Approach for COVID-19 Infection using Salivary Label-free SERS Fingerprinting and Artificial Intelligence

Clinical diagnostics for SARS-CoV-2 infection usually comprises the sampling of throat or nasopharyngeal swabs that are invasive and create patient discomfort. Hence, saliva is attempted as a sample of choice for the management of COVID-19 outbreaks that cripples the global healthcare system. Although limited by the risk of eliciting false-negative and positive results, tedious test procedures, requirement of specialized laboratories, and expensive reagents, nucleic acid-based tests remain the gold standard for COVID-19 diagnostics. Thus, the simplest screening modality based on label-free surface enhanced Raman scattering (LF-SERS) has been demonstrated for scrutinizing the SARS-CoV-2-mediated molecular-level changes of the saliva samples among healthy, COVID-19 infected and COVID-19 recovered subjects. Moreover, our LF-SERS technique enabled to differentiate the three classes of corona virus spike protein derived from SARS-CoV-2, SARS-CoV and MERS-CoV. Raman spectral data was further decoded, segregated and effectively managed with the aid of machine learning algorithms. The classification models built upon biochemical signature-based discrimination method of the COVID-19 condition from the patient saliva ensured high accuracy, specificity, and sensitivity. The trained support vector machine (SVM) classifier achieved a prediction accuracy of 95% and F1-score of 94.73%, and 95.28% for healthy and COVID-19 infected patients respectively. The current approach not only differentiate SARS-CoV-2 infection with healthy controls but also predicte a distinct fingerprint for different stages of patient recovery.



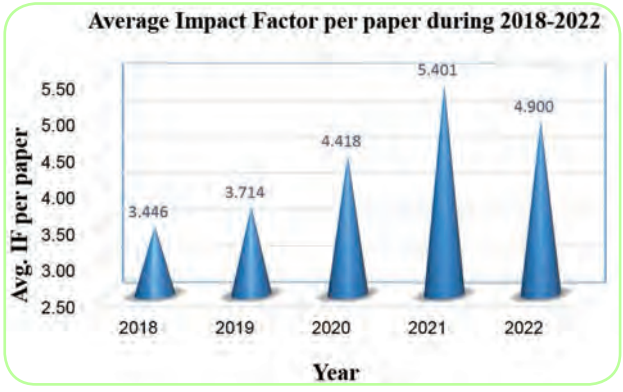
Scientific Excellence

3.0 Scientific Excellence

Research Excellence

CSIR has published 5846 research papers during 2022 in SCI journals of repute.

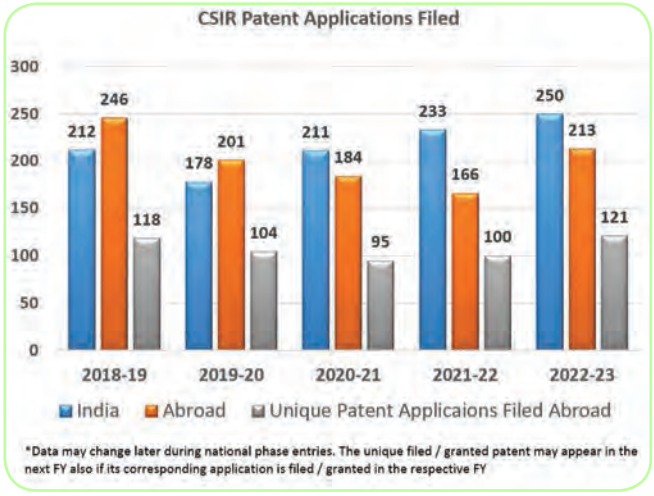
The new knowledge generated from CSIR laboratories is reflected in terms of high average Impact Factor (4.9). Following graphs shows the trend of research over the last five years.

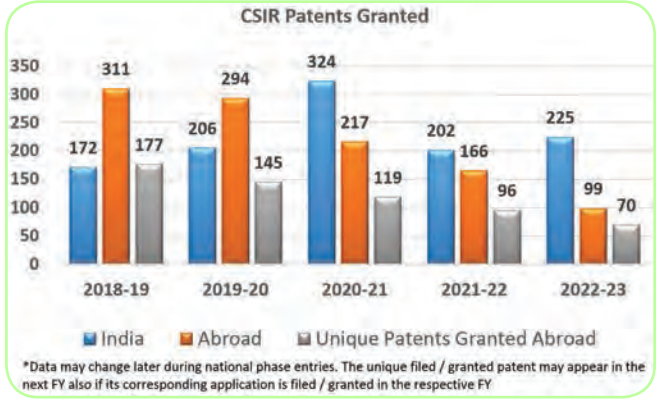


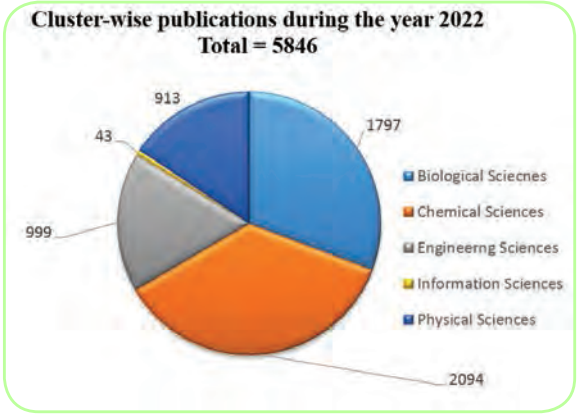
* The Journal Citation Report (JCR) database, from 2022 year onward has started presenting the Journal Impact Factor (JIF) with one decimal place, rather than three.

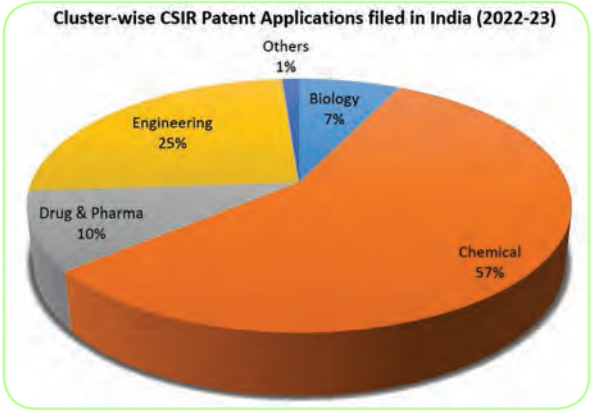
Excellence in Intellectual Property

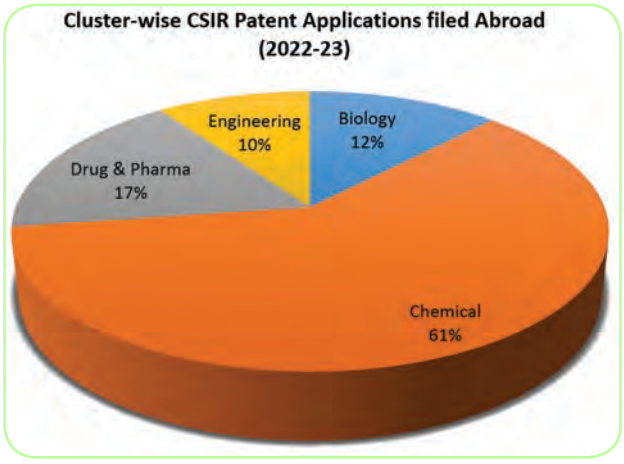
During 2022-23, CSIR has filed 213 Patent applications abroad (121 Unique Patents) and 250 Unique Patents applications in India and it has been granted 99 Patents abroad (70 Unique Patents) and 225 Unique Patents in India.









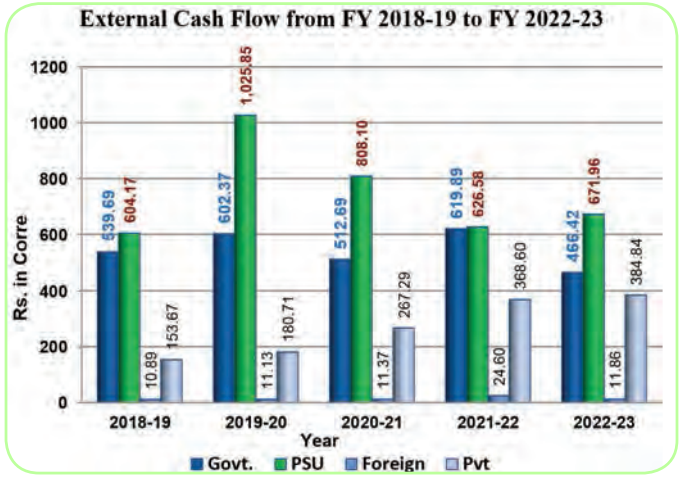


CSIR's Copyright Filing

CSIR filed 74 Copyright applications during 2022-23. The copyright applications filed by CSIR subsist in different categories such as literary work (54%), software (43%) and artistic work (3%).

Value Generation through External Cash Flow (ECF)

CSIR's External Cash Flow stood at Rs. 1535.08 Crore during 2022-23. Following graph provide data on ECF generated over the last five years:



Theme-wise Significant S&T Contributions

4.0 Theme-wise Significant S&T Contributions

CSIR Theme Directorates

CSIR's "Thematic approach" to harness multidisciplinary talent and infrastructure for solving specific challenges in identified sectors, is an initiative 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. Eight CSIR Theme Directorates have been formed with participation of various CSIR laboratories from different clusters with an aim to perform complementary research for the benefit of the society. The eight Theme Directorates are:

- Aerospace, Electronics and Instrumentation & Strategic Sectors (AEISS)
- Agri, Nutrition and Biotech (ANB)
- Chemical (including leather) and Petrochemicals (CLP)
- Civil Infrastructure & Engineering (CIE)
- Ecology, Environment, Earth & Ocean Sciences and Water (E3OW)
- Energy (Conventional & Non-Conventional) and Energy Devices (EED)
- Healthcare (HTC)
- Mining, Minerals, Metals and Materials (4M)

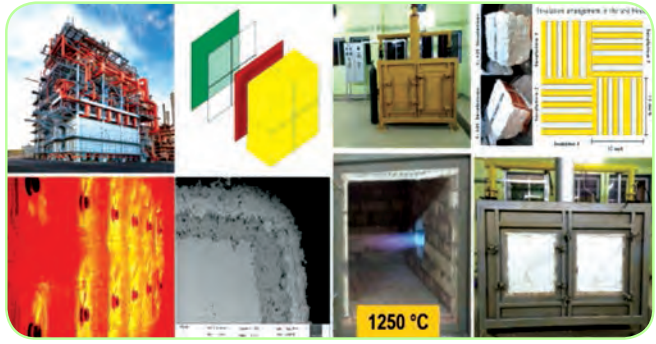
The Theme Directorates are envisaged to provide greater alignment to and for enhancing industrial/ stakeholder focus of CSIR R&D activities. The roadmap and activities of each theme would focus at substantial contributions towards each of the parameters - public good, private good, strategic good and societal good.

CSIR Theme Directorates

Theme AEISS: Aerospace, Electronics and Instrumentation & Strategic Sectors

Development of Thermal Barrier Coatings for Casing Material of Box Furnace

CSIR-CECRI has developed a facility for testing the performance of thermal barrier coatings at 1200° C. The developed coatings demonstrated adequate performance. These coatings can be used in aerospace, oil and gas sectors.



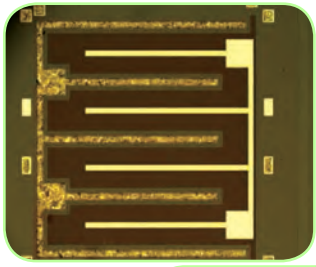
Leathergrade System for Quality Inspection of Finished Leathers

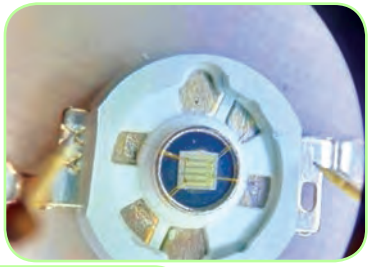
CSIR-CEERI and CSIR-CLRI developed Leathergrade System is a seamless method to grade finished leather based on the identified defects using the state-of-art Artificial Intelligence and Machine-Vision technologies. The software is user friendly and customizable for industrial flexibility. The multiple parameters of leather such as defects, colour, area and grade of the leather can be found using Leathergrade System for enhanced productivity. The Leathergrade System was launched at CSIR-CEERI, Chennai Centre on October 20th, 2022.

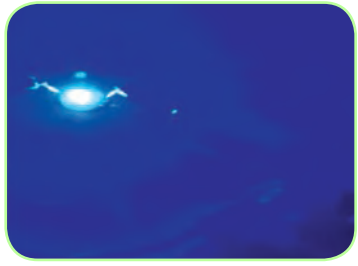
Development of Fabrication Techology of Blue LEDs

The GaN based blue LEDs are widely used for various application such decorative, dispaly, solid-state lighting application, etc. CSIR-CEERI has developed and sucessfully demonstrated the fabrication techology of blue LEDs. The blue LED chips have been designed with

chip size of ~1mmx1mm and emission wavelength in the range of 450-460 nm with an output power of ~55 mW @ 100 mA current.







Development of IR source for Gas Sensing Applications

In several environmental monitoring systems, sensing of harmful gases like carbon monoxide (CO) and carbon dioxide (CO_2) are required. CSIR-CEERI has fabricated, packaged and characterized Low Temperature Co-fired Ceramics (LTCC) based thick film IR source for CO_2 and CO gas sensing applications. Spectra of the developed IR source was in the range of 2.5 to 14 micron, which is suitable for the gas sensing applications.

Hansa-NG

CSIR-NAL has designed and developed Hansa-NG (New Generation) aircraft which is an all composite two seat light trainer aircraft to be used as an ab-initio flying training aircraft for the flying clubs in India. The Hansa-NG is a modified version of CSIR-NAL's Hansa-3 aircraft, to make it more useful as a trainer aircraft. Hansa-NG satisfies the requirements of flying clubs for obtaining PPL (Personal Pilot License) & CPL (Commercial Pilot License). The Hansa-NG was displayed & flight demonstrated in Wings India-2022, Hyderabad. Aircraft was well appreciated by the user community and CSIR-NAL received Letter of Intent (LOI) for procurement of 110+ aircrafts.

High Altitude Platform (HAP)

CSIR-NAL has taken up the development of High Altitude Platforms (HAP) for applications like broadband communication, surveillance, earth observation, climate research etc. HAP is a solar powered unmanned aircraft envisaged to operate at the stratosphere regime, i.e. approximately 20 km altitude, and with maximum endurance so that it can emulate a perpetual flight. The launcher design and fabrication of the sub-scale prototype flight has been completed. First TV-1 airframe structure has been completed and has been used for structural analysis and power system tests. TV-2 for Captive Carry tests has also been completed.

Unmanned Aerial Vehicle (UAV)

CSIR-NAL has been working on design and development of Vertical-take-off-and-landing (VTOL) Unmanned Aerial Vehicle (UAV) to carry 100 kg electromagnetic

system for geophysical exploration studies. Drone based Electromagnetic and Magnetic System (DREAM) Mission project was initiated to develop indigenous electromagnetic sensor suit & integrate with bought out Drone for geophysical exploration studies. In the project, electromagnetic sensor suit was successfully developed (jointly by CSIR labs - NGRI, CEERI, CSIO & NAL). Magnetic sensor (~5 Kg) was procured and integrated with CSIR-NAL developed drone and successfully conducted field trials at Leh, Chumathang & Puga valley. CSIR-NAL has carried out preliminary design activities towards development of the required UAV using an on-board generator.

Visual Landing Aids for Naval Operations

Night Vision Goggles (NVG) compatible LED lights for Helo Deck Visual Landing Aid System on Indian Navy Ships has been designed and developed by CSIR-CSIO. The technology has been transferred to M/s Elcome Integrated Systems Pvt. Ltd., Mumbai for further production.

Time Dissemination via Network Time Display

The directive of the Indian Computer Emergency Response Team (CERT-In), Govt. of India require all service providers, data centres, and Government organisations to connect to the Network Time Protocol (NTP) Server of CSIR-NPL for synchronisation of all their Information and Communications Technology (ICT) systems clocks. CSIR-NPL performed study to analyse the performance of Network Displays within CSIR-NPL campus.

Broadband Rydberg Atom based Quantum Sensor

Electromagnetically Induced Transparency (EIT) concept has been established at CSIR-NPL, which is capable to measure E-Field from 1 MHz to 50 GHz in terms of Rydberg atom energy levels. The developed sensor is frequency independent and directly traceable to universal Planck constant. E- Field Sensitivity upto 1 mV/cm/Hz has been achieved. The picture depicts Rydberg Atom based Quantum Sensor developed at CSIR-NPL.

Theme ANB: Agri, Nutrition & Biotech

Characterization of Nutraceutically Important Metabolites from *Ulva lactuca* and Development of Functional Food Products

Seaweeds are rich in fiber, protein, vitamins and other bioactives, which have shown to have positive effect on human health. CSIR-CFTRI carried out *in vivo* toxicological studies on safety of the seaweed *Ulva lactuca,* to characterize the nutritional and nutraceutical profile and develop functional products based on the seaweed. Acute and sub-acute toxicity studies revealed that *Ulva lactuca* was safe for consumption. Five food products (flakes, powder, burger patty, pasta, rusk) based on *Ulva* were developed and shelf-life studies were performed.

Non-Digestible Carbohydrates as Functional Mimics of Human Milk Oligosaccharides.

The existing infant formulae lack human milk oligosaccharides (HMOs), which are small but complex carbohydrate structures that shape and modulate the gut microbiota during infancy. CSIR-CFTRI has identified *Bifidobacterium infantis, B. breve,* and *B. bifidum* as the most abundant bacterial species, through a 16S rRNA metagenomic study on infant fecal samples. Rigorous screening of various polysaccharides has enabled to identify crucial oligosaccharides that confer a competitive advantage for the growth of *B. infantis* and *B. bifidum,* relative to *B. adolescentis.* Studies have been performed to identify oligosaccharides which can contribute to the growth and proliferation of the two bifidobacteria species.

Seaweed Mission

India has 7516.6 kilometres of coastline, consisting of nine maritime states and two union territories. It harbours 4 million fishermen in 3288 fishing villages of 70 coastal districts. The last few decades have witnessed resource degradation, poverty and marginalisation in the fisheries sector. By considering 193,834 km² of territorial waters (up to 12 nautical

miles) accessible to artisanal fishermen; prospects of taking up seaweed farming at pan India level are eminent. The country is fast emerging as one of the important seaweed production centres in Southeast Asia for *K. alvarezii* production with estimated 765 thousand man-days of employment, having annual turnover of around ₹ 2 billion.

The CSIR's seaweed mission implemented by CSIR-CSMCRI aims to extend the commercial cultivation for diversification of livelihood and assured income in coastal rural settings, where locations are conducive for undertaking seaweed farming. CSIR-CSMCRI surveyed 82 sites (Andaman: 16; Maharashtra: 15 sites; Goa: 13 sites; Karnataka: 21 and Kerala: 17 sites) to identify the

potential sites for undertaking seaweed farming and determined the growth rate and recorded the physio-chemical parameters at each location. Based on the prefeasibility data collected, 34 sites were selected for seaweed cultivation (Andaman: 4; Maharashtra: 12; Goa: 3 - 4; Karnataka: 5 and Kerala: 10). As per the convention, 15 sites, with Daily Growth Rate (DGR) ≥ 3%; were found to be suitable for undertaking commercial farming.

Genetic Improvement of High Value Medicinal Plants *Inula racemosa* and *Picrorhiza kurroa*

Genetic improvement of high value medicinal plants *Inula racemosa* and *Picrorhiza kurroa* was undertaken by CSIR-IHBT by assessing genetic variations among germplasm lines and undertake selections for genetic improvement of targeted plant species.

With the main intervention to layout multi-location trials of *Inula racemosa*, trials were laid out in randomized block design involving three replications at four locations Ribling, Shansha, Janjheli and Palampur and involving ten breeding lines which were identified through progeny selection approach. One of the selections, CSIR-IHBT-IR-09, performed consistently better than the check (population mean) for root biomass and this selection was also rich in active metabolites (dehydrocostus lactone, isoalantolactone and alantolactone). Quantification of marker compounds in breeding lines in multi-location trials was done and lines IR-09 and IR-07 were found most promising across locations. Regarding Isolation and characterization of chemical markers, lead molecules and industrially important compounds, the process for enriched extracts was standardized using roots of *Inula racemosa* with forty percent purity (40% hexane: ethyl acetate by column chromatography) from the roots of *Inula racemosa*.

For *Picrorhiza kurroa,* layout of multi-location trials were laid out using clonal lines in randomized block design involving three replications at four locations Ribling, Shansha, Salgraon and Palampur and involving six clonal lines which were identified through progeny selection approach. One of the selections, CSIR-IHBT-PK-03, performed consistently better than the check (population mean) for root biomass and this selection was also rich in active metabolites (Picroside-I and Picroside-II). Quantification of marker compounds in breeding lines in multi-location trials was done and lines PK-03 and PK-05 were found most promising across locations. The process for enriched extracts was standardized using stolons of *Picrorhiza kurroa* for the enrichment of Picroside-I and Picroside-II with sixty percent purity (30-40% methanol: chloroform by column chromatography).

Selection of *Inula racemosa* (Pushkarmool) has a potential of 8.2 ton/ha yield of dry root biomass, rich in Dehydrocostus lacone (7.092 mg/g), Isoalantolactone (32.694 mg/g) and Alantolactone (26.37 mg/g).

Selection of *Picrorhiza kurroa* (Karoo) has potential of 7.2 q/ha yield of dry root biomass, root extracts are

Selection IR-09 of *Inula racemose*

Clonal selection PK-03 of *Picrorhiza kurroa*

rich in Picroside-I (9.63%), Picroside-II (1.825%) and Picroside-III (0.322%).

High Resolution NextGen Remote Sensing for Medicinal, Aromatic and Commercially Important Crops

CSIR-IHBT provided an approach for rapid and onsite identification of the medicinal plants in the field using hyperspectral remote sensing techniques. The green (555-598 nm), red (605 nm), and NIR (725-840 nm) wavelength regions were identified suitable for discrimination of threatened medicinal plants such as *Saussurea costus*, *Valeriana jatamansi*, and *Picrorhiza kurroa* using random forest classifier. Identification of medicinal plants in the field requires taxonomic skills, which is one of the major bottlenecks in the conservation and management of these plants.

Introduction, Characterization and Cultivation of *Ferula assa-foetida* (Heeng) in cold desert regions of Indian Himalayas

CSIR-IHBT introduced sixty-six (66) accessions of *Ferula assa-foetida* (Heeng) from Iran and Afghanistan in the country through the ICAR-National Bureau of Plant Genetic Resources (ICAR-NBPGR), New Delhi. The institute also standardized seed germination of *Ferula assa-foetida* by overcoming seed dormancy and established Heeng germplasm Resource Centre at CSIR-IHBT, Palampur. A total of 47052 plants have been distributed to the farmers in Himachal Pradesh, Ladakh and J&K and covered over 7.06 ha area under Heeng cultivation. The characterisation of different accessions of Heeng on the basis of morphological parameters and molecular markers have been perfomed along with the biochemical characterization of leaf and root samples *of Ferula assa-foetida* accessions. The picture shows the Heeng germplasm Resource Centre at CSIR-IHBT, Palampur.

Fermentation Strategies for Scale-up Production and Validation of Fermented Turmeric in Coupling with Purification Process and its Healthcare Applications

CSIR-IIIM developed a method for producing fermented turmeric which increases the content and bioavailability of curcuminoid, which is an active ingredient of turmeric, compared to turmeric extract, and removes the peculiar bitter taste and smell of turmeric through fermentation of turmeric using specific lactic acid bacteria, microbial consortium from medicinal plant and probiotics yeast. By increasing the bioavailability, a method for producing fermented turmeric that can effectively inhibit/prevent various allergic diseases and increase its effect even when ingested in the same amount as general turmeric extract, is developed.

Field Trial for Early Maturity of Cotton using Anacardic Acid Formulation

CSIR-NBRI conducted field trials to obtain data of Anacardic acid for early maturity stage in cotton. Three years field trials data confirmed 10% increase in cotton yield. The toxicity test of Anacardic acid is in progress at CSIR-IITR.

Preparation of Certified Reference Material of Important Phytomolecules

CSIR-NBRI prepared four aromatic reference materials – Geraniol, Eugenol, Methyl Chavicol, and (+) Limonene. Homogeneity, characterization and assignment of property value have been completed. Log term stability study is under progress. Application for NABL accreditation of the Institute as Refrence Material Producer based on the requirements of ISO 17034-2016 has been submitted for the four aromatic reference materials. Adequacy audit has been completed.

CRISPR/Cas9-mediated Mutation in XSP10 and SlSAMT Genes Impart Genetic Tolerance to Fusarium Wilt Disease of Tomato

In a study conducted by CSIR-NEIST, the dual-gene CRISPR-edited lines of XSP10 and SlSAMT genes conferred a strong phenotypic tolerance to Fusarium wilt disease.

The reverse genetic studies in transient and stable lines of tomato (*Solanum lycopersicum L.*) revealed that, XSP10 and SlSAMT function together as negative regulators in conferring genetic tolerance to Fusarium wilt disease.

Valorisation of Fishery Waste for Development of Biofertiliser, Biorefinery, Biofeed & Recovery of Biopolymers

CSIR-NIO has developed protein rich fish silage (organic acid and biological) for floriculture, horticulture and aquaculture applications. The CSIR-NIO's technology for "Process of making Bio-Fertilizer from fishery waste fish silage" has been transferred to M/s. Oceanic Paints Pvt. Ltd. The comparative assessment of fish silage as organic fertilizer vis-à-vis control have shown that the Fish Biofertiliser could be effectively used as a growth promoter for chilli and brinjal plants. Extraction, characterization and processing of collagen and anti-oxidant activity of collagen from fishery waste has been standardised. The work minimises pollution and odor problem associated with fish waste generated in the marine and inland fish processing plants as well as domestic fish markets of India. Minimizing the impact of excessive organic loading on the environment, i.e., near to zero waste emission, thereby preventing the untoward effects associated with it. It can also create employment in fish processing industries and fishing communities.

Theme CLP: Chemicals (including leather) and Petrochemicals

Development of Sustainable Leather Alternatives for Animal and Synthetic Leather

CSIR-NIIST has developed an affordable technology to produce an alternative to conventional leather materials with leather like properties using agricultural wastes, reducing the environmental issues associated with agriculture waste. The technology has been transferred to Streekaya Pvt. Ltd.

Drop in Liquid Sustainable Aviation and Automotive Fuels (Biojet Fuels)

CSIR-IIP developed DILSAAFTM (Drop in Liquid Sustainable Aviation and Automotive Fuels) process is a single reactor Hydroprocessing of Esters and Fatty Acids (HEFA) process, similar to the two-step HEFA process, except that the product contains aromatics at levels close to the specification requirements. The fuel has been demonstrated on a single civilian aircraft flight (Bombardier Q400 Turboprop) at 25%, blending with Jet A1 and multiple military transport plane sorties totaling over 50 hours (Antonov AN-32) at 10% bio-jet blending with Jet A1. CSIR-IIP has supplied 8700 liters of the developed fuel to Indian Air Force.

Silicon Mission

CSIR-CSMCRI is the nodal for the Silicon Mission sub-vertical that aims to support silicon industry in the country. The objective of the Mission is to develop & deploy cost competitive technological solutions of the silicon industry and efficient utilization of indigenous resources towards the self-reliance. The Mission also aims towards establishing an IP generation, and technology transfer and Start-ups to enrich Indian silicon industry.

Process Development for Production of 4-alkyl Resorcinol Compounds for Healthcare Application and API synthesis

Kilogram scale production of substituted 4-alkyly resorcinol compounds has been performed for their commercial use at CSIR-IHBT. The process is a scalable and low cost process for 4-alkyl resorcinol compounds production as an alternate of existing commercial process to support industry and Make in India initiative.

Hydrogenated Soya PC (95%) from Soya Lecithin Powder

CSIR-IICB has developed a Process for Hydrogenated Soya PC (HSPC, 98%) from Soya Lecithin Powder by Isolating pure PC (≥95%) from Soya Lecithin Powder supplied. The process was developed at 50 g/ batch and process demonstration was conducted.

Process Know-how for Ortho-Chloro Benzonitrile

A catalytic process for the preparation of o-chloro benzonitrile by vapour phase ammoxidation of o-chloro toluene was developed at CSIR-IICB at a batch scale of 100 g along with providing the design of the reactor. Reaction was demonstrated at 10 g catalyst scale with a minimum of 75% conversion and above 98% selectivity. Active catalyst preparation at 100 g batch with know-how details was demonstrated.

Theme CIE: Civil Infrastructure & Engineering

Development of Fiber Bragg Grating Long Gauge Sensors

Gratings in different types of optical fibers using femto-second laser were developed by CSIR-CGCRI for application. Structural analysis for SHM and FEM on test building has been done using procured sensors. The fabricated sensors will be evaluated on the test building.

Structural Health Index for Prioritization of Flexible Road Network, for Planning of Maintenance and Rehabilitation needs

The current methods for evaluating the structural health of flexible pavements at the network level have several limitations, including the incomplete utilization of available deflection data and the reliance on challenging-to-obtain inputs. CSIR-CRRI has developed a Pavement Structural Health Index (PSHI) which utilizes the full deflection bowl determined using Falling Weight Deflectometer (FWD). The adoption of PSHI in pavement management systems has the potential to improve decision-making processes, optimize maintenance and rehabilitation strategies, and ultimately enhance the performance and durability of road networks. The objective of the study was to develop Structural Health Index for prioritization of flexible pavement network, for planning of maintenance and rehabilitation needs.

Airfield Pavement Management System

CSIR-CRRI conducted the study sponsored by Airports Authority of India (AAI), for implementation of Airfield Pavement Management System (APMS) for 10 Airports of India using PAVER software. APMS for 10 airports located at Chennai, Rajahmundry, Khajuraho, Gaya, Kolkata, Vadodara, Surat, Gaggal, Imphal and Agartala have been developed to provide specific recommendations to AAI for actions required to maintain the airfield pavement network at an acceptable level of service.

Web-based Road Information System and Road Maintenance Management System

CSIR-CRRI has successfully established web-based Road Information System (RIS) and Road Maintenance Management System (RMMS) for Kerala State PWD roads. The objective was to establish an enhanced and user-friendly web based system for State PWD Roads to ensure that PWD is able to effectively plan and prioritize its road improvement and maintenance works and prepare realistic proposals for budgetary allocations for road maintenance. The major activities conducted by CSIR-CRRI included, providing training to Kerala PWD officials on RMMS, one-time road inventory and pavement condition (functional and structural) survey using Modern Survey Techniques viz. Network Survey Vehicle and Falling Weight Deflectometer for 4000 km of State Highways (SH), technical assistance for procurement of web based RMMS software, analysis using Highway Development and Management Tool (HDM-4) for the identified road network.

Wind Tunnel Investigations on Aero-elastic Model of a RC Chimney for Sagardighi TP Extension Project Phase-III, Unit-5 (1X660 MW)

CSIR-SERC carried out Wind tunnel investigations on a 275 m tall RC chimney in isolated and in interference conditions. Tests were conducted on the 1:250 scale aero-elastic model and model was instrumented with strain gauges at four different locations i.e., at base, at about 0.25 H, 0.5 H and at 0.75 H to measure the bending moment at those locations and instrumented with accelerometers at top to measure tip accelerations. Measurements were carried out for various angles of wind incidences for both shell alone and shell with flue liner cases at different wind speeds in the range of

9.33 m/s to 37.25 m/s under isolated and interference conditions. Based on the detailed analysis of the measured data of all the test cases, the final design bending moment, shear force and design tip deflections were evaluated and provided. The results were very important for the design of the proposed RC chimney. A view of the model of chimney with interfering buildings/ structures in wind tunnel is shown below.

Seismic Evaluation of Self-acting Valve using Shake Table

The seismic characteristics of the self-active valve were evaluated at CSIR-SERC using 5T 2m x 2m traiaxial shake table. The resonant search was carried out using sweep sinusoidal signal with the frequency varying from 1Hz to 50 Hz for a duration of 20 minutes. The resonant frequencies of the valve were identified for all the three translation directions (that is X, Y and Z directions). The DBE and SSE seismic tests were carried out based on the spectrum provided by the clients. The spectrum compatible time histories were generated for design basis earthquake (DBE) and Safe shutdown earthquake (SSE). The target spectrum was found to corroborate well with the achieved spectrum. The seismic tests were carried out for five DBE and one SSE spectrum compatible excitation. During the seismic tests, the values were energized using nitrogen cylinder in order to maintain the pressure inside the valve. The valve was able to withstand the seismic excitation and was found to be in functional condition after the test.

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

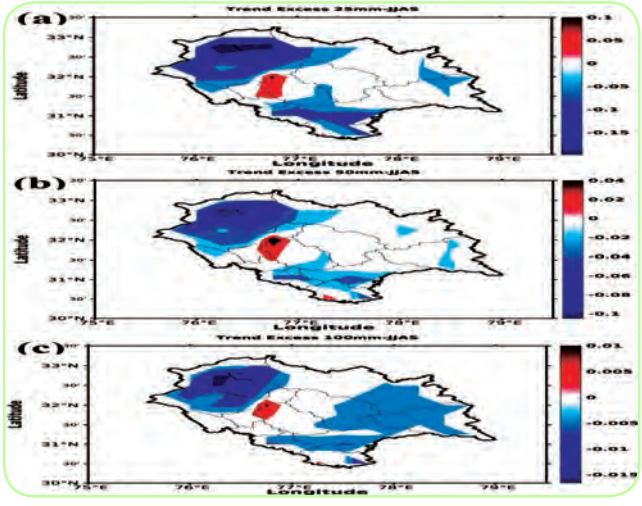
Analytical Methodology for Quantification for Dioxin-like POPs

CSIR-NIIST has developed and validated the analytical methodology using low cost Gas Chromatography-Mass Spectrometry, GC-MS/MS, technique based confirmatory quantification for dioxin-like Persistent Organic Pollutants (POPs) for the first time in the country. The developed NABL accredited (as per ISO/ IEC 17025:2017) method is applicable for analysis of dioxin-like POPs in environmental, food and feed matrices. The test reports issued by CSIR-NIIST are globally acceptable with ILAC-MRA recognition.

The developed method make significant impacts in reducing the cost of analysis from 800 – 1500 USD (~ 1 Lakhs INR) to 300-500 USD and also reduces the time of analysis from one week to 1-2 days.

Extreme Rainfall Event Analysis Over the State of Himachal Pradesh in India

Extreme Rainfall Events (EREs) are very localized and intense events witnessing heavy rainfall resulting in flash floods and landslides in the Himalayan region. The trend of EREs in the state of Himachal Pradesh shows an increasing trend. CSIR-4PI attempted to quantify the climatological feature of EREs in the state of Himachal Pradesh in the western Himalayan mountain region. Multi-source observed datasets for the long-term period, i.e., 1901 to 2020, were considered for the analysis. The climatology analysis indicated that northern and southern parts of Himachal Pradesh receive comparatively more rainfall, and the state witnessed a decreasing trend of the rainfall in the current decade. The classifications of these EREs in terms of monsoon and non-monsoon with a different threshold of daily rainfall are being analyzed, and it is found that almost 90% of extreme events are observed in the monsoon season. The zone centered around 32.5° N and 76.25° E seems to be the hotspot for the frequent EREs in the



mountainous state. The spatial analysis of the ERE trend also indicated that almost 40% of the state witnesses the heavy rainfall throughout the years. This observational study will help in understanding the dynamics of these EREs in the higher altitude regions and can be used for hydro-meteorological disaster management and mitigation. The trend in monsoon rainy days with different thresholds is shown in the figure shown.

3-D Crustal Structure in Kumaon–Garhwal Himalaya using Joint inversion of Receiver Functions and Surface Wave Group Velocity Get access Arrow

CSIR-4PI investigated the 3-D shear velocity structure (Vs) of the crust beneath the Kumaon–Garhwal Himalaya using joint inversion of interpolated receiver functions from 57 seismic stations, and Rayleigh wave group velocity dispersion data in the period 2–100 swith significantly improved horizontal resolution of about 25 km. The velocity image reveals several important features. In the shallow crust, the Main Himalayan Thrust (MHT) is characterized as a flat-ramp-flat structure, inferred from the presence of low Vs of 3.1–3.4 kms−1 representing wet sediments dragged along the MHT and lying above the crystalline Indian crust of Vs ~3.6 kms−1. The MHT is at a depth of about 8 km beneath the southern edge of the Himalaya, dipping at 3º to the North. At the front of the High Himalaya, the dip increases significantly to about 35º −40º representing the ramp and reaching a depth of 24 km. Farther North beneath the High Himalaya, the MHT continues as a nearly flat structure. The middle crust (20–30 km) has reduced Vs (3.3–3.5 kms−1) below the northern part of the Lesser Himalaya, possibly due to the presence of fluid released by metamorphism of the subducting Indian crust along with the presence of mica produced as a consequence of deformation. The thickness of the crust is ~50 km beneath the sub and Lesser Himalaya and increases abruptly in the front of the High Himalaya to 60 km and remains so till the southern part of Tethys Himalaya. The observed thick crust with lower seismic velocity (and rigidity) beneath the High Himalaya could be responsible for its high topography. CSIR-4PI reported almost 6–8 km thinning of the crust in the eastern segment of Garhwal Himalaya adjoining Nepal.

Diesel Particulate Matter Monitoring

The usage of diesel-operated engines in coal mines in India has increased in the last few decades. As a result, the involuntary exposure of coal miners to Diesel Particulate Matter (DPM) and gases is an important reason for coal miners developing a number of lung diseases. Exposure to DPM is high-risk factor in developing cardiopulmonary and lung cancer mortality. CSIR-NEERI conducted a study to assess exposure to diesel smoke by testing 1-NP metabolites in urine and their relation with lung function. The study area included an active open-cast coal mine near Nagpur. DPM monitoring in workplace air was carried out using the ultrafine sampler (SKC-Leland Legacy). Seven days of sampling were conducted for 8 hr. duration. 1-nitropyrene and other PAHs were identified by GC-MS. Biomonitoring was carried out for cross-sectional evaluation of the association of DPM exposure to specific biomarkers. Health survey was also carried out among the miners to record primary health complaints and other demographic, and socio-economical characteristics. The locations of Open Cast Mine and DPM monitoring station at the mine are shown in the pictures below.

Restoration of Crude Oil Contaminated Environment using Bioremediation Technology

CSIR-NEIST has developed a bioremediation technology to restore the crude oil contaminated sites using microbial and phytoremediation approaches. The technology has been implemented for various clients like, OIL India Limited, ONGC etc. It has helped in restoring

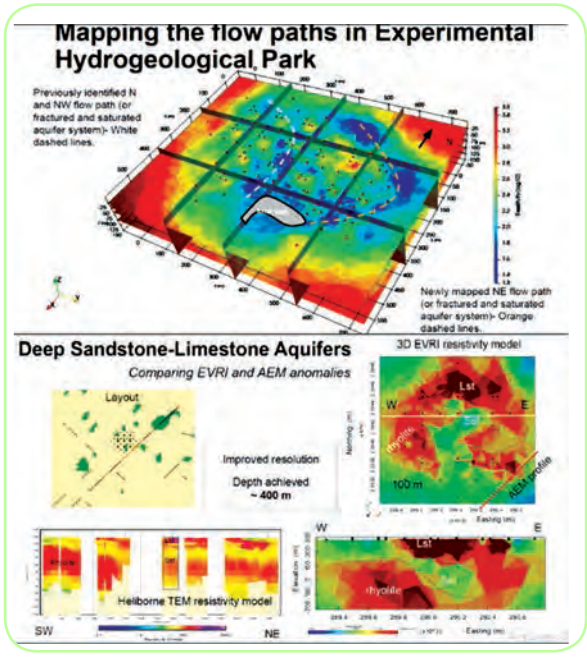
more than 27 ha of land along with development of forest cover having more than 1.0 Lakh plantations with high biomass production for carbon sequestration purpose. Recent pictures from bioremediated sites (1) Talap and (2) Philobari, Dibrugarh, Assam) of OIL, Duliajan, are shown below.

1

2

EVRI: A Novel method for 3D Subsurface Mapping

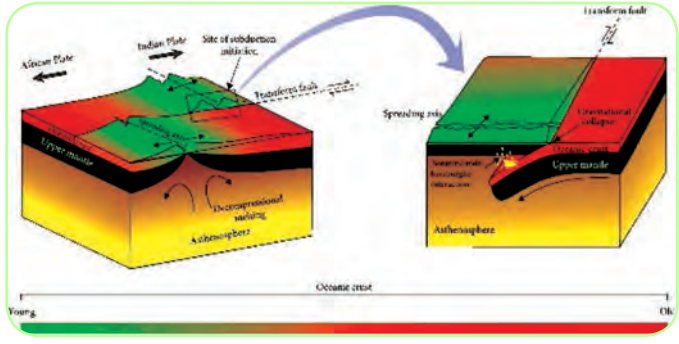
CSIR-NGRI has developed Electric-field Vector Resistivity Imaging (EVRI) survey design layout for arbitrary geometries. The Institute has successfully deployed and tested the EVRI instrument (both in 2D and 3D) for Arid mega project funded/sponsored by Ministry of Jal Shakti and CGWB where heliborne data was missing either with noise condition or in urban context. Also it provides the improved depth of investigation (~400 m) in 2D as compared to other near surface geophysics tools, which is comparable to heliborne geophysical data. In urban context, EVRI tool has been tested for near surface investigations at highly urbanised Joshimath region and provided a subsurface image of upto ~100 m depth. The technology can be utilized for deep mineral exploration and other resources mapping. In urban context, this tool may also fill the data gap for near surface exploration activities where other methods are quite noisy and so have bad data quality issues.



Tectonic and Magmatic Processes along the Slow-spreading Mid-oceanic Ridges and Subduction Zone in the Indian Ocean

CSIR–NIO launched the multi-disciplinary programme on Tectonic and Magmatic Processes along the Slow-spreading Mid-oceanic Ridges and Subduction Zone in the Indian Ocean, mainly to understand the morphotectonics, and locating hydrothermal vents on the slow-spreading Carlsberg and Central Indian ridges, and to understand the structure and tectonics of the Andaman-Nicobar Subduction Zone, forearc and backarc basins. To address these objectives, high-resolution multibeam bathymetry, gravity, magnetic, sub-bottom profiler and physical oceanographic data along with water and sediment samples were collected at selected locations, through five scientific expeditions.

The geophysical data based on the physical tracers identified in the water column, supported by very high magnetic susceptibility and metal content based on the



sedimentological analyses, and increased load of Mn oxidizing bacteria with high bacterial viability based on the microbiological analyses, potential sites of present / past hydrothermal activities have been located. Petrological and geochemical studies of fracture zone mantle peridotites revealed their refertilization through boninitic melts generated during flux melting in response to spontaneous subduction initiation beneath Central Indian Ridge. Geochronological studies of Central Indian Ridge gabbros suggests presence of xenocrystic zircons (2525 Ma-173 Ma) corroborating preservation of continental crust and multiple stages of recycling concurrent with the Gondwana assembly and dispersal. The marine geophysical investigations conducted in the Andaman Sea resulted in the discovery of prominent gas flares and chemosynthetic communities over the cratered seamount, off Nicobar region, and revised age of opening for the Andaman Backarc Basin.

Theme EED: Energy (Conventional & Non-Conventional) and Energy Devices (EED)

Energy Production from Renewable Sources

Programs for energy production from renewable sources have been adopted to mitigate anthropogenic-induced climate change, to address the possible future exhaustion of fossil fuel supplies, and to ensure national energy security. To exploit the full potential of the renewable energy, the installations need to be built even further out in the sea. With the aim to identify potential hybrid renewable energy farming sites, CSIR-NIO conducted study Gujarat coast and identified sites for wind and wave energy harvesting. The Institute also carried out extreme value analysis of offshore winds & waves at the potential site and evaluated the hydrodynamic performance of a floating wave energy converter.

Battery-Supercapacitor Hybrid

CSIR-CECRI has developed a process for supercapacitor electrode grade carbon as a substitute to carbon import for supercapacitor device. The technology Know-how on (i) Value added high surface area Carbon for the fabrication of Supercapacitors and (ii) Process for the fabrication of 2.7 V, 100 F cylindrical supercapacitors was transferred to M/s Qmax Ion (P) Ltd, Chennai on May 6th, 2022. CSIR-CECRI team, in partnership with M/s Qmax Ion (P) Ltd, Chennai, has developed a battery-supercapcitor hybrid device to meet the high power and energy demand by the electric vehicles. Generally, the life of the battery is diminished due to the high power demand by the electric vehicles during starting-running when overloaded. The developed supercapcitor-battery hybrid will increase the battery life as the high current demand will be managed by the supercapcitor. As a proof of concept, the battery-supercapcitor hybrid device was demonstrated in e-rickshaw.

Development of Ultrathin Paper-based Ceramic Separator

CSIR-CGCRI has developed ultrathin paper based ceramic separator, which has been scaled up for application in Li/Na ion batteries. The Institute successfully synthesised LLZO based solid state electrolyte as fast ion conducting electrolyte for all solid slytate Li-ion battery application.

Anaerobic Gas lift Reactor (AGR) Technology for the generation of biogas and biomanure from organic waste

An MoU has been signed between CSIR-IICT and M/s Ellision Oil Field Services Private Limited (ESPL), Ahmedabad, for the installation of biogas plant acrosss India for the capapcity below 250 kg/day.

Metrological Characterization of Multi-Vendor Phasor Measurement Units

CSIR-NPL metrologically characterized Phasor Measurement Units from different manufacturers as per IEC/IEEE 60255-118-1:2018 standard for their effective implementation in the Indian Power Grid for effective monitoring, protection and control of the grid.

Theme HTC: Healthcare

Ras Binding Peptides as Selective Inhibitors of mTOR Signaling Complex-2

CSIR-CDRI has been focused on discovery of small synthetic peptides exhibiting strong Ras binding ability. The peptides are designed from the Ras binding domain of mSIN1 responsible for binding to Ras for specific up-regulation mTOR complex-2. The synthetic Ras binding peptides has ability to perturb binding of activated Ras with endogenous mSIN1 as a result of competitive binding. These novel Ras binding peptides are stable to proteases and able to penetrate into the cell as demonstrated using FITC tagged peptide in cell culture assay. These Ras binding peptide have demonstrated a unique property of arresting cell invasion and cell migration that mediates distal metastasis suggesting that these novel molecules abrogate metastases. These peptides have shown capability to significantly abrogate distal metastases by intra-tumor administration in syngenic, orthotopic mouse model of TNBC. Thus this invention provides novel Ras binding peptides as first-in-class mTOR complex-2 inhibitors which significantly control metastases in animal model.

Design and Development of Brain Targeted Biomimetic Delivery System

CSIR-CDRI envisage to develop a biomimetic delivery system to target brain that could alter the permeability of BBB due to its endogenous origin and selectively target the site of action owing to its homing ability. CDRI sheathed the donepezil (DNP) loaded Mesoporous Silica Nanoparticle (MSN) with exosome. Exosomes have been successfully harvested from isolated primary astrocytes, cultured in-house from C57/BL6 pups and sheathed around DNP loaded MSN of less than 100 nm optimized using QbD (Quality by Design) approach. Release of DNP from DNP_MSN-ADE and DNP_MSN was found escalated at acidic pH and sustained for 120 hours in comparison to free DNP solution. Furthermore, the hemolytic damage due to silica and DNP was deterred with developed biomimetic drug delivery system.

Pharmacokinetic Studies of Withanone

Withanone (WN) is an active constituent of *Withania somnifera* (Ashwagandha) that has remarkable pharmacological responses along with neurological activities. However, for better understanding of the pharmacokinetic and pharmacodynamic behavior of WN, a comprehensive *in-vitro* ADME (absorption, distribution, metabolism, and excretion) studies are necessary. A precise, accurate, and sensitive reverse-phase ultra-performance liquid chromatographic method of WN was developed by CSIR-CDRI and validated in rat plasma for the first time. The developed method was successfully applied to the in-vitro ADME investigation of WN. The passive permeability of WN was assayed using PAMPA plates and the Plasma Protein Binding (PPB) was performed using the equilibrium dialysis method. Pooled liver microsomes of rat (RLM) and human (HLM) were used for the microsomal stability, CYP phenotyping, and inhibition studies. CYP phenotyping was evaluated using the specific inhibitors. CYP inhibition study was performed using specific probe substrates along with WN or specific inhibitors. WN was found to be stable in the simulated gastric and intestinal environment and has a high passive permeability at pH 4.0 and 7.0 in PAMPA assay. The *in vitro* results of pH-dependent stability, plasma stability, permeability, PPB, blood partitioning, microsomal stability, CYP phenotyping, and CYP inhibition studies demonstrated that WN could be a better phytochemical for neurological disorders.

Development of Bioactive Ceramic Fillers Reinforced High Performance Polymer based Osteoconductive Spinal Cage Implant

CSIR-CGCRI has developed an indigenous process technology for designing and manufacturing bioactive ceramics reinforced osteoconductive high performance polymers composites based interbody spinal cages implant. A spinal cage implant prototype fabricated using in-house 3D printer was demonstrated for potential application in spinal interbody fusion surgery.

Automatic Segmentation of Brain Regions

CSIR-IICB has performed automatic segmentation of relevant regions of brain [e.g., Corpus Callosum (CC)] and calculated its two-dimensional (2D) and three-dimensional (3D) features to feed into a multivariate pattern analysis using different statistical machine learning techniques. Marked reduction in thickness and length of the CC was observed in demented subjects. The classification results using large patients' cohort showed CC atrophy based features are capable of distinguishing healthy and mild/moderate AD patients. The classifiers obtained more than 90% sensitivity and specificity in differentiating demented patients from healthy cohorts and importantly, achieved more than 90% sensitivity and >80% specificity in detecting mild AD patients. The Institute created a unified platform integrating our image analysis algorithms and machine learning protocols to detect AD from brain MRI slices. This online platform named, CCADD (Corpus Callosum based Alzheimer's Disease Detection) is capable of providing a likelihood of AD status for a given MRI data uploaded by the users.

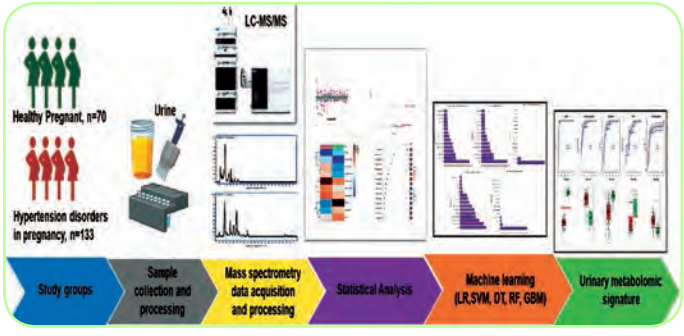
Development of Indole based Fluorescence Probes

Indole-based fluorescence probes have gained increasing attention for their applications in organelle-specific live cell imaging due to its bioavailability and low toxicity. These probes are designed to target specific organelles such as the Lipid Droplets, Ribosomal RNA in nucleolus, and Endoplasmic Reticulum (ER), for organelle-specific imaging. After synthesis, the probes are evaluated for their photophysical properties, including fluorescence quantum yield, excitation, and emission spectra, and photostability. In addition, the probes are tested for their cytotoxicity and cell permeability, which are critical for their applications in live cell imaging.

CSIR-IICB has developed various Indole based fluorescence probes by fine tuning the substitutions at electron rich indole moiety by attaching suitable π conjugation and electron with drawing groups. A number of indole based organic fluorophores have been synthesized and explored for fluorescence microscopic applications, which help to measure not only the morphological states of organelles but also the cellular physiological responses. Overall, the synthesized probes showed a wide range of biological studies, including monitoring Lipid Metabolism process using LipiK510, tracking the local environment of nucleolus by specific binding of the probe with rRNA in neurodegenerative disease, wash free souper resolution ER imaging for monitoring ER stress using SGAG-07-058 in live cells. These biological processes are required to be studied in real time using florescence bio-probes for early diagnosis of the pathological conditions and for developing new therapeutics for a range of diseases.

Integrated Metabolomics and Machine Learning approach to Predict Hypertensive Disorders of Pregnancy

Hypertensive disorders of pregnancy account for 3% to 10% of maternal-fetal morbidity and mortality worldwide. CSIR-IICB Conducted study to discover hypertensive disorders of pregnancy–specific candidate urine metabolites as markers for hypertensive disorders of pregnancy by applying integrated metabolomics and machine learning approaches. Among all metabolites, adenosine and thiamine metabolites were found to differentiate participants with hypertensive disorders of pregnancy from participants with healthy pregnancies; hence, these metabolites can serve as a promising noninvasive marker for the detection of hypertensive disorders of pregnancy.



Trans dermal Patches using BC Membranes

Bacterial Cellulose (BC), is a highly pure cellulose (devoid of hemicelluloses and lignin) produced by bacteria. The unique physical and mechanical properties of BC, arising from its tridimensional and branched nano and micro-fibrillar structure, as well as biocompatibility triggered the interest to produce BC membranes that can be used for drug loading and controlled release by making Trans dermal patches. Mupirocin impregnated membranes were prepared at CSIR-IIIM for antibacterial activity and *in-vitro* drug release study. Skin irritation test of the drug impregnated BC membrane was carried out in animal model. *In vivo* efficacy of cellulose membranes

impregnated with mupirocin was determined against *S. aureus* MRSA 15187 by using a dermal mouse model which resulted in 2.5 log reduction. Pharmacokinetic study for mupirocin impregnated BC membrane is detectable in plasma, therefore, mupirocin was released from the patches to the application site.

Evaluation of Phototoxicity of different Xenobiotics such as Cosmetics/Drugs and Environmental Pollutants

Few chemicals that are present in cosmetics/drugs and environmental pollutants have ability to absorb UV-R/Visible light and get sensitized and induce phototoxicity. CSIR-IITR explored the sensitizing potential and molecular mechanism of phototoxicity of these chemicals. The identification of biomarkers for phototoxicity can aid in the development of more accurate and reliable methods for assessing the phototoxic potential of different chemicals. This can help in the identification of potential hazards associated with the use of these chemicals, and in the development of more effective safety guidelines for their use. Identification of biomarkers will help the clinicians to detect photosensitive diseases in human beings at early phase and suggest the suitable management of diseases.

Theme 4M: Mining, Minerals, Metals and Materials

Polymer-based Coatings to Improve the Performance of Ballistic Materials

CSIR-CECRI has developed Polymer based Coatings to improvise ballistic material for light weight bullet resistant jacket/vest for better energy absorption, energy distribution and to reduce back face signature. Graphene oxide was synthesized by modified Hummers method and was mixed with cross linked polymers and coated on the surface of para aramid woven fabric.

Optimized Phosphate base Glass under Microwave Heating

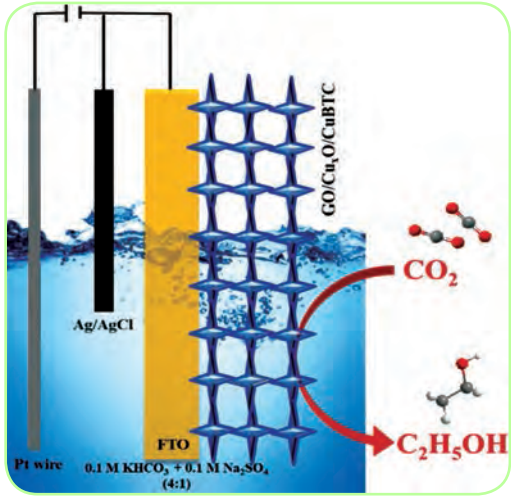
Optimized phosphate base glass with Fe doping has been melted in air, inert and reducing atmosphere in the microwave heating and compared with conventional glass prepared in air. Glass has been developed by CSIR-CGCRI with satisfactory parameters.

Development of Graphene-Based Materials as Booster Dose Additives to Fully Formulated Engine Oil for Enhancement of Lubrication Properties

Energy efficiency and environment are of paramount importance to reduce the fuel consumption and subsidize the negative impact of energy/fuel spending on our eco-system. Indian automotive industry is one of the largest in the world with an annual production of 23.96 million vehicles (FY: 2015–16) and it accounts for 7.1% of the India's GDP. Therefore, it has great impact on fuel consumption. CSIR-IIP developed graphene-based materials as booster dose additives to fully formulated engine oils for reduction of friction and wear, which can eventually improve the fuel efficiency and extent the life of engine components.

Design and Development of Nanostructured Hybrid Materials comprising a Semiconductor Light Harvester and Molecular Complex for Photo-Electrochemical Reduction of CO_2 to Methanol

CSIR-IIP has developed an efficient Polymer based Coatings (PEC) reduction system for conversion of CO_2 to ethanol selectively by using a photocathode consisting of a ternary composite of CuxO/GO with a copper-based metal organic framework (Cu-MOF). The maximum ethanol yield was found to be 162 uM cm-2 after 4h at -0.5 V vs Ag/AgCl. The better charge separation, higher mobility and density of photogenerated charge carriers on the interface of nanocomposite led to the higher availability of photo-electrons for CO_2 reduction that is further confirmed by the DFT studies. Furthermore,

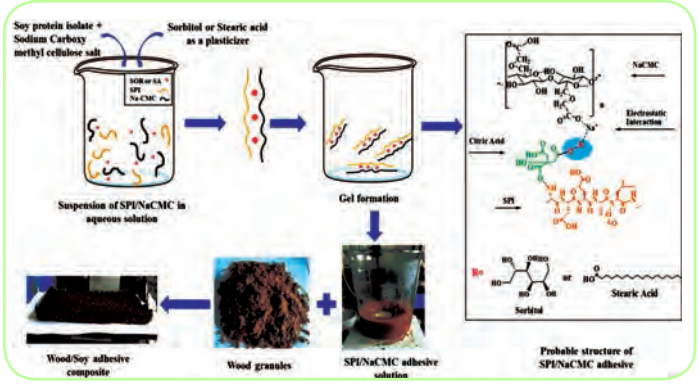


DFT calculations suggested the binding of CO_2 over GO/CuxO/Cu-BTC surface via Copper atom through the vertical orientation that brought the CO_2 molecules closer to the composite and therefore is considered as most favorable adsorption configuration. The figure schematically represents PEC Reduction of CO_2 to Ethanol using Ternary Composite GO/CuxO/Cu-BTC.

High-performance Soy Protein Isolate based Adhesive and its application as a Binder in Waste Wood Granules Bio-composite

In recent years, bio-based polymers have been highly studied for adhesive application in the wood and plywood industry. The non-toxicity and water-soluble eco-friendly based materials on biopolymers have great interest to researchers, engineers & material scientists as they have benefits in keeping the environment safe. CSIR-NEIST carried out study to observe the high-adhesion performance of soy protein adhesive in an aqueous solution prepared by using Soy Protein Isolate (SPI) and sodium carboxymethyl cellulose (NaCMC) composition in the presence of citric acid cross-linker. Different plasticizers (Sorbitol, Stearic acid) were compared for various SPI/CMC composite ratios (90/10, 80/20 in weight) to study their performance in the adhesion activity.

The results showed that gel formation time decreases with the addition of stearic acid compared to sorbitol. In addition, water solubility decreased for stearic acid-containing adhesive compared to sorbitol-



containing adhesive. Later, SPI/CMC composite gel was mixed with waste wood granules to investigate the mechanical strength of the adhesive material. The composite with the 8:2 ratio of SPI/CMC showed better mechanical strength compared to the composite with the 9:1 ratio. In the presence of sorbitol or stearic acid, bending strength and young modulus decreases and bending strain increases compared to non-modified SPI/CMC composite.

Corrosion Behavior of Different Rail Steels in Varied Environments

The rail steels are often seen to be susceptible to three types of corrosion namely atmospheric, microbial and stray current corrosion which result in reduced service life and premature replacement of rails. CSIR-NML performed a study to evaluate the comparative corrosion performance comprehensively through standardized test exposures in weathering, saline and microbial environments of six different rail steels developed by SAIL, India. Six different grades of rail steels were evaluated for their relative corrosion performance in 5% NaCl foggy environment through salt spray chamber at temp 35 ± 1°C. The time to first rust (yellowish) spot appearance was recorded around 65 min, 50 min, 45 min, 60 min, 70 min and 60 min for NCC, Cu-Mo, 1080Cr, 705, 699 and 90UTS steels, respectively. The corrosion rate trends (in ascending order) were found to be as Cu-Mo < 1080Cr < NCC < 705 < 699 < 90UTS.

This investigation can facilitate the Indian Railways to select appropriate rail grade for application in corrosion prone sections based on severity of atmospheric exposure and microbial corrosion.

Multi Component Zr-based Biocompatible Alloys for Biomedical Application

CSIR-NML has developed novel alloys based on the Zr-Ca-Si-Ti-Fe system for biomaterial application with modulus ≤ 50 GPa and density ~2.8 gm/cm3, closer to that of bone. Five compositions of ZrTiFe alloy of 450 grams have been prepared. Biological test and toxicity test of ZrTiFe alloys have been performed. The figure below shows the fabricated ZrTi based dental implants and the design of the dental implant.

Development of Advanced Giant Magneto-Impedance (GMI) based Sensor for Structural Health Monitoring of Engineering Structure with Enhanced Area Coverage

Magneto-impedance sensors are gaining ground in industrial applications due to enhanced sensitivity and portability of the device. These sensors typically contain amorphous / nanostructured soft magnetic microwires as the sensing element. CSIR-NML initiated work for developing a Giant Magneto-impedance based array sensor for detection of carburization in austenitic steels / components used in petrochemical refinery units. Based on CSIR-NML's laboratory experimentation and technical inputs, a device was fabricated and coined as "MagRays". The sensor element used in the MagRays comprises of a nanostructured material in the form of microwire prepared using CSIR-NML's in-water quenching facility. In the developed device an array of such sensor microwires have been used for large area coverage. Device showed satisfactory performance during laboratory tests on service exposed petrochemical refinery unit component (Johnson screens) and on defective weld.

Contributions to Government of India Missions

5.0 Contributions to Government of India Missions

Skill India Mission

CSIR Integrated Skill Initiative Programme Phase-II (2020-25)

CSIR has been contributing significantly to the progress of scientific and technological developments in the country through its "CSIR Integrated Skill Initiative". CSIR labs are engaged in conducting industry oriented training/skilling programmes.

Several CSIR laboratories are conducting National Skill Development Corporation (NSDC) accredited courses and many of them are connected with Sectoral Skill Councils (SSC) like Leather, Life Sciences, Agriculture, Capital Goods, Automotive, Paint & Coating and Aerospace & Aviation. During the year, 622 skilling/reskilling programmes have been conducted and a 17226 personnel have been trained across all CSIR labs.

CSIR-CDRI offered seven certificate courses under the CSIR-CDRI Skill Development Program. These courses provide an opportunity for skill development and hands-on experience in the area of healthcare and life science. During the year, 62 aspirants from more than 45 colleges of different part of country participated in the programs. Candidates were trained for durations ranging from four months to a year depending upon the recommendations from their Institutes. During the period, 191 post graduate students from more than 100 colleges of different parts of country received training. CSIR-CDRI also provided different kinds of training of short duration in various disciplines against payment to six aspirants. The training comprised both lectures and practicals by experienced scientists with emphasis on practical R&D aspects in a particular domain.

Under the category of training for scholarship awardees, candidates getting scholarships/selected/nominated from some of the prestigious institutions of India are provided training. The training comprises of both lectures and practical by the scientists and technical staff. The scholarship includes, (i) Indian Academy of Sciences, INSA-IASc-NASI Summer Research Fellowship, (ii) INSPIRE Fellowship, (iii) UPCST Fellowship and (iv) AcSIR - Dr. APJ Abdul Kalam Summer Training Program. During the period, eleven of aspirants received training.

CSIR-CECRI has conducted the following skill development trainings and refresher courses during the period:

Title	Duration	No. of participants
Industrial Wastewater Treatment Technologies	4-8 April, 2022	233
Surface Coatings for Value Added Products: Decorative and Functional Applications	9-13 May, 2022	66
Basics of High-resolution Imaging Techniques and their Applications to Science and Technology	4-8 July, 2022	33
Operation and Maintenance of Analytical Instrument	18–22 July, 2022	52
Surface Analytical Techniques	1-5 August, 2022	37
Biosensor: Design and Applications	12-16 September, 2022	31
Up-Skilling training workshop on "Emerging Solar Energy Technologies: Fundamentals to Device Fabrication"	15-19 September, 2022	52
Chromatography and Thermal Analysis	19-23 September, 2022	38
Photolithography Based Micro-fabrication of Sensors	19-23 September, 2022	31
Foundation Course on Solar Energy Materials - Fundamentals to Device Fabrication	10–14 October, 2022	43
Corrosion protection technologies for construction of buildings and structures	17–21 October, 2022	23
		(Contd.)

DST- SERB Sponsored - ABHYAAS Program Kaaryashaala (High-End Workshop) through Accelerate Vigyan on "Advanced Materials for Energy Conversion and Storage"	27th June, 2022 till 2nd July, 2022	25 (from 6 States of India)
DST- SERB Sponsored - ABHYAAS Program Vritika (Skill Internship) through Accelerate Vigyan on "Training for Expertise in Fabrication and Testing of Photoelectrochemical Device for Hydrogen Production"	27th June, 2022 till 27th July, 2022	5 (from 3 States of India)
Two-week International Special Refresher training programme for the staff of PRODA, Nigeria on "International Special Practical Hands-on Training on Lithium Ion Battery Manufacturing: The R & D Perspective"	25th July, 2022 till 5th August, 2022	9
DST- SERB Sponsored - Two-day Workshop on "Additive Manufacturing: A Technology of Rapid Customization"	20–21 September, 2022	41

CSIR-CGCRI conducted skill development programmes on "terracotta processing" at CSIR-CGCRI, Khurja Centre and at two different locations of West Bengal. Aim of this training programme was to provide necessary skills to the artisans to inculcate the basic understanding of raw materials, process, quality awareness towards achieving modern terracotta products. In these programmes various aspects of terracotta processing were discussed and hands on training on raw material processing, mould making, slip casting, glaze application. terracotta jewelery making etc was provided. Another skill development programme on "Physical Testing of Refractory Materials as per IS Standard" was conducted at CSIR-CGCRI, Kolkata and CGCRI, Naroda Centre, Gujarat.

Different test procedures for refractory materials as per Indian Standard were demonstrated and discussed. A total number of 108 artisans and 32 students/industry people/entrepreneur were trained.

During the period, CSIR-CRRI conducted various training programmes and around 550 participants got benefitted. A few of the training programmes conducted were:

- The Ministry of Road Transport and Highways (MoRTH) approved 15-day Certification Course on "Road Safety Audit and Other Road Safety Related Aspects".
- Five days regular training program on “Design of Bridge Structures & Foundation”.
- Three days customized training program on “Maintenance of Rural Roads – Road Asset Management and Budgeting” which was attended by participants nominated / sponsored by National Rural Infrastructure Development Agency (NRIDA), Govt. of India.
- Nine-day regular training program on “International Course on Dissemination of Highway Development and Maintenance Model, HDM-4”.

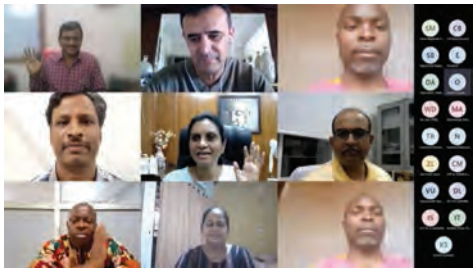
- Five days long customized training program organized on "Design, Construction and Quality Control of Flexible and Rigid Pavements" which was attended by participants nominated / sponsored by NRIDA, Govt. of India.

As a part of CSIR Integrated Skill Initiative, CSIR-IIIM, is offering several skill development courses for diploma holders, graduates, people from industries in various disciplines of Biological and Chemical sciences. Basic knowledge generation, hands on experience in operation and maintenance of sophisticated equipment are the highlights of the course. The main aim of these courses is to create the high-quality skilled workforce relevant to current and emerging industry need in the S&T sector through training/skilling in diverse areas at different National Skill Qualification Framework (NSQF). It further aims at promoting entrepreneurship through skilling, Training of Trainers and Incubation center.

During the period, CSIR-IICT organized several training and skill development programs. The programs organised by CSIR-IICT are as follows:

Title	Duration	No of Participants
High End Skilling Workshop for Researchers on Application of Tools, Techniques and Databases in IPR Protection and Commercialization	11-22 April, 2022	17
Analytical Skills Development Course (ASDC-2022) sponsored by The Organization for the Prohibition of the Chemical Weapons (OPCW), The Netherlands	25-29 April, 2022	19 (from 18 different countries)
Basic cell and Molecular Biology Laboratory Application Training	21st March, 2022 till 13th May, 2022	
Skill Development Training on "Water Purification & Analysis"	May 2022 and August 2022	--
Basic Certification Course in Bioinformatics and Cheminformatics through online to B.Sc and M.Sc Chemistry Students of B.V. Raju College, Bhimavaram, Andhra Pradesh and from Bhavans College, Secunderabad	30th May, 2022 to 10th June, 2022	69
Modern methods of Chemical Analysis including Spectroscopic & Chromatographic methods of Analysis	1st August, 2022 till 2nd September, 2022	20
Entrepreneur Development Programme on "Accelerated Anaerobic Composting Technology: Concept to Commissioning & Marketing" to Telangana State Agriculture Marketing Department officers	23rd August 2022	35
Analytical Skills Development Course-Global sponsored by The OPCW, The Netherlands	5-16 September, 2022	20 (from 16 countries)
Analytical Skills Development Course-Asia sponsored by the OPCW, The Netherlands	Two-weeks commencing on 10th October, 2022	11 (from 10 Asian countries)
Skill Development Training on "Lab Technician - R&D" during	1-30 November, 2022	14
Skill Development Program on "Animal Cell Culture Techniques" in association with Gujarat State Biotechnology Mission (GSBTM), Gujarat	21st November till 30th December 2022	19
Training of Trainers (ToT) program on "Modern methods of Chemical Analysis including Spectroscopic & Chromatographic methods of Analysis" to the Ninth batch of Central Revenue Control Laboratories (CRCL), Govt. of India, officers	19th December 2022 to 20th January 2023	20
OPCW, The Netherlands, sponsored Two-Week "Analytical Skills Development Course-2022"	Commenced on 16th December 2022	18 (from 15 countries)
Skill Enhancement Training program to 10th Batch (Group A & B) officers from CRCL, Govt. of India, on "Advanced Chromatography and Spectroscopy Techniques"	6th February, 2023 till 10th March, 2023	--

Skill Development Training program on "Water Purification & Water Analysis"	13th February, 2023 to 10th March, 2023	--
Skill Development training program exclusively for women on "Analytical Food Chemistry"	27th February, 2023 till 5th March, 2023	32
Orientation cum Training Programme for the M.Sc Chemistry students from North Eastern States	19th December, 2022 till 18th March, 2023	--



During the year, CSIR-IHBT conducted various Skill Development Programmes as follow:

- Floriculturist-Protected Cultivation Course (02 No.) and Gardener Course (01 No.).
- Three Capacity Building Programmes for UG/ PG/ Ph.D. students of MDU, Rohtak and BHU, Varanasi.
- Three Capacity building programs on bamboos for agriculture officers, artisans and farmers of Himachal Pradesh.
- Training programme for UG students sponsored by Gujarat State Biotechnology Mission.
- Training programmes for UG students of Swami Sarvanand Group of Institutes, Dinanagar, IKGPTU, Kapurthala, Punjab.
- Six hands on training programs in thee batches for different Universities/Colleges students.
- Completed LSSSDC approved two skill courses of (DBT-HIMCOSTE) Quality Control Biologist (QCB) and Lab Technician/Assistant (LT/A) under Skill Vigyan Program.
- Two exposure visit: Farm livelihood community resource persons (Krishi and Pashu Sakhi) and Mahila Kisan.

- Programme on “Entrepreneurship Skill Development on Enzyme Bioprocessing” funded by Ministry of Micro, Small & Medium Enterprises (MSME), Government of India.

CSIR-NGRI has conducted four Skill Initiative trainings under various themes of the institute such as 1. Groundwater Exploration Techniques (GET); 2. Seismology -Theory, Practice and Applications; 3. Groundwater Quality Monitoring and Assessment; 4. Advanced Training Program on Analytical Geochemistry. Under the above four skill training programs 141 participants have successfully imparted skills.

At CSIR-NIO, the Skill Training Course offered to Sagar Mitras & Fisheries Extension Officers in Aquaculture Technologies & Water Quality Management helped the fish farmers in doubling their income.

CSIR-SERC conducted the following programmes during 2022-23:

Workshop on Entrepreneurship Development in Spice Processing

CSIR-CFTRI conducted a Workshop on Entrepreneurship Development in Spice Processing on September 20th, 2022 in hybrid mode. The topics covered in the program were current status and opportunities in spice processing, spice nutraceuticals and trends towards their value addition, analytical methods in spice processing, encapsulation of flavours and colorants, fumigation & infestation control for safe storage of spices, food safety standards & regulation in spice processing etc. A demonstration on processing of spices was also held. 78 participants benefitted from this skill development program.

Title	Duration
Online Advanced Course on "Smart Materials and Intelligent System Designs (SMISD-2022)"	05-06 May, 2022
Online Advanced Course on "Fatigue and Fracture Behaviour of Steel and Concrete Structures and Components (FFBSCSC-2022)"	19-20 May, 2022
Online Advanced Course on "Recent Advances in Concrete Technology & Durability of Concrete Structures (RACT&DCS-2022)"	24-26 August, 2022
Online Advanced Course on Microstructural Characterization Techniques and Mix Design of Special Concretes	14-16 September, 2022
Online Advanced Course on Engineering of Precast Concrete Technology for Mass Housing	22-23 September, 2022
Online Advanced Course on "Recent Advancements in Earthquake Engineering"	16-18 November, 2022
Online Advanced Course on "Quality Control and Assessment of Field Concrete and Rehabilitation of Structures"	24-25 November, 2022
Online Advanced Course on "Advanced Computational Methods for Structural Engineering"	29-30 November, 2022
Online Advanced Course on "Seismic Damage and Mitigation of Structures"	7-9 December, 2022
Online Advanced Course on "Wind Loads and Effects on Structures"	14-16 December, 2022
Online Advanced Course on "Geopolymer Concrete"	2-3 February, 2023
Online Advanced Course on "Fatigue and Fracture Behaviour of Metallic Components"	8-10 February, 2023
Online Advanced Course on "Conductive Green Concrete for Sustainable Infrastructure"	15-16 February, 2023
Online Advanced Course on "Behaviour and Design of Connections in Steel Structures"	15-17 March, 2023
Online Advanced Course on "Structural Health Monitoring of Civil Infrastructure"	30-31 March, 2023
Industry sponsored training programme on "Condition Assessment and Retrofitting of Concrete Structures for Enhancement of Service Life"	7-10 February, 2023
Industry sponsored training programme on "Bridge Health Monitoring, Rehabilitation and Management (BREAM)"	20-24 February, 2023
Five-Day Mason Training Programme	18-22 July, 2022

Workshop on Post-Harvest Technologies for Horticultural Crops

CSIR-CFTRI organised an online workshop on Post-Harvest Technologies for Horticultural Crops on September 30th, 2022. Main topics covered were: Post-harvest technologies for horticultural crops, Post-harvest technologies for extension of shelf life of fruits and vegetables and pack house operation, Post-harvest spoilages, control measures and decontamination methods of fruits and vegetables, Packaging requirements for fresh fruits and vegetables, Minimal processing of fruits and vegetables, Drying and osmotic dehydration of fruits & vegetables, Preservation of fruits and vegetables such as pickles and chutneys, Machineries for processing of fruits & vegetables, Technology transfer protocols for setting up fruit and vegetable processing industry. Fifty-four participants attended the workshop from 16 States.

Specialised Training in Field of Life Sciences

To generate more specialized and highly skilled workforce for life sciences industries, CSIR-IMTech with its expertise in several areas of life sciences that include microbiology, fermentation technology, biochemistry, infectious diseases, Bioinformatics, and structural biology, has been offering Structured Internship Training (6 months long duration). During 2022-23, short-term training courses and online/ offline training/webinars/lectures were conducted at CSIR-IMTech under Skill Development Program. CISR-IMTech is registered as a Training Provider and Training Centre under National Skill Development Corporation (NSDC) and is also accredited for Job Role Laboratory Animal Attendant (AGR/Q4606) from Agriculture Skill Council of India (ASCI).

CSIR-NBRI organized nine skill development programmes viz. Phytochemical Analysis Technician, Bioinoculant Producer for agriculture, Certified course in Advanced Bioinformatics, Improved Composting, Atomic Absorption Spectrophotometer Operation, Bonsai Technique, Home Gardening and Dehydrated Floral Craft Making during 2022-23. A total number of 351 individuals were trained under the programme.

DBT Skill Vigyan Program under Life Sciences Sector Skill Development Council (LSSSDC)

CSIR-NEIST provided training in the DBT Skill Vigyan Program under Life Sciences Sector Skill Development Council (LSSSDC) for three students on the qualification pack of Lab Technician/Assistant.

Training on Entrepreneurship Development

Training on Entrepreneurship Development was conducted at CSIR-NEIST, Itanagar branch Arunachal Pradesh, Under Skill Vigyan Program. The course was offered as per Agriculture Skill Sector of India for a period of six months to four students.

Earthquake Awareness Program

CSIR-NEIST conducted Earthquake Awareness Programme at different schools/colleges of Assam and covered more than 11,000 school children and other school staff.

Course on Precision Measurement and Quality Control (PMQC)

A Diploma certificate course on Precision Measurement and Quality Control (PMQC) was conducted at CSIR-NPL, comprising of lectures and training on precision measurement skill.

World Youth Skills Day 2022

CSIR-SERC and CSIR-CLRI jointly organized the World Youth Skills Day 2022 celebrations on July 15th, 2022. Student participants were invited from three Atal Tinkering Laboratories (ATL) schools in the Chennai region about 100 students and 5 teachers participated the programme.

CSIR Jigyasa ATL workshop and CSIR Jigyasa ATL-STEM Workshop

CSIR Jigyasa ATL workshop has been organized exclusively for the students of the adopted schools in Tiruppur (18-19 Oct. 2022), Tiruvarur (21-22 Nov. 2022), Vellore (7 Feb. 2023) and Namakkal (23-24 Feb. 2023) districts of Tamil Nadu. A team of CSIR-SERC and CSIR Madras Complex scientists visited the schools, delivered lectures on basic science, the latest scientific advancements, hands-on battery experiments, etc., and witnessed the facility created under the ATL program. About 1450 students and 120 teachers from 11 ATL schools participated in the workshop.

As a part of CSIR Jigyasa – Tamil Nadu STEM Initiative (Vanavil Mandram), a one-day student-scientist connect programme "Exploring Science" has been organized by CSIR-SERC on December 5th, 2022, at CSIR Campus, Taramani for the state government school students of Tamil Nadu. Nearly one hundred students and more than fifteen teachers from Kanchipuram, Ranipet, Villupuram, and Kallakkurichi districts schools participated in this event.

Swachh Bharat Mission

Swachhata Pakhwada 2022

CSIR and its Laboratories/Institutes across the Nation observed Swachhata Pakhwada 2022. Some of the highlights are provided below:

CSIR-CDRI organized the Swachhata Pakhwada 2022 during May 1–15, 2022. The institute carried out several activities, including administration of pledge for swachhata, shramdan, cleanliness drive, plantation, sanitation drive, nukkad natak, drawing and painting competition (where more than 60 children participated in the competition), weeding out of records, disposal of obsolete items, etc. During the concluding session, the most active participants of swachhata pakhwada were felicitated.

CSIR-CECRI conducted a cleaning campaign of office premises including all R&D divisions and residential areas. Drawing Competition on the theme "Swachh Bharat" and Essay Competition on the theme "Clean India: Your thought" were conducted for the wards of CECRI staff Director, CSIR-CECRI administered Swachhata Pledge to all the employees of CSIR-CECRI. Sapplings were planted by staff and students in the campus. A special campaign to dispose of obsolete and waste materials was organised.

Swachhata Special Campaign 2.0

CSIR-NIO started the Swachhata Special Campaign 2.0 during October 2-31, 2022. Cleanliness drive was conducted throughout the institute, and thereafter tree plantation by staff and students was organized during the campaign.

Technology for Compost Booster

CSIR-IHBT developed the technology for Compost Booster which is a single solution for stabilization of night soil/kitchen waste containing cold-tolerant efficient hydrolytic bacteria supplemented with plant growth promoters. The technology has been transferred to M/s Amalgam Biotech - A division of Amalgam Engineering Veerbhadra Nagar, Baner, Pune.

Swachh Sagar, Surakshit Sagar/Clean coast safe Sea

CSIR-NIO participated in the coastal cleanliness campaign "*Swachh Sagar, Surakshit Sagar*/Clean coast

safe Sea" organized by Government of Goa in association with the Union Ministry of Earth Sciences, Ministry of Environment, Forest and Climate Change. The beach cleaning drive was inaugurated by the Hon'ble Governor of Goa, Shri P.S. Sreedharan Pillai and the pledge was taken by Hon'ble Chief Minister of Goa, Dr. Pramod Sawant and other Goa government officials on September 17th, 2022 followed by beach cleaning on the occasion of International Coastal Clean Up Day. CSIR-NIO staff participated in the beach cleaning drive at Miramar.

Development of Briquetting Technique for Utilization of Steel Plant Solid Waste

Several iron oxide fines such as Basic Oxygen Furnace (BOF) sludge, Blast Furnace (BF) sludge, Electro Static Precipitator (ESP) dust, sinter returns, BF flue dust, etc. are generated in different units of a steel plant. CSIR-NML aims at utilizing fines in BOF after producing briquettes. Optimizing the process parameters for good-quality briquettes and the mix ratio, suitable binder, and its quantity of addition, etc. cylindrical briquettes are developed in the laboratory, which can provide 280 kg/cm2 cold crushing strength. Further, large-scale production of briquettes of around 50 tons has been carried out. These briquettes have been used for the plant trial in a BOF of 100-ton capacity to assess its performance. The trial has been conducted successfully in SMS 3 of the Bhilai Steel Plant (BSP). Approximately, 2-4 tons per heat has been charged in the 160-180 tons capacity converter by replacing a proportional amount of iron ore/scrap as coolant. A total of around 18 heats were conducted in BSP. The furnace operation was smooth. There was no breaking of briquettes during handling, no excessive fumes generation was observed, and better slag formation with normal final slag chemistry.

Swasth Bharat Mission

IoT enabled, Smartphone Based Colposcope for Cervical Cancer Examination

The technology is an offshoot of projects and expertise at CSIR-CEERI. Such indigenous developments are initiated to support the Start-Ups in product development and manufacturing domains. Know how for "IoT enabled, Smartphone based Colposcope for Cervical Cancer Examination" has been licensed to M/s Divine Meditech Pvt. Ltd., Uttar Pradesh on October 7th, 2022.

Nutrition Intervention of Severely Acute Malnourished

Six months' pilot study for Nutrition Intervention of Severely Acute Malnourished (SAM) children in Mysore was conducted by CSIR-CFTRI during January to July 2022 in collaboration with Spirulina Foundation, Tumkur and Department of Women & Children Development (DWCD), Government of Karnataka. 150 Children from Mysore district were provided with weekly pack of nutritious products developed by CSIR-CFTRI like zinc fortified mango bar, energy and protein rich burfi, high protein rusk and Spirulina chikki. According to the dosage and schedule, the beneficiary children had to consume these supplements in addition to their regular diet to enhance their macro and micronutrient status. Considerable progress was observed after 6 months of serving the food products as more than 80% of the children became healthy and the remaining children moved from SAM to Moderately Acute Malnourished (MAM) category. Similarly, nutritional intervention study was launched for Severely Acute Malnourished (SAM)/Severely Undernourished (SU) children of Para Development Block, Raghunathpur Sub Division, Purulia District, West Bengal for about 155 children. The program was launched for three months (Apr-Jun'22) and as per the preliminary report, very good improvement was found in the health status of the beneficiary children.

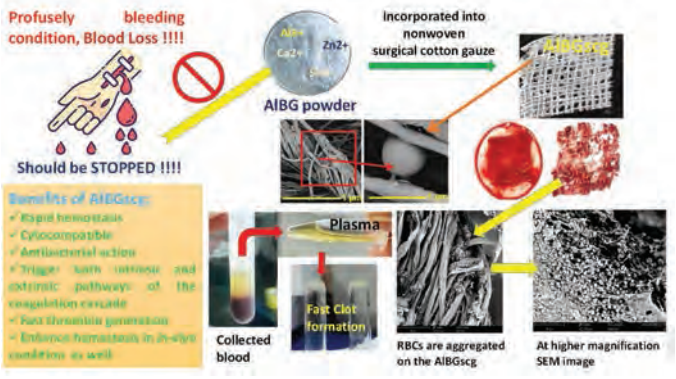
Development of a Biodegradable and Biocompatible Nanoceramics/ Bioactive Glass-Polymer Composite Material with Anti-bacterial Properties

The CSIR-CGCRI fabricated polycaprolactone nanofibers PCL/ZnO-BG films showed good cyto-compatibility and

excellent anti-microbial activity against *S. aureus* and *C. albicans*. However, due to the increased particle size of Bioactive Glass (BG), the PCL/ZnO film exhibited better biodegradation compared to the PCL/ZnO-BG film in soil-water slurry, indicating the potential of using this filler incorporated PCL films as medical textiles.

Mesoporous Antibacterial Bioactive Glass Microsphere Impregnated Non-woven Surgical Cotton Gauze Based Hemostatic Dressing for Profusely Bleeding Military Wounds

As a hemostatic dressing, the AIBG that was made and placed in surgical gauze was studied at CSIR-CGCRI. AIBGscg was found to shorten the time required for clot formation in the study, and because it produces a bulk clot by converting prothrombin into thrombin, its capacity to stick to RBCs was remarkable.



Development of Dialysis Machine for Hemodialysis of CKD Patients

Chronic Kidney Disease (CKD) is a problem of epidemic proportions in India. CSIR-CSIO has developed a prototype of Dialysis Machine for hemodialysis of CKD patients. The lab testing has been done for proper functioning of the machine by running DI water to test for desired flow rates of different flow circuits, sensing and alarm systems, functioning of user interface etc. The machine has indigenously developed blood circuit pump, heparin pump and sensing mechanism for detection of air-bubble, clot, blood leakage etc.

Kinnow (Citrus Reticulata) Peel Extract for Epilepsy and Associated Neurobehavioral Complications

Kinnow peel is rich in a variety of dietary flavonoids, however it is regarded as a bio-waste. CSIR-IHBT aimed to investigate the efficacy of the peel extract in a mouse model of epilepsy. The epileptic animals were administered daily with the extract and challenged with a chemoconvulsant repeatedly. It was observed that the extract treatment showed a marked suppression in the severity of epileptic seizure after 20 days of the extract treatment. Furthermore, the treated epileptic animals also showed improvement in spatial cognitive functions and depression-like behavior. The findings showed that Kinnow peel extract suppresses epileptic seizures and linked cognitive impairments and depression due to its interaction with cAMP Response Element-Binding Protein signaling.

POSHAN Maitree

Protein and iron deficiency anaemia affect almost 50% of children and women in India. CSIR-IHBT has developed several value added food products that are fortified with micronutrients such as protein, iron, zinc and calcium. CSIR-IHBT in collaboration with Directorate of Women and Child Development, Govt. of Himachal Pradesh conducted a nutrition supplementation program called "POSHAN Maitree" for malnourished children, pregnant and lactating women under the aegis of POSHAN Abhiyaan.

CSIR-IHBT in collaboration with Integrated Child Development Services, Distt. Kangra conducted a pilot scale nutrition supplementation study in the Panchrukhi block, tehsil Palampur, Himachal Pradesh. The fortified food products developed by CSIR-IHBT namely Iron and zinc enriched Spirulina based energy bars, Protein and fiber enriched multigrain energy bars and Multigrain protein beverage mixes were supplemented to the beneficiaries comprising Severely Acute Malnourished children (SAM), Moderately Acute Malnourished children (MAM), high risk pregnant and lactating women. A total of 150 nos. of beneficiaries were covered. After 6 months of supplementation, there was a significant improvement in terms of weight gain among malnourished children leading to reduction in the numbers of SAM and MAM children in the block. Further the products were tested for their bio-efficacy in terms of promoting recovery from iron deficient anaemia and general debility in collaboration with Rajiv Gandhi Government Post Graduate Ayurvedic College & Hospital, Paprola, Kangra. Preclinical evaluations indicated that fortified food products were able to promote recovery from acute protein and iron malnutrition. Similarly, clinical evaluations indicated that the fortified food products developed

at CSIR-IHBT promoted hemoglobin recovery, mean corpuscular volume and hemoglobin and reduced serum glutamate pyruvic transaminase and glutamate oxaloacetate transaminase enzyme levels indicating hepatoprotective function and recovery from iron deficient anaemia. Supplementation among beneficiaries improved their health status and resulted in reduction in percentage of SAM and MAM children. The CSIR-IHBT products have been officially approved under Mukhya Mantri Balsuposhan Yojana, an intensive nutrition supplementation program initiated by Govt. of Himachal Pradesh.

POSHAN Abhiyaan
PM's Overarching Scheme for Holistic Nourishment
सही पोषण – देश रोशन

Development of Thermostable Insulin Formulation

CSIR-IICB conducted a collaborative research with Bose Institute, Kolkata under which a series of peptide as insulin excipient was screened for thermo- and storage stability.

Screening and in vivo validation of four amino acid containing 77 small tetrapeptides with potent inhibition of both heat and storage induced insulin fibrillation. Sequence of tetrapeptides based on core sequence (N'V-Y-Y-RC'), each having single amino acid substitution by the rest 19 natural amino acids at a time for each position of a tetrapeptide. Molecular structural basis of peptide-insulin interaction and possible mechanism for thermostability has been determined. Peptides can maintain insulin in the active form without any loss for months, prevent in vivo amyloidoma formation, require no other toxic excipients and is compatible with various commercial insulin preparations. In addition, these are non-toxic, non-immunogenic and heat-stable. Thus a thermostable insulin formulation was prepared for translation.

CSIR-Phytopharmaceuticals Mission

CSIR-IIIM is the Nodal laboratory for pan-CSIR Mission on Phytopharmaceutical Drug Development. The mission project has five CSIR labs working on preclinical development of plant based leads for treatment of various diseases. In this mission, CSIR-IIIM is developing two leads, IIIM-141 and IIIM-64 for treatment of Alzheimer's disease and rheumatoid arthritis, respectively. The institute has completed all IND enabling studies, further, clinical trials are to be conducted.

CSIR-Antiviral Mission

The Antiviral Mission of CSIR is led by CSIR-IICT, and CSIR-IIIM is a participating institute. Under this mission, CSIR-IIIM is working on the medicinal chemistry of few important scaffolds to discover new candidates for drug development. CSIR-IIIM is able to identify new compounds which show *in-vitro* antiviral activity against SARS-CoV-2.

CSIR-IND Mission

The CSIR-IND Mission is led by CSIR-IICT, and CSIR-IIIM is participating in the mission. Under this mission, CSIR-IIIM is working on preclinical/clinical development of two anticancer lead compounds. The GMP manufacturing is ongoing for one of the lead, after which clinical trials will be started. For another lead, preclinical studies are ongoing.

CSIR-Sickle Cell Anemia Mission

The Sickle Cell Anemia Mission of CSIR is led by CSIR-CCMB. and CSIR-IIIM is participating in the mission. CSIR-IIIM is working on medicinal chemistry as well as nutraceutical product development under the Mission. With the help of industry partner, CSIR was able to get DCGI approval for using hydroxyurea in India for Sickle cell anemia. Regarding nutraceuticals, the efficacy and preclinical Tox has been completed.

CSIR-Pan-Cancer Mission

CSIR-CDRI is the Nodal of the CSIR-Pan-Cancer Mission, with CSIR-IIIM as a participating institute. Under this mission, CSIR-IIIM is working on medicinal chemistry for PARP and PI3K targets; and preclinical development of one PI3K inhibitor. The medicinal chemistry efforts has led to identification of new hit compounds against both the drug targets. The efficacy and Absorption,

Distribution, Metabolism, and Excretion (ADME) studies have been completed for one of the preclinical candidate.

Development of CROMA-3

CSIR-NBRI has developed a formulation having enhanced bio-availability and therapeutic effects of curcumin. An edible matrix of turmeric rhizome has been used to prepare a 100% herbal standardized herbal formulation, called as CROMA-3 containing polysaccharides and curcumin through a simple process. CROMA-3 contains more than 10% curcumin in a polysaccharide matrix, which exhibits several advantages, including less toxic, more bio-available and superior medicinal effects such as oxidative stress neutralizing potential, anti-inflammatory and immune boosting activities as compared to curcumin alone. This standardized extract has huge potential for the development of nutraceuticals, functional foods and biopharmaceuticals.

Make in India Mission

Fabrication Technology for GaN based Blue and White LEDs

CSIR-CEERI has developed indigenous fabrication technology of GaN based blue and white LEDs. All the fabrication process steps including photolithography, mesa, transparent conducting layer, n & p-contacts, passivation, wafer thinning, backside reflector, dicing etc. were optimized indigenously. For mesa etching, chlorine chemistry (Cl2 & BCl3) was used to etch GaN. Further, n-contact (Ti/Al/Ni/Au) were deposited on n-GaN to form n-contact. Afterwards, transparent conducting layer of Ni/ITO was evaporated on p-GaN for uniform current spreading. To passivate the device, a low temperature (~ 300 degree centigrade) PECVD SiO_2 layer was deposited. Finally, thick metals (Ti/Au: 30/250 nm) was deposited on n & p-contacts for pad formation for electrical connections. Further, wafer was thinned to ~ 150 µm and chips were separated using mechanical dicing. Chips were packaged and characterized. Different LED products like LED bulb (5 W), LED string (42 in series) were developed and demonstrated.

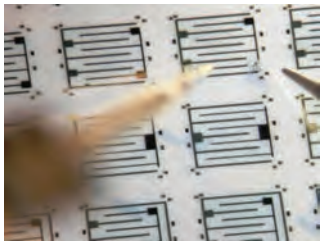
Portable EM Radiation Power Meter

With the advent of connected devices, IoT, personal and wireless communication devices, larger EM/RF radiation exposure in the environment is foreseen. This necessitates development of portable and low-cost RF intensity measurement system to quantitively access the level of cumulative Electromagnetic/RF radiation intensity at a particular location. Prototype of a low cost RF intensity measurement system has been developed at CSIR-CEERI. A broadband antenna, RF to DC converter and corresponding read-out circuit have been developed. The circuit consists of an RF to DC conversion module (LTC5508 logarithmic amplifier) to convert the incident RF radiation to a DC voltage level. The output voltage is converted to its digital equivalent using ADS1115 and the corresponding power level is displayed on the LCD panel.

Mobile Food Processing and Demonstration Unit

CSIR-CFTRI has developed a Mobile Food Processing and Demonstration Unit. The advantages of Unit are - on-site demonstration of food processing technologies to farmers; create awareness about the advantages of food processing, particularly during excess production, and encourage them to take up value addition at farm-level, by converting into semi-finished or finished






products; the unit is primarily designed for processing tomato to convert it in to products like puree, ketchup, sauce, juice, paste, chutney, dehydrated slice, slices in pouch, tomato-onion chutney, curry etc.; it can also be used for other food processing operations & the unit is versatile to have commodity based (mango, orange, potato, onion etc.) processing lines to operate in different locations and also throughout the year.

Pothole Repair Machine

CSIR-CRRI has indigenously developed a compact and low cost Pothole Repair Machine which uses bitumen emulsion based cold mix technology. The machine is self-propelled and self-contained (including cleaning of pothole and compaction of mix after placing it in the pothole).

Development of Antireflective and Self-Cleaning Coatings on Solar Cover Glass

CSIR-CGCRI has developed Antireflective and self-cleaning coatings on solar cover glass with enhanced power output for silicon based solar panels and devices.

Development of GaN Based UV-C LED

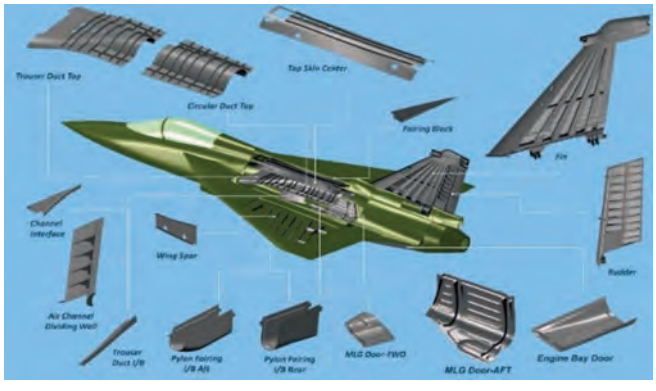
CSIR-CEERI has demonstrated first indigenous designed and fabricated UV-C (wavelength - 275±10 nm) LED chips at wafer level. Chip size is 1.0 mm x 1.0 mm.

Preparation of 1,2,3,4-tetrahydroquinoline using Organocatalytic Transfer Hydrogenation

Quinoline based compounds are well recognized for their medicinal importance and the respective substituted compounds has great potential in the market. This low volume high price compound and the associated substituted compounds are expected to play great role in pharmaceutical market. CSIR-CSMCRI has developed a metal-free catalyst derived from non-specialty chemicals for the transfer hydrogenation of quinoline under mild reaction conditions. The developed catalytic protocol replaces hydrogen gas (conventional approach) with an organic hydride source and achieved good conversion and selectivity toward the desired product.

Composite Parts Developed for LCA-Tejas

CSIR-NAL has developed many critical technologies for the Light Combat Aircraft (LCA) – Tejas and continues to support this major national Programme. The laboratory has played a pivotal role in the development of the composite parts for LCA-Tejas which include Fin & Rudder, Wing Spars, Wing Fuselage Fairings, Fairings blocks, Centre Fuselage parts & Under carriage doors. The innovative technologies developed by CSIR-NAL not only reduces the cost but also improves the structural efficiency by minimizing the number of mechanical joints. The innovations have resulted in more than 20% savings in cost and 25% reduction in weight of the LCA-Tejas.

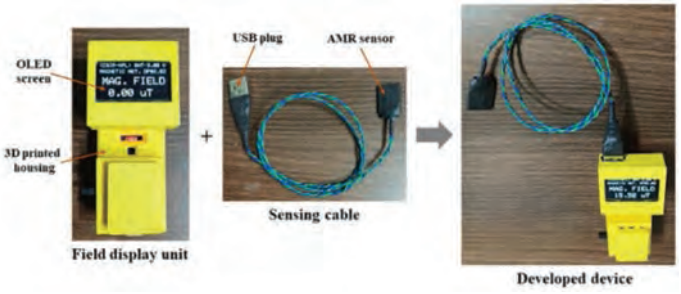


CSIR-NAL has a tie-up with Tata Advanced Systems Ltd. (formerly TAML), for supply of critical components for the series production of LCA. Supply of critical components has been completed for first batch of 20 aircrafts (SP1-20) to IOC standard in 2019 and supply of components to FOC standard is under progress for

the batch of 20 aircrafts (SP 21–40). The entire Quality assurance support for the above programs has been provided by CSIR-NAL.

Pocket Sensor for Weak Magnetic Field Sensing

A highly sensitive low-cost, small-sized device for measuring weak magnetic field in the range of ±800 μT with a permissible accuracy of less than 2% has been developed and calibrated by generating standard values



of magnetic field using Helmholtz coil at CSIR-NPL. The performance parameters associated with the device such as accuracy, linearity, repeatability, and hysteresis has also been determined. Further, the device has been compared with fluxgate magnetometer in reading weak magnetic fields. The device has significant applications in aviation, space, data handling & storage, geological surveys, and healthcare sectors. The device can also be used as a reference standard in calibration/testing laboratories.

Development of Certified Reference Compounds from Plants

CSIR-NBRI has developed about nine certified reference compounds obtained from plants. Out of which five have been transferred to M/s Aashvi Technology LLP, Ahmedabad. CSIR-NBRI has made Certified Reference Materials (CRM) for testing of essential oils for their purity. Several CRM compounds are being used in a variety of health-enhancing products, cosmetics, beverages.

Sashakt Bharat Mission

Structural Safety Audit and Suggestions for Strengthening Measures for the 2-Bridges under Yamuna Hydel Scheme

CSIR-CRRI conducted the Structural Safety Audit and provided suggestions for strengthening measures for the 2-Bridges under Yamuna Hydel Scheme in District Dehradun (bridges along Dakpathar Barrage and head regulator of the barrage) in Uttarakhand.

Effective Utilization of Middlings of Coking Coal Washery for Recovery of Carbon Values

Coking coal is a scarce commodity in India. The demand of coking coal in steel sector is increasing day by day due to the expansion of existing steel plants and addition of Greenfield projects in the country. CSIR-NML worked on addressing the characterization of middling and fine coal samples from coking coal washeries, explore the possibility of recovering the washed coal at about 18%-19% ash from middlings of coking coal washeries by wet and dry process, and to develop process flowsheet for producing a product with 18% ash for enhancing the carbon recovery and reduction of surface moisture of washed products. Two coking coal washeries have been identified to collect the middling samples to carry out the study. From the study it was possible to achieve a product with 18-19% ash from 42-45% middling samples by reducing the top size of 13mm to -1mm using spiral concentrator.

Destructive Test/Analysis for Establishing Life Estimation Matrix (LEM) of VKD Boiler Tubes

Indian Navy (IN) operates several ships powered by boiler units. As part of regular maintenance efforts for marine boilers, IN needed destructive testing and analysis of test results for the sake of establishing life estimation matrix for boiler tubes. Accordingly, for the project sponsored by the Central Boiler Inspection Unit (CBIU), Western Naval Command, Indian Navy (IN), Mumbai, CSIR-NML carried out tests for mechanical properties of tensile strength, hardness, stress rupture strength along with microstructural conditions. Boiler tubes in the initial and service-exposed conditions were evaluated. Obtained results were used to establish the life estimation matrix in the initial and service exposed stages.

Metallurgical Investigation to Explore the Damage Mechanism of Worn Out Quill Shaft

The Quill shaft of the main fuel Pump of the aero-engine, was worn out during service exposure.

CSIR-NML carried out studies to identify the root cause of material damage, based on the specimen received for investigation. Macro observation revealed that the load-bearing surface of the teeth of the quill shaft i.e., on the gear-box side, was damaged. The bulk chemical composition of the virgin and damaged components exhibited deviation in carbide forming elements i.e., Chromium and Tungsten with respect to the specification. The bulk hardness of the virgin and damaged components were close to each other. The microstructure of the components was tempered martensite containing discrete carbides at the lath boundary. Degradation of microstructure at the core was absent for the damaged component. The cross-sectional structural investigation showed extensive thinning of the teeth. Formation of layered deformed zone and plastic flow of material along the direction of rotation was evident. Surface examination of the damaged teeth (gear-box side) illustrated material flow lines, deformed zone along the surface of the teeth, overlapping of material near edges, and fragmentation of the material.

The investigation confirmed that the damage of gear tooth material occurred under excessive torsional load. The deformation of the gear teeth material gradually thinned down the tooth alloy and caused extensive material flow near tooth edge. During service under excessive torsional stress, the material was fragmented. Excessive stress beyond the tolerance limit may either have generated from improper lubrication or due to mechanical misalignment.

Development of Sensor for In-situ Structural Health Monitoring of Engineering Components Exposed to High Temperature and Stress

This module addressed the development of non-destructive techniques for the advanced manufacturing processes like laser and hybrid laser weld quality assessment of Nickle-based super alloy. Hybrid laser-arc welding of nickel-base alloys can increase productivity and decrease costs during construction and repair of critical components in nuclear power plants. The keyhole formed under high laser intensity gives the hybrid welding technique the greater penetration depths compared to arc welding. To assess the quality of welds phased array ultrasonic and ultrasonic imaging were used to measure the level of porosity in terms of their size and locations of the pores inside the weld through proper signal analysis.

Jal Jeevan Mission

Affordable IoT-enabled Water Service Delivery Measurement and Monitoring Sensing System for Rural Deployment

The Ministry of Jal Shakti launched the Jal Jeevan Mission (JJM), "*Har Ghar Jal*", to connect each household with functional taps and supply regular drinking water of prescribed quality at the rate of a minimum of 55 litre per capita per day (LPCD). The mission aims to measure water quality and quantity parameters of drinking water to help ensure service delivery to households. It also seeks to reduce physical and commercial losses in the water distribution system and improve the recovery of water charges.

CSIR in collaboration with National Jal Jeevan Mission (NJJM) launched a program to provide cutting-edge research & innovations with an interdisciplinary/ transdisciplinary approach. It intends to develop affordable indigenous technologies, including Sensors, IoT end-nodes & Gateways, Cloud & Analytics, and Dashboards, to provide threat analytics, forecasting, and use of machine intelligence for optimising and decision support systems for operation and maintenance of water resources, provides assured and long-term availability of water quality and quantity and service delivery monitoring.

The project executed at CSIR-CSIO aimed to deliver several research and innovations, including indigenous IoT architecture, Data Integration and deployment of ETL Layer,

Uniform Standards and protocols for hardware and IoT, onsite and automatic calibration methodology, indigenous RISK-PiNET software for operation and maintenance of water distribution system. An integrated and indigenous SMART water management system (Sensor-nodes, Gateways, Cloud & Analytics, and Dashboard-visualization) for service delivery measurement and monitoring (quality, quantity and regularity) was developed. The figure below shows CSIR-CSIO'S IoT Field Test Bed Pilot for Jal Jeevan Mission.

Start-up India Mission

Incubation facilities at CSIR-IHBT

CSIR-IHBT has signed the following agreements under "CM Startup Scheme" for incubation facility at CSIR-IHBT under which the Institute will act as a mentor to nurture the idea of the Start-up:

Agreement signed with Ms. Seema Kumari, VPO Banuri, Tehsil Palampur, Distt. Kangra, for Value addition of flowers through dehydration technology. Under the mentorship of CSIR-IHBT, the Start-up will work to make value added products of flowers through dehydration technology.

Agreement signed with Ms. Shikha Kalsi, Village-Bani, Post office-Bani, Tah. Barsar, Distt. Hamirpur, for Hydroponic cultivation of Nardostachys jatamansi. The Start-up will work for the Hydroponic cultivation of *Nardostachys jatamansi.*

Agreement signed with Ms. Yamini Sharma, V.P.O Purana Bazar Tehsil Sundernagar District Mandi for development of Plant based digestive stimulant for human gut health. The Start-up will work for the development of Plant based digestive stimulant for human gut health.

Agreement signed with Mr. Ranjiv Singh VPO Raja Ka Bagh, Tehsil Nurpur, Distt. Kangra, for Hydroponic farming of *Bacopa monnieri* and *Rauvolfia serpentine.* The Start-up will produce Hydroponic high-value medicinal plants (*Bacopa monnieri* and *Rauvolfia serpentine*).

Agreement signed with Mr. Suveer Singh, Sanyard, Tehsil Sadar Mandi, Distt. Mandi, for Hydroponic production of high-value vegetables (Kale, cherry tomato and lettuce etc.). The Start-up will produce Hydroponic high-value vegetables (Kale, cherry tomato and lettuce etc.).

Inauguration of BioNEST Bio-incubation Centre

CSIR-IIIM, Jammu has setup the Department of Biotechnology (DBT) sponsored BioNEST Bio-incubation Centre. The Centre was inaugurated by the Hon'ble Minister of S&T, Dr. Jitendra Singh in April 2022. The incubator will provide nationwide opportunities to local entrepreneurs of Jammu & Kashmir to avail the services and facilities provided by CSIR-IIIM, Jammu & Biotechnology Industry Research Assistance Council (BIRAC) through their established networks.

Inauguration of North India's First Biotech Park at Ghatti, Kathua district

CSIR-IIIM Jammu, has been playing an instrumental role in setting up the Biotech parks in UT of J&K, along with the support from DBT and Department of Science & Technology, Govt of Jammu & Kashmir (JKDST). The North India's first biotech park was inaugurated by the Hon'ble Minister of S&T, Dr. Jitendra Singh, in May 2022.

"Start-up Expo" at Jammu, as part of *Azadi Ka Amrit Mahotsav*

The mega event on Start-Up Expo, first of its kind in Jammu, was inaugurated by the Hon'ble Minister of S&T, Dr. Jitendra Singh on September 30th, 2022. The

two-day event attracted huge crowd of entrepreneurs, investors, industry leaders, scientists, researchers, bio-incubators, manufacturers, regulators and members of civil society on the second day.

Co-organised "Kashmir Expo Start-ups for Livelihood", as part of *Azadi Ka Amrit Mahotsav*

The three-day 'Kashmir Expo Start-ups for Livelihood' was co-oransied by CSIR-IIIM, Jammu along with the DST, New Delhi, during November 2022. The event was inaugurated by the Hon'ble Minister of S&T, Dr. Jitendra Singh. Innovators in various fields displayed their products, technologies and services. About 55 Start-ups from across India participated in the expo organized at Sher-i-Kashmir International Conference Centre (SKICC).

Namami Gange Mission

Ground Water Quality Assessment of Major River Basins of Uttar Pradesh

In collaboration with Ground Water Department (GWD), Uttar Pradesh, CSIR-IITR performed the pre- and post-monsoon analysis of ground water quality in major river basins namely: Hindon, Ghaghara, Central Ganga, Ramganga and Yamuna basin of Uttar Pradesh, with the objectives of collection of ground water samples from sites specified by GWD followed by analysis of the physiochemical parameters, metals and bacteriological parameters. Common parameters that were detected beyond acceptable limits in all the basins included physico-chemical parameters: Nitrate, Fluoride; metals: Calcium, Iron, Lead, Cadmium and Manganese and bacteriological parameters: Coliforms.

The data was interpreted using different indices such as Water Quality Index (WQI), Heavy metal Pollution Index (HPI) and Wilcox to determine its suitability for usage and consumption. The strenuous exercise generated real-time ground water quality data in the geo-tagged locations and helped in developing awareness among the concerned authorities to abandon the use of hand pumps and wells at locations where the water quality was not up to the mark for domestic usage by the public.

Analytical Study on Ganga Water

CSIR-NEERI carried out analytical and interdisciplinary project to provide the scientific rationale to understand bacteriophage and microbial population diversity, purifying properties of the Ganga and disease predictions. This study concluded that the concentration of Dissolved Oxygen (DO) throughout the River Ganga was high or near saturation despite substantial organic load being discharged into the river. The presence of phytoplanktons contributed significantly towards an intraday variation of about 5 mg/L. Further, it was concluded that the diversity of phytoplankton is an indicator of pollution.

Another critical aspect of monitoring was microbial diversity and presence of bacteriophages in the River Ganga. The study identified the trend of bacteriophages against pathogenic, non-pathogenic and opportunistic pathogenic bacterial isolates in water and sediment was the same. The metagenome-viromes from freshwater sediments differed from the viromes previously collected from other freshwater sediments. The freshwater sediments from the River Ganga housed novel viromes and included undiscovered double-

stranded DNA viruses. Most importantly, the Ganga River is home to important bacteriophages and other microbiomes that can be related to its non-putrefying properties.

Aquifer Mapping in Parts of Ganga-Yamuna Doab

Ganga and Yamuna rivers are most severely affected by the anthropogenic pollution caused by municipal untreated sewerage disposal, urban solid waste, biomedical hazardous waste, etc. CSIR-NGRI conducted aquifer mapping with focus on palaeo channels in parts of Ganga-Yamuna Doab in Kaushambi-Kanpur stretch with the objectives of tracking the inferred paleochannel further northwestward in the inter-fluve region; 3D Mapping of Principal Aquifers system; Establishing linkages between aquifer system including paleochannel with river system; and Locating sites suitable for development of a plan for Managed Aquifer Recharge.

Digital India Mission

E-Pronnati Software

CSIR-NGRI has developed the E-Pronnati software system, which is a paperless transparent office system with enhanced capabilities supporting prompt decision making for CSIR. Orientation training was conducted by the Institute to all the common cadre officers of CSIR and the labs for effective implementation of paperless office during August 2022.

Important Technological Contributions towards Sustainable Development Goals (SDGs)

6.0 Important Technological Contributions towards Sustainable Development Goals (SDGs)

SDG 2: Zero Hunger

Technologies for manufacturing/processing of food products

The technology for manufacturing/processing of multigrain protein powder products/variants has been developed by CSIR-IHBT and transferred to Maatritava Foods, Kangra, Himachal Pradesh.

Technology for manufacturing/processing of (i) Granola/protein/energy bars - (millet and cereals, protein based) products, and (ii) instant protein beverage mixes products/variants have been developed by CSIR-IHBT and transferred to M/s Ketav's Ayush Health Care Products, Kangra, Himachal Pradesh.

SDG 3: Good Health and Well-being

Nutra Chikki with added Spirulina

Introduction

CSIR-CFTRI has developed process know-how for chikki preparation with added Spirulina. Chikki is a ready to eat traditional sweet snack consumed by all sections of population in India. Spirulina, a blue green alga (*cyanobacterium*) has been extensively studied and is now in widespread usage throughout the world as a health food and a dietary supplement. Spirulina is a concentrated source of protein (65-70%), vitamins, especially B12, Provitamin A (β carotene) and Vitamin E, minerals, especially iron. It is also rich in gamma linolenic acid (GLA), an omega 3 fatty acid. Initiatives to use Spirulina to combat malnutrition have been taken up in various parts of India and clinical studies have been carried out establishing the beneficial effects of inclusion of Spirulina in diet. The addition of Spirulina to traditional Chikki improves the protein and micronutrient profile of the product making it suitable for combating the Malnutrition among children, adolescent girls, pregnant and lactating mothers. The product has been found to be well accepted by the consumers, especially children.

The product takes the advantage of the consumers' preference for traditional foods to meet their nutritional needs. The product is also positioned to cater to the nutritional programmes of Women and Child Development Dept. of Govt. of India targeted at combating malnutrition among children, adolescent girls, pregnant and lactating mothers.

Online Fortification of Atta (Whole Wheat Flour) / Refined Wheat Flour (Maida)

CSIR-CFTRI has developed the process for online fortification of atta and maida in which micronutrients (vitamins and minerals) are added to the wheat flour during milling process continuously online in order to gain more nutritive products. The fortification process is accomplished by adding the micronutrients through a volumetric or gravimetric feeder placed at the end of the milling process. Online uniform mixing of micronutrients to wheat flour is challenging as the quantity of the micronutrients to be added is very minimal in large capacity commercial mills. The technology can be integrated with the existing manufacturing process and adapted to a wide range of the production capacities (20 to 300 tons per day) with minimal investment. Option with fully automatic control with interlock system for feeder and atta output is provided. The process is simple to operate and monitor continuously. The fortification cost of the atta and maida are very nominal at about 8-10 paisa per kg of products including the

fortificants and processing charges, which makes it a low-cost technology. The atta fortification technology of CSIR-CFTRI has been transferred to more than fifty industries located at different parts in the country. Himachal Pradesh became one of the first state to distribute fortified wheat flour to all the beneficiaries through public distribution system (PDS). Harmony food Pvt. Ltd., Vishakapattanam, is fortifying wheat flour of 1000 metric tons per month and selling the product in southern states of the country.

Preparation of Beverage Mix from Malted Ragi

Ragi is known to contain good amount of calcium, sulfur and amino acids. Besides, ragi in the malt form can be an excellent cereal base for products like beverages and hence preparation of an instant beverage based on ragi malt was developed. CSIR-CFTRI has standardized the technology and general methods of processing instant beverage mix from malted ragi. Ragi was blended with a small proportion of barley & protein concentrate to make a product with a desirable nutritional profile. The product can be packed in flexible laminated packaging material or in PET or glass bottles or refill packs in card board box as retail consumer packs. When packed as unit pouches, a shelf life of 1 year for foil laminate and about 6 months for metallized polyester/polyethylene was predicted under normal storage conditions (65% RH and 270°C). The product mix can be used in the preparation of a beverage after reconstitution in water, milk or such other potable liquids.

Nutri Fruit-Bars enriched with Vitamin C and Zinc (Mango and Mixed fruit bars)

CSIR-CFTRI has developed Nutri Fruit bars enriched with Vitamin C and Zinc from the tropical fruit pulps of mango, banana, guava, grape, etc., to improve the immunity and maintain general health. The nutri fruit bars are concentrated products with good nutritive value with the natural carotenoids, anthocyanins and other phytonutrients. The products are appealing and consumed readily as a nutria dense snack. The products are packed in food grade packaging with unit packs of 25 grams and delivers the nutrients to the target population. Nutri fruit bars were distributed among the migrant workers, health care professionals, doctors and police personnel as immunity booster.

Development of Lyophilised Formulation

Amphotericin B (AmB) has been the mainstay and Gold Standard drug for treatment of both leishmanial and fungal infections due to its wide-spectrum antibiotic action. However, overwhelming nephrotoxicity and hypokalemia, has led to evolving different liposomal formulations. Recent resurgence of post kala azar dermal leishmaniasis (PKDL and VL-HIV co-infection) and the invasive fungal infections emphasize the need for better liposomal AmB with immunomodulatory activity to treat such complicated cases. CSIR-IICB has developed a single shot therapy with PC-SA liposomal formulation of Amphotericin B which leads to clearance of parasites in-vivo against experimental VL. The formulation also has immunomodulatory activities thus preventing relapse and re-infection. The studies revealed antifungal efficacy as well of this formulation. Thus, the formulation has prospects for the treatment of invasive fungal infections and mucormycosis making them a lucrative commercial product. CSIR-IICB has partnered with Lifecare Innovations for mass scale production of lyophlisation and refining into GMP/GLP standard. Lifecare Innovations will undertake Manufacture of Investigational Drug and develop Quality Parameters/ QC & QA Protocols at their WHO GMP Liposomal Drug Plant in Lucknow Biotech Park.

SDG 6: Clean Water and Sanitation

Synthesis of Ceramic-Polymer Composite Membrane: A Novel Next Generation Technique for Water/Waste Water Treatment and Pervaporation Application

CSIR-CGCRI has developed Thin Film Ceramic-Polymer Composite Nanofiltration Membranes over ceramic substrate by Interfacial Polymerization (IP). Use of polyethylenemine with trimesoyl chloride and glutaraldehyde crosslinkers gave rise to dense crosslinked structure with low pore size. Different

coating approaches were explored to form stable and uniform functional layer over ceramic substrate. A series of composite membranes were fabricated and characterized using FESEM, EDX and XPS analyses. The membrane with optimum properties exhibited clean water permeability in the range of 20-32 Lmh/bar and highest rejection of 99.5% for Cu(II), 99% for Pb(II), 85% for As(V) and 60% for Cr(VI) from 5mg/L aqueous solution. Complete regeneration of the robust ceramic substrate was possible by removal of the polymeric functional layer with free chlorine treatment followed by ultra-sonication.

High Flow Rate Iron Removal Filter

Ground water or bore well water have presence of iron and manganese which does not pose health risk but cause unpleasant taste, odour and stains which are complicated for most of the applications in domestic and also for industrial purposes. To remove iron from contaminated water, CSIR-CMERI developed High flow rate iron removal filter towards iron removal process free from health hazards. The technology has been licensed to more than 20 MSMEs and has also been commercialized.

Scaleable Cation Transfer Membrane for Alkaline Water Cell

CSIR-IICT has synthesized the cation transfer membrane for alkaline water cell and provided assitance in improving the design of alkaline cell to 50 lit/hr capacity.

Bioprocess for Detoxifying Perchlorate

Perchlorate is an emerging thyroid disrupting chemical used in many industry sector especially space R&D, arms & ammunition sector etc. Severe ground water contamination of perchlorate and associated public health problems are reported in the recent past in India. CSIR-NIIST has developed a technology by which the toxic chemical can be detoxified using specific microbial system and a bioprocess. The technology was implemented at field. Using this technology, safe drinking water was produced from a perchlorate contaminated abandoned community well in Ernakulam district in Kerala.

Sampling, Anlaysis and Database on POPs

India is a party to Stockholm Convention on Persistent Organic Pollutants (POPs). The objective of the convention is protection of human health and environment from the harmful effects of POPs. CSIR-NEERI with expertise in monitoring of POPs in environmental and products, is carrying out extensive sampling and anlaysis and create comprehensive database on POPs. The data is useful to understand the extent of contamination, possible human health effects.

SDG 9: Industry, Innovation and Infrastructure

IoT enabled, Smartphone based Colposcope for Cervical Cancer Examination

The technology is an offshoot of projects and expertise at CSIR-CEERI. Such indigenous developments are initiated to support the start-ups in product development and manufacturing domains.

The know how for “IoT enabled, Smartphone based Colposcope for Cervical Cancer Examination” was licensed to M/s Divine Meditech Pvt. Ltd., Gautam Buddha Nagar, Uttar Pradesh.

Use of Jarofix in Road Construction

Jarofix is a waste material generated from zinc industry in huge quantity. Jarofix was investigated at CSIR-CRRI and its performance study was carried out in the field by constructing an experimental section - pilot study along SH-9, Chittorgarh to Udaipur. The construction was carried out under the guidance of CSIR-CRRI

and the Institute also carried out performance study for three years. Based on the findings, Jarofix is now used in the construction of 15 approaches of flyovers along NH 76 Udaipur to Bhilwara section where 6 lane construction has been completed and about 4 lacs ton jarofix has been used so far. Near Kota and Bundi, Rajasthan, about 10 lacs ton jarofix is being used in the construction approaches of fly overs.

Process Know-how for Development of Special Chemicals

CSIR-IICT has developed a catalytic process for the preparation of *Ortho-Chloro Benzonitrile* by vapour phase ammoxidation of *o-chloro toluene* at a batch scale of 100 g and provided the design of the reactor. Reaction was demonstrated at 10 g catalyst scale with a minimum of 75% conversion and above 98% selectivity. Active catalyst preparation at 100 g batch with know-how details was demonstrated.

A process for continuous bromination of *2[H]-heptafluoropropane* (HFC-227ea) at laboratory scale was developed and demonstrated to client. A process for *vinylidene fluoride* (24937-79-9) was also developed and demonstrated to the client.

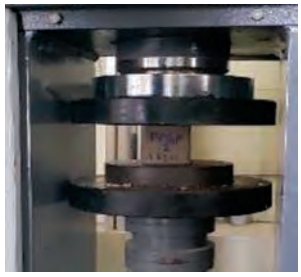
Ambient Temperature Cured One-Part Geopolymer Binder

Geopolymer binder has the potential to reduce CO_2 emissions and energy consumption by approximately 60% and 80%, respectively, and are widely recognized as sustainable alternatives to ordinary portland cement

Slump Flow of One-Part Geopolymer Binder Paste

Test for Compressive

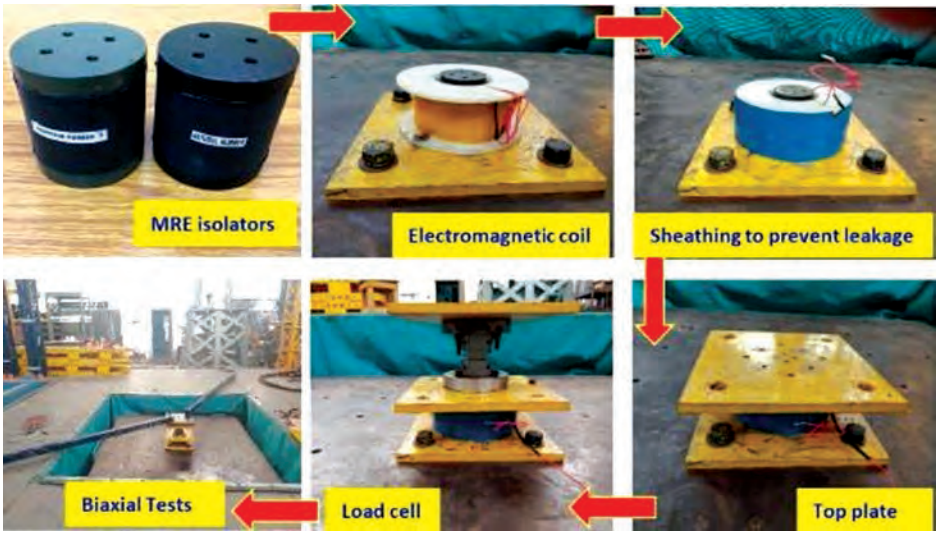
Tested specimen after



(OPC). Conventional or two-part geopolymers are formed by a reaction between a solid aluminosilicate precursor and concentrated aqueous solution of alkali hydroxide, silicate, carbonate, or sulfate, that is, two parts in addition to water. One-part geopolymer technology is in the research stage at CSIR-SERC. In one-part mixtures, only a dry mixture is needed in addition to water. The dry mixture is prepared by mixing a solid aluminosilicate precursor with a solid alkali-activator. The one-part geopolymer have the advantages such as waste to wealth conversion, high rate of strength development, zero cement, zero water for curing or ambient temperature curing, avoids hazardous alkali activator solutions and highly suitable for cast in-situ applications. The new product is developed at CSIR-SERC through industrial by-products, thus there is minimum or no adverse environmental impact. The fly ash and slag used in the binder will help in solving the problem of associated disposal and air pollution caused due to its dispersion.

Laminated Vibration Isolators with Magneto-Rheological Elastomers (MRE)

To ensure that sensitive hospital equipment remains functional after a major seismic event, an effective isolation technique is needed to protect the equipment from high acceleration. CSIR-SERC has developed a prototype adaptable isolator using laminated magneto-rheological elastomer (MRE) sheets, with steel plates in alternating layers and an electromagnetic arrangement. The MRE is developed using both natural rubber and synthetic chloroprene rubber as base matrix. Smartness in rubber matrix is introduced by disbursing micro sized carbonyl iron (CI) particles during the base matrix preparation. The CI particles infused elastomeric matrix is cured in the absence of magnetic field, resulting in an isotropic MRE. When subjected to an external magnetic field, the dynamic characteristics of MRE gets altered due to chain-like orientation of CI particles. Due to the variation of shear modulus of MRE



isolators under external magnetic field, they are adaptive and impart good isolation effects under varying excitations.

The developed smart MRE isolators are demonstrated for their use in translational vibration isolation of equipment and machines in critical infrastructure. The envisaged smart MRE isolator will offer vibration protection of critical equipment under varying earthquake scenarios. This could lead to standardized design of critical equipment that can be deployed at all seismic zones.

Column Flotation Technology for Processing Lean Grade and Fine-Grained Ores

The column flotation technology is a new mineral beneficiation method developed on strong scientific principles for processing of fine, low-grade ores and minerals. The merits of the technology include improved metallurgical performance in terms of grade and recovery, effective cleaning of froths, small foot print, low capital investment, less operational and maintenance costs with user-friendly controls. Extensive laboratory scale studies were carried out at CSIR-NML Madras Centre on feed to sillimanite flotation circuit to arrive at the required reagents' dosages, optimum grade, and recovery of sillimanite and design parameters of flotation column installed at M/s KMML. M/s McNally Sayaji Engineering Limited, Bengaluru, CSIR-NML's engineering partner, executed the supply of all equipment and instruments, fabrication, erection, and integration of all sub-systems consisting of air compressor, air dehumidifier, column shells and conditioners etc. Technology Package for Flotation reagent development has been carried out in collaboration with M/s Somu Organo Chem Pvt. Ltd., Bengaluru, and Flotation column design, engineering, erection, commissioning, stabilization and training has been varied out in collaboration with M/s McNally Sayaji Engineering Limited., Bengaluru. The figure below shows a commercial scale flotation column of 200 TPD installed at Bhelatand Coal Preparation Plant of M/s Tata Steel Limited.

Continuous Pilot Scale Reverse Flotation of Iron Ore

CSIR-NML has used reverse flotation method for beneficiation of iron ores wherein silica gangue is selectively floated from iron ore using reagents. The objective is to obtain an iron rich concentrate with alumina ≤3% with maximum yield and tailings with Fe <45% with maximum alumina from inferior grade iron

Pilot Scale Processing of Iron Ore Slime

ore through froth flotation process. Studies on different reagent scheme have been carried out to improve the selectivity of the flotation process. With the encouraging results of batch pilot scale studies (20-25 kg) in earlier project carried out at CSIR-NML, continuous pilot scale flotation of 15 tonnes of de-slimed product of iron ore slime was conducted and validated the bench scale results showed a concentrate of 2.77% Al2O3 with 83.8% yield and tailings with 43.2% Fe at 1kg/ton collector dosage.

Electronic Packages for Ultrasonic Flow Meter for On-board Propellant Gauging of Spacecraft

Spacecraft propellant gauging is one of the important activities that allow estimating the amount of propellant available onboard in a spacecraft. The propellant availability dictates the life of the spacecraft; also the data related to the propellant availability determines the mission sequence and decisions. CSIR-NML along with LPSC, ISRO, Bangalore, fabricated four systems using flight qualified electronics for on-board propellant gauging of space craft based on CSIR-NML technology fluid flow rate detection through a narrow tube. Qualification tests of the devices for continuous and pulsating modes for further use in Indian spacecraft will be carried out on ground in space environment. The electronic package development involves pulser, receiver, onboard storage and signal processing so as to enable acquisition, analysis and delivery of data from spacecraft to the ground stations. Design and components for the master module has been confirmed and the fabrication of the master module has been completed. Trials of the master module from 0.1 LPM to 6 LPM flow rate was successfully completed. Fabrication of flight qualified modules are in progress.

SDG 13: Climate Action

An Assessment of Avoided CO_2 Emissions during Construction, Maintenance and Operation of National Highways

Using existing data available with the National Highways Authority of India (NHAI) and in consultation with experts from Ministry of Environment, Forest and Climate Change (MoEFCC), the report has been jointly prepared by CSIR-CRRI, CSIR-IIP, IORA Ecological Solutions, and The Energy and Resources Institute (TERI).

Development of biodegradable cutlery from agricultural waste (Vetiver grass and Rice waste)

CSIR-NIIST has developed different cutlery items such as plates, cups, glasses, and others from indigenous underutilized crop like vetiver grass and from agriculture waste of rice. Technologies have been successfully transferred to two industries.

SDG 17: Partnerships to achieve the Goal

Inhalable Particles Containing Drugs used in Multi-Drug Resistant (MDR) Tuberculosis

CSIR-CDRI received funding by the India TB Research Consortium for an academic Clinical Trial to determine safety/tolerability, pharmacokinetics and early measurement of Centinhale activity. GMP manufacture of Centinhale will be undertaken under Form 29 permission from CDSCO/UP FSDA. The collaborative project funded by the ICMR and Norwegian Research Council has been concluded. CSIR-CDRI has prepared dry Powder Inhalation formulations with suitable properties and their anti-TB effects were compared with orally-administered medicines in a mouse model of TB. The results have been promising and further study plans have been formulated.

High Impact Technologies Licensed/Commercialised

7.0 High Impact Technologies Licensed/Commercialised

Technology of Nucleic Acid Staining Dye GreenR™

The Technology for Nucleic Acid Staining Dye, GreenR™, has beendeveloped by CSIR-CDRI. The dye binds with DNA/RNA, to exhibit green fluorescence and is non-mutagenic, cost-effective and easy to dispose. The dye binds to nucleic acids of all kinds (genomic DNA, plasmid DNA and RNA, PCR amplified products of different sizes). It can be used with PCR master Mix for highly sensitive real-time qPCR experiments. The technology has been patented, licensed and transferred to M/s Gene to Protein Private Limited, Lucknow in May 2022. The Product was launched on February 16th, 2023 and is being marketed by M/s GPPL and also available on Government e-Marketing (GeM) portal.

Technology of a New Fluorescence Quencher CDRI-Q2 (UniQ)

CSIR-CDRI developed and transferred the technology know-how of "A New Fluorescence Quencher UniQ for nucleic acid research and diagnostic applications" to M/s Biotech Desk Pvt. Ltd. (BDPL), Hyderabad on February 24th, 2023. The technology has been patented (both in India and Abroad) and licensed (non-exclusive) to M/s. Biotech Desk Private Limited, Hyderabad.

Process for Fabrication of Supercapacitor

CSIR-CECRI has developed an economically viable process for large-scale production of 2.7 V, 100 F cylindrical supercapacitor using indigenous electrode materials. Using the process, electrode performance can be tuned as per the requirements. The process has been transferred to Qmax Ion Private Limited, Chennai.

Process for CO_2 Capture under Flue Gas Conditions

CSIR-CECRI has developed a simple and cost-effective approach for fabrication of bench-mark nanomaterial (BMN), which demonstrates effective carbon capture characteristics under flue gas conditions. The BNM developed by CSIR-CECRI exhibited a CO_2 adsorption capacity of ~3.7 mmol/g under conditions relevant to flue gas (0.2 bar and >75°C). The developed adsorbent is also found to be promising in terms of carbon capture metrics proposed by US DOE. CSIR-CECRI has successfully produced the adsorbent in bulk-scale level and transferred the technology to Summit Hygronics Pvt., Ltd., Coimbatore, on June 17th, 2022.

Manufacture of Four Coat Paint Schemes consisting of Epoxy & Polyurethane Paint Systems for Concrete Structures

This multicoat system protects the concrete structures which are located in the marine environment. The coating system protects the concrete as well as the rebar embedded inside the concrete and hence the durability of the structure is increased. CSIR-CECRI's four coat paint technology has been transferred to Berger Paints India Limited, Kolkata.

IoT-enabled Handheld Colposcope System for Cervix Condition Analysis and Cervical Cancer Screening

CSIR-CEERI has developed an indigenous IoT-enabled handheld colposcope system for cervix condition analysis and also for cervical cancer screening. The developed colposcope system is cost-effective and has the state-of-the-art features like connectivity to smartphone-based app for quick data visualization and analysis, cloud connectivity for direct communication between patients and doctors, software-based decision support to predict cervical cancer and on-device rechargeable battery support for continuous operation in rural camps. The developed system has been deployed at various hospitals for intensive testing and validation purpose. Further, the technology has been trasferred to M/s Divine Meditech, Noida on October 7th, 2022 for mass production and also for launching this technology in Indian market.

Technology for Non-Recovery Type Coke Oven, Drag Type Coke Oven with Stamp Charging and Coke Quenching

CSIR-CIMFR has developed non-recovery coke ovens. Non-recovery ovens are generally preferred due to less capital investment, less pollutant and flexibility in operation compared to by-product ovens. CSIR-CIMFR has developed a comprehensive technology package for Non Recovery Type coke oven with stamp charging and coke quenching system. The technology has been transferred to M/s. Tuaman Engineering Ltd., Kolkata.

Technological modules for Mob Control Vehicle

To provide modern technical support to paramilitary forces deployed in maintaining law and order and internal security operations, CSIR-CMERI has developed three innovative categories of Mob Control Vehicles (MCVs) - Compact, Medium, Heavy. The following technological modules developed by CSIR-CMERI for Mob Control Vehicles have been transferred to M/s Himatsingka Agencies Pvt. Ltd., Jharkhand.

1. Water Canon System, used as a non-lethal weapon to disperse aggressive mob,
2. Front Shovel, utilized for better maneuver ability of MCV during riots,
3. Multi Barrel Tear Shell Launching System, mounted on the roof of the MCV, it can fire tear gas shell simultaneously from several barrels and deliver large quantities of less lethal ammunition in a very short time covering larger areas. It can be retracted to load the tear gas shell from inside the vehicle,
4. Wide Angle Video through Video Stitching, using the twin camera systems installed in front and rear side of the vehicle on the roof top, first hand information of the surroundings can be provided to the security personnel stationed inside the vehicle. Video stitching algorithm is developed for combining multiple overlapped videos to produce an online seamless high resolution video, and
5. PTZ Camera with Telescopic Mast, a high end PTZ camera with night vision features is installed on the roof to perceive the surroundings of the MCV. Mast elevates the PTZ Camera for clear long range view.

Vehicle Mounted Drain Cleaning System

The CSIR-CMERI developed Vehicle Mounted Drain Cleaning machine is designed for up to 5,000 people density i.e. best suitable up to 300 mm diameter and up to a 100-metre length of the sewer system. The scavenging system is economical and will help the manual scavengers to enhance their efficiency,

performance and also safeguard them against intrusive pathogens. The technology Know-how has been transferred to M/s Kam Avida Enviro Engineers Pvt.Ltd.

Steel Slag Valorization Technology for Development of Processed Steel Slag Aggregates

CSIR-CRRI's Steel Slag Valorization Technology technology for developing processed Steel Slag Aggregates for construction of roads has been transferred to Arcelor Mittal Nippon Steel, Hazira, Surat. The technology has been successfully utilized in the construction of India's First Steel Slag Road at Hazira, Surat. Around one lakh ton processed steel slag

aggregates were utilized as 100 % substitute of natural aggregate in steel slag road construction.

Production of Bioplastic and Violacein Pigment from Himalayan bacterial isolate PCH194

Technology transfer agreement to establish upscaled facility for production of dual bio-products (bioplastic and violacein pigment) from Himalayan bacterial isolate PCH194 has been signed with M/s HAUCH Ecovations Pvt. Ltd., Ludhiana. Punjab, on November 15th, 2022.

Production of Biodiesel from Used Cooking Oils

CSIR-IIP technology for biodiesel production aims to strengthen the CSR (Corporate social responsibility) activities undertaken by different state biofuel boards like CBDA Raipur, UP Bioenergy etc. related to rural development and empowering livelihoods by creating distributed energy models for such communities.

The biofuel generated from used cooking oils may be used in high power sources like Genset, power engines and agriculture-related equipment's etc. for the upliftment of rural economy. The Biodiesel produced from UCO also conforms to the BIS specification 15607:2016. The technology for production of biodiesel from used cooking oils has been transferred to KNP Arises Green Energy Pvt. Ltd., Jaipur.

Fin & Rudder parts/assemblies for Series Production of LCA-Tejas

The technologies and products developed by CSIR have enabled successful development of a front ranking 4+ generation fighter. This has led India to become one of the top 7 countries with capability to design, develop and produce a world class fighter. CSIR-NAL licensed Agreement for transfer of Design Know-how of Fin & Rudder parts/assemblies for Series Production of LCA-Tejas to Hindustan Aeronautics Limited, Bengaluru.

Multi Copter Drones for Societal Applications

CSIR-NAL developed medium-class BVLOS (Beyond Visual Line of Sight) multi-copter UAV is made out of a lightweight carbon fiber foldable structure for ease of transportation and has unique features like autonomous guidance through dual redundant MEMS-based digital Autopilot with advanced flight instrumentation systems. The uniqueness of this UAV is its higher payload and higher endurance which is perfect for last-mile delivery, floriculture mapping, geo exploration, precision agriculture pesticide spraying and medical transport at remote places. CSIR-NAL signed License Agreement for commercialization of Multi Copter Drones (Quadcopter, Hexacopter & Octacopter) for Societal Applications with three MSMEs -Apolo Computing, Hyderabad, Bliss Aerospace, Bangalore & Gopalan Aerospace, Banaglore.

Certified Reference Material (CRM)

CSIR-NBRI has prepared some of the commercially important Certified Reference Materials (CRMs) / Reference Materials (RMs) of medicinal and aromatic nature as per the requirements of ISO-17034-2016. In this regards following five CRMs have been prepared - L-Carvone, Eugenol, Geraniol, (-) Menthol & Mangiferin and transferred to M/s Aashvi Technology, LLP, Ahmedabad.

Microbial Bio-fertilizer

Microbial Bio-fertilizer or Bioinoculants increases yield by approximately 20-30% and also enhances the nutritional value of agricultural and floriculture crops. It is used to treat seeds, seedlings, tubers and other planting materials for increasing agriculture productivity and reducing use of chemical fertilizer. CSIR-NBRI's technology to produce microbial bio-fertilizer has been transferred to M/s Uma Sankar Sabuja Dunia Ltd., Nabrangpur, Odisha.

Bio-available Curcumin (CROMA-3)

CSIR-NBRI has developed a formulation having enhanced bio-availability and therapeutic effects of curcumin. An edible matrix of turmeric rhizome has been used to prepare a 100% herbal standardised herbal formulation, called as CROMA-3 containing polysaccharides and curcumin through a simple process. CROMA-3 contains more than 10% curcumin in a polysaccharide matrix, which exhibits several advantages, including less toxic, more bio-available and superior medicinal effects such as oxidative stress neutralising potential, anti-inflammatory and immune boosting activities as compared to curcumin alone. This standardized extract has huge potential for the development of nutraceuticals, functional foods and biopharmaceuticals. The technology to produce CROMA-3 has been transferred to M/s Techno Chemical Industries Ltd., Kerala.

Development of Leather Alternatives from Cactus

Conventionally available leather is derived either from animal sources, which involves the use of harmful chemicals and are not so ecofriendly process, whilst indulging animal cruelty; or synthetic leather derived from non-biodegradable plastics such as polyvinyl chloride or polyurethane. A sustainable alternative has been developed from cactus, which could be used to develop leather based products in a more affordable and sustainable approach. CSIR-NIIST transferred the technology for development of leather alternatives from cactus to Streekaya Services Pvt Ltd, Mumbai, Maharashtra.

Imporved variety of Citronella, Jor Lab C-5 and Lemongrass Varieties of Jor Lab L-8, Jor Lab L-15

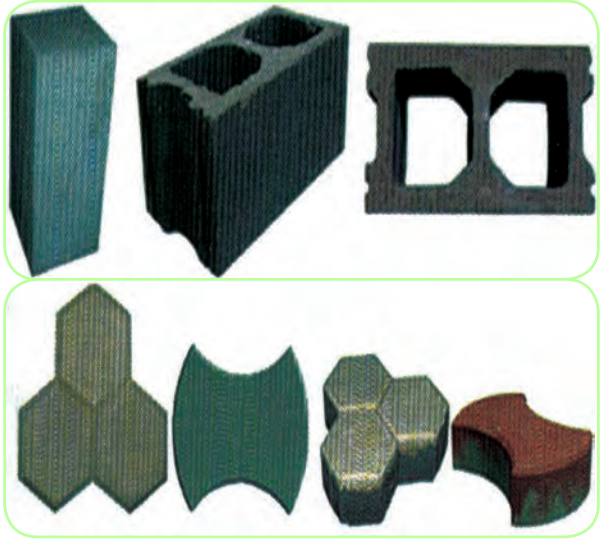
CSIR-NEIST exchanged anMoU for transfer the Agrotechnology and knowhow of High yielding variety of Java Citronella Jor Lab C5 to the M/s Bengal Medicinal and Aromatic Plant, Kolkata, West Bengal. The Agro technology will help the farmers to generate good income through cultivation.

Modular Onsite Wastewater Treatment cum Resource Recovery Unit (NOWA)

CSIR-NIIST's onsite wastewater treatment cum resource recovery system (NOWA) is specifically designed for places without sewerage network where the wastewater can be treated for recovering valuable resources. It can recover reuse quality water, organic manure and bioenergy from organic wastewater. This will find application for apartments, restaurants, catering units, bakery untis, agro based MSMEs, etc. Implementation of this technology will ensure better sanitation conditions and also reduce usage of fresh water.The technology has been licensed non-exclusively to Triangle chemicals.

Eco-Friendly GeoPolymer Concrete Blocks

GeoPolymer Concrete (GPC) building block technology offers a speedier and cost effective environmentally sound alternative to conventional walling materials. It can be easily adapted to suit special needs of users by modifying design parameters and is a highly profitable business for micro and small scale building material producers and construction companies. It can be extensively used in buildings, landscaping, in container yards, foot paths, parking lots, etc. The production of GPC blocks also leads to a scientific, systematic and eco-friendly utilization of industrial wastes, components will be more versatile in terms of structural efficiency, durability and minimize the consumption of currently used energy–intensive materials, increased conversion of wastes to wealth. The new eco-friendly blocks lead to a drastic reduction in the carbon footprint, embodied energy. The CSIR-SERC's technology for production of GeoPolymer Concrete (GPC) has been transferred to M/s. Debrique Creative Labs Pvt., Ltd., Chennai.



LIBs Recycling Plant setup

CSIR-NML signed an MoU with M/s Recyclib Pvt. Ltd., New Delhi for the transfer of Know-how for the recovery of Co, Li, Mn, Cu, Ni, Al, graphite and saleable plastics from waste lithium-ion batteries (LIBs). Based on the demonstration, training & license provided by CSIR-NML to M/s Recyclib Pvt. Ltd., New Delhi on July 23rd, 2022, the recycling plant has been set-up for commercial production to recover Co, Li, Mn, Cu, Ni, Al and graphite as saleable product from LIBs. All the equipment is connected in a closed-loop for extraction and recovery of metals from waste LIBs. The newly commercialized recycling company is now operational for the production of saleable products of Cu, Ni, Co, Mn and Li from LIBs based on CSIR-NML technology.

Transfer of Technological Know-How for the Recovery of Metals from Lithium-ion Batteries

CSIR-NML has transferred the technologocial know-how for recovery of Lithium (Li), Nickel (Ni), Manganese (Mn), Cobalt (Co) from spect Lithium-ion Batteries (LIBs) to M/s ReCy Energy Pvt Ltd, Pune.

Process know-how to prepare 100% Water Soluble Sulphate of Potash from Distillery Ash

Sugar cane is one of the most important resource to augment bioethanol availability. However, the effluent from ethanol distillery, commonly known as spent wash / vinasse, poses enormous environmental challenge, particularly in view of rising demand of fuel ethanol. Alcohol industries generate 8-15 L of spent wash for each litre of ethanol produced. CSIR-CSMCRI has developed technology that involves in systematic processing of spent wash to recover desalted organics which has been an excellent cattle feed ingredient and recovery of fertilizer grade potash which is of high demand because of its non-availability in the country. This process enables complete recovery of water that is recycled back to plant/process/industrial use and ensures no ground water contamination from the distillery industry. The process know how has been transferred to DCM Shriram Bio Enchem Limited, New Delhi.

Production of SAP from *Kappaphycusalvarezii* and its application

Since many decades, the cultivation of *Kappaphycusalvarezii*, a main source of biostimulant and carrageenan is the traditional occupation for more than 1500 farmers in the coastal line of Tamil Nadu & Gujarat. Usage of SAP in agricultural cultivation increases the yield by 10.22% which leads to additional income of ₹ 18600 crores for Agricultural farmers of our country till now. Nearly 1000 farmers are involved in the cultivation of seaweed on an annum. CSIR-CSMCRI's technology for production of SAP from *Kappaphycusalvarezii* and its application know-how has been transferred to Seaweed India Private Limited, New Delhi.

Important Contributions to Rural Sector

8.0 Important Contributions to Rural Sector

India's First Biotech Park at Ghatti, Kathua district, J&K

The Hon'ble Minister of S&T, Dr Jitendra Singh inaugurated North India's First Biotech Park at Ghatti, Kathua district, J&K. The Biotech Park to act as hub for incubation of new ideas and will support the agri-entrepreneurs, Start-Ups, progressive farmers, scientists & scholars not only from J&K, but from neighbouring states of Punjab, Haryana and Himachal Pradesh and can be new model of rural agri-entrepreneurship.

Retractable Roof Polyhouse

In order to overcome the adverse climatic impacts and open-air pest infestations, the CSIR-CMERI developed Retractable Roof Polyhouse is used to manipulate sunlight quantity, quality and duration, water stress, humidity, carbon dioxide levels, and crop and soil temperatures for cultivation of horticultural crops. The Retractable Roof Polyhouse combines the benefit of both the natural outdoor environment and a controlled greenhouse environment to allow growers to extend harvest seasons. It helps in growing organically or chemical-free crops in order to achieve higher revenues and lower production costs. Farmers can cultivate both seasonal and non-seasonal crops throughout the year which can fetch higher value and income. The Retractable Roof Polyhouse increases harvesting period, reduces requirement of pesticide and also reduces cost of crop cultivation. The Technology has been transferred M/s Blue Stallion Equipments (P) Ltd., Ludhiana, Punjab.

Patch Fill: The Pothole Repair Machine

CSIR-CRRI has indigenously developed a compact and low cost Pothole Repair Machine which uses bitumen emulsion based mix technology. This machine is self-propelled and self-contained, and can carry out cleaning of pothole using compressed air, as well as placing bituminous mix and its compaction to fill up the pothole.

The machine helps in constructing roads in high-altitude Himalayan region where design and construction of roads are more difficult as compared to plain terrain due to the non-availability of skilled labour and lack of space. Compared to cost of other similar equipment available abroad, this equipment is about 70 per cent cheaper. 'Patch fill' equipment contributes towards *'AtmaNirbhar Bharat'* and 'Make in India' endeavours. It is also a step towards 'Clean India' by introducing green technology for maintenance of road pavement, and avoiding use of environmentally polluting hot-mix technology.

Preparation of 'Pushti' Products for Target Population

CSIR-CFTRI has prepared 'Pushti', a take home ration, following the ingredient composition guidelines by the Women and Child Welfare Department, Karnataka. Four different formulations were prepared and the products were evaluated for their acceptability studies among the children of age group 6-26 months, in collaboration with St. John's Research Institute, Bangalore. The acceptability trials were undertaken in rural areas of selected districts of Karnataka state. The formulation is based on green gram and rice along with ragi.

ChloriSense: An IoT Enabled Portable USB Colorimeter for Detection of Residual Chlorine in Water

ChlorineSense, developed by CSIR-CSIO, is a portable USB colorimeter used to detect residual chlorine in water by quantifying the change in color of the sensor strips. It is a compact battery powered device having Bluetooth connectivity that can be used on the Mobile App ChloriSense. It also records test location and data can be stored either locally in the device or emailed to the intended user. This device is further extendable to other water quality parameters testing utilising colorimetric paper strips such as pH, nitrate, etc. The device has potential usage in the "National Water Quality Management and Surveillance Program" of GoI, and is a suitable solution for low resource areas especially rural sectors using Field Test Kits (FTKs) for water testing.

Seaweed Cultivation and By-product Development in Ramanathapuram

CSIR-CSMCRI has successfully demonstrated the following three processes to the officials of Fisheries Department, Government of Tamil Nadu at the Fisheries Building, Mandapam: (01) K-SAP production process from 500 Kg of fresh *Kappaphycusalvarezii* seaweed; (02) Semi-refined carrageenan (SRC) production process from total 250 Kg of dry *Kappaphucusalvarezii* seaweed in total three batches, in total 16 hours continuous operation time interval, and (03) agar production process from 25 Kg of dry *gracilariaedulis* seaweed. These processes are expected to benefit the rural women folks in Ramanathapuram district of Tamil Nadu State.

Decentralized Processing Units for Fruits and Vegetable Value Addition

The technologies developed for the post-harvest value addition of indigenous fruits and vegetables by CSIR-NIIST was transferred to various organisations, self-help groups and farmers' consortia in order to prevent the post-harvest loss and to support the local farmers' groups. A turnkey execution of 500 kg per day processing unit for dehydration, preservation and value addition of regional fruits & vegetables was successfully completed for HORTICORP, Govt of Kerala.

Climate-based Malaria Forecasting System

CSIR-IICT has developed a GIS based visualisation platform and climate based malaria prediction system. Based on epidemiology and climate data, CSIR-IICT has developed the malaria epidemiology visualisation platform to understand the disease transmission intensity in a given geographic region. Additionally, climate based malaria forecasting models are developed using advanced modelling approaches such as machine learning and deep learning models (LSTM and transformer model). The epidemiology based decision support system and climate based malaria forecasting model helps the public health authorities

to implement appropriate control measures, well in advance, for reducing mortality and morbidity due to malaria.

CSIR Aroma Mission Phase II

Himachal Pradesh is the highest producer of aromatic marigold essential oil in the country. In phase-II of the CSIR-Aroma Mission during 2022, CSIR-IHBT catalyzed rural economy through cultivation of aromatic marigold covering 1370 ha area, leading to production of 8.0 tonnes of essential oil and revenue generation of ₹ 11.2 Cr.

CSIR Floriculture Mission

The first Tulip Garden in Himachal Pradesh at CSIR-IHBT, was open to the public during One Week One Lab celebrations in the last week of February, 2023. Increasing demand of flowers in the domestic market has given impetus to bulb production of flower crops such as tulips and lilium in the country, whereby CSIR-IHBT has provided bulb production technology to farmers of high altitude regions such as Lahaul & Spiti and Ladakh to meet the indigenous demand. Besides floriculture, apiculture is also being promoted under the mission programs and 3300 bee-boxes were supplied to farmer groups to boost generation of additional income. Besides, 187 gardens were established in schools, 20 vertical gardens were laid out at public places and seven products were developed under the mission program.

Lavender Festival at Bhaderwah, Jammu & Kashmir

The Hon'ble Minister of S&T, Dr Jitendra Singh, inaugurated the Lavender Festival held during May 25-26, 2022, at Bhaderwah Jammu & Kashmir, to celebrate India's Purple Revolution which is in sync with Hon'ble PM's vision of doubling of farmers' income and agri-entrepreneurship. Twenty-five lavender farmers and start-ups were felicitated during the occasion. Hon'ble Minister visited the Aroma exhibition and interacted with farmers and Agri-entrepreneurs. He also inaugurated six distillation units under CSIR-IIIM for Lavender. During the festival, Industry-Academia-Farmers meet was also organised with special focus on Lavender cultivation, in which more than 250 people from Industry, Academia, and Farmers participated.

Pushp Krishi Mela & Bougainvillea Festival

The Pushp Krishi Mela & Bougainvillea Festival were organized by CSIR-NBRI, Lucknow, during March 19-20, 2023. Three hundred individuals including farmers and entrepreneurs participated from different clusters developed across the country under the floriculture Mission. The main objective of this programme was

to disseminate among the farmers the technology & information on floricultural crops available with the institute so that they can increase their income through floriculture besides traditional farming. More than 10 lakh planting material (bulbs and seeds) and informative agricultural literature etc. were distributed to the participants. The participants were trained on different aspects of floriculture through various technical sessions and workshop. Twenty-two progressive farmers from different clusters were also felicitated in the programme.

Earthquake Monitoring and Hazard Assessment

CSIR-NGRI, Hyderabad is operating a dense network of over 80 seismic broadband and strong motion stations deployed all over the Uttarakhand state for earthquake monitoring and hazard assessment. Five more stations have been added in and around Joshimath area particularly for monitoring landslides and floods in the region. The system is equipped with data transfer to CSIR-NGRI in real-time. Additionally, two Infrasound sensors have beeninstalled in the audible frequency range and one automatic water level meter along the Alaknanda river in Govindghat. This also includes pressure and temperature measurements. Data from these field station enables real-time monitoring of the situation in and around Joshimath. CSIR-NGRI has also developed an early warning system for geohazards in the Himalayan region based on Artificial Intelligence and Machine Learning (AI-ML), that enables automatic event detection, classification, location and tracking based on the incoming real-time data.

Installation of Mushroom Spawn Production Unit and Vermicompost Unit

CSIR-NEIST branch Itanagar, installed a mushroom spawn producing centre and a vermicompost demonstration unit at Kimin under Rural Technology Demonstration Centre. Branch Lab organised various training programme on mushroom cultivation and vermicompost production to help the people of North Eastern region.

Inclusion & Accessibility to Persons with Disabilities (PwD)

9.0 Inclusion & Accessibility to Persons with Disabilities (PwD)

This chapter highlights the provisions, inclusiveness and number of disable persons who have been recruited in CSIR laboratories. The data presented here are based on the data received from the CSIR laboratories pertaining to financial year 2022-23 on the number of persons with disabilities positioned at various CSIR laboratories.

The CSIR and its laboratories having staff with disabilities adheres to the guidelines and policies of the Govt. of India regarding PwD issued from time to time.

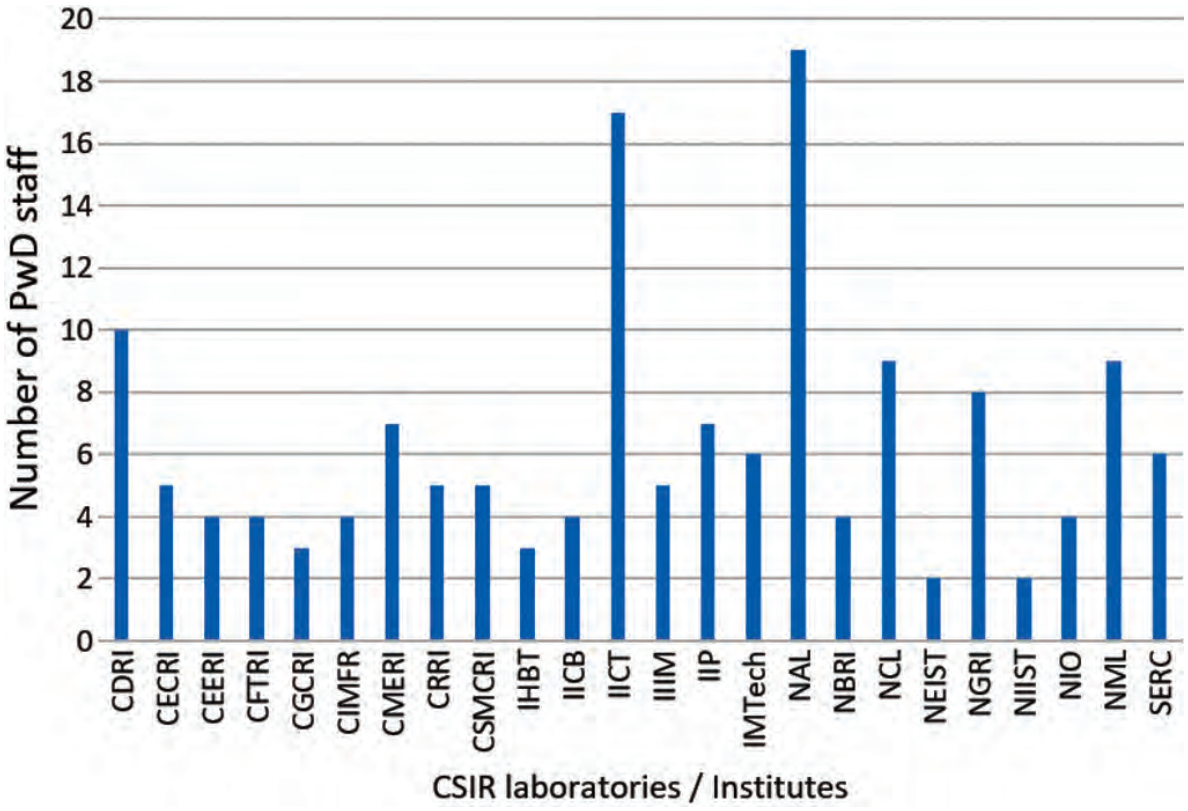
Laboratory-wise status of activities and policy decisions taken for Implementation of the Rights of Person with Disabilities (RPwD) Act 2016 during the Financial Year 2022-23 are as below:

- **CSIR-CECRI** complies with the implementation of rights and entitlements as provided in RPwD Act 2016.Appropriate working environments such as provision of ramps, hand-rails, lift, etc. have been provided to facilitate the PwD.CSIR-CECRI Jigyasa and Skill Development activities also include the participation of PwD.
- At **CSIR-CFTRI**, ramp has been provided for smooth movement of PwD.
- **CSIR-NBRI** complies with the implementation of the RPwD Act 2016 (Act No.49 of 2016).

CSIR-NBRI adheres Section 33 & Section 34 of the Act, regarding identification of posts for reservation and Reservation of PwD.

Appropriate working environment such as provision of hand-rails, lift, etc. have been provided to facilitate the working of PwD.

- At CSIR-NML,the main building, dispensary, labs etc have been made access friendly for PwD by installing ramp and also has lift facility to accommodate wheel chairs for movement from one floor to the other.



- CSIR-CSMCRI identified two posts for PwD, one for Technical Assistant and other for Junior Stenographer and advertised vide Advt. No. 01/2023. CSIR-CMERI constructed ramp at Staff Club sports facility and also constructed ramp with handrail in the renovated Open Air Stage.

- The CSIR-IHBT constructed link corridor from laboratory to scholar hostels in ramp form to facilitate better accessibility to the PwD. Lift facilities have been provided in the four storey newly constructed hostel of the institute.
- At CSIR-NAL, ramps have been provided in all the buildings for easy movement of PwD staff members.

- Ramps have been constructed and elevators have been installed in many labs to make the workplace PwD friendly. These labs include, CSIR-NCL, CSIR-CSMCRI, CSIR-CFTRI and other labs such as CSIR-NGRI have provided low angle ramp and stainless-steel side supports for easy movement of wheel chairs including library, guest house, dispensary, food court, sports complex etc. Additional wheel chair is provided at reception.

At CSIR-HRDG, relaxation of age and marks for the exams conducted,have been given to the candidates belonging to Divyangjan (PwD) as follows:

- Age relaxation of 5 years in upper age limit for applying for the award of JRF.
- Under CSIR-UGC National Eligibility Test (NET), the Junior Research Fellowships are awarded to candidates belonging to PwD category as per Govt. of India Reservation Policy.

Further, the candidates belonging to Divyangjan (PwD) category are given relaxation in cut-off marks for qualifying the JRF-NET exam for award of JRF-NET and Eligibility for Lectureship (e.g. in the June-2022 NET, the cut-off marks for 'General' category candidates in the area of Chemical, Earth, Life, Mathematical and Physical Sciences was 50.75%, 60.29%, 98.814 (percentile), 48.38% and 50.25%, respectively and in contrast to this the cut-off for the candidates belonging to PwD category in the area of Chemical, Earth, Life, Mathematical and Physical Sciences was 25.35%, 32.33%, 61.809 (percentile), 25% and 25.63%, respectively). Similar was the case for 'Eligibility for Lectureship' for candidates belonging to PwD category compared to candidates of other categories.

About 90 Doctoral and Postdoctoral fellows belonging to Divyangjan/PwD category are supported by CSIR during 2022-23 who constitute about 0.95% of the overall beneficiaries of doctoral and postdoctoral fellowship programme of CSIR.

Allocation under various schemes for the benefit of persons with disabilities, the amount released and amount utilized:

CSIR-HRDG - No separate allocation is made for any of the category and the lumpsum grant is allocated to CSIR for doctoral and postdoctoral fellowships under the umbrella scheme "Capacity Building and Human Resource Development". As per estimates, a research fellow on an average is paid ₹ 5.00 lakh annually and thus an overall estimated amount of over ₹ 4.0 crore has been utilized for persons with disabilities.

Central Management Activities

10.0 Central Management Activities

CSIR Governing Body Meetings

During the year, the 198th, 199th, 200th and 201st meetings of CSIR Governing Body were held on April 27th, 2022, October 1st, 2022, December 17th, 2022 and February 27th, 2023 respectively.

The 198th CSIR GB Meeting

The Chairman, GB and DG, CSIR, Dr Shekhar C Mande welcomed all the members to the 198th meeting of the GB, CSIR. One of the GB member, Shri Baba Kalyani, CMD, Bharat Forge Ltd., expressed that as the Nation moves towards India@100, the country shall experience exponential growth in several sectors and domains. Initiatives undertaken by CSIR and technologies developed thereof should be aligned with the objectives set by the Government for India in 2047.

Agenda items of the 198th GB Meeting:

- Confirmation of the Proceeding of the 197th meeting of the GB, CSIR held on October 12th, 2021.
- Action taken on the proceeding of the 197th meeting of the GB, CSIR.
- CSIR Young Scientist Awards 2021 – information thereof.
- Shanti Swarup Bhatnagar Prizes for Science and Technology 2021- information thereof.
- G N Ramachandran Gold Medal for Excellence in Biological Sciences and Technology 2021 – information thereof.
- CSIR Bhatanagar Fellowship 2021 - information thereof.
- Consideration and Recommendation of the CSIR Annual Report for the year 2020-21 - information thereof.
- Consideration and Adoption of Annual Accounts of CSIR for the Financial Year 2020-21 – approval thereof
- Closure of CSIR-CSIO Delhi (Service and Maintenance) Centre – approval thereof.
- Correction of Name of the Awardee of CSIR Diamond Jubilee Technology Award (CDJTA) 2020 – approval thereof.
- Placement of proceedings of Performance Appraisal Boards'(PABs') Meetings of Constituent Laboratories/ Institute of CSIR - information thereof.
- Amendment in Rule 7 of Section II of Part-IV of CSIR Administrative Services (Recruitment & Promotion) Rule, 2020 i.e. Recruitment Rule for the Post of Junior Secretariat Assistant (Finance & Accounts) – approval thereof.
- *Jigyasa Vigyan Mahotsav* 2022 – approval thereof.

Supplementary agenda items of 198th GB Meeting

- Extension of Indian Oil – CSIR Research – GAP Project approval thereof.
- Taking over the operation of FTL/SFPL by CSIR-IIP from Society for Petroleum Laboratory (SFPL) under Rationalization of Autonomous Bodies as part of the initiatives by GoI - approval thereof.
- Transfer of land measuring 60X35 mtrs = 2100 sq. mtrs. from CSIR-IIP, Dehradun – Khasra No. 79 to M/s. GAIL Gas Ltd. (a Govt. of India Undertaking Maharatan PSU) for setting up a CNG/PNG Infrastructure set up within the CSIR-IIP premises as part of their city Gas Distribution (CGD) network - approval thereof.
- Delegation of Recruitment powers to Head, CSIR – 4PI – approval thereof.
- Delegation of powers to Approve Investment of various funds of CSIR to the Financial Adviser, CSIR/ DSIR and amendment to constitution of Committee recommending the same (Investment) in case of CSIR – Hqrs. - approval thereof.

The DG, CSIR and Chairman, GB, Dr Shekhar C Mande, made a presentation on achievements of CSIR during the last six months and expressed his deep appreciation to all the Members of the Governing Body and thanked them for their suggestions and supports extended to the CSIR as it was his last GB meeting as the DG, CSIR and Chairman, GB, before superannuation.

The 199th CSIR GB Meeting

The 199th CSIR GB Meeting was held on October 1st, 2022. The meeting was chaired by Dr N Kalaiselvi, the newly appointed Director General of CSIR and Secretary, DSIR. The GB Members welcomed the new Chairperson and DG, CSIR to her first GB meeting. Two new GB members, Dr N Anandavalli, Director,

CSIR-SERC, Chennai and Dr D Srinvasa Reddy, Director, CSIR-IICT, Hyderabad, were also introduced and welcomed for their first GB.

Welcoming the GB Members, Dr. N Kalaiselvi, Chairperson, GB & DG, CSIR, made a brief presentation and stressed on the importance of leveraging the expertise of CSIR during the *Amrit Kaal* and envisaged a revitalized and empowered CSIR, especially during CSIR@80 to CSIR@100 with a greater visibility of CSIR.

The DG, CSIR briefed on the legacy of CSIR in "providing India-specific Science & Technology Solutions" and the role of CSIR in future to become "Reliable, Real-time, Sustainable, Unique & Ultimate solution provider".

In her presentation, the DG, CSIR emphasized the focus of CSIR to become "Nodal & Model for Global STI in 2047".

Agenda items of 199th GB Meeting:

- Confirmation of the proceedings of the 198th GB meeting held on April 27th, 2022.
- Action taken on the proceedings of the 198th GB meeting.
- Proposal for demolition of 12 staff quarters of colony behind the institute at CSIR-CSMCRI, Bhavnagar - approval thereof.
- Demolishing of elevated reservoir near Purchase Section at NCL – approval thereof.
- Proposal for demolition of unutilized dilapidated infrastructure for more than decades - Demolition of 16 nos. type II staff quarters, 01. No. type VI quarter and abandoned room/ building beside Old Thermal Shed at CSIR - CMERI - approval thereof.
- Dismantling of distressed folded roof structure in CSIR-CSIO, Chandigarh - approval thereof.
- Alienation of CSIR - Central Leather Research Institute land measuring 2656 sq meter in favour of Highways Department, Chennai Metropolitan Plan Division II, Chennai for construction of Grade separator at Rajiv Gandhi Salai (OMR) and Sardar Patel Road junction at Madhya Kailash, Chennai - approval thereof.
- Payment of Honorarium for external (official and non - official) members of Internal Complaints Committee - approval thereof.
- Regularization of Reduction in the number of steps for final selection of proposals from Industry (IOP) under CSIR - NMITLI - ratification thereof.
- Amalgamation of Consultancy Development Centre (CDC) with CSIR - information thereof.
- Reporting of Global Tender Enquiries (GTEs) floated during the period from January 8th, 2021 to April 8th, 2022 - information thereof.
- Placement of proceedings of Performance Appraisal Board's (PABs) meetings of Constituent Laboratories/ Institutes of CSIR - information thereof.
- Approval of the Cabinet for "Widening access of the Traditional Knowledge Digital Library (TKDL) database to users, besides patent office" - information thereof.
- CSIR Awards for S&T Innovations for Rural Development (CAIRD) – information thereof.
- Adjustment of excess DPC incumbents holding the posts of ASO(Gen/F&A/S&P), consequent upon reduction of DPC Quota from 50% (as per CSIR ASPR Rules, 1982) to 25% (as per CSIR ASRP Rules, 2020) - approval thereof.

Supplementary agenda items of 199th GB Meeting:

- Consideration and Recommendation of the CSIR Annual Report for the Year 2021-22 - approval thereof.
- Consideration and Adoption of Annual Accounts of CSIR for the Financial Year 2021-22 - approval thereof.
- To designate CSIR – Fourth Paradigm Institute with Director as per Rule 53A of Rule and Regulation and Bye – Laws of CSIR - approval thereof.
- Revision of CSIR's Research Fellowship Guidelines - approval thereof.
- CSIR Technology Awards (CTA) 2022 - information thereof.

The 200th CSIR GB Meeting

The meeting was presided by Dr Jitendra Singh, Hon'ble MoS (IC) of S&T and Vice President, CSIR, as the Guest of Honour.

Dr N Kalaiselvi, Chairperson, GB & DG, CSIR, welcomed all the members for the meeting and informed that the 200th GB Meeting is a paperless meeting. The DG, CSIR, made a presentation on the achievements of CSIR from the 199th to the 200th GB Meetings. The DG, CSIR, informed that the CSIR Society Meeting was chaired by the Hon'ble Prime Minister of India and President, CSIR, on October 15th, 2022

and the Hon'ble PM, on October 10th, 2022 dedicated to the Nation, the CSIR technology-based 10,000 TPA Hydrazine Hydrate plant at GACL, Dahej, Gujarat. The DG, CSIR added that with the commercialisation of the technology, India would be saving ₹ 400 crore per annum in foreign exchange. The DG, CSIR, said that the 'One Week, One Lab' campaign announced by Hon'ble Minister S&T, Dr Jitendra Singh, on the CSIR Foundation Day 2022 will be rolled out on January 6th, 2023. CSIR's role in the G-20 programmes and plans for IISF-2023 were also highlighted in the presentation. Some of the notable technologies transferred during the period, accolades, etc, were also presented.

The Hon'ble Minister S&T, Dr Jitendra Singh, addressed the landmark 200th CSIR Governing Body Meeting. The Hon'ble Minister, S&T, made the announcement on a Special Call for Research Grant Proposals for Women Scientists. The call for research grant proposal is for women scientists including those who have taken a career break and are interested in returning to research and re-establishing their career. Keeping in tune with the transformations happening in CSIR, the Hon'ble Minister also released the new tagline, ***CSIR-The Innovation Engine of India.***

Dr Jitendra Singh said that the 'One Week, One Lab' initiative of CSIR should serve to augment outreach and visibility of the laboratories and their activities. The Hon'ble Minister added that CSIR should involve industries right from the beginning when nurturing start-ups.

Dr Jitendra Singh said, the legacy of CSIR is built on the cumulative contribution of its several national laboratories and institutes. He said, each laboratory of CSIR is unique and specialises in as diverse areas as genomics to geology, material technology to microbial technology and food to fuel.

The Hon'ble Minister called upon a pool of CSIR scientists to reorient and revitalise the organisation to emerge as Global Centres of Innovations in the *Amrit Kaal*. The implementation of paperless E-office across all labs with effect from April 1st, 2023 and E-performance appraisal system for administrative cadre staff for Reporting Year 2022-2023 and onward was also appreciated.

The Hon'ble Minister also suggested that a virtual summit of all labs can be held regularly in which they can learn new things from each other's experience.

Agenda items of 200th GB meeting:

- Confirmation of the Proceedings of the 199th meeting of the GB, CSIR held on October 1st, 2022.
- Action taken on the proceedings of the 199th meeting of the GB, CSIR.
- Providing Council premises at CEERI, Pilani, measuring 27.31 Sq.m. on rent to Post Office for services at CEERI Campus - approval thereof.
- Demolishing of distressed car garages structure in CSIR-CSIO, Chandigarh – approval thereof.
- Providing Council premises at CEERI, Pilani, measuring 288.27 Sq.m. on rent to SBI for banking purposes -approval thereof.
- Consideration and approval of the Committee Report relating to Review of CSIR Resources Centres/ Regional Centres/ Extension Centres/ Zonal Centres/ Branch Laboratories - approval thereof.

- Withdrawal of CSIR procedure for "Losses and Its Write-off" and adoption of procedure stipulated in General Financial Rules (GFR) and Delegations of Financial Power Rules (DFPR) - information thereof.
- Composition of Selection Committee/ Departmental Promotion Committee for various posts under Isolated categories where Director of Labs./Instts or JS (Admn.), CSIR is the Appointing Authority - approval thereof.
- CSIR Residence Allotment Rules, 2022- approval thereof.
- A one-time Special call for inviting research grant proposal from women Scientists under Extramural Research Scheme - approval thereof.

The 201st CSIR GB Meeting

In the 201st meeting of the Governing Body (GB), CSIR, held on February 27th, 2023, Dr N Kalaiselvi, Chairperson, GB & DG, CSIR, welcomed all the members for the meeting and noted that it was the last meeting of the present GB as the tenure was to conclude soon. She extended her profound gratitude to every GB member on behalf of CSIR.

Agenda items of 201st GB meeting

- Confirmation of the Proceedings of the 200th meeting of the GB, CSIR held on December 17th, 2022.
- Action taken on the proceedings of the 200th meeting of the GB, CSIR.
- Amendment of CSIR Guidelines for donation of surplus/obsolete/unserviceable stores in order to expand the scope of eligible donee institutions - information thereof.

CSIR Foundation Day 2022 Celebrations at CSIR Headquarters

On the occasion of the CSIR Foundation Day 2022, a CSIR Leadership Meet, chaired by the Hon'ble Minister (IC) S&T, Dr Jitendra Singh, was held on September 26th, 2022. Details of the same is given in Chapter 1.

The 81st Foundation Day of the CSIR was also celebrated at the CSIR Headquarters on September 26th, 2022. Brief highlights of the function are as follow:

- Several Fun Games/Sports activities including Tug of war, Lemon Race and Musical Chair were organized for the employees of CSIR Headquarters.
- The main function was held in the afternoon of September 26th, in the Shanti Swarup Bhatnagar Sabhagar. The function began with the CSIR Anthem and lighting of lamp. Welcome Address was delivered by the JS (Admn), CSIR, which was followed by the addresses of the DG, CSIR, and the FA, CSIR.

Following mementos, awards, appreciation certificates were presented during the function:

a) Mementos (shawls, wrist watches and *sammaanpatras*) were presented to the Retirees for the year 2021 & 2022 *(Foundation Day Celebrations 2021 was put on hold due to COVID-19 pandemic).*

b) Mementos (wrist watches) were presented to the employees who had completed 25 years of service in CSIR in the year 2021 & 2022 *(Foundation Day Celebrations 2021 was put on hold due to COVID-19 pandemic).*

c) Appreciation Certificates were presented to the meritorious students (wards of CSIR employees) for securing more than 90% marks in at least three science subjects. Also, Studentship @ ₹ 1500/- per month was awarded to the children of CSIR employees who have secured admission in 2021 & 2022 in (i) B.Tech or integrated M.Sc Courses in IITs; (ii) 2-year long Post Graduate Programme (PGP) in Management through Common Admission Test (CAT) in IIMs and (iii) MBBS Course in AIIMS, New Delhi and AFMC, Pune after qualifying the competitive exam.

d) Awards for the winners of the fun games (organised for the CSIR employees) were presented.

- The Staff of CSIR Hqrs presented a cultural programme, following which the Chairperson of the Foundation Day Committee delivered the vote of thanks.

Headquarters Activities

11.0 Headquarters Activities

11.1 Central Planning Directorate (CPD)

Budgeting and Planning

The Central Planning Directorate (CPD) is mandated to facilitate the overall CSIR Budgeting & Planning activities for CSIR with inputs from various divisions, Directorates, CSIR laboratories/ units and other stakeholders. CPD has carried out the budgeting and related planning for CSIR for FY 2022-23 and also coordinated the budget planning and allocation as per BE/RE for CSIR research activities under FTT/ FTC/ NCP/ FBR/ FCP projects and Mission Projects and allocation and release under CSIR Infra Budget Heads for all CSIR laboratories/ units/ centers for carrying out their infrastructure management and day-to-day activities.

The Directorate prepared the Demands for Grants document for FY 2022-23 along with drafting replies to the questionnaires and coordinating the presentation of the DG, CSIR and Secretary, DSIR for Department related Parliamentary Standing Committee on Science & Technology, Environment & Forests and Climate Change. Action Taken Report (ATR) for Department related Parliamentary Standing Committee on Science & Technology, Environment & Forests and Climate Change on Demands for Grants for FY 2022-23 as per their 360 & 368 reports have been prepared and submitted by CPD.

Responses to Parliament Questions

The CPD has prepared responses to Parliament Questions on varied issues such as the performance of CSIR, socially useful technologies and products developed by CSIR, Research & Innovation facilities, schemes for skill development, Aroma Mission, research projects of CSIR, self-financing of CSIR, facilities for Research & Development, participation of people in R&D, pollution by Green Crackers, Role of CSIR, Central Drug Institutes in the Country, CSIR Research Scholars, CSIR Laboratories, Research Fellowship, Scientific Temper among Children, among others. For the Monsoon & Winter sessions of 2022 and Budget session of 2023, around 320 questions were responded to, including CSIR inputs provided to DST and other Ministries.

The CPD provided inputs relevant to CSIR likely to be raised in the Parliament sessions and submitted the same to the Ministry of Parliament Affairs.

Inputs for Draft Cabinet Notes/EFC/SFC of different Ministries/Departments

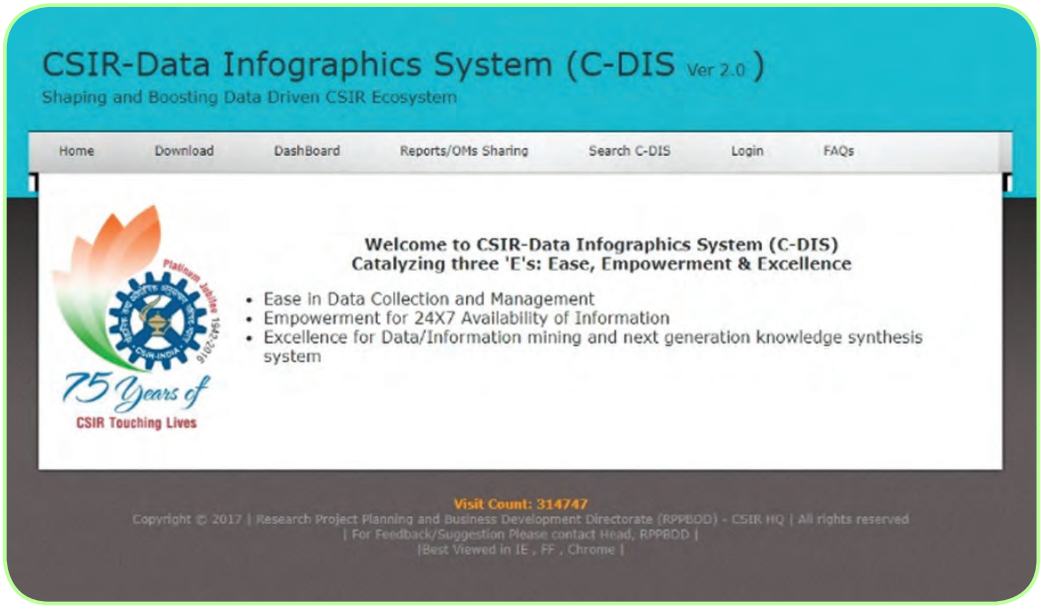
The Directorate acted as a nodal point for preparing CSIR inputs/observations for important Draft Cabinet Notes (DCN), Cabinet Proposals, Projects/ Schemes/Memorandum of different Ministries/ Departments for the consideration of the Expenditure Finance Committee (EFC) and Standing Finance Committee (SFC). These notes/proposals are on varied issues such as the National Science, Technology and Innovation Policy, 2022 (STIP 2022); Modified Programme for Development of Semiconductors and Display Manufacturing Ecosystem in India; Drugs, Medical Devices and Cosmetics Bill, 2023; Strengthening Cooperative Movement in the Country and Deepening its reach up to the Grassroots; Digital Personal Data Protection Bill, 2022; EFC Memorandum of Continuation of Atal Innovation Mission; Critical and Strategic Minerals India's Strategy and Roadmap, among others. During the year, CPD examined around 35 DCN/ EFC/SFC memorandums and provided CSIR inputs/ observations.

Co-ordinating Hon'ble Minister's visit to CSIR constituents

Constituent laboratories/Units of CSIR invite different Ministers to various events of National importance for show casing CSIR activities and achievements. In this direction, CPD coordinated visits of the Hon'ble Minister for Science & Technology, Dr Jitendra Singh, to different CSIR labs/units and for CSIR Hqrs events.

Management of the CSIR C-DIS Portal and providing data for the DARPAN Portal

The CPD is managing the C-DIS (CSIR Data Infographics) Portal which is being used by PAN CSIR as a centralized system for data collection, coordination and curation. The system is designed and developed in-house by



CPD. Apart from this, CPD is the nodal Directorate for providing data for Project's / Scheme's KPI information listed on DSIR/CSIR DARPAN Portal.

Constitution of Boards and Committees

Performance Appraisal Boards (PABs)

In accordance with the CSIR Rules & Regulations and Bye-Laws (59, 60A & 61), CSIR constituted a Performance Appraisal Board (PAB) for each of its Constituent laboratories/ institutes for assessing the performance. CPD prepared a lab-wise summary of the PAB proceedings after completion of the appraisal exercise along with agenda items for information of the CSIR Governing Body.

Re-constitution of the Advisory Committee (AC)

The Advisory Committees (ACs) have been constituted by CSIR for each of its constituent units for a period of three years. The Advisory Committee steers research programmes and manages affairs of the units within the framework of CSIR Rules & Regulations and Bye-Laws. The Directorate re-constituted the Advisory Committees for CSIR-TKDL, Delhi and CSIR-URDIP, Pune for 3 years comprising 8-10 high-level eminent scientists and technologists.

Fact Finding Committee to look into the issue of distribution of monies

CPD coordinated a Fact Finding Committee to look into the issue of distribution of monies (on account of honorarium) in CSIR-CIMFR during the period 2017-18 to 2020-21. The CPD also prepared CSIR inputs to PMO on the brief status and a way forward for a few issues/ technologies related to CSIR.

Facilitation of Various Projects

Development and Certification of 19 seater Light Transport Aircraft (SARAS Mk2)

The CPD is coordinating CSIR's ambitious project SARAS Mk2. SARAS Mk2 has been approved for continuation in the 15 FCC and a steering committee has been formulated as per the direction of former Hon'ble MoST for monitoring the progress of the project under the chairmanship of the DG, CSIR and Secretary DSIR. Based on the recommendation of the Committee, the project received SFC revision with time overrun without cost overrun.

Facility Creation Projects

CSIR has operationalized Facility Creation Projects (FCP) for funding of projects to build a new infrastructure or upgrade the existing one in order to meet new technological challenges and for generating revenues. Facility Creation Projects are not only meant for building/ infrastructure creation, rather they are expected to have good potential for ROI. These projects are supported only under Capital Budget Head with an intention to seed self-sufficiency by judicious planning and business exploitation from the proposing labs. Six ongoing Facility Creation Projects (FCP) are supported by CSIR HQ as on March 31st, 2023.

Coordination of the CSIR CHAMP project

The CPD is coordinating a project aimed towards setting up CSIR HPC, AI & ML Platform (CHAMP) at CSIR-4PI. The CSIR project aims towards setting up a CSIR HPC facility with the 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.

Coordination of CSIR TKDL project/s

The CPD is coordinating CSIR-TKDL project/s aimed towards safeguarding India's Traditional Knowledge against Bio-piracy attempts at International Patent Offices.The efforts include the Indian system of Medicine/Practices from Ayurveda, Unani, Yoga, Siddha and Sowa Rigpa. The Directorate also provides support to CSIR-TKDL for the modernization and upgradation of the IT infrastructure of the TKDL Unit in order to widen its scope as per National IPR policy and National ambitions.

Audit Matters

The CPD as the nodal Directorate is looking after the CSIR and its laboratories'/institutes' related Audit matters (both internal and external audits for all the projects).

e- Samiksha

The Directorate has been working towards matters related to e-Samiksha pertaining to CSIR Hqrs. Till now the CPD has responded to more than a hundred OBS/s and UID(s) to DSIR.

11.2 Director General's Executive Directorate (DGED)

The Director General's Executive Directorate (DGED) has the responsibility of coordinating, assisting and facilitating various scientific & technical assignments for the Director General, CSIR. The Directorate also interfaces with all CSIR laboratories/institutes and with various Directorates, Divisions and Units of the CSIR headquarters on important S&T matters. The DGED is also entrusted with collating, updating and submitting information sought by PMO, Cabinet Secretariat, Office of the Minister of Science and Technology, Principal Scientific Advisor and other offices from time to time.

Further, the DGED engages with various Ministries, Departments, Academic Institutions, etc., for various events/occasions like convocations, conferences, foundation days etc., and facilitating the same through messages, presentations and so on.

The DGED schedules and organizes important meetings of the DG, CSIR. These include the CSIR Theme Directors meetings, HoDs meetings of CSIR Hqrs, the CSIR Directors meetings and so on. The DGED also catalyses implementation of the decisions taken in the meetings including the CSIR Society, CSIR GB and so on.

11.3 Human Resource Development Centre (HRDC)

CSIR's Human Resource Development Centre (HRDC) has the mandate of training & development, nodal agency for third party audit and skill India initiative in S&T domain. During the year, the Centre was engaged in organizing brainstorming sessions, training programmes, TPA and CSIR integrated Skill India Initiative. The Centre started organizing residential training programmes post COVID-19 pandemic and organized few residential training programmes at the Centre and other CSIR Labs. Other significant activities of the Centre during the period are given here under:

International knowledge sharing workshop on cross border Innovation Acceleration and Challenges in International Transfer of Technologies

International Knowledge Sharing Workshop on Cross-border Innovation, Acceleration and Challenges in International Transfer of Technologies was jointly organized during November 14-15, 2022 by CSIR & DSIR, Ministry of Science & Technology, India, in association with Asian and Pacific Centre for Transfer of Technology (APCTT) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). CSIR-HRDC coordinated the workshop in Hybrid Mode. Out of around 350 participants registered for the programme, 36 were international participants from 17 countries. Nearly seventy participants joined the workshop in-person.

The workshop panelists belonged to various domains including International Organizations such as FAO, ILRI, ISA, DWIH, UKRI, RIS; Indian National Organizations such as CSIR, IITD, SPMVV, Government Departments including Office of PSA, MoE Innovation Cell; Public Sectors Units like NRDC; Industries such as International Tractors, IOCL, TATA Power Company Limited, Ankur seeds and Mahyco Pvt. Ltd.; Innovation eco-system partners such as Research Parks, Incubation Centres and start-ups.

Major Training & Development Programmes for Scientists & Technical personnel

The major programmes organized to develop skills and competencies of CSIR Scientists & Technical personnel have been:

- Programme on Excellence in Leadership (for Newly Joined Directors)
- Programme on Emerging Trends and Best Practices in R&D Project Management
- Planning, Monitoring and Evaluation of R&D Projects for Scientists
- Induction Programme for Newly Recruited Scientists
- Programme on Excellence in Leadership
- Coordinators' Conclave-cum-Workshop for "CSIR Integrated Skill Initiative Programme"

Training Programmes on Administration and General Management

- Orientation Programme for newly promoted Section Officers
- Programme on RTI and transparency audit
- Orientation Training Programme for recently promoted SOs and recently joined ASOs
- Programme on Procurement of Goods and Services
- Awareness Programme on Gender Sensitization and Sexual Harassment of Women at Workplace: Prevention, Redressal and Procedures
- Workshop on Procurement Procedures on GEM (for CSIR-CBRI Roorkee)
- Programme on Noting, Drafting and Service Rules for Lucknow based laboratories; (CSIR-IITR, CSIR-NBRI, CSIR-CIMAP, CSIR-CDRI)
- Workshop on Government e-Marketplace (GeM) for CSIR-CLRI, Chennai
- Programme on Work-Life Balance

Third Party Audit under RTI Act

CSIR-HRDC carried out third party audit of the 44 Public Authorities under DSIR [i.e. DSIR(1), CSIR(40), AcSIR(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.

During the year, the Centre has conducted Third Party Audit of 39 Public Authorities of DSIR and Indian Institute of Management, Lucknow, under Ministry of Education (MoE), for proactive disclosures under RTI Act. During the period, the Centre has earned external cash flow of ₹ 2.95 Lakhs through Third Party Audit of public authority, IIM Lucknow, under MoE.

CSIR Integrated Skill India initiative

CSIR has been contributing significantly to the progress of scientific and technological development in the country through its major programme "CSIR Integrated Skill Initiative" across different CSIR laboratories at various levels by providing training in diverse areas for undergraduates, post graduates and research students. They are also engaged in conducting Industry oriented training/ skilling programmes that have been well accepted by users. These skilled/ training programmes are also connected to possible employment generation including small scale technopreneurship.

In order to enhance the success-rate of this programme and achieve better employment generation, several CSIR laboratories are conducting National Skill Development Corporation (NSDC) accredited courses and many of them are now connected with Sectoral Skill Councils (SSC) like Leather, Life Sciences, Agriculture, Capital Goods, Automotive, Paint & Coating and Aerospace & Aviation. CSIR-HRDC is performing the nodal responsibility for this programme in coordinating, monitoring, facilitating and implementing the activities among all the participating CSIR laboratories and connecting them to NSDC and SSCs.

CSIR Integrated Skill Initiative is successfully progressing in its Phase II (2020-25). The measurable outcomes for the period from April 2022 till February 2023 is as below:

Total no. of Skilling/ Reskilling programmes = 622

Total no. of personnel trained = 17226

During the year, CSIR-HRDC in association with CSIR-NIO, Goa conducted the Coordinators' Conclave-cum-Workshop for "CSIR Integrated Skill Initiative Programme" during February 16-17, 2023 with the objective to review and prepare future course of action.

Coordination of Brainstorming Session

The Centre has coordinated the Brainstorming Session on Additive Manufacturing in April 2022. Fruitful discussions in the brainstorming session provided the opportunities for future collaborations between CSIR and Industries/academia in India and abroad.

Programme on Noting, Drafting and Service Rules, February 6-7, 2023, at CSIR-IITR, Lucknow.

One Day Workshop on GeM organized at CSIR-CLRI, Chennai, on February 13th, 2023

International knowledge sharing workshop on cross border Innovation Acceleration and Challenges in International Transfer of Technologies during November 14-15, 2022

Coordinators' Conclave cum Workshop for CSIR Integrated Skill Initiative (February 16-17, 2023) in association with CSIR-NIO, Goa

Induction Programme for Newly Recruited Scientists organized at CSIR - IHBT during February 13-18, 2023

Excellence in Leadership Programme organized during December 8-9, 2022

Training/Awareness Programme for PME Scientists/Financial Officials of CSIR labs commenced at CSIR-CDRI (August 25-26, 2022)

Programme on Work Life Balance at CSIR-HRDC, Ghaziabad (March 14th, 2023)

11.4 Human Resource Development Group (HRDG)

The Human Resource Development Group (HRDG) of CSIR works with the following mission & vision:

- to promote and foster upgradation of the stock of well qualified, highly specialized scientists, engineers and technologists for R&D in all disciplines of S&T in the country.
- to have an integrated approach to National Human Resource Development for Science, Engineering & Technology by encouraging and promoting research in the Universities and Institutes of higher learning.
- To invest in basic and interdisciplinary research that is harbinger of the 'high-tech' and technology of tomorrow.

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. To achieve this goal, CSIR-HRDG has been implementing a scheme *"Capacity Building and Human Resource Development" which has four sub-schemes viz. (i) Doctoral and Postdoctoral Fellowship Scheme, (ii) Extramural Research Scheme and Emeritus Scientist Scheme, (iii) Promotion and Recognition of Excellence through award scheme, and (iv) Promoting knowledge sharing through Travel and Symposia Grant Scheme.*

Significant activities of HRD Group during 2022-23 are:

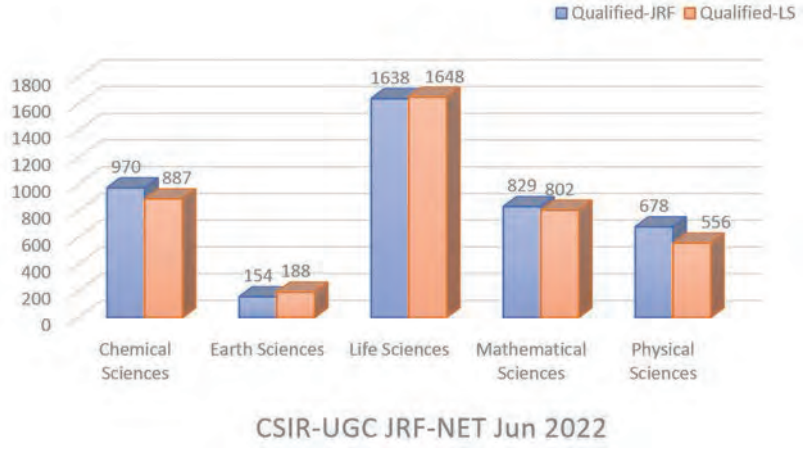
National S&T Manpower Development

Junior Research Fellowship (JRF)

The CSIR-UGC NET June examination was conducted online during September 16-18, 2022 at 306 centres in 166 cities across the country. A total of 221746 candidates registered and 162084 candidates appeared for the examination. The result was declared on November 16th, 2022. A total number of 4269 candidates qualified for CSIR/UGC Junior Research Fellowship & lectureship and 4081 qualified for lectureship only.

Subject	Chemical Sciences	Earth Sciences	Life Sciences	Mathematical Sciences	Physical Sciences	Total
Qualified-JRF	970	154	1638	829	678	4269
Qualified-LS	887	188	1648	802	556	4081

Out of 4269 candidates qualified for JRF, 3300 are to be supported by UGC and rest by CSIR.



CSIR-UGC JRF-NET Jun 2022

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 2022-23, sixty (60) Senior Research Associates were selected and their total number as on March 31st, 2023 was 145.

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 2022-23, twenty-five (25) JRF-GATE fellowships were awarded and around 152 JRF-GATE Fellows have been working at end of financial year 2022-23 in different CSIR laboratories.

To contribute in Digital India Initiative of the Government of India, CSIR YUVA (Yuva Vaigyakink Anveshan) Portal for inviting online applications from young postgraduates and doctorates researchers has been launched. The YUVA portal will digitally empower the young researchers who will contribute in the scientific, technological development and knowledge economy of the country in near future. The YUVA portal is fully online portal from submission of application to final selection for award of Senior Research Fellowships (SRF-Direct) and Research Associateships (RA). The YUVA portal is operational and 5000 plus online applications have been received in the portal. Now the selection process is underway.

Under its "Capacity Building and S&T Human Resource Development: Doctoral and Postdoctoral Fellowship Programme" at CSIR-HRDG, CSIR provides age relaxation of 5 years to women candidates in upper age limit for award of Fellowships/Associateships to pursue doctoral and postdoctoral research with the aim to encourage women candidates to opt science and technology as career.

As a result of the steps taken by CSIR to encourage women in the field of S&T, the women participation has witnessed an upward trend in their overall strength in the doctoral and postdoctoral fellowships awarded by CSIR. In the year 2022-23, the women representation is about 45.8% of about 9000 doctoral and postdoctoral research fellows being supported by CSIR across the country, as compared with 36% in 2017-18 and 42% in 2018-19.

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 2022-2023 are as given below:

Schemes	No. of Proposals Considered	Proposals Recommended	Proposals Renewed
General	479	144	506
Emeritus Scientist	52	32	72
Sponsored	35	10	20

To empower women scientists and to celebrate the *Amrit Kaal*, CSIR has instituted "A Special Call for Research Grants for Women Scientists (CSIR-ASPIRE)" with the objectives:

- To align the Government of India's initiative to empower women and promote 'Nari Shakti' in the country
- To support the Hon'ble Prime Minister's efforts to put Nari Shakti at the forefront of India's development journey

Nearly three thousand online applications have been received from women scientists/academicians for seeking support under CSIR's Scheme.

Travel / Conference Grants

Travel grant is provided by CSIR to young researchers for presenting research papers at International conferences abroad. For organizing national/ international conferences/ symposia/ workshops etc., a total of 1352 proposals from universities/institutes/ scientific societies etc were considered and 281 cases were recommended for support. Similarly, a total of 1137 research scholars from Indian academic and R&D institutions applied for travel grant support to present their research work abroad and CSIR recommended

458 research scholars to present their research work abroad under its scheme for promoting knowledge sharing.

Schemes	Total Considered	Total Recommended
Travel Grant to students	1137	458
Travel Grant to regular employees	127	67
Symposia Grant	1352	281

CSIR Jigyasa

The President, CSIR and Hon'ble Prime Minister of India, Shri Narendra Modi, in the CSIR Society Meeting held on April 6th, 2016 had suggested CSIR to create a vibrant student-scientist interaction. Following the direction articulated by Hon'ble Prime Minister, the CSIR and Kendriya Vidyalaya Sangathan (KVS) signed an MoU on Student – Scientist Connect program 'Jigyasa' on July 6th, 2017. CSIR's Jigyasa program is aimed to inculcate the culture of inquisitiveness and scientific temper among the students. Till date, more than 4,50,000 students and 5000 teachers have benefitted, directly since its inception in 2017.

The Hon'ble Prime Minister of India and President, CSIR, in the CSIR Society Meeting held on February 14th, 2020, had appreciated the student outreach Jigyasa program and stressed on the importance of developing virtual labs so that science can further be taken to all segments of the students residing in each and every corner of the country. In this regard, CSIR has developed a Virtual Lab (VL) Platform in collaboration with Indian Institute of Technology, Bombay (IITB), under Jigyasa program, and the VL platform was launched by the Hon'ble Minister of S&T, Dr Jitendra Singh on November 22nd, 2021.

More than 170 activities such as comics, infographics, videos, simulations, games, podcast etc. are available on the Jigyasa online portal. The major objective of Jigyasa 2.0: Virtual Lab integration program is to develop an inspirational science lab where students will play, simulate, experiment, read and have fun while carrying out experiments virtually from any part of the natio". During 2022-23, more than 290 Atal Tinkering Labs (ATL) Schools have also been adopted to enable students' curiosity to learn better.

CSIR signed the following MoUs under Jigyasa program:

CSIR, India and Chief Development Officer (CDO) Bulandshahr signed MoA in presence of the Hon'ble CM of Uttar Pradesh, Shri Yogi Adityanathji on August 27th, 2022. A total of 866 Government schools at Bulandshahar are to be benefitted through the MoU and special attention will be given to 109 astronomy labs set up under the Jigyasa program.

CSIR and Royal Society of Chemistry (RSC) signed MoU on September 22nd, 2022, in the presence of the DG, CSIR along with Dr Paul Lewis FRSA, Chief Operating Officer. During the occasion, a Coin Battery Experiment was also organized in which 2000 students and 30 CSIR laboratories participated.

Another MoU was signed between CSIR, India and Karnataka Science and Technology Academy (KSTA) in the presence of Prof. S Ayyappan, Chairman from KSTA, Head, CSIR-HRDG, Director CSIR-NCL and Director CSIR – NIEST on June 20th, 2022.

11.5 Information Technology Directorate (ITD)

The following are the significant activities of the Information Technology Directorate (ITD) of CSIR during the year:

Implementation and Management of Aadhaar Enabled Attendance system (AEBAS)

The Division contributed as nodal division for implementation and management of Aadhaar Enabled Attendance system (AEBAS) system in CSIR and its labs along with implementation of IP based surveillance system. To meet the surveillance requirement, the division implemented IP based surveillance system for CSIR Hqrs and in Science Centre also.

Coordination with MHA and CSIR Labs for IT/ Cyber Security Policies Implementation

The communication received from MHA regarding the vulnerability/Security threat forwarded to concerned labs along with technical guidance for remedies and their response forwarded to MHA. The Division coordinated with CSIR Labs to implement IT related policies and followed up for their compliance as directed by Miety, Cert-In etc. by all the CSIR Labs.

DARPAN (Dashboard for Analytical Review of Projects Across Nation)

The Division coordinated and facilitated in implementation of DARPAN, which is developed by NIC with a vision for "Analytical Monitoring of the Plans and Schemes of Government at various Level through one consolidated dashboard with anytime and anywhere access". The dashboard displays information in an objective and quantifiable way, helping to get a comprehensive view of the whole issue in a single window access for identified Programme/Schemes

Supporting IMPACT and other Legacy Software

The Division coordinated and facilitated Finance division of CSIR Hqrs for processing financial data for preparation of their balance sheet and various financial reports to be submitted by CSIR. The technical support for section specific legacy Application Software such as Recruitment, R&I, ISTADS, monitoring / follow up cases by O/o DG CSIR have been maintained by the division

Implementation of SPARROW system of APAR for the Non-Technical Cadres in CSIR

The IT Division Coordinated with NIC Team for data collection of employees. The Division provided support to Nodal Officers of each CSIR lab for timely data collection and data validation. The Division also provided the IT infrastructure, platform and support to the SPARROW Team for training and timely implementation of SPARROW System.

CSIR's Face Recognition based Attendance System

The Division contributed by facilitating IT infrastructure for setup, installation and running of FRAS system. The IT Division is nodal point to coordinate with CEERI Team for the device setup and facilitate service at CSIR-HQ and its location in Delhi.

eOffice (eFile) implementation at CSIR Hqrs and its units and all CSIR Laboratories/Institutes

The Division provided operational and functional support to all eOffice users of the CSIR HQ and its units. Access of eOffice through Web VPN are functional in CSIR Headquarters. The process of implementing the e-office in all CSIR Laboratories has been initiated.

Implementation of Digitization for CSIR

- Initiation of digitization process for recruitment module for CSIR Hqrs.
- Initiation of digitization process for recruitment and assessment module for RAB.

- Initiation of digitization process for recruitment and assessment module for CSIR as whole.
- Design and development of in-house ITAPPS system to support various functions of different teams of CSIR Hqrs.

11.6 Innovation Management Directorate (IMD)

Innovation Management Directorate (IMD) handles the Mission mode projects, NMITLI Projects, and COVID-19 MLP projects of CSIR. The Directorate also handles a few policies initiatives -project related, audit queries, parliamentary questions, Draft Cabinet Note Comments, other forms of reporting, etc. Key initiatives handled by IMD during the year 2022-23 include the following:

CSIR-COVID-19 and Society MLP Projects

CSIR pursued focused R&D to develop, integrate, scale up, and deploy necessary technological interventions for combating COVID-19 in the Country. Considering the multifarious problems created by the coronavirus which require interventions in several areas and a multi-pronged strategy, CSIR set up five technology verticals for addressing the emerging situation due to pandemic. Since inception, 51 distinct projects under 5 verticals viz., diagnostics, drugs, digital & molecular surveillance, hospital and assistive devices and supply chain & logistics support management were approved.The details of the MLP projects in the FY 2022-23 is given below:

Project Title
Culturing of coronavirus and its variants and discovery of potent SARS-CoV-2 inhibitors assisted by High throughput antiviral screening and testing facility.
Waste water based Epidemiological Monitoring for SARS-CoV-2 Virus and Antibiotic Resistant Bacteria
Development of mRNA platform for Vaccines and Biotherapeutics
Phenome India-CSIR Health Cohort Knowledgebase
CSIR Multi-centric long term T cell immune monitoring for COVID-19 (PoV-CoV)
HPC Cloud Resource at CSIR for COVID-19 Researchers support for Indian Researcher
AI enabled multi-modal sensing system for Non-Contact Monitoring of vital signs to screen COVID-19 Suspects.
Development of proof-of-concept vaccine strategies for COVID-19
Repurposing of colchicine for management of COVID-19 patients
Corona Sample Testing Project
Production of indigenous qRT-PCR (INDI-FluorAMP) kit for testing of Covid-19 with all MAKE-IN INDIA ingredients

Mission Mode Projects

CSIR's Mission Mode Projects (MMPs) are being implemented in identified areas by synergizing the best competencies available in various CSIR labs and outside institutions and focused in a particular area in a concerted way with the ultimate aim of designing, developing, and deploying products and technologies with stakeholder support addressing an unmet need and import substitution under the *'Atmanirbhar Bharat'* initiative of the Government of India. In the FY 2022-23, following 14 missions were under implementation:

Project Title
CSIR Innovation Centre for Next Generation Energy Storage Solutions [LIB - Lithium Ion Battery]
Indigenous Development of Technologies for Advanced Devices and Laboratory Instruments (IDEAL)
Sickle Cell Anemia Mission-Phase II
Advanced Technological Interventions in Food Safety (ATLAS)
Development of Advanced Materials and Devices for Opto-electronic, Biomedical and Strategic Applications (AMO)
Bulk Chemicals
Aerospace Materials and Technologies (AMT)
CSIR-Phytopharmaceuticals Mission Phase-II
Discovery and Pre clinical development of Antiviral for Covid 19 and other Diseases
Immuno modulatory function of Nutritionals and a nutraceuticals for health and wellness (IMMUNITY)
AI Enabled Technologies and Systems
Hydrogen Technology Mission
Plastic Depolymerization and Upcycling
Medical Instruments and Devices

CSIR-New Millennium Indian Technology Leadership Initiative (CSIR-NMITLI) Program

The strategy adopted for NMITLI is to obtain an inverse risk-investment profile i.e. low investment - high-risk technology areas (with global leadership potential) with investments increasing as developments take place and the projects move up on the innovation curve with reduction in risks. Therefore, the program has been positioned differently with certain distinctive features. These features have been evolved based on large scale national consultation and due diligence.

In the FY 2022-23, following 5 projects were under implementation.

Project Title
Development of Innovative eco-friendly / formaldehyde free Fluorescent Pigments for vast array of water and solvent based applications
Developing Dental Implants for Advanced and Critical Applications
Development of novel anti-stroke phytopharmaceutical formulation from the roots of a Ashwagandha variety, NMITLI-118
Industrially scalable Ashwagandha (*Withaniasomnifera*) charged formulation for better bone health
Development of Ayurveda based botanical drugs for prophylaxis and management of the New Corona Virus Disease (COVID-19)

Key Project Highlights

COVID-19 MLP Projects

Umifenovir Clinical Trial

Umifenovir was selected as a candidate for drug-repurposing against SARS-CoV-2 by CSIR-CDRI. CSIR-funded Clinical Trials under project titled "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 completed.

The clinical trials were undertaken at three clinical trial centers in Lucknow as per the protocol/study design approved by the Drug Controller General of India (DCGI). The results of the trial (*Int J Infect Dis*. 115:62-69, 2022) showed that the drug exhibits statistically significant efficacy for mild-asymptomatic patients. It is efficacious, safe, and well-tolerated at the tested dosage of 800 mg BID, maximum 14 days. The expert committee of the DCGI, further, recommended the conduct of large-scale multicentric trial. The trials were conducted by CSIR-CDRI's industry partner M/s Medizest.

Stabilized Prefusion Spike Protein based Vaccine Design for COVID-19

CSIR-IMTech has designed different Spike protein constructs to express it in prefusion stabilized form. These constructs were cloned and expressed in mammalian expression vector, expressed in CHO and HEK-293 cell and protein was purified. The purified protein was used for immunization in mice and anti-Spike antibody elicitation was evaluated by ELISA. Further mice sera will be used for in-vitro SARS-CoV-2 neutralization assays to evaluate the in-vitro vaccine efficacy. Proof of Concept including hamster challenge study has been established.

Mission Mode Projects

Advanced Materials Mission

CSIR has launched a mission project on advanced materials, wherein innovation and understanding properties and performance that satisfy the technological and devices developments and materials research are being pursued with an interdisciplinary approach. The development of new materials and their application to deliver a device/prototype/product is being undertaken, through cohesive multidisciplinary R&D efforts of CSIR labs. Some of the tangible outcomes of the Advanced Materials Mission (AMM) project are summarized below:

- Electronic and electrochromic devices (ECD), where the optical properties can be controllably tuned by electrical signals, fall in the family of smart devices with low energy footprint and at the same time contribute to efficient energy utilization and management. The indigenous development of smart electrochromic coating on rigid/flexible substrates with advanced features coinciding with the globally benchmarked materials has been achieved.
- New direct white light emitting materials such as single-phase phosphor, glass-ceramics and phosphor-in-glass (PiG) composites-based materials have been developed that exhibit high thermal stability, high luminous efficacy, and high color rendering index along with tunable correlated color temperature for cool lighting and their potential application in photo-luminescence and electro-luminescence devices and optical fibers.
- Flexible dye-sensitized solar cell/modules for self-powered wearable/portable electronics have been developed indigenously that supports low power sensor/actuator nodes to realize self-powered Internet of Things (IoTs) with indoor power conversion efficiencies greater than 30% realized under standard 1000 lux CFL illumination.

Sickle Cell Anaemia (SCA) Mission - Blood PCR Diagnosis of SCA: Development of a Point of Care device for the detection of mutations causing monogenic genetic disorders: Hemoglobinopathies and musculopathies as the model

CSIR-CCMB has developed a simple, robust and economical point-of-care procedure and devices (namely Direct blood/dried blood spot-based ARMS-PCR) to differentiate between patients, carriers and normal subjects. This inexpensive genetic testing protocol can obviate the need for sophisticated tests and has the potential for use in testing for several monogenic genetic disorders.

The protocol involves the collection of the blood sample on a filter paper (Dried blood spot, DBS) and conducting an ARMS-PCR using a small unprocessed DBS spot in a single tube/reaction which allows the detection of both mutant and wild alleles at the mutation in one reaction. The same protocol works equally well using freshly collected whole blood without any processing. A combination of both types of samples makes it useful in various settings including epidemiological or population-based screening.

The test has undergone several levels of quality testing. This includes using a blinded method for hundreds of samples referred to a National Genetic Testing facility in Hyderabad. The results of many of the samples have been checked with Sanger Sequencing, which is the gold standard for mutation detection. The same method has been tested for individual variability by providing hundreds of blinded samples to various lab staff. Further, close to 6000 samples collected from a screening of school children and high-risk populations for sickle cell anaemia have shown robust results that match with the HB-electrophoresis and HPLC results. A few discordant samples have only highlighted thelimited sensitivity of Hb electrophoresis and have matched with the Sanger sequencing results.

Bulk Bisphenol A (BPA)

Bisphenol-A (BPA) is an essential feedstock for making polycarbonate & epoxy resins used in paints & coatings, adhesives, electronics, packaging & other industries. The global market for Bisphenol-A is projected to reach 7.1 Million Tons by 2027, growing at a CAGR of 2% over 2020-2027. The total estimated annual demand of 1,35,000 tons in India is imported today.

Under CSIR's 'Bulk Chemicals Mission Program, CSIR-NCL has developed a continuous catalytic pilot scale process for the production of 4,4' Bisphenol-A (BPA) from phenol and acetone. Nearly complete conversion (90-99%) of the raw material (acetone) was achieved at steady-state operation. A highly pure colorless BPA is produced in the continuous process.

The uniqueness of the method developed by CSIR-NCL is a novel downstream process technology, which makes this indigenous technology competitive with global benchmarks. The technology will enable the import substitution of this essential raw material and help in India's Atmanirbhar initiative. The process is ready for technology transfer and further co-development to a commercial scale. M/s. Atul Ltd, Gujarat and M/s. Dipak Nitrate Ltd, Vadodara Gujarat has already signed MTA & NDA agreement with CSIR-NCL for BPA process.

Hon'ble Minister of State (I/C), S&T, Dr Jitendra Singh inaugurated the Bisphenol-A (BPA) pilot plant facility on August 21, 2022.

Innovative Technology for Extraction of Critical Metals from SpentLithium-Based Batteries of Any/Mixed Chemistries

India generates over 50,000 tonnes of lithium-ion battery (LIB) waste every year, which is expected to increase threefold by 2025. CSIR initiated a Bulk Chemicals Mission Project to develop a technology that dismantles 100 kg spent LIBs and can extract all metals from LIB electrode material and demonstrate at 1kg product level.

CSIR-NML, Jamshedpur has developed CSIR's first holistic process that can tackle any type of Lithium based batteries, to extract and separate high pure salt products of Lithium, Nickel, Cobalt, Manganese, Aluminium, Copper, and Reusable Graphite. This process ensures the recovery and yield of Li, Co, Ni, Mn (>95%) with purity >min. 99.6% as carbonate/ nitrate/ chloride/ sulfate/ oxide/ phosphates (eliminating iron, aluminium, copper) for direct new battery making. It is a blue print tailored patent filed process that can utilize any type of black mass, which provides recyclers a flexibility to buy/collect/use any type of lithium battery and use them to recover all metals. The process would result in utilization of huge reserves of spent lithium batteries generated in India, and recycling them to recover and supply indigenous metal precursors, which will bring the cost of batteries and in turn the cost of EVs. The pilot plant is slated to be commissioned at CSIR-NML, Jamshedpur, which shall be first of kind Hire-Operate-Transfer (HOT) platform for MSMEs and Entrepreneurs in India. Currently, the lab has signed agreements with five Indian firms.

CSIR H_2T Program

CSIR is implementing CSIR H_2T Program in a Mission Mode Project. The H_2T program has 3 mission components, one each in hydrogen production, hydrogen storage and hydrogen utilization areas. The mission program in green hydrogen production is focused on water electrolysis. The mission program on hydrogen storage is focused on carbon fiber composite tanks for high-pressure (350, 700 bar) storage. And the mission program on hydrogen utilization is designed to further improve (double) the performance of our current fuel cell technology, which has already been successfully licensed to an industry partner.

The mission program on electrolysers comprise development of technologies for PEM electrolyser (10 kW), AEM electrolyser (3 KW) and SOEC electrolyser (1 kW). Each of these programs is targeted to develop and deliver complete systems i.e., integration of stack, the balance of plant and power electronics. Additionally, the programs will focus on the development of the core technologies namely, the electrolyzer stacks and all the key sub-components (e.g., bipolar plates, interconnects, CCMs, MEAs, the balance of stack component, etc) and materials (e.g., catalyst, membranes, graphite composites, electrolytes, ceramic formulations, gaskets, etc) therein.

Additionally, the H_2T program also has 15 other futuristic programs, which are at nascent stages in terms of technology and scale. Some of these programs are likely to feed into the mission program as soon as they demonstrate successful proof of concept demonstration. Some examples of such programs are hydrogen from industrial/ municipal wastewater, electrolysis of sea water, and pyrolysis of biomethane to produce hydrogen and high-value carbon

New Millennium Indian Technology Leadership Initiative (NMITLI) Projects

Demonstration and validation of an LT-PEMFC System for Automotive Application

CSIR under its NMITLI Program launched the project "Demonstration and validation of a LT-PEMFC System for Automotive Application" in PPP mode for designing, developing and demonstrating a car retrofitted with fuel cell stack. CSIR-NCL, Pune and CSIR-CECRI, Chennai Center as part of the Industry Originated Project (IOP) category of the CSIR-NMITLI Program partnered with M/s KPIT Ltd., Pune as an industrial partner in PPP mode for the development of automotive grade PEM Fuel Cell Technology. The major deliverables from the project were: Define Specifications for FC System; Define system Architecture; System FMEA and HAZOP analysis for Automobile; Assembly and Testing Fuel Cell Stack; Simulation Testing with Fuel Cell; Integration Testing of the Vehicle; Performance Testing of the Vehicle; and Road Trials.

After the successful trial run of India's first indigenously developed Hydrogen Fuel Cell (HFC) Stack fitted in a Car at CSIR-NCL, Pune, project team of CSIR and KPIT have up-scaled the developed technology of Fuel Cells and fabricated a Stack of 20 kWe automotive grate LT-PEMFC. It has been retrofitted in Bus and a trial run has been conducted.

The Hon'ble Minister (I/C) S&T, Dr Jitendra Singh launched the first indigenously developed Hydrogen Fuel Cell Bus by KPIT-CSIR.

In the spirit of "*Atmanirbhar Bharat*", CSIR is now focusing on developing vendors who can manufacture the numerous components of fuel cells technology, resulting in the creation of new jobs and reducing dependence on imports.

Novel DPP IV Inhibitor for the treatment of Diabetes

DPP-IV inhibitors are a novel class of anti-diabetic drugs. Sitagliptin is a preferred DPP-IV inhibitor worldwide. The proposer company, Cadila Pharmaceuticals Limited, Ahmedabad had developed a novel DPP IV inhibitor, namely, CPL-2009-0031 as a pro-drug of Sitagliptin in collaboration with CSIR-CDRI and CSIR-NEIST under CSIR-NMITLI. The activity profile of the product is found similar during preclinical studies in Rats & Mice when compared with Sitagliptin. IND-related studies with the compound were completed in the first phase of the project. CPL-2009-0031 was found to be non-mutagenic or non-clastogenic in genotoxicity studies. CPL-2009-0031 did not reveal any adverse effect on sex organs and fertility of male rats in reproductive studies. Overall, the Investigational drug CPL-2009-0031 has been found to be safe in animal studies at doses much higher than the anticipated human dose. Further, all the phases (I, II and III) of the human clinical trial have been completed for the novel investigational product under CSIR-NMITLI. The food effect study was completed without any safety concerns and no significant difference in food effect was observed between CPL-2009-0031 and Sitagliptin. DCGI has granted permission in November 2022 for the manufacturing & marketing of the product as Sitagliptin Fenilelenil Phosphate. This is the first indigenous diabetes drug developed under CSIR-NMITLI.

11.7 Innovation Protection Unit (IPU)

Towards promoting IP culture and strengthening Intellectual Property Rights (IPR) management, CSIR, through its Innovation Protection Unit (IPU), is implementing Intellectual Property Management (IPM) scheme to proactively secure and manage the Intellectual Property assets to realize monetary and strategic value from it.

The Innovation Protection Unit of CSIR (IPU) caters to the protection of Intellectual Property generated across CSIR in various forms such as Patents, Trademarks, Designs and Copyrights. The IPU aims to capture, secure and manage the formidable intellectual property asset so as to realize appropriate and commensurate monetary and strategic value for CSIR and the nation. The Unit protects the intellectual property generated as a result of important R&D activities carried out across CSIR Laboratories/Institutes as well as those generated by EMR grantees of CSIR, and CSIR schemes like NMITLI projects; at national and international levels.

The activities thus cover the patentability assessment and framing of the techno-legal-commercial patent application as per the requirements of the different countries, prosecuting these to secure the IP rights and subsequently safeguarding and maintaining the CSIR's IP. It also encompasses Pre-Grant and Post-Grant Oppositions / Litigation.

The IPU has also initiated a comprehensive Thematic Review of CSIR's IP Portfolio since 2022 based on commercialization status, strategic interest/ importance to CSIR/nation. Under this new Initiative, the CSIR patent portfolio has become lean so as to hold only the patents/patent applications of relevance to CSIR/Nation.

The activities pertaining to the compliance of the IPR issues related to the Biological Diversity Act of India, 2002 were also initiated at IPU as early as 2005, which included complete procedure for seeking approval of the National Biodiversity Authority (NBA) in the case of inventions involving Biological Resources obtained from/occurring in India. The activity entails filing the application for approval, receiving approvals from the NBA by way of execution of Access and Benefit sharing (ABS) agreements and filing the approvals with the Indian Patent Office for compliance.

In addition to securing IP rights, IPU is also involved in vetting of all the MoUs and agreements of CSIR with regard to the IP clauses.

IPU's mandate also includes developing Human Resource in the field of IPR which includes conducting IP co-ordinators meet to harmonise the IP practices across all CSIR labs, provide on the job training to the TIFAC woman Scientists, provide short term internship to graduates, organize seminar/conference/meets in association with HRDC, URDIP, IPO and law firms on different aspects of IP management.

The current active Patent portfolio of CSIR includes 1250 patents In Force (*granted patents*) and 1379 patent applications under prosecution (*in various stages of processing after filing till grant*) in India.

In foreign jurisdictions, CSIR holds 601 unique inventions *In Force*, with a total of 1368 individual patents in different countries. Similarly, in foreign jurisdictions, there are 322 unique inventions under prosecution (*in various stages of processing after filing till grant*), resulting in 623 individual patent applications in different countries.

CSIR holds 94 registered Trademarks emanating from 170 applications. Likewise, the number of registered copyrights is 685 derived from 927 applications. The IP portfolio further comprises 58 registered Industrial designs stemming from 130 applications.

11.8 International S&T Affairs Directorate (ISTAD)

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.

International cooperation activities coordinated during FY 2022-23 are encapsulated as below:

BILATERAL COOPERATION

Country Specific Bilateral Cooperation Programmes of CSIR

Argentina

A high-level Argentine delegation headed by Mr Daniel Filmus, Hon'ble Minister of Science, Technology and Innovation (MINCYT) of Argentina along with 5 other Delegates from Ministry, Embassy and Research Institutions in Argentina visited India. From Indian side, Dr Jitendra Singh, Hon'ble Minister for S&T co-chaired the meeting. Other dignitaries included PSA to the Government of India; Secretaries of DST, DSIR, MoES & SERB; AS (LAC), MEA; and representatives of DBT, DST and CSIR.

The DG, CSIR, Dr N Kalaiselvi proposed that CSIR could support establishment of centres of excellence and incubation centers in Argentina in identified priority

areas. Dr Kalaiselvi expressed CSIR's keen interest in offering human resource development opportunities (capacity building/ skill development programmes) as per the requirements of Argentina. ISTAD disseminated information regarding CSIR-TWAS Postgraduate and Postdoctoral Fellowship Programme. Dr Jitendra Singh and Mr Daniel Filmus jointly announced the call for proposals for 2023-24 under inter-governmental programme between DST, India and the MINCYT, Argentina.

Australia

Several new research linkages were developed both at individual and institution levels with strong connect with the Indian S&T Diaspora.

Monash University: CSIR developed linkages with Monash University under which CSIR-CBRI was networked to identify potential collaborations on building materials. Faculty from Monash University visited CSIR-CBRI and delivered talk on "Fibre-reinforced Polymers for Reinforcement of Seawater Sea Sand Concretes" on January 2nd, 2023 at CSIR-CBRI.

University of Newcastle: Ongoing collaboration linkages and potential cooperation opportunities between CSIR and Australia were discussed with Prof. Ajayan Vinu, Director, Global Innovative Center for Advanced Nanomaterials and Global Innovation Chair Professor, School of Engineering, University of Newcastle on January 13th, 2023. For developing collaboration linkages Prof. Vinu suggested that for potential R&D as well as academic collaborations, CSIR and AcSIR should approach the Australia's Group of Eight (Go8) universities. CSIR participated in the 4th International Conference on Emerging Advanced Nanomaterials (ICEAN) 2022 at Newcastle, Australia and showcased CSIR activities.

Royal Melbourne Institute of Technology (RMIT): A meeting was held on December 6th, 2022 with a four-member high-level team from RMIT. It was informed that

in Phase II of the AcSIR-RMIT joint PhD program, CSIR and RMIT would invite participation of Australian and Indian industries in the program including providing training in identified areas. The DG, CSIR proposed enhancing R&D collaborations in the priority areas such as minerals and metals.

Bangladesh

CSIR – BCSIR Cooperation: S&T cooperation linkages were further strengthened between CSIR, India and the Bangladesh Council of Scientific and Industrial Research(BCSIR) with the signing of a MoU between CSIR and BCSIR on September 6th, 2022. The MoU signed by the Heads of the two institutions, was exchanged in the presence of Hon'ble Prime Minister of India, Shri Narendra Modi and Hon'ble Prime Minister of Bangladesh, Ms Sheikh Hasina during the VVIP visit at New Delhi.

A Joint Working Committee was set up for steering and formulating a Joint Working Programme for successful implementation of collaboration activities under the newly signed MoU between CSIR and BCSIR. The Joint Working Committee met on January 3rd, 2023 and on January 31st, 2023 to discuss and finalise the Joint Working Programme that included the mutually agreed cooperation areas, modes and modalities of cooperation and the administrative and financial terms for execution of the mutually agreed activities.

The DG, CSIR and Secretary, DSIR, Dr N Kalaiselvi, delivered (online) the Plenary Talk on 'Energy and its Challenges' on December 1st, 2022 in the BCSIR Congress-2022 held during December 1-3, 2022 at Dhaka.

Belarus

The meeting of Acad. S.A. Chizhik, First Deputy Chairman of the Presidium of the National Academy of Sciences (NAS), Belarus with the DG, CSIR on November 9th, 2022 deliberated on specific modes for CSIR-NASB partnership.

Series of Topical Interaction meetings between researchers of CSIR and NASB were organized between CSIR and NSB Institutions to share work profiles, interest in collaboration and identify mutual priorities to take forward the collaboration.

- Biological and medical sciences (January 19th, 2023); (CSIR: 10; Foreign: 10; Five (5) CSIR Institutes (IGIB, IITR, CDRI, CCMB and IMTECH))
- Physical Sciences and IT (February 2nd, 2023); (CSIR: 16; Foreign: 9; Five (5) CSIR Institutes (CEERI, CSIO, NPL, CGCRI and 4PI))
- Chemical Sciences (February 9th, 2023): (CSIR:13; Foreign: 9; Five (5) CSIR Institutes (CSMCRI, IICT, NCL, IMMT and CIMFR)
- Technical Sciences (February 16th, 2023); (CSIR:11; Foreign: 9; Five (5) CSIR Institutes (CMERI, AMPRI, CGCRI, IMMT and NML)

Czech Republic

CSIR-CAS Cooperative Science Programme: Three joint projects, invited through joint call of CSIR, India and Czech Academy of Sciences (CAS), Czech Republic, were supported for a period of two years from July 2021 to June 2022. In view of the COVID-19 pandemic, the projects were extended by one year. Smooth execution of the above projects was ensured through administrative and financial support for the exchange of CSIR and CAS personnel.

The 2nd Call inviting joint R&D proposals was announced on April 19th, 2022. Five (5) project proposals were received. The Selection Committee constituted by the DG, CSIR for evaluating, reviewing and recommending the project proposals for support, met on November 17th, 2022 and recommended funding of project titled "Graphene-Diamond Heterostructures for Electrochemical Supercapacitors and Gas Sensing Applications" of CSIR-IMMT for 2 years starting February 15th, 2023 for joint execution by CSIR-IMMT and the Institute of Physics, CAS.

France

Bilateral Meeting between CSIR and CNRS

A high-level bilateral meeting between CSIR, India and National Centre for Scientific Research (CNRS), France was held on February 21st, 2023 at CSIR-NPL, New Delhi with the participation of 12 member teams from each side led by the Heads of the two institutions.

Dr N. Kalaiselvi, DG, CSIR & Secretary, DSIR and Prof. Antoine Petit, President and CEO, CNRS appreciated the successful relationship between CSIR and CNRS. Introducing the CSIR team, Dr Kalaiselvi briefed about the renewed focus and priority areas of CSIR and its efforts towards sustainable development.

Interest for expanding collaboration in the field of health, applied mathematics, artificial intelligence and machine learning, smart agriculture, digital science communication, energy, flow batteries, metrology and capacity building bilateral exchanges in these sectors was discussed. The French team invited CSIR to collaborate with CNRS in their networks and programs. Interest for strengthening Industrial collaborations between the two organizations were also discussed.

Indo-French Workshop on Clean and Sustainable Energy Technologies (INFINITE)

The Indo-French Workshop on Clean and Sustainable Energy Technologies (INFINITE) was jointly organized by CSIR–CIMFR, Dhanbad and the CNRS, France, during February 21 - 24, 2023 at CSIR–NPL, New Delhi. The workshop featured topics such as Solar Energy, Hydrogen Energy, Carbon Capture Utilization & Storage, Electrochemical Energy Storage and Clean Fuels. The deliberations and interactions identified India – France research collaborations in areas of Photovoltaics, Hydrogen, Electrochemical storage, Biomass, Carbon capture storage & utilisation and Clean Fuels.

Participation in the programmes of the Embassy of France in India

- As part of the Indo-French Healthcare Symposium held in New Delhi on November 28th, 2022, an Indo-French One Health Scientific Workshop was organized by the French Embassy in India.
- The call for proposals under French Institution in India (IFI) - program of the Embassy of France in India was shared with CSIR researchers who were supported/guided for making the applications. As a result, Dr. Robindro, CSIR-IIP, visited the University of Franche-Comte, France, during November 20-25, 2022 on the research trip availing the fellowship.

Germany

CSIR-BMBF Cooperative Science Programme

- CSIR – BMBF ProjectonTransition pathways for solving the urban wastewater, fecal sludge and septage problem in Indian cities based

on resource orientation and business models (TRAPA) under execution by CSIR-NEERI and CSIR-NIIST in collaboration with German partners, was reviewed by the External Review Committee and was approved for continuation in the second year (2022-23) with a grant of ₹30.96 Lakh to CSIR-NEERI and ₹28.96 lakh to CSIR-NIIST for FY 2022-23.

The project was successfully executed with due funding from CSIR Hqrs. A team of scientists from Germany visited CSIR-NEERI and CSIR-NIIST and four (4) researchers from CSIR (NEERI and NIIST) visited Germany.

New learning and understanding on the best practices (such as "small-scale decentralized wastewater treatment plants"; "blackwater collection through vacuum toilets"; "Combined Heat and Power generation concept"; etc.) that team from CSIR-NEERI and NIIST would leverage in their ongoing activities in the area. A team of German experts visited CSIR CSIR-NEERI and CSIR-NIIST. The team was connected with CSIR-CLRI for further discussions and collaboration on Wastewater treatment technologies. Under the project CSIR-NEERI and CSIR-NIIST demonstrated treatment technologies for grey and black wastewater.

The following technologies were implemented under the project by CSIR-NEERI at Nagpur for demonstrating the concept of Transition Pathways:

- Phyto-Floraft technology for safeguarding the waterbody as a part of the project on liquid waste management at GVAK - "Go Vigyan Anusandhan Kendra".
- Grey Water Technology: Inauguration of Up-flow Compact Constructed Wetland (UCCW) based Sewage Treatment Plant for treating greywater (3000 litres per day of greywater generated from kitchen, wash area and Bathrooms) generated in GVAK Campus.
- Black water Treatment: CSIR-NEERI's Technology based on Solid-Liquid Separation was implemented, where the waste solid was further bioprocessed while the liquid was treated in reactor followed by UCCW prior to disinfection.

- A discussion meeting was held with the team from the German Federal Ministry of Education and Research on May 12th, 2022 to discuss plans for inviting new joint research proposals under CSIR-BMBF cooperation programme.

CSIR-FhG Cooperation Programme

- A Tech-Dialogue on Sustainable Building Technologies focused on "Sustainable Building Materials – Way to Net Zero Emissions" was held on June 15th, 2022 in partnership with Fraunhofer Gesellschaft (FhG), Germany. The session covered the topics such as "Geo-polymerization based Building Components" and "Waste-to-Wealth - Lightweight / Renewable Materials including Waste to Value Added Products" (TRL 5 & above) developed by Fraunhofer IBP and CSIR Labs.
- Following effort was made to enhance cooperation activities
  - New areas to the cooperation agreement i.e. Next-gen Energy and Circular Economy were added (November 10th, 2022)
  - CSIR's participation in a technology implementation proposal by IIT Jodhpur and FhG for waste water treatment titled "Indo-German Collaboration for Advanced Wastewater Treatment at Sangaria CETP, Jodhpur". Exploratory topical interaction with CSIR-NIIST (February 6th, 2023) and CSIR-CLRI (March 13th, 2023) was organized for leveraging CSIR's technology for implementation with FhG and IITJ at Sangaria CETP.
  - Taking forward CSIR-FhG cooperation in Hydrogen for establishing joint centre at CSIR-NCL on Hydrogen Technologies. Connceted CSIR-NCL and FhG India to discuss further.
  - Following topical interaction meetings were held both online and physical to explore potential collaboration possibilities:
    - Transforming Agri Waste to Hydrogen (December 9th, 2022)
    - Exploring cooperation in Fuel Cells (January 25th, 2023)
    - Discussion of CSIR-NIScPR and Fraunhofer Institutions for a Bilateral Workshop Proposal on the topic "STI policy issues/ innovations systems/Emerging technologies for Industries 4.0" for submitting to IGSTC for funding.

CSIR-DAAD Cooperation

An Agreement of Cooperation (AoC) between the CSIR, Indiaand theGerman Academic Exchange Service (DAAD) was finalized and signed in January 2023. The Agreement has a provision for exchange of upto

15 researchers annually from each side for stay from 14 days to 90 days in all subject areas of CSIR. The cooperation activities under this AoC shall be based upon the principle of reciprocity for the mutual benefit of both sides.

CSIR-DLR Cooperation

A team of experts from DLR, Germany visited CSIR-NAL on February 20-24,2023. CSIR-DLR to explore S&T cooperation for "flight physics research, aerodynamic, structural and control system design of solar electric unmanned high altitude platforms". A Non-Disclosure Agreement (NDA) was signed between CSIR-NAL and DLR, Germany to explore this cooperation.

CSIR – DWIH Connect

- A meeting with the Director of DAAD and German Center for Research and Innovation (DWIH), of Federal Republic of Germany was held on October 20th, 2022 to discuss strengthening and deepening India – Germany R&D collaboration through CSIR.
- CSIR partnered with DWIH for organizing a Design Thinking Workshop targeting Green Mobility in India. CSIR, IIT Delhi and DWIH together planned the workshop including finalizing the terms, selection procedure and the contents. CSIR team partnered in this initiative with DWIH for brainstorming sessions for planning as well as extending organizational support during the workshop.

The India – Germany Design Thinking PostDoc Workshop titled "Integrated Engineering for Future Mobility' for early career researchers from India and Germany was held at IIT Delhi and CSIR Science Centre at New Delhi during March 20-24,2023. A total of 16 Indian (11 from CSIR, 5 from IIT Delhi) and 12 German (from 9 Technical Universities) researchers benefitted from this interdisciplinary design thinking workshop that provided the participants an opportunity to present their research.

- CSIR participated in the Indo-German roundtable on Science Communication –April 8th and June 8th, 2022 organized by DWIH. Scientists from CSIR presented CSIR activities/interest in Science Communication.

Guyana

The Apex level meeting between Hon'ble Prime Minster of India and Hon'ble President of Guyana in January 2023 agreed to constituting Joint Working Groups (JWGs) under the umbrella of the existing India-Guyana Joint Commission to take forward India-Guyana cooperation. It was agreed that the Working Groups would be co-chaired at Secretary level from the Indian side. Accordingly, a JWG on 'Technology and Innovation' was constituted.

The JWG on 'Technology and Innovation' met on March 28th, 2023 (online mode). A presentation was made by CSIR that gave an overview of CSIR and showcased its technological and research prowess including specific developments in Agriculture, Biotechnology (including Food Technology) & Biodiversity Conservation, Environmental/ Low-carbon Technologies, Mining & Minerals, Oil & Gas sectors, Sustainable Infrastructure, Healthcare and efforts of CSIR in Digitization in STEM field (CSIR Jigyasa Virtual Lab for promoting digital education in STEM, Analyti CSIR, an online platform providing access to analytical and R&D facilities of CSIR Labs across the country and TKDL, a Global benchmark of TK database).

The Hon'ble Minister of Guyana welcomed India-Guyana partnerships for development of sustainable innovation ecosystem in Guyana.

Israel

CSIR DDR&D linkages

Some of the connects established have been in the fields of Therapeutics; Quantum and Lasers; Health, Hydrogen & Water; and Aerospace. In view of the active interest, the CSIR, India and the Directorate of Defense Research and Development (DDR&D), Israel, agreed to consider a broad based collaboration arrangement to promote industrial research and development cooperation through an MoU.

CSIR - BOH Cooperation

A Tripartite MoU between CSIR-CEERI, CSIR-CSIO and M/s Breath of Health (BOH) was signed. MoU mainly provides for working together on the Non-Communicable Disease (NCD) diagnostics system development in India using human Breath Analysis, with focus on: a) Joint study for screening breath for different diseased and healthy persons for identifying commonalities specific to particular diseases; b) Joint Development towards miniaturizing the NCD diagnostic system and developing a low-cost module.

Mexico

CSIR held topical interactions on May 23rd, 2022 to understand partnership potential and identify interest, wherein officials from MEA, GoI and scientists from CSIR-IICT, CSIR-CDRI, CSIR-CCMB, CSIR-CIMAP, CSIR-IMTECH, CSIR-HQ, AcSIR from India and officials of Ministry of Foreign Affairs, Mexican Agency for International Development Cooperation (AMEXCID) of the Ministry of Foreign Affairs and scientists from National Autonomous University of Mexico (UNAM), National Polytechnic Institute (IPN), Center for Research and Advanced Studies of the National Polytechnic Institute (CINVESTAV) participated. The meeting strengthened the interest in developing collaborations and Ambassador of India to Mexico strongly recommended formalizing the cooperation at corporate level between CSIR and AMEXCID. Follow up meetings to discuss the cooperation details and finalising the Memorandum of Understanding (MoU) were conducted during November – December 2022 and February 2023.

An MoU on Research, Technology and Innovation cooperation between CSIR and AMEXCID was signed by Dr N. Kalaiselvi, DG, CSIR and H.E. Federico Salas Lotfe, Ambassador of Mexico to India on March 4th, 2023 in the august presence of Hon'ble Dr Jitendra Singh, Minister of S&T, and Hon'ble Mr Marcelo Ebrard Casaubon, Minister of Foreign Affairs of Mexico.

Nepal

On February 13th, 2023, a discussion meeting was held with Nepal Academy of Science and Technology (NAST) to develop a new Working Programme (WP) beginning in 2023. Potential topics/areas and mechanisms for CSIR – NAST cooperation were discussed.

Russia

- CSIR-CIMFR got connected with two institutes of the Far Eastern Branch of Russian Academy of Sciences (FEB RAS) namely, Institute of Automation and Control Processes (IACP) and Khabarovsk Federal Research Center (KhFRC) for discussing collaboration for setting up of the "Centre for Excellence in Intelligent Mining Systems" (CoE-IMS). The CoE-IMS is being proposed between CSIR-CIMFR, and IACP FEB RAS, and KhFRC FEB RAS to foster collaborative research and develop solutions for safety in mining operations.
- An MoU was formulated as a broad framework to support cooperations aimed at (i) Development of solutions for mining industry; (ii) Development of mine hazard prediction technologies using artificial intelligence, machine learning, deep learning, image processing, IoT-based sensors etc.; and (iii) Joint research and development on intelligent mining systems for efficient monitoring, control, automation and communication to improve safety and productivity in mines.
- CSIR-CRRI and Road Industry Research Institute (ROSDORNII) were connected through a Topical Interaction meeting held on June 30th, 2022 and July 1st, 2022 for identifying priority areas specifically for road construction, operational and maintenance activities as well as ensuring road safety.
- CSIR participated in the 12th meeting of the India Russia Joint Working Group on Science and Technology organized jointly by DST and MINOBRNAUKI, Russia on January 11th, 2023. CSIR presented its interest for strengthening collaboration discussions with Russian counterparts. Russian Academy of Sciences expressed keen interest to develop collaboration linkages with CSIR.

Switzerland

In a boost to the development of therapies for the treatment of Malaria, CSIR and Medicines for Malaria Venture (MMV) signed an MoU on October 13th, 2022. The MoU provided scopes for conducting research

and development activities with an aim to discover new therapies, address anti-microbial resistance, and conduct clinical trials, among other objectives. The collaboration would be targeted towards development of affordable and innovative therapies for the treatment of Malaria. Dr N. Kalaiselvi, DG, CSIR and Secretary, DSIR, GoI and Dr David Reddy, Chief Executive Officer, MMV signed the MoU on behalf of their respective organizations.

Taiwan

CSIR Industrial Technology Research Institute (ITRI) Collaboration: Amendment to the CSIR-ITRI MoU signed in October 2017 in Taipei, Taiwan for a tenure of 5 years with validity upto October 2022, was signed to indicate appropriate IP clause as also extending the MoU for another five (5) year period for taking forward S&T cooperation between CSIR and ITRI. A project specific NDA was finalised for easing out implementation of activities under CSIR-ITRI framework.

CSIR-National Applied Research Laboratories (NARLabs) Connect: Partnership dialogue was

initiated with the NAR Labs. Established in June 2003, NARLabs has combined eight national laboratories into an independent non-profit institute under Ministry of Science and Technology (MOST), with major mission to establish R&D platforms, support academic research, promote frontier S&T and foster high-tech manpower.

Other collaboration platforms /partners: Collaboration opportunities were explored in the area of Semiconductors through CSIR-CEERI and CSIR-CSIO. Dr Suchandan Pal, Chief Scientist, CSIR-CEERI was nominated as a keynote speaker in the 2022 Taiwan-India Exchange Workshop organised by the FENG CHIA UNIVERSITY, Taiwan at IIT-Guwahati during September 4-6, 2022.

Turkey

The Plan of Cooperation for the year 2022-2026 between CSIR, India and the Scientific and Technological Research Council (TÜBİTAK), Republic of Türkiye was signed in December 2022 that defined the Program of the Call (PoC) for Research, Development and Innovation Projects in the years 2022-2026. The joint call for Inviting Project Proposals was announced on December 15th, 2022. Five (5) project proposals with participation of industry from both sides were received against the call.

USA

Oklahoma State University: During the meeting held with the visiting experts from Oklahoma State University (OSU), USA on August 10th, 2022 and CSIR labs CSIR-CSIO, CSIR-CDRI, CSIR-IICB and CSIR-IMTech, the OSU team expressed interest in building collaborative partnerships with CSIR in research areas that aim to promote one-health research integrating human & veterinary medicine with oncology/infectious disease focus; developing collaborative centers that are geared towards pandemic responses against emerging diseases; use of biomedical/bioengineering approaches to enhance bench to clinic research; and providing research & training opportunities as well as developing new twinning degree programs with research intensive CSIR institutions.

National Security Council Secretariat: A meeting between ISTAD-CSIR and the National Security Council Secretariat (NSCS) took place for exploring partnerships between CSIR and US organisations on July 25th, 2022. NSCS has been holding wide range of consultations with all relevant Stakeholders-Government, industry and academia to zero down on specific areas of collaboration between India and the US, as pertaining to Critical Emerging Technologies. As recommended by the meeting, CSIR's inputs on the potential areas of partnerships with US organisations were prepared and provided to NSCS.

University of Texas at San Antonio: Meetings with a team from University of Texas at San Antonio (UTSA) were organised on December 9th, 2022 and January 18th, 2023 to explore partnership. A white paper on "neuro-inspired AI" was shared with the relevant CSIR labs.

Twinning of CSIR Institutes with their Partners Abroad

With an objective to enhance mutually beneficial subject specific collaboration, Institute-to-Institute level research linkages were promoted. Nine topical cooperation arrangements in the areas of non-communicable disease diagnostics,drugs development, healthcare, physical and chemical sciences, marine ecology and instrumentation, etc.were approved for signing.

CSIR's Participation in Inter-Governmental S&T Cooperation Funding Programmes

Twenty-four collaborative R&D projects were bagged by CSIR institutes for execution jointly with the research and technology organizations from 15 Countries with a total grant of Rs. 1,711.08 lakhs + USD 10,13,940 + £ 438,198.68 and € 48,970 under various funding mechanisms. Execution of these projects was facilitated through review, obtaining applicable clearances including for project based agreements, and grant of security sensitivity clearances.

MULTILATERAL COOPERATION

G20 Research and Innovation Initiative Gathering (RIIG)

The CSIR-led G20 Research and Innovation Initiative Gathering Conference on the theme "Materials for Sustainable Energy" was organised at Ranchi on March 2nd, 2023. The Conference encompassed inaugural, technical and valedictory sessions, a plenary lecture on "Strategy towards Low-Carbon Transition driving India towards Net-Zero", special

sessions for interventions, suggestions and presentations by the foreign delegates and a Panel Discussion.

The deliberations focused primarily on three priority areas viz, a) 21st Century Challenges Related to Energy Materials & Devices, b) Solar Energy Utilisation and Photovoltaic Technology, and c) Materials and Processes for Green Energy. 20 foreign delegates from ten G20 member countries, six (6) invited guest countries and an international organisation joined the Conference. Thirty eight Indian delegates and special invitees from scientific departments, research and academic institutions and industry participated in the RIIG Conference. Leading experts were drawn from institutions such as IITs, IISERs, CSIR Labs, industry such as Godi India Pvt. Ltd., think tanks including NITI Aayog and Indian Energy Storage Alliance. Well known energy experts and policy makers including Dr V.K. Saraswat (Member NITI Aayog), Dr G. Satheesh Reddy (Scientific Adviser to RakshaMantri), Prof. Ashok Jhunjhunwala (IIT Madras), Prof. Vijayamohanan K. Pillai (IISER, Tirupati), Dr Rahul Walawalkar (Indian Energy Storage Alliance), Dr Ashish Lele (Director, CSIR-NCL, Pune), Dr Anjan Ray (Director, CSIR-IIP, Dehradun), Mr SabaKalam (ISA) and many others deliberated on the main theme and sub-themes of the Conference.

NAM S&T Centre

Twenty-five CSIR scientists participated in five international events organised by NAM S&T Centre in partnership with its foreign partners, as mentioned.

- International Roundtable on "Energy Storage Systems" organized by NAM S&T Centre jointly with the Center of Excellence on High Voltage Engineering, University of Witwatersrand, South Africa on September 12th, 2022 (virtual mode).
- International Workshop on "Role of Science, Technology and Innovation (STI) in Achieving Sustainable Development Goals – 2030" organized jointly by NAM S&T Centre and the Indian Ocean Rim Association (IORA) Secretariat, Mauritius at IORA, Mauritius on May 24-25, 2022 (virtual mode).
- International Workshop on "Water Purification Technologies, Arsenic Removal from Ground water and Integrated Water Management" organized jointly by NAM S&T Centre and CSIR-CSMCRI at CSIR-CSMCRI, Bhavnagar on June 28-30, 2022 (hybrid mode).
- International Workshop on "Leveraging Innovations for Infrastructure Development and Sustainable Industrialization" organised at National University of Science and Technology (NUST) Innovation Hub, Zimbabwe during November 17-18, 2022 (hybrid mode).
- International Workshop on "Development of Food Green Cities for Urban Sustainability" organised jointly by NAM S&T Centre and Nepal Academy of Science and Technology (NAST), at NAST on April 26-27, 2022 (virtual mode).

Organisation of Events jointly with NAM S&T Centre

- International Training Workshop on "Emerging Trends in Materials, Design, Manufacturing of Footwear and Leather Products in Developing Countries" was organised by CSIR-CLRI on January 30-31, 2023 at CSIR-CLRI, Chennai under sponsorship and partnership with the NAM S&T Centre, Indian Leather Technologists Association (ILTA) and LERIG Trust Chennai, with participation of 11 foreign participants and 75 Indian experts.
- International Workshop on "Water Purification Technologies, Arsenic Removal from Groundwater and Integrated Water Management" was organized on June 28-30, 2022 at CSIR-CSMCRI (hybrid mode) under sponsorship and partnership with NAM S&T Centre with participation of 16 foreign experts and 28 experts from India.

World Association of Industrial and Technological Research Organizations (WAITRO)

- Poster of CSIR comprising snapshot of CSIR and recent technologies developed by CSIR were displayed at the WAITRO Summit 2022, the flagship event of WAITRO held during November 14-16, 2022. CSIR provided inputs for designing of the poster by Africa Massive, South Africa.
- CSIR participated (online) in the 26th WAITRO General Assembly meeting held in Cape Town, South Africa on November 16th, 2022 and participated in the election process during the general assembly in its capacity of full member of WAITRO.
- CSIR participated in the project of WAITRO on "International Benchmarking Exercise of RTOs". Regarding mode of participation of CSIR, ISTAD organized several consultative meetings with the authorities in WAITRO Secretariat, to understand the objective of the project and to decide the mode of CSIR's participation. From CSIR, experts from CSIR-NIScPR; CSIR-IMD, CSIR-TMD, CSIR-CPD and CSIR-ISTAD participated in the interactions.
- ISTAD represented CSIR in the session on "China's International Science and Technology Cooperation Funding System" organized by WAITRO China Office on January 13th, 2023. CSIR, India along with UNSW, Australia; CSIRO, Australia; TISTR, Thailand; and NTU, Singapore were selected for networking session "Introduction of International Research Institutes".
- Participation of CSIR Scientist was enabled in the "International Workshop on the Research Network Creation of IoT for Community Water Supply Production" organized by Thailand Institute of Scientific and Technological Research (WAITRO nodal Asia and Pacific) on August 30th, 2022.

The Asian and Pacific Centre for Transfer of Technology (APCTT)

- AnInternational Knowledge Sharing Workshop on "Cross-border Innovation, Acceleration and Challenges in International Transfer of Technologies" was jointly organized by DSIR, CSIR in association with Asian & Pacific Centre for Transfer of Technology (APCTT) of the UN Economic and Social Commission for Asia & the Pacific (UN-ESCAP) on November 14-15, 2022.
- CSIR participated in the International Conference on Innovation, Technology Transfer and Cooperation for Addressing Climate Change with a focus on enhancing development, diffusion, and transfer of innovative and emerging technologies for addressing climate change in urban areas across the Asia Pacific region was organised (online) jointly by DSIR and APCTT December 6th, 2022.
- An Industry-Academia-Government Consultative Meeting to address the Challenges of Energy and energy devices was organized by CSIR-DSIR and APCTT on October 17th, 2022.
- Technology profile of CSIR with respect to Tea Harvesting and the details of the technology developed jointly by CSIR-CMERI and CSIR-IHBT was shared with DSIR and APCTT on the technology /Joint R&D request from the Tea Research Institute of Sri Lanka for building "Intelligent devices for selectively plucking tea leaves".
- CSIR inputs were provided to DSIR, the nodal department of UN-ESCAP-APCTT, for presenting the Country Statement on 'Fourth industrial revolution technologies for sustainable development' during the fourth session of the Committee on Information and Communications Technology, Science, Technology and Innovation of UN-ESCAP which was held at Bangkok from August 3rd till September 1st, 2022.

European Molecular Biology Organization (EMBO)

Following awards/fellowships were bagged/activities under taken by CSIR:

- EMBO Lecture Course entitled "Microphysiological systems: Advances and applications in human relevant-research" was granted to CSIR-CCMB. The lectures were organized at Atal Incubation Centre of CCMB during October 31 - November 4, 2022.
- Dr Santosh Chauhan, Senior Principal Scientist, CSIR-CCMB was awarded EMBO Global Investigator Award (2020) with an annual grant of up to EUR 7000 per year for four years to cover travel, accommodation and other expenses for networking and training activities. Approval was granted for accepting annual grant of upto EUR 7000 per for the years 2023 and 2024 by CSIR-CCMB for the EMBO Global Investigator Award (2020) to execute/ implement the activities for which it has been sanctioned by EMBO, the funding agency.

- EMBO Scientific Exchange Grant Fellowship awarded to Ms Pratima Debnath, Ph.D Scholar and Project Associate-II, working at CSIR-NBRI (under the supervision of Dr. Sane) for a short duration of 3 months visit to CAE, France (under Dr L Nussaume) to learn the technique of detecting rapid changes in the protein levels, which would be beneficial for CSIR-NBRI in their research cooperation.

A 22 member EMBO delegation including scientists, EMBO journal editors and course coordinators visited CSIR institutes CSIR-IGIB; CSIR-IMTech; CSIR-IICB and CSIR-CCMB during February 25 to March 5, 2023 for interaction with students and scientists for Scientific exchange, training, and networking to foster international collaboration and strengthen ties with the scientific community in Europe and India. The meeting of senior officials of CSIR Hqrs and Director-CCMB with Director, EMBO was held on February 27th, 2023.

Organization for Prohibition of Chemical Weapons (OPCW)

In view of the experienced skilled personnel and suitable analytical facility available at CSIR-IICT, the institute has been awarded for organizing the Analytical Skill Development Course (ASDC) during 2018-2022 by OPCW. During the year CSIR-IICT conducted three Analytical Skill Development Courses.

Pravasi Bharatiya Academic and Scientific Sampark (PRABHASS)

CSIR had developed a National Digital Platform namely, (Pravasi Bharatiya Academic and Scientific Sampark) (PRABHASS) Portal to connect with the global Indian S&T Diaspora for jointly addressing societal and scientific challenges. PRABHASS portal features are:

a) Database of over 6000 diasporas from 47 countries
b) Registered for Societal Benefits (Diaspora – 430 and Experts in India – 587)
c) Indian R&D institutions - 267 affiliated with 8 major S&T departments/ministries (DST, DBT, CSIR, ICMR, ICAR, DAE, DOS, MoES) and MEA.

- CSIR-NIScPR was awarded the project titled “Enhancement and Management of Digital Platform “PRABHASS” to Connect Global Indian S&T Community” from 2022-2024. Necessary approvals were obtained for release of funds to CSIR-NIScPR. The progress of the project was monitored.
- CSIR viewpoint with regard to Diaspora, VAIBHAV and PRABHASS was highlighting in all appropriate fora (High Level Bilateral Meetings/Conferences/ Visits etc) and specifically in the discussion meeting (November 29, 2022) of Secretaries of DST, MoES, DRDO and DG, CSIR with the PMO regarding engagement of Indian Diaspora through VAIBHAV and PRABHASS. Secretary DSIR and DG, CSIR apprised the members on CSIR’s initiatives for diaspora engagement and about PRABHASS. CSIR participated in the follow-up meeting in February 2023 for discussing the VAIBHAV research program.
- PRABHASS Portal published about 80 International Collaboration opportunities of different Departments/Ministries/Bi-lateral/Multilateral organizations as also on about 30 Webinars/ Lectures programmes involving foreign experts.
- The portal was effectively used for connecting Indian S&T Diaspora across CSIR Institutes.
- Dr Arni S.R.S. Rao, a renowned Mathematician from USA, delivered a talk titled "A Mathematical Model to evaluate Human Development Index (HDI) and Translational Science & Development' in the HRDC Induction Programme for the Newly Recruited Scientists of CSIR during February 13-18, 2023 at CSIR-IHBT.
- PRABHASS together with NCERT organized four (4) National Student Outreach Programs with joint participation of Indian and Diaspora experts. These have been telecasted live on PM eVidya Channel and also on the CSIR and NCERT’s social networking handles.

a) Webinar on "Soil-Water Quality Management" delivered by Mr Pankaj Kumar Gupta from Wetland Hydrology Research Lab, University of Waterloo, Canada on June 10th, 2022.
b) A Webinar on "Genetic Engineering: The Life beyond imagination" was delivered by Mr Abhishek Mishra, Dept. of Pathology & Genomic Medicine, Houston Methodist Research Institute, Houston, Texas, USA (June 24th, 2022).
c) A Webinar on “Radiology in the Service of Mankind” delivered by Dr Abhishek Mahajan, Clatterbridge Cancer Centre, University of Liverpool, United Kingdome (Jan 27th, 2023).

d) A Webinar on "Silent Pandemic of Superbugs" delivered by Dr Rajesh Bhatia, Food and Agriculture Organisation of the United Nations, New Delhi (Feb. 17th, 2023).

Human Resource Development

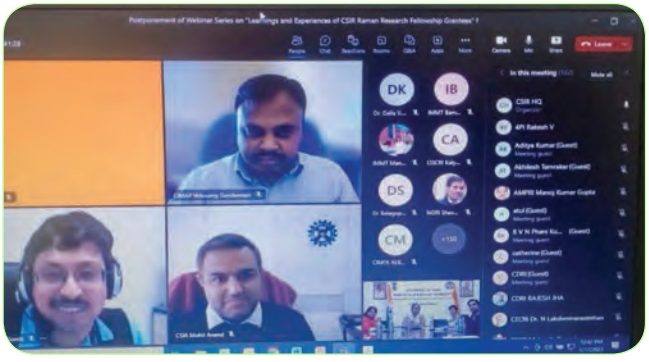
Capacity building of CSIR Scientists through Raman Research Fellowship (RRF) Scheme:

Fifteen (15) CSIR scientists were selected for the grant of RRF for FY 2022-23.

S. No.	Name and Designation	CSIR Institute	Period	Host Institute
Austria				
1	Dr. Archana Singh Principal Scientist	CSIR-IGIB	3 Months	Prof. Dr Iris Gratz, Deputy Head of Department, Research Group Leader, Department of Biosciences, University of Salzburg, Salzburg, Austria.
Belgium				
2	Dr Chanchal Loha Principal Scientist	CSIR-CMERI	3 Months	Prof. Geraldine J. Heynderickx Senior Professor, Department of Materials, Textiles and Chemical Engineering, Laboratory of Chemical Technology, Ghent University, Belgium.
Italy				
3	Dr Manoj Kumar Gupta Scientist	CSIR-AMPRI	3 Months	Dr Christian Falconi Assistant Professor, Department of Electronic Engineering, Univ. of Rome Tor Vergata, Rome, Italy
4	Dr Kiran Mahadeo Subhedar Sr. Scientist	CSIR-NPL	3 Months	Dr Chiara Portesi National Institute of Metrological Research (INRiM), Stradadelle, Italy
Germany				
5	Dr N. Ramesh Kumar Principal Scientist	CSIR-NIIST	3 Months	Dr Tonni Grube Andresen Independent Group Leader, Department of Plant-Microbe Interactions, Max Planck Institute for Plant Breeding Research, Cologne, Germany
6	Dr D. Shashidhar Principal Scientist	CSIR-NGRI	4 Months	Dr Simone Cesca; Scientist, Physics of Earth Quakes and Volcanoes GFZ German Research Centre, Postdam, Germany
Singapore				
7	Dr Sachin Tyagi Principal Scientist	CSIR-CSIO	3 Months	Dr. Ranjan Singh Associate Professor, Division of Physics and Applied Physics, Nanyang Technological University, Singapore
UAE				
8	Dr N. Ayyadurai Principal Scientist	CSIR-CLRI	3 Months	Dr Vijayavenkataraman Sanjairaj Assistant Professor, Division of Engineering, New York University Abu Dhabi, UAE
UK				
9	Dr V. Naveen Principal Scientist	CSIR-NAL	6 months	Dr Dipa Roy Senior Lecturer, Dept of Composites, Materials and Processing, School of Engineering, University of Edinburgh, UK
10	Dr Atasi Pal Principal Scientist	CSIR-CGCRI	6 Months	Professor Jayanta Sahu Head of group, Specialty Optical Fiber, Optical Research Centre (ORC), University of Southampton, UK
11	Dr Sisir Mantry Principal Scientist	CSIR-IMMT	4 Months	Prof. Tanvir Hussain Professor of Coatings and Surface Engineering, Department of Mechanical, Materials and Manufacturing, Faculty of Engineering, University of Nottingham, UK
12	Dr T. Murugan Principal Scientist	CSIR-CMERI	4 Months	Prof. Konstantinos Kontis, Mechan Chair of Engineering, Professor of Aerospace Engineering, University of Glasgow, UK
USA				
13	Dr Pooja Devi Principal Scientist	CSIR-CSIO	4 Months	Prof. Yury Gogotsi Charles T. and Ruth M. Bach Distinguished University Professor, Director, A.J. Drexel Nanomaterials Institute, Drexel University, Philadelphia, USA
14	Dr.Tarun Kumar Das Principal Scientist	CSIR-NML	4 Months	Professor Lalita Udpa Department of Electrical and Computer Engg., Michigan State University, USA
15	Dr Manas Kumar Dalai Senior Scientist	CSIR-IMMT	4 Months	Prof. Bibhudutta Rout Department of Physics, University of North Texas, Denton, USA

Webinar Series entitled "Learnings and Experiences of CSIR Raman Research Fellowship Grantees": CSIR through ISTAD launched an Interactive Webinar Series entitled "Learnings and Experiences of CSIR Raman Research Fellowship Grantees" on January 17th, 2023. The DG, CSIR and Secretary, DSIR, Dr N Kalaiselvi inaugurated the series. The webinar was delivered by the CSIR Raman Research Fellowship (RRF) grantees who had already availed of the fellowship. Through these Webinars, the grantees shared their research work for which they were awarded the Fellowship and their experiences and learnings from their stay in the host institutes/countries.

The inaugural webinar was held online on January 17th, 2023 with participation of 220 CSIR family members. Following RRF awardees of the FY 2019-20 delivered the talks:



a) Dr V. Sundaresan, Principal Scientist, CSIR-CIMAP RC Bengaluru
b) Dr Shiv Narayan, Principal Scientist, CSIR-NAL
c) Dr Joshy Joseph, Principal Scientist, CSIR-NIIST
d) Dr Bama Prasad Bag, Sr. Principal Scientist, CSIR-IMMT
e) Dr Priyabrata Banerjee, Principal Scientist, CSIR-CMERI

Capacity building of foreign researchers through CSIR-TWAS Fellowship:CSIR/TWAS had received a total of 89 applications through TWAS's online portal out of which 73 were found eligible (36 for Postgraduate and 37 for Postdoctoral fellowships); all 73 were duly accepted by the CSIR Laboratories/Institutes. All the eligible applications were examined by CSIR. Based on the academic merit and recommendations of the respective CSIR Laboratories/Institutes, 24 candidates against 30 slots, were recommended for the award of the CSIR-TWAS Fellowships-2021.

CSIR mobilized the foreign nationals working in CSIR Labs for participation in the G20 Research and Innovation Initiative Gathering (RIIG) Conference on Circular Bio-economy held in Dibrugarh and Itanagar during March 24-25, 2023.

ISTAD, CSIR coordinated 20 Training Programmes organized at different CSIR laboratories during 2022-23 for foreign candidates, in which 136 (18 online) trainees were trained.

S. No.	Training Programme	Country/No. of Participants	CSIR Lab.	Dates
1	Analytical Skills Development Course (ASDC) under sponsorship of OPCW	20 participants from 19 countries (Botswana, Morocco, Iraq, Uganda, Malaysia (2), Pakistan, Tunisia, Nigeria, Thailand, China, Sri Lanka, Seychelles, Bangladesh, Algeria, Cameroon, Namibia, Burkina, Sierra Leone, Faso, Syria)	CSIR-IICT	Apr 25-29, 2022
2	Physical SIP on Calibration	2 Participants from Bhutan	CSIR-NPL	May 9-30, 2022
3	Demonstration of DAS instrument to record earthquake signal	3 Participants from Russia	CSIR-NGRI	May 19-30, 2022
4	Training on Traffic Engineering and Road Safety Audit	1 participant from Mauritius	CSIR-CRRI	July 25-29, 2022
5	Training on Li-Ion Battery Manufacturing: R&D Persp.	9 participants from Nigeria	CSIR-CECRI	Jul 25-Aug 8, 2022
6	Research work on Phylogenetic analysis	1 Participant from Sri Lanka	CSIR-CCMB	Aug 1-31, 2022
7	Analytical Skills Development Course (ASDC) under sponsorship of OPCW	20 participants from 16 countries (Kenya-3, Sudan, India-2, Morocco, Zambia, Malawi, Chile, Iraq, Sierra Leone, Brazil, Uganda-2, Zimbabwe Nigeria, Algeria, Tunisia, Suriname)	CSIR-IICT	Sep 5 -16, 2022
8	Training of LMT instruments	1 Participant from Germany	CSIR-NGRI	Sep 27 - Oct 15, 2022

(Contd.)

9	Online Scientific Interaction Programme	18 participants from 2 countries (15 from MUSSD, Sri Lanka; 3 from BSB, Bhutan)	CSIR-NPL	Nov 1-3, 2022
10	Sakura Science Program 2022	2 participants from Japan	CSIR-CMERI	Nov 12-19, 2022
11	To attend Management Development Program on Policies on Biomedical Devices	11 Participants from countries (Mauritius, Nepal-2, Nigeria, Oman, Panama-2, Sudan- 3, Tajikistan, Tunisia)	CSIR-CSIO	Nov 14 – Dec 2, 2022
12	Knowledge Sharing on Medicinal and Aromatic Plants	5 Participants from Thailand	CSIR-CIMAP	Nov 15-17, 2022
13	Training in the field of "Ultrasonic Metrology"	1 Participant from Uzbekistan	CSIR-NPL	Dec 1-15, 2022
14	Inter-comparison artifact and participating in Physical Scientific Interaction in Electrical Metrology	2 Participants from Nepal	CSIR-NPL	Dec 4-17, 2022
15	Analytical Skills Development Course (ASDC) under sponsorship of OPCW	19 participants from 17 countries (Botswana, Brazil, Morocco, Iraq, Uganda, Malaysia-2, Nigeria-2, Thailand, Algeria, Seychelles, Namibia, Burkina Faso, Syria, Morocco, Cameroon, Malawi, Maldives)	CSIR-IICT	Dec 5 -16, 2022
16	Research studies "Computational Studies of Cancer Targets and Cancer-Immune Interactions	3 Participants from Sweden	CSIR-NCL	Jan 20 -Apr 30, 2023
17	Training on microbial culture preservation and understand related documentation	3 Participants from Nepal	CSIR-IMTECH	Jan 22-28, 2023
18	Emerging Trends in Materials, Design, Manufacturing of Footwear and Leather Products in Developing Countries	11 participants from countries [Egypt, Indonesia, Mauritius, Myanmar, Nigeria, Palestine, Sri Lanka, Uganda (2), Vietnam (2)]	CSIR-CLRI	Jan 30-31, 2023
19	Self-capacity development in Physico-Mechanical Metrology under CSIR-NAST program	3 participants from Nepal	CSIR-NPL	Feb 14, 2023
20	IGSTC awarded PECFAR Fellowship to TU Munich	1 Participant from Germany	CSIR-CMERI	Mar 22 - May 21, 2023

International Conferences/Workshops Organized with Participation of International Experts

Eight (8) international conferences / workshops enhancing international recognition of CSIR were organized by CSIR institutes. About 186 foreign delegates from all over the world and about 1776 national participants attended these events that enabled them network with their international peers.

S. No.	Title	Host CSIR Lab	Duration		Venue	Indian Faculty/ Participants	Foreign Faculty/ Participants
			From	To			
1	International Conference on Chemistry and Applications of Soft Materials	CSIR-NIIST	25/7/2022	27/7/2022	CSIR-NIIST	250	50
2	73rd International Committee on Coal and Organic Petrology Meeting and Symposium	CSIR-CIMFR	18/9/2022	25/9/2022	New Delhi	250	50
3	Collagen Symposium 2022	CSIR- CLRI	6/10/2022	8/10/2022	CSIR-CLRI	300	06
4	11th International Conference on Advances in Metrology (AdMet-2022) & Pre-AdMet Workshops	CSIR- NPL	22/8/2022	26/8/2022	CSIR-NPL (Hybrid)	50	13
5	3rd International virtual workshop on Global Seismology and Tectonics (IVWGST-2022)	CSIR- NEIST	20/9/2022	30/9/2022	CSIR-NEIST	480	48
6	Indo-US Workshop on Strengthening Chemical Supply Chain Security Capability in India and Bangladesh	CSIR- NEIST	5/12/2022	6/12/2022	CSIR-NEIST	40	06

(Contd.)

7	CRISPR/Cas Based Plant Functional Genomics and Computational Modeling (Hybrid)	CSIR- NEIST	18/1/2023	21/1/2023	CSIR-NEIST	156	04
8	International Conference on "Communication and Dissemination of Traditional Knowledge (CDTK 2023)" (Hybrid)	CSIR-NIScPR	14/2/2023	15/2/2023	NASC, New Delhi	250	09

In Addition, the following Events were Organized by CSIR Laboratories

- International Society for Applied Ethology (ISAE) India workshop for 2022 on Animal Welfare Progress in India at CSIR-IGIB, New Delhi on January 28th,2023 through virtual mode with participation of three experts from UK (2) and Canada (1) and Seven(7) experts from India.
- One-day workshop on Pollution Awareness for School Children in collaboration with Indian Institute of Technology (IIT), Delhi on November 25th, 2022 at CSIR-NPL, with participation of foreign experts (11) from Germany, Czech Republic and 300 Indian participants including school children.

Scientific Interactions through Exchange Visits

Over 2800 CSIR scientists / technical officers were provided international exposure through topical interactions (mostly online), participation in international events organized by CSIR and international organizations, collaborative projects and fellowship schemes. Of these, 46 visits of CSIR Directors and Scientists 'G'/'H' were facilitated as part of internalization strategy and for international benchmarking. These visits facilitated projecting CSIR globally.

About 700 foreign scholars and scientists were connected with CSIR. Of these 290 foreign scientists / research scholars visited various CSIR institutes and CSIR HQs for collaborative projects, workshop / seminar participation, business meetings, training courses and research internship programmes that further provided S&T networking opportunities. Out of 290, 136 foreign nationals visited CSIR institutes (+18 online) to undergo various training courses.

Expanding International R&D Collaboration Linkages through Outreach Activity

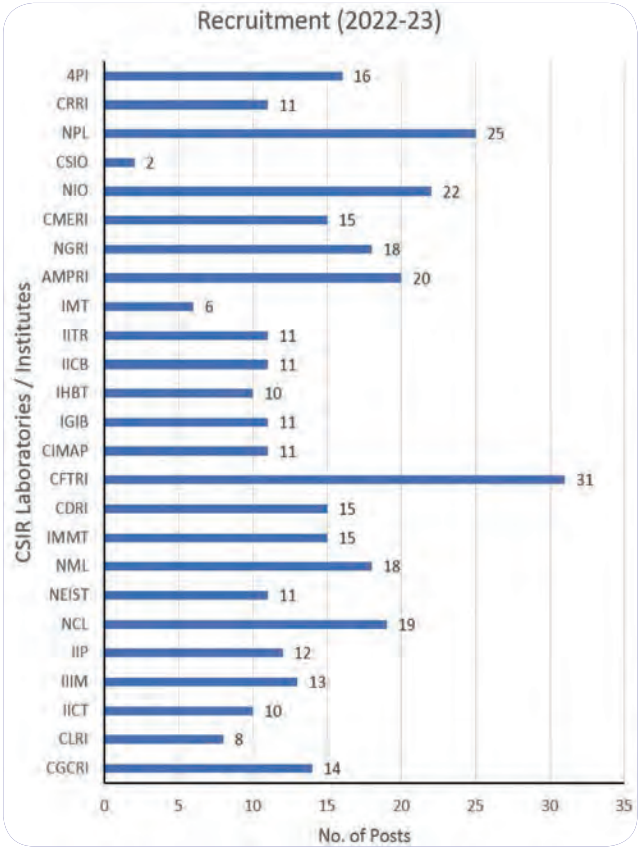
During the Science Summit at 77 United Nations General Assembly, 2022 (SSUNGA77) CSIR organized a two-day event entitled "CSIR, India: An Innovation Hub for Global Sustainable Development" on September 22 & September 28, 2022 with an aim to showcase CSIR's contributions to Science and Technology and its efforts towards Global Sustainable Development. During inaugural session on September 22, 2022, Dr N. Kalaiselvi, Director General, CSIR and Secretary, Department of Scientific and Industrial Research, Government of India gave an overview of CSIR and invited collaborations. It was followed by scientific sessions focused on Food, nutrition and botanical innovations (No poverty, Zero hunger - SDG 1, 2); Affordable Healthcare (SDG 3); and Water & life below water (SDG 6, 13, 14).

The scientific sessions of September 28, 2022 were focused on Sustainability – Energy, Environment, Cities, Communities (SDG 7,11,13); and Industry and Infrastructure – Materials for global society (SDG 8,9,12); followed by a panel discussion that summarized the discussions and deliberated on the future priorities and significance of international collaboration for global good.

CSIR also participated in the Plenary sessions and Thematic Day shosted by other international organisations as part of the Science Summit at the UNGA77.

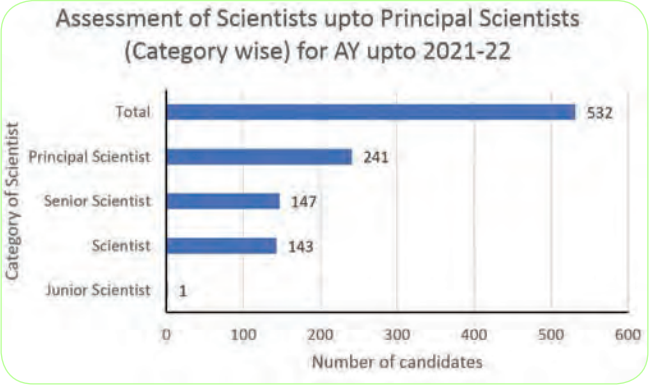
11.9 Recruitment and Assessment Board (RAB)

The Recruitment & Assessment Board (RAB), CSIR, facilitated a total of 355 posts of Group IV scientists for advertisement at lab / institute level by 25 CSIR Laboratories / Institutes during 2022-23.

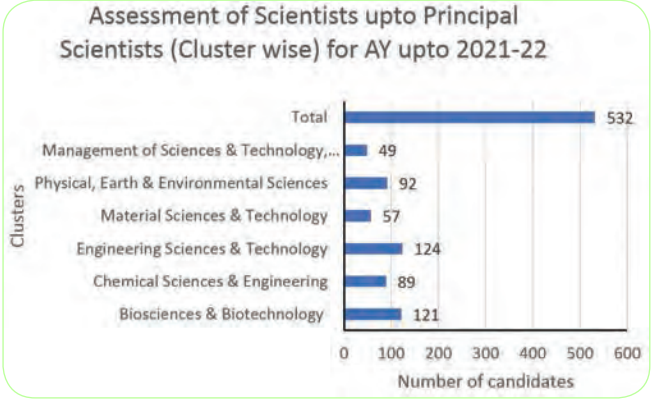


Assessment of Scientists to Principal Scientists due for promotion during 2022-23 covering all the areas were conducted for the Assessment Years upto 2021-22.

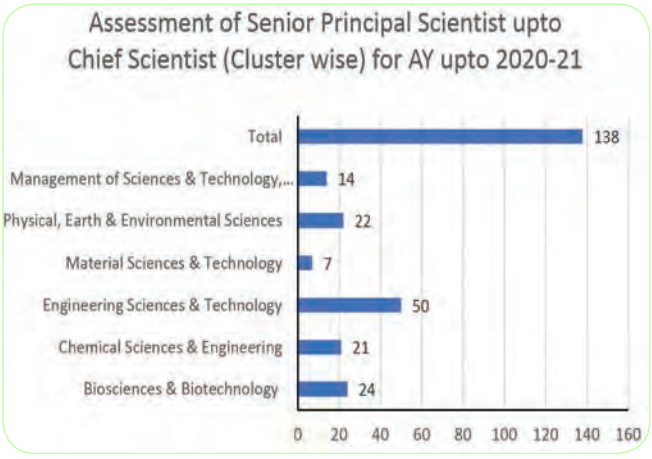
A total of 532 candidates (Scientists to Principal Scientists) were assessed by CSIR-RAB in six broad core areas of R&D in which 1, 143, 147 and 241 were Junior Scientist, Scientists, Senior Scientists and Principal Scientists respectively.

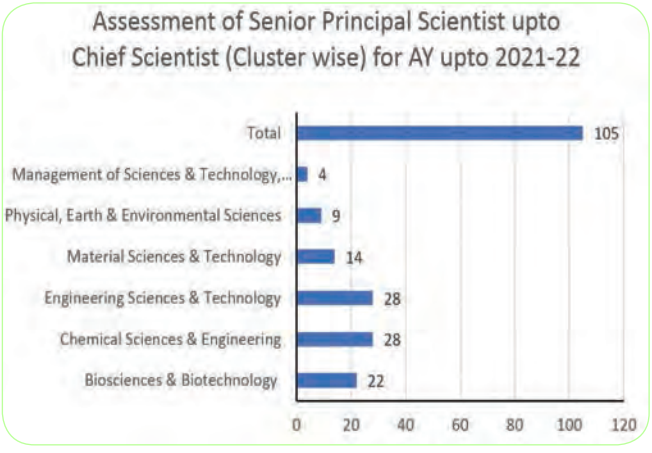


For all six clusters, for the assessment of Scientist to Pr. Scientist, 121 in Biosciences & Biotechnology, 89 in Chemical Sciences & Engineering, 124 in Engineering Sciences & Technology, 57 in Material Sciences & Technology, 92 in Physical, Earth & Environmental Sciences, and 49 in Management of Sciences & Technology, and Policy Studies were assessed for the Assessment Years upto 2021-22.

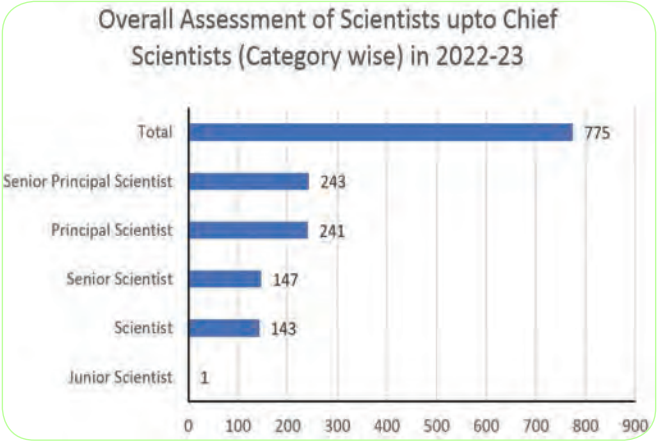


The centralized assessment of 138 and 105 (total 243) Senior Principal Scientists through 'Peer Review' process for the Assessment Years 2020-21 and 2021-22 respectively were also successfully conducted.





Overall, assessment of scientists carried out by CSIR-RAB for a total of 775 candidates in 2022-23 is as presented below:



CSIR-RAB has been now conducting a totally paperless Assessment process on e-proannati at all levels.

11.10 Science Communication and Dissemination Directorate (SCDD)

Outreach Activities

The Science Communication and Dissemination Directorate (SCDD) carries out dissemination activities of CSIR's scientific research and technological achievements through a dynamic social media presence on various platforms comprising of:

YouTube: https://www.youtube.com/CSIRINDIA1942

Twitter: https://twitter.com/CSIR_IND

Facebook: https://www.facebook.com/INDIA.CSIR

Instagram: https://www.instagram.com/csirindia/

For social outreach at large, the SCDD produces and disseminates publicity materials such as posters, banners, short videos on various Science, Technology and Innovative achievements of CSIR, CSIR Blogs and activities of CSIR labs and announcements related to upcoming CSIR news/events and exhibitions.

The SCDD also participates in major exhibitions and expos across India and abroad, including mega-events like the India International Science Festival and the Indian Science Congress.

The SCDD supported many exhibitions and events during the year 2022-23. Some of the exhibitions are given in the table below.

S. No.	Event Name	Date	Place
1.	Madhya Pradesh Scientific Literacy cum Health & Wellness Festival	24-26 March, 2023	Dindori, Madhya Pradesh
2.	Govt. Achievements & Schemes EXPO-2023	03-05 March, 2023	Pitampura Dilli Haat, New Delhi
3.	Vibrant Haryana	24-26 February, 2023	Karnal, Haryana
4.	Alluring Rajasthan	23-25 February, 2023	Udaipur, Rajasthan
5.	STREE 2020 National Conference & Expo	24-26 November, 2022	Jawaharlal Nehru University(JNU), New Delhi
6.	Rise in Uttar Pradesh 2022	22-24 November, 2022	HRIT Group of Institutions, Ghaziabad
7.	India Development & Scheme Expo	04-06 November, 2022	Dillihaat, Janakpuri, New Delhi
8.	Vision Rajasthan 2022	01-03 November, 2022	Sirohi, Rajasthan
9.	7th VIBRANT India-2022	14-16 November, 2022	Pitampura Dilli Haat, New Delhi
10.	Third Gramodaya Mela and Shardotsav	09-11 October, 2022	Chitrakoot, Madhya Pradesh
11.	Jaipur Expo 2022	22-24 September, 2022	Jaipur, Rajasthan
12.	Vibrant Uttarakhand 2022	26-28 August, 2022	Prem Nagar, Aashram, Haridwar, Uttarakhand
13.	25th National Science Exhibition	25-27 August, 2022	Central Park Maidan, Salt Lake City, Kolkata
14.	9th Indian National Exhibition-Cum-Fair	04-08 August, 2022	KMDA ground, Patuli, kolkata
15.	Aspiring Harayana 2022	28-30 July, 2022	Hisar, Harayana
16.	Garavi Gujrat 2022	08-10 July, 2022	Mehesana, Gujarat
17.	Rise in Uttarakhand 2022	07-09 July, 2022	Dehradun, Uttarakhand
18.	6th Government Developments & policies	06-08 May, 2022	Bhopal, Madhya Pradesh

The 'Pride of India Mega Expo' in the 108th Indian Science Congress 2023

The 'Pride of India Mega Expo' in the 108th Indian Science Congress – 2023 organised at RTM Nagpur University, Nagpur, Maharashtra, during January 3-7, 2023.

The Expo was inaugurated by Dr Jitendra Singh, Hon'ble Minister (IC) S&T, along with Shri Devender Fadnavis, Deputy CM, Maharashtra. Dr N Kalaiselvi, Secretary DSIR & DG, CSIR along with Directors and Heads of the CSIR labs/units visited the CSIR Pavilion at the 'Pride of India Mega Expo'.

CSIR laboratories from across the Nation participated in the CSIR Pavilion and showcased technologies under different themes using display of posters, exhibits of products, models and working systems.

The well-coordinated and successful participation of CSIR in the 'Pride of India Mega Expo' at the Indian Science Congress (ISC) 2023, helped CSIR in gaining immense outreach and promotion of CSIR's achievements/technologies to a large audience ranging from schools & college students, researchers, faculty members and delegates, which included some overseas participants as well. The overall footfall at the CSIR pavilion during January 3-7, 2023 has been reported to be around 1 lakh. CSIR bagged the 'Best Exhibitor of the Year' Award.

India International Science Festival (IISF) 2022, MANIT, Bhopal, January 21-24, 2023

The India International Science Festival (IISF) 2022, was held at Maulana Azad National Institute of Technology (MANIT), Bhopal, Madhya Pradesh during January 21-24, 2023 with the theme "Marching Towards *AmritKaal* with Science, Technology & Innovation". As a part of the Science Festival, the 'Mega Science & Technology Expo' of IISF 2022 was organised at MANIT, Bhopal during the four days of the event.

The Mega S&T Expo was inaugurated by Dr Jitendra Singh, Hon'ble Minister (IC) S&T, along with Hon'ble CM of Madhya Pradesh Shri Shivraj Singh Chouhan and Hon'ble Minister S&T of Madhya Pradesh, Shri Om Prakash Saklecha. Hon'ble Ministers along with Dr N Kalaiselvi, Secretary DSIR & DG, CSIR visited CSIR Pavilion.

CSIR laboratories from across the Nation with nearly 25 Scientists, Technologists and Research Scholars participated in the CSIR Pavilion at the 'Mega S&T Expo', IISF 2022 and showcased technologies under different themes using display of posters, exhibits of products, models and working systems.

CSIR Pavilion won the 'Best Pavilion in the Expo' Award at the Mega S&T Expo of IISF 2022 held at MANIT, Bhopal.

CSIR Pavilion @Mega S&T Expo, IISF 2022

"Akash for Life" Exhibition at Uttaranchal University, Dehradun during November 4–6, 2022

The National Conference and exhibition on "Akash for Life" was organised by Vijnana Bharati in association with various science Ministries/Departments and Uttarakhand State during November 4-6, 2022, at Uttaranchal University, Dehradun, Uttarakhand. CSIR setup the exhibition related to the theme of *panchabhootas* i.e JAL (water), VAYU (Air), PRITHVI (Earth), AKASH (Sky) and AGNI (Energy). Posters on technologies on the *panchabhoota* theme were designed, printed and displayed by SCDD-CSIR in the exhibition along with display of the working models.

The CSIR, through SCDD, also participated and showcased innovations and technologies based on various themes such as Food & Agriculture, Aerospace, Chemicals & Petrochemicals, Metals, Minerals & Mining. CSIR's participation in some of the major theme events during the year are listed below:

S. No.	Event Name	Date	Place
1	13th Agrovision 2022	25-28 November, 2022	Nagpur, Maharastra
2	INDIA CHEM 2022	02-03 November, 2022	Pragati Maidan, New Delhi
3	Government Achievements & Schemes EXPO	17-19 June, 2022	Pragati Maidan, New Delhi
4	ChemTech world Expo 2022	08-11 June, 2022	Bandra Kurla, Mumbai
5	9th IME 2022	02-04 April, 2022	Eco park, kolkata
6	DefExpo 2022	18-22 October, 2022	Ghandhinagar, Gujarat
7	Bengaluru Tech Summit	16-18 November, 2022	Bangalore Palace

Team CSIR received "Best R&D Exhibition Award" at Bengaluru Tech Summit 2022 from Shri Basavaraj Bommal, Hon'ble CM, Karnataka.

CSIR in Media: Daily News Bulletin

The SCDD compiles and publishes weekly News Bulletin taking clips received from various CSIR labs and other sources like Google alert, Twitter, Facebook, etc. The published news of CSIR are compiled on weekly basis and the news bulletin is published and circulated to CSIR Labs and the entire CSIR family members over email.

Monthly, Quarterly and Annual Reports and Media Reports

The Directorate has the responsibility of bringing out the various reports of CSIR in a time bound manner. This involves collation of information from various labs, Directorates, synthesizing the information, reorganizing and editing the information received.

The SCDD prepared Monthly Reports and Quarterly Reports of CSIR. These reports are prepared in a time bound manner by gathering inputs from all the CSIR laboratories.

During the year, SCDD prepared and finalized the following Annual Reports for CSIR and DSIR:

CSIR Annual Reports for year 2020-21 and 2021-22 (English & Hindi) finalized and uploaded on CSIR website during March 2023.

CSIR's report for part year 2022-23 (till Oct 2022) was prepared & finalized and sent to DSIR for inclusion in DSIR Annual Report for the year.

The SCDD prepared the Year End Review of CSIR for Press Information Bureau (PIB) for the year 2022 which was published in PIB on December 31st, 2022.

CSIR Science Museums and Archives

Progressing with the MoU signed between the CSIR and the National Council of Science Museum (NCSM), Ministry of Culture, for enhancing the promotion of scientific temper amongst the general public as well as dissemination of science, SCDD undertook the following projects under setting-up of Science Museums/Archives across CSIR labs:

i. Establishment of CSIR-CGCRI Archives at CSIR-CGCRI, Kolkata

ii. Development of Science City at CSIR-IICT, Hyderabad

The SCDD coordinated the submission of Detailed Project Report for Development of Science City at CSIR-IICT, Hyderabad, to the Ministry of Culture.

CSIR-CGCRI has been awarded a project for two-years for establishing the Archives at CSIR-CGCRI, Kolkata. The project is reviewed by an Advisory Committee constituted at CSIR Hqrs and convened by the SCDD. The Museum has been named after the former Director General, CSIR and the first Director of CSIR-CGCRI, Kolkata, Dr Atma Ram, as "Atma Ram Memorial Museum & Archives".

Inauguration of "Atma Ram Memorial Museum & Archives" at CSIR-CGCRI, Kolkata

CSIR Proposals for Development of TechDome under Central Vista

One of the important component of the *Nav Bharat Udayan* under the Central Vista redevelopment plan of Govt. of India (GoI), is the TechDome showing the scientific and technological journey and achievements of the country. The Development of TechDome for Central Vista Project is commissioned and monitored at the O/o Principal Scientific Adviser (PSA) to GoI with involvement of all S&T Ministries. At CSIR Headquarters, SCDD has been assigned as the Nodal in the Development of TechDome for Central Vista Project and has been involved in the discussions & meetings with Centre for Development of Advanced Computing (C-DAC) as a participating organisation for content development for TechDome.

In this regard, a High Level Screening & Selection Committee was constituted at CSIR Hqrs, convened by the SCDD, for reviewing, screening and selecting the proposals received from CSIR labs for Development of TechDome under Central Vista. Out of eleven (11) proposals received from different CSIR labs, six (06) proposals were recommended by the Committee and further the six proposals were forwarded to the O/o PSA through C-DAC, with due approvals.

CSIR One Week, One Lab (OWOL) Campaign

The SCDD coordinated with CSIR-CBRI, Roorkee, in commemorating the 'One Week, One Lab' (OWOL) campaign of CSIR, with the Curtain Raiser held on January 5th, 2023. The campaign was launched by the Hon'ble Minister (IC) S&T, Dr Jitendra Singh along with Dr N Kalaiselvi, Secretary DSIR & DG, CSIR. The event witnessed the presence of Directors and Heads of CSIR Laboratories/Units and Headquarter Directorates.

International Women's Day Celebrations at CSIR

CSIR celebrated the International Women's Day on March 9th, 2023, to honour the Pride of Women in CSIR contributing directly or indirectly in the progress of science and society, coordinated by SCDD. Mrs Manju Singh, an educationist and Dr Jitendra Singh, Hon'ble Minster S&T (IC), were the Chief Guests on the occasion. Ms Nivruti Rai, Country Head, Intel India, joined the event as the Guest of Honour. The Principal Scientific Advisor (PSA) to the Govt. of India, Prof A. K. Sood and Dr M Ravichandran, Secretary, MoES and Dr Rajesh Gokhale Secretary, DBT also joined the celebrations together with their families. Directors & Heads of CSIR laboratories and Heads of CSIR Headquarter Directorates along with their

spouses; and many CSIR staffs joined the celebration physically and online.

11.11 Technology Management Directorate (TMD)

The Technology Management Directorate (TMD) facilitates CSIR and its laboratories to connect with industry, line ministries, state Governments and other organizations for providing high quality technology-based products/solutions/services as well as supporting competitive advantage to citizens of the country.

Some of the CSIR-TMD initiatives are listed below:

CSIR Aroma Mission

The CSIR has successfully implemented Aroma Mission Phase I (2017-2020) and Phase II (2020-2023). Phase III is being implemented across the country with the involvement of eleven CSIR Laboratories CSIR-CIMAP, Lucknow (Nodal); CSIR-IHBT, Palampur; CSIR-IIIM, Jammu; CSIR-NBRI, Lucknow; CSIR-IITR, Lucknow; CSIR-NEIST, Jorhat; CSIR-URDIP, Pune; CSIR-IICT, Hyderabad; CSIR-NCL, Pune: CSIR-IIP, Dehradun; and CSIR-CEERI, Pilani.

The overall aim of the CSIR Aroma Mission is "Catalysing Rural Empowerment through Cultivation, Processing, Value Addition and Marketing of Aromatic Plants".

CSIR Aroma Mission Phase-I (2017-2020) and Phase-II (2022-2023) has been successful in utilizing the knowledgebase available in CSIR institutes in the area of aromatic plants and leveraged it in an effort to help Indian industry reposition itself to meet the present-day challenges in the domain. With the implementation of CSIR Aroma Mission, the segment is maturing and there is global connect in a significant manner, providing newer opportunities which are associated, however with several challenges.

Significant achievements so far are:

i. ~30,200 hectares Area covered under cultivation of aroma crops;

ii. 384 improved and efficient distillation technologies/ units have been deployment;

iii. 50 new region-specific varieties developed;

iv. 1365 numbers of skill development programs organized across the country developing 81,264 trained human resource;

v. the implementation of CSIR Aroma Mission is able to generate ~71 lakh man-days of rural employment; and

vi. about 110 numbers of new entrepreneurship developed including 40 women entrepreneurs.

Key Outcomes

Purple Revolution: Empowering Farmers in J&K

- Cultivation in 10 districts of J&K increasing the farmer's income from ₹20,000/- to ₹200,000/- per acre per year; and
- Women farmers are being trained especially for nursery raising providing employment and entrepreneurship opportunities. Produced 20 lakh quality plants worth ₹ 1.0 crore.

Efforts of Farmers of Bhaderwah (Jammu & Kashmir) highlighted by Hon'ble Prime Minister through "Mann Ki Baat" for Lavender cultivation under Aroma Mission

Atmanirbharata in Lemongrass essential oil

- Introduction of high yielding varieties suiting different climatic zones in India, benefiting 20 Tribal cluster in 10 States/UTs.With the implementation of CSIR Aroma Mission, India becomes largest exporter in the world with about 600 tonnes worth ₹ 60 crores of lemongrass essential oil exported during 2021-22.

Golden revolution in Himachal Pradesh

- Introduction of improved varieties of Marigold (*Tage*tesminuta L.) yielding high grade aromatic oil and suitable for rainfed areas and wild animal menace.
- Total essential oil production in the country is 6.5 tonnes of marigold oil (worth ₹ 5.9 crore), which has enhanced the farmers' income 2.5 times over traditional crops (₹ 50,000-60,000/ha/year).

CSIR Floriculture Mission

CSIR Floriculture Mission Phase-I (2020-2023) is successful to enhance farmer's income and entrepreneurship development through high value floriculture utilizing CSIR technologies. Phase-II has been initiated across the country with the involvement of six CSIR Laboratories CSIR-NBRI, Lucknow (Nodal); CSIR-IHBT, Palampur; CSIR-IIIM, Jammu; CSIR-NEIST, Jorhat; CSIR-CFTRI, Mysuru; CSIR-CIMAP, Lucknow.

Implementation of CSIR Floriculture Mission helped to bring about 1250 hectares of land under Floriculture in 21 States and UTs. The significant achievement has been the indigenous development of Tulip bulb production in Lahaul & Spiti under the mission that helped in reducing the import of planting materials. For the first time Lilium flowers were transported through cargo flight from Leh, Ladakh (UT) to Delhi flower market on August 11th, 2022 with first consignment of 5000 flowers costing about ₹ 2,50,000/-. For the domestication of indigenous wild ornamental plants, propagation techniques including Tissue Culture have been developed for 20 species that are collected from Western Himalaya, Eastern Himalaya, Western Ghats, Eastern Ghats and Indo-Gangetic plains.

In collaboration with the Khadi and Village Industries Commission (KVIC), Apiculture has been integrated with CSIR Floriculture Mission for high quality Honey production. So far, total 49 clusters have been established with the distribution of about 2500 Bee Boxes provided by to the clusters developed by CSIR Labs benefiting around 2000 farmers.

Tulip Garden developed using indigenously produced planting material at CSIR-IHBT, Palampur


Cold Storage units and Refrigerated Vans provided to farmers by CSIR for enhanced shelf-life and rapid transportation to the flower markets


Production of high quality natural honey with the help of bee boxes provided by KVIC to the clusters developed under CSIR Floriculture Mission

Investigational New Drug (IND) Project

Promising molecules for disease conductor like Anti malarial, Anti-hyperlipidemic and for pulmonary fibrosis are under various stages of IND enabling studies.

CDRI-S007-1500 - an oral fracture healing molecule-IND has been approved, and it has been transferred to industry (TROIKAA Pharmaceuticals Ltd Gujarat) for further development.

Cancer Biology Project

A patentable cost-effective synthesis strategies of an anti-cancer drug 'Olaparib' has been established. CSIR-URDIP had confirmed non-infringing route and Indian Patent has been filed. Discussion with Industry is on-going. Smac mimetic against Therapy Resistant Cancer has been developed.

In NCE endeavor, Indian and foreign patent application has been filed for Smac mimetic PCT (IN202011055682, WO2022130411). All the cancer related preclinical animal models have been established at CSIR-CDRI.

Cancer Genome Project

A multifactorial approach including whole genome, epigenome and transcriptome sequencing of Indian breast cancer patients is being followed to uncover the whole mutational, immunological and infection landscape.

During the reporting period, a network with hospitals across India including regulatory approvals has been established [CSIR; Tata Memorial Centre (Mumbai), AIIMS (New Delhi), Rajiv Gandhi Centre (Delhi), Saroj Gupta Centre (Kolkata), Prashanti

Hospitals (Pune)] for patient studies and a Whole genome sequencing for 100 pairs (tumor/adjacent normal) of the breast cancer patients have been completed. RNA Sequencing is in progress. State-of-the-art organoids were generated from 8 patient tumors.

Design, Development and Certification of HANSA-NG

CSIR-NAL in Aug 2018 started project entitled "Design, Development and Certification of HANSA-NG" with the support from CSIR-HQ. Hansa-NG is India's first all-composite light aircraft designed & developed by CSIR-NAL in the CS-VLA category, ideally suited for ab-initio flying training, sport and hobby flying. Hansa-NG is a two seater, low wing aircraft, low noise emission and option to use both MOGAS and AVGAS allows for more flexible and economical operations meeting IFR certification. All glass cockpit with cabin comfort and good ergonomics easy to fly with good handling qualities & low operation and maintenance cost. Hansa-NG would be affordable and appreciable single engine aircraft.

Project Definition Phase of Regional Transport Aircraft (RTA)

The project definition phase for 'Regional Transport Aircraft (RTA)' of India is being implemented at CSIR-NAL with executive support from TMD, CSIR. The phase involves configuration design of RTA and preparation of DPR. The aim is to evolve a configuration for a turboprop aircraft which can meet requirements of regional connectivity in India. It will fulfil the demands of various Regional Indian Airlines in terms of additional payload, 90-seat configuration, operations from high altitude airfields and better payload capability from short airfields at high altitude etc. Top Level Aircraft requirements have been evolved with multi-organizational task teams. The overall aircraft configuration, seat layout along with initial sizing have been carried out. The design philosophy, architecture and layout of respective systems are being finalized. Major components like wing, empennage, fuselage, power-plant and landing gear are sized and positioned appropriately. Airfoil selection, Engine selection, high lift device sizing and cabin and fuselage layouts are also worked out. Three-view diagram of the aircraft and design summary have been completed.

Ministry of Home Affairs approved the required Qualitative Requirement/Trial Directive of Mob Control Vehicle (MCV) of CSIR

On direction from the Prime Minister's Office (PMO), CSIR-CMERI had designed, developed and produced three variants of R&D Prototype Mob Control Vehicles. The vehicles are presently at CRPF-RAF campus for trainings and demonstrations of 09 core technology modules as well as technology acquaintance purposes. In total about 58 officials and staffs of CRPF-RAF had participated in several operational training, re-training programs and mock up trials of MCV prototypes, besides demonstration to MHA committee. During FY 2022-23 the necessary 'Qualitative Requirement/ Trial Directive (QR/TD)' of all three variants of MCVs i.e. Heavy Category, Medium Category and Tractor based have been approved by CRPF, Ministry of Home Affairs. CSIR-CMERI has transferred the technology of some of the modules of MCV on non-exclusive basis to two Indian Industries for commercialization and necessary procurement by Police Forces.

AI based Intelligent Solutions for Road Safety through Technology & Engineering (iRASTE)

CSIR-CRRI in collaboration with M/s Intel India, M/s Mahindra & Mahindra, INAI-Applied Research Center for AI, IIIT-Hyderabad with support from TMD, CSIR is implementing a project for Road Safety in Nagpur City using Artificial Intelligence.

This proposed application oriented pilot project covers the aspects of enhancing safety in public transit using the AI based CAS (installation in selected buses in Nagpur city) as well as simultaneous improvement of road infrastructure through the development of geometric improvements plans for the identified black spots and its management.

As on April 2023,150 vehicles have been equipped with Collision Avoidance System (CAS) devices, 1100 drivers have been trained for defensive driving and on usage of Advanced Driver Assistance System (ADAS). About 60% of drivers in ADAS-enabled buses have shown sustained behavioral improvement in safe driving. Till now there are about 20% reduction in road crashes. Economic Impact Assessments for four typical black spots have completed. 20 numbers of Grey spots (potential future blackspots/accident spots) have been identified based on AI and data comprehensions. The spots are being validated in association with DCP traffic.

Road safety Index has been defined and validated for two pilot corridors. Pilot awareness programs at Greyspot and Blackspot have been completed. Sustained social media campaign has been initiated. The plan is evaluate on-ground impact of these safety interventions after its implementation.

Priority implementation of S&T solutions to 200+ problems from Line Ministries

As per direction of office of Principal Scientific Adviser, CSIR/DSIR planned to coordinate the activities for implementation of S&T solutions for 200 + S&T problems as outlined by Line Ministries and Departments. These are in the domain of Energy and Climate Change Mitigation, Infrastructure, Agriculture, Food and Nutrition, Education, Social Empowerment and Health. Out of 214 needs of 32 Ministries/Departments, so far 147 numbers of S&T needs are discussed where 17 Ministries/Departments attended online meetings. CSIR has committed to address and lead 20 S&T needs while participate in 46 challenge areas. About 35 received problems statements, only two need comes under CSIR purview. CSIR has already started working for one S&T need of Ministry of Social Justice and Empowerment; and Communicated to Ministry of Steel for its couple of needs. Meeting are being planned to take the subject ahead along identifying funding patterns for prospective joint projects.

MoUs/Agreements/S&S Clearance

CSIR has undertaken and executed Agreements/MoU with Indian as well as foreign clients for exploring possibilities/executing projects under Sponsored R&D, Collaborative/Cooperative R&D categories. The names of industries include BMGF, USA, Colgate Palmolive Company, New York; Saudi Aramco Technologies Company, Kingdom of Saudi Arabia; AIRBUS Group of India Private Limited, Bengaluru; BASF India Ltd., Mumbai; Chodai, Co., Ltd., Japan; Automotive Robotics (India) Pvt Ltd, Hyderabad; EcoC2 Industries, LLC., USA; Total Energies One Tech S.A.S France; Aprisium Pte. Lte Singapore; Super Silica Bangladesh Limited, Bangladesh; Zimmer and Peacock Ltd, UK; Corning Incorporated, US; Petrolube Oil Company, Jeddah, Saudi Arabia; PreviPharma Consulting GmbH, Mannheim Deutschland Germany; Vertellus Holdings LLC, Indianapolis US; Kellogg Brown & Root LLC, USA, Seshasayee Paper & Boards Limited, Tamil Nadu, etc.

This is an important part of business development activities of CSIR. The proposals received included S&S clearances for Agreements, Contract R&D, Technical services, Licensing involving foreign clients. 19 proposals were processed for execution including security & sensitivity clearances.

Corporate Social Responsibility (CSR)

Ministry of Corporate Affairs through Notification G.S.R. 776(E); dated 11th October 2019 in the gazette of India has made amendments to Schedule VII (item-ix) of Companies Act 2013 (18 of 2013). The Amendment of Schedule VII has included organizations like Council of Scientific & Industrial Research (CSIR) engaged in conducting research in science, technology, engineering and medicine aimed at promoting Sustainable Development Goals (SDGs) to receive contributions from Corporates under CSR.

CSIR had earlier issued the Policy and Guidelines to enable CSIR/Laboratories to accept CSR grants from Corporates/Industries while implementing projects for promotion of SDGs. It facilitated CSIR and its laboratories to solicit CSR funds from Corporate/ Industry to carryout R&D activities for promotion of SDGs. Subsequent notifications/clarifications issued by Ministry of Corporate Affairs (MoCA, GoI) were communicated to labs for further guidance.

CSIR got registered as Implementing Agency with MoCA for undertaking CSR activities. CSIR has initiated proactive engagement with Indian corporates/ industries.

Corporates\industries such as CIPLA, Sun Pharma, SPICMIL, HAL, SBI Foundation, Northern Coalfields Ltd., Kancor Ingredients Ltd, Claycraft (I) Pvt. Ltd, Tata Elxsi Limited, etc. have made contributions under CSR to CSIR/labs.

11.12 Traditional Knowledge Digital Library (TKDL)

The Traditional Knowledge Digital Library (TKDL) initiative protects and preserves the country's traditional knowledge, particularly, Indian Systems of Medicine, through digitalization. Established with the primary objective to prevent misappropriation of India's valuable traditional knowledge as a prior art database, the TKDL contains in a structured and searchable format, information on Indian traditional knowledge related to Ayurveda, Unani, Siddha & Sowa Rigpa as well as Yoga practices from about 480 texts available in public domain.

Over 33,000 medicinal formulations from different Indian systems of medicine and Yoga were transcribed into the TKDL database in the year 2022-23. Thus, the TKDL database now contains over 4.5 lakh formulations of which around 2.7 lakh are available to patent offices as prior art.

On August 17th, 2022, the Cabinet chaired by the Hon'ble Prime Minister, Shri Narendra Modi approved the "Widening access of the Traditional Knowledge Digital Library (TKDL) database to users, besides patent offices". With this, the TKDL can cater to a vast user base that would include businesses/ companies, research institutions, practitioners of Indian Systems of Medicine, researchers, educators & students, among several others. While catering to its primary mandate of preventing grant of wrong patents on Indian traditional knowledge, the TKDL database will also push creative minds to innovate for better, safer and more effective solutions for a healthier and technology endowed population.

During the year, two TKDL Access Agreements were signed - one with the INPI, France (National Patent Office) on September 14th, 2022 and the second with Eurasian Patent Organization (EAPO – a Regional Patent Office) on February 18th, 2023. This takes the number of patent offices that have access to the TKDL database to sixteen.

During 2022-23, as a part of the ongoing efforts to address misappropriation of Indian traditional knowledge, TKDL evidences were filed in 185 patent applications based on Indian systems of medicine, as third party or pre-grant oppositions on grounds of lack of novelty or inventive step. Thus, the total number of patent applications that have been amended, withdrawn, abandoned, refused or rejected based on TKDL evidences is now 309.

A two-day training program on Traditional Knowledge Digital Library (TKDL) and Biological Diversity Act (BDA) 2002 was organized for the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) Member States, jointly by the Min of AYUSH and CSIR in April 2022.

A high level delegation of the World Health Organization – Global Centre for Traditional Medicine (WHO-GCTM), led by Dr Shyama Kuruvilla, Senior Strategic Adviser, visited the CSIR-TKDL Unit in July 2022 to understand the activities of the Unit. The WHO team appreciated the TKDL activities, especially in the context of the GCTM objectives on the continued relevance of traditional medicine to address global healthcare needs. The CSIR-TKDL team also participated in various national programs to create awareness on the TKDL.

The CSIR-TKDL Unit continues to actively participate in the deliberations of the PCT Minimum Documentation Task Force and WIPO Inter governmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC).

In 2022-23, close to 100 project staff were actively engaged in the TDKL activities. Among these, about 40 were newly engaged project staff and trained extensively in transcription work and related IT techniques to contribute to the objectives of TKDL projects.

11.13 Unit for Research and Development of Information Products (URDIP)

Dr Jitendra Singh, Hon'ble Minister of State (IC) for Science & Technology and Earth Sciences, inaugurated the new institutional building of CSIR-URDIP on August 20th, 2022 in Pune.

IP Search and Analysis for Anti-Viral Mission mode project focusing on COVID-19:CSIR-URDIP provided search and analysis for around 600+ compounds from April 1st, 2021-Dec 30th, 2022. Detailed prior art search and comparative analysis enlisting the differences between the proposed compounds versus the prior art structures, therapeutic activity as well as the mechanism of action were enlisted. Comments on the patent filing opportunity, were highlighted based on the information as shared with CSIR-URDIP. Further recommendations to evaluate the new use/new indication, mechanism of action, enhanced efficacy, etc were provided which provides assistance in taking decisions towards, patent filing and claim drafting strategy based on the details of the biological activity**.** The inputs were used for shortlisting the potential candidates for further R&D development and IP filings.

CSIR-URDIP provided search and analysis to obtain and furnish information on the product patents, filing dates, expiry dates for around 10 agrochemicals to be undertaken by the Agrochemical mission for Phase-I and proposed to continue the activity for Phase-II of the mission.

The Unit completed around 14 IP related Search Requests for the participating labs in the Hydrogen Technology Mission Project.

Under Skill development initiatives of CSIR, during 2022-2023, 10 students were trained in the area of

Patent Informatics under the Post Graduate Diploma in Patinformatics (PGDP) program offered at CSIR-URDIP under the aegis of AcSIR.

The Unit also conducted cyber security awareness program by staff of IT department on October 13th, 2022.

A training workshop was organized for Patent agent examination, May 2022 at CSIR-URDIP. Thirty sessions of one-hour duration each organized during March-April 2022.

CSIR-URDIP Scientists have conducted "Hands on IP training" to IP coordinators from CSIR labs at CSIR-IPU, New Delhi as part of Hands-on Practical Training to CSIR Personnel 2022-23 during November, December 2022 & January 2023.

CSIR-URDIP signed an MoU with Procter & Gamble Company, USA for providing Patent and Scientific Information Search and Analysis services (International). Another MoU was signed with KPIT Technologies Ltd., Pune for providing IP search and analysis services (National).

Annexures

ANNEXURE I

Awards and Recognitions 2022-23

During the year, CSIR, its laboratories/institutes and the CSIR staff received numerous awards and recognitions, as listed below:

Awards/Recognition	Name of the Awardees	Lab Name
The Golden Peacock Eco-Innovation Award 2022 for Environmental Surveillance for SARS-CoV-2 Virus in Wastewater for Effective Management	CSIR	
National Intellectual Property Awards 2021 & 2022 under The Top R&D Institution/Organisation for Patents Filing, Grant & Commercialization	CSIR	
Exhibitor of the Year Award at Pride of India Mega Expo during 108th Indian Science Congress, 3-7 Jan 2023	CSIR	
Best Pavilion in the Expo Award at the Mega Science & Technology Expo, 8th IISF 2022, during 21-24 January 2023	CSIR	
Best R&D Exhibitor Award at Bengaluru Tech Summit-2022, organized by Dept. of Electronics, IT & BT, Science &Technology.,Govt. of Karnataka	CSIR	
Technology Transfer Impact Award 2022, by The Society of Technology Management (STEM)	CSIR-CDRI	CSIR-CDRI
• National Women Scientist Award for Excellence in Translational Research • DST- One among the 75 Scientists under 50 Shaping India 2022 • Listed in top 2% of scientists in the world in the area of Pharmacology and Pharmacy	Dr Ritu Trivedi	CSIR-CDRI
NASI-Young Scientist Platinum Jubilee Award (2022) in the field of Bio-medical, Molecular Biology and Biotechnology	Dr Rahul Shukla	CSIR-CDRI
CRSI-Bronze Medal, 2022 by Chemical Research Society of India	Dr Namrata Rastogi	CSIR-CDRI
SERB Power (Promoting Opportunities for Women in Exploratory Research) Fellowship	Dr Divya Singh	CSIR-CDRI
Certificate of Appreciation - Highly Cited Author 2021 from RSC for publishing research in the top 5% of highly cited works from Indian institutions	Dr Subrata Kundu	CSIR-CECRI
Certificate of Appreciation - Highly Cited Author 2021 from RSC for publishing research in the top 5% of highly cited works from Indian institutions.	Dr M. Sathish	CSIR-CECRI
National Award for Empowerment of Persons with Disabilities (Divyangjan) – 2022, on the occasion of International Day of Disabled 2022	Dr Bhausaheb Ashok Botre	CSIR-CEERI
National Technology Excellence Award for Women, 2022, Technology Development Board	Dr A. Hepsiba Kiranmayee	CSIR-CEERI
IETE-CEOT (94) Award (Biennial)-2022	Dr Suchandan Pal	CSIR-CEERI
Best Institute (Food Technology) - Poshak Anaaz Award, during the National Nutri Cereal Convention 4.0	CSIR-CFTRI	CSIR-CFTRI

Honorary Fellowship of Karnataka Science and Technology Academy	Dr Sridevi Annapurna Singh	CSIR-CFTRI
Best Institute Award during 4th Millets & Organics – International Trade Fair 2023, Department of Agriculture and KAPPEC, Government of Karnataka	CSIR-CFTRI	CSIR-CFTRI
Medal for Young Scientist, Indian National Science Academy (INSA), New Delhi	Dr Hrishikesh Tavanandi	CSIR-CFTRI
Eminent Mining Engineering Personality, Felicitated at IE(I) Durgapur on December 2022	Prof. Arvind Kumar Mishra	CSIR-CIMFR
Women Pride Awards-2022, Dainik Bhaskar	Dr Vetrivel Anguselvi	CSIR-CIMFR
Young Engineer Award from Institution of Engineer, India	Dr Arka Jyoti Das	CSIR-CIMFR
Vishwakarma Award from CIDC NITI Aayog	Dr Aditya Rana	CSIR-CIMFR
Elected Fellow, The National Academy of Sciences, India	Dr N. C. Murmu	CSIR-CMERI
Er. M. P. Baya National Award 2022 in Mechanical Engineering by the Institution of Engineers (India) Udaipur	Dr D. N. Ray	CSIR-CMERI
IEI Young Engineers Award by The Institution of Engineers (India) at the 36th National Convention of Production Engineers	Dr Manidipto Mukherjee	CSIR-CMERI
Best Hindi implementation in the Institute, 1st Prize (Presidential Shield) by TOLIC, Durgapur, Department of Official Language, Ministry of Home Affairs, Govt of India	CSIR-CMERI	CSIR-CMERI
हिंदी भाषा और साहित्य के प्रचार-प्रसार एवं अन्य हिंदी सेवा कार्यों के लिए दुर्गापुर हिंदी भाषा मंच द्वारा ट्रॉफी/स्मृति चिह्न से सम्मानित किया गया	श्री संजय कुमार मिश्र	CSIR-CMERI
Institute entered into the India Book of Records & Asia Book of Records, 2022 for Construction Technology of the First Steel Slag Road in India	CSIR-CRRI	CSIR-CRRI
Pt Jawaharlal Nehru Birth Centenary Award during 81st Annual Session of Indian Road Congress, October 8-11, 2022, Lucknow,	Dr Ambika Behl	CSIR-CRRI
• 13th CIDC Vishwakarma Award • Women Construction Empowerment Award by Civil Engineering & • Construction Review team	Dr Siksha Swaroopa Kar	CSIR-CRRI
IEI Young Engineers Award 2021-22 in Electronics & Telecommunication Engineering	Dr Shashi Poddar	CSIR-CSIO
Institute received "Medicall Made in India Innovation Awards 2022" during Medicall – Hospital Equipment Expo.	CSIR-CSIO	CSIR-CSIO
7th BRICS Young Scientist Conclave 2022	Dr Manoj K. Patel	CSIR-CSIO
IEI Young Engineers Award in Computer Engineering	Dr Rishemjit Kaur	CSIR-CSIO
DYAAPE-Distinguished Young Alumni Award for Professional Excellence 2022 by NIT, Warangal	Dr Aparna Akula	CSIR-CSIO
The Outstanding Scientist Award-2022 by the Society of Tropical Agriculture	Dr Shobhit Singh Chauhan	CSIR-CSMCRI
Elected Fellow, The Maharashtra Academy of Sciences (MASc-2022)	Dr Ankush Biradar	CSIR-CSMCRI
Elected Fellow, The Indian National Science Academy	Dr Sanjay Kumar	CSIR-IHBT
Elected Fellow, The National Academy of Agricultural Sciences (NAAS)	Dr Ram Kumar Sharma	CSIR-IHBT
Alexander Fleming Memorial Award during 6th World Congress on Drug Discovery and Development-2022	Dr Pamita Bhandari	CSIR-IHBT
Fellow, The Royal Society of Chemistry (FRSC)	Dr Pralay Das	CSIR-IHBT

ISPP-ASPB Young Scientist Award of Indian Society of Plant Physiology	Dr Vivek Dogra	CSIR-IHBT
Elected Fellow, The Indian National Science Academy	Dr Arun Bandyopadhyay	CSIR-IICB
Elected Fellow, The National Academy of Sciences, India (NASI)	Dr Rupasri Ain	CSIR-IICB
Ramalingaswami Re-entry Fellowship 2022	Dr Sourish Ghosh	CSIR-IICB
Elected Fellow, The Royal Society of Chemistry (FRSC)	Dr P. Jaisankar	CSIR-IICB
Elected Fellow, The Royal Society of Chemistry (FRSC)	Dr Sujoy K Das	CSIR-IICB
Elected Fellow, The National Academy of Sciences, India (NASI)	Dr Prathama S. Mainkar	CSIR-IICT
Industrial Medal Award-2021 by Biotech Research Society of India (BRSI) on 7th December 2022	Dr Mohana Krishna Reddy Mudiam	CSIR-IICT
NOCIL Award 2022 by Indian Institute of Chemical Engineers	Dr A. Gangagni Rao	CSIR-IICT
NESA Green Technology Innovative Award- 2022 by National Environmental Science Academy	Dr Sanjib Kr Paul	CSIR-IICT
Eminent Mass Spectrometrist Award-2019 by Indian Society for Mass Spectrometry (ISMAS) during 34th ISMAS Symposium on Mass Spectrometry, 15-18 February 2023	Dr Mohana Krishna Reddy Mudiam	CSIR-IICT
Vocational Excellence Award by Rotary club of Bombay Sea Face	Dr S. Sridhar	CSIR-IICT
Best Institute Award - NGIC 2021 from HP Green R&D centre Bengaluru	CSIR-IICT	CSIR-IICT
Fellow, The Telangana Academy of Sciences 2022	Dr Ramakrishna Sistla Dr Chittaranjan Patra Dr A. Sai Balagi	CSIR-IICT
Silver Medal, Chiranthan Rasayan Sanstha 2023	Dr Chittaranjan Patra	CSIR-IICT
International Travel Grant (SERB- ITS) for IBA-IfIBiop 2022, Taiwan	Dr Vinod Kumar	CSIR-IIIM
DST-SERB- Start-up Grant 2021	Dr Kuljit Singh	CSIR-IIIM
DST-SERB- Start-up Grant 2022	Dr Rashmi Sharma	CSIR-IIIM
Elected Fellow, The Royal Society of Chemistry, England	Dr Sandip B. Bharate	CSIR-IIIM
CRSI Bronze Medal 2022	Debaraj Mukherjee	CSIR-IIIM
JSPS Research Grant Award 2022-2023	Showkat Rashid	CSIR-IIIM
Member, International Younger Chemists Network (IYCN) 2023	Ravindra Phatake	CSIR-IIIM
Eat Right Research Award–2022	Dr Ramakrishnan Parthasarathi	CSIR-IITR
Elected Fellow, The National Academy of Sciences, India (NASI)	Dr. Ashwani Kumar	CSIR-IMTech
Award of Excellence in Service (Empowering Persons with Disabilities)	Dr Alka Rao	CSIR-IMTech
Pashudhan Samridhi India Award 2022	Dr Neeraj Khatri	CSIR-IMTech
CRSI Bronze Medal 2023 in Chemical Sciences	Dr Swapanali Hazarika	CSIR-NEIST
Special Award at the International Congress of Society for Ethnopharmacology, India for promotion of Ethnopharmacology in the country	Dr G. Narahari Sastry	CSIR-NEIST
Elected Fellow, The International Science Council (ISC)	Dr Harsh K. Gupta	CSIR-NGRI
Member, Indian National Young Academy of Sciences–2022	Dr Shib Sankar Gangauli	CSIR-NGRI
Elected Fellow, The Indian Academy of Sciences	Dr Ravi Kumar M	CSIR-NGRI
Elected Fellow, The Geological Society of India	Dr Mondal NC	CSIR-NGRI
Elected Member, Council of Geological Society of South Africa	Dr Raju PVS	CSIR-NGRI
Khem Raj Gupta Gold Medal (K. R. Gupta Award) by the Geological Society of India	Dr Tarun C Khanna	CSIR-NGRI

Prestigious Anni Talwani Memorial Prize 2022 by Indian Geophysical Union (IGU)	Dr B. Prasanta K Patro	CSIR-NGRI
National Geoscience Award–2019 by the Ministry of Mines, Govt. of India	Dr D. Srinivasa Sarma	CSIR-NGRI
National Award for Geoscience and Technology 2022	Dr V. M. Tiwari	CSIR-NGRI
National Geoscience Award-2019 by Ministry of Mines	Dr A. P. Singh	CSIR-NGRI
• INAE Young Engineer Award–2022 in the Field of Interdisciplinary and Special Engineering for Technology Innovations in Agricultural Waste Management • Kerala State Young Scientist Award–2022 In the Field of Agricultural Science	Dr Anjineyulu Kothakota	CSIR-NIIST
Best Exhibition Stall Award at National Institutions in the Kerala Science Congress	CSIR-NIIST	CSIR-NIIST
ICAR NAAS Associate Award 2023	CSIR-NIIST	CSIR-NIIST
SERB International Research Experience (SIRE) Fellowship 2022-23 by SERB, Govt. of India	Dr Balakumaran P.A.	CSIR-NIIST
NASI Young Scientist Platinum Jubilee Award 2022	Dr Harsha Bajaj	CSIR-NIIST
CSIR Raman Research Fellowship 2022-23	Dr Ramesh Kumar N	CSIR-NIIST
Fellowship Award, The National Environmental Science Academy (NESA), New Delhi	Dr Jyothibabu Retnamma	CSIR-NIO
Lifetime Achievement Award of the Indian Society of Applied Geochemists (ISAG)	Prof. Sunil Kumar Singh	CSIR-NIO
The National Award in Ocean Sciences 2022	Dr Aninda Mazumdar	CSIR-NIO
Water Hero Award by The Ministry of Jal Shakti, Dept of Water Resources, Govt of India	Dr Firoz Badesab	CSIR-NIO
Distinguished Women Researcher by Venus International Foundation	Dr Maria Judith Gonsalves	CSIR-NIO
Team 2022 won the TATA INNOVISTA Award as The Most Innovative Partner	Dr Sarmishtha Palit	CSIR-NML
INAE Fellowship 2022	Dr Sandip Ghosh Chowdhury	CSIR-NML
CSIR Raman Research Fellowship 2022-23	Dr Tarun Kumar Das	CSIR-NML
Elected Fellow, The Indian Society for Non-Destructive Testing	Dr Sarmishtha Palit Sagar	CSIR-NML
• Elected International Committee for the Weights and Measures • Elected Fellow, INSA	Prof. Venu Gopal Achanta	CSIR-NPL
MRSI Medal 2022 during IUMRS-ICA 2022	Dr N Vijayan	CSIR-NPL
EMSI-Excellence in Microscopy Award	Dr Jai Shankar Tawale	CSIR-NPL
• Elected Fellow, The Indian National Academy of Engineering • Outstanding Professor of Academy of Scientific and Innovative Research (AcSIR)	Dr (Mrs.) N. Anandavalli	CSIR-SERC
• Elected Fellow, The Indian National Academy of Engineering • DAAD Research Ambassador in Engineering for 2022-2025	Dr Saptarshi Sasmal	CSIR-SERC
Textile Reinforced Concrete Prototyping Technology listed in Top 100 Indian Innovations 2022 by Indian Innovators Association.	CSIR-SERC	CSIR-SERC
Institution of Engineers (India) Young Engineer Award 2021-22	Dr B. S. Sindu Dr Mohit Verma	CSIR-SERC
Eminent Engineer in ACCE(I) Foundation cum Awards Day 2022	Dr K. Sathish Kumar	CSIR-SERC
The Excellent Engineer Award jointly by the Hindu Tamil Thisai (The Hindu Group) and Ramco Cement	Dr B. Arun Sundaram	CSIR-SERC

ANNEXURE II

CSIR Patent Applications Filed and Granted during 2022-23

CSIR Lab/ Institute	India		Abroad*			
	Filed	Granted	Filed	Unique Patent Applications filed	Granted	Unique Patents Granted
AMPRI	7	10	8	3	2	2
CBRI	1	2	0	0	0	0
CCMB	0	2	2	1	1	1
CDRI	5	6	4	3	1	1
CECRI	9	8	1	1	0	0
CEERI	9	1	1	1	0	0
CFTRI	4	10	0	0	0	0
CGCRI	4	2	0	0	1	1
CIMAP	4	1	1	1	0	0
CIMFR	14	5	2	2	0	0
CLRI	7	8	0	0	3	3
CMERI	24	6	4	1	0	0
CRRI	4	3	0	0	0	0
CSIO	10	3	2	1	2	2
CSIR(SCH)	1	1	0	0	0	0
CSMCRI	12	15	10	3	4	4
4PI	0	0	0	0	0	0
IGIB	2	1	10	3	2	2
IHBT	1	3	11	5	2	2
IICB	2	3	11	6	8	2
IICT	12	10	22	10	6	3
IIIM	4	1	7	7	4	4
IIP	8	5	10	7	3	3
IITR	2	0	0	0	0	0
IMMT	5	8	5	3	0	0
IMTech	6	3	3	3	12	8
NAL	4	5	0	0	0	0
NBRI	1	6	0	0	0	0
NCL	61	65	54	37	39	28
NEERI	9	1	3	2	0	0
NEIST	1	1	0	0	0	0
NGRI	0	0	0	0	0	0

NIIST	4	3	39	19	5	3
NIO	1	0	0	0	0	0
NIScR	1	0	0	0	0	0
NMITLI	0	1	0	0	0	0
NML	9	18	0	0	4	1
NPL	2	7	1	1	0	0
SERC	0	1	2	1	0	0
Total	**250**	**225**	**213**	**121**	**99**	**70**

*Data may change later during national phase entries. The unique filed/granted patent may appear in the next FY also if its corresponding application is filed/granted in the respective FY

ANNEXURE III

Foreign Patents Granted to CSIR during 2022-23

CSIR-AMPRI				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
1	United States of America	11414349	Advanced Multi-Functional Asbestos Free Thermal Insulating Material and the Process for Preparation Thereof	Verma Sarika, Sanghi Kumar Sunil, Khan Mohammed Akram, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar
2	South Africa	2020/06736	High Performance Glossy Finish Green Hybrid Composites with Variable Density and an Improved Process for Making Thereof	Asokan Pappu, Gupta Manoj Kumar, Mishra Alka, Peters Edward, Kulshreshth Ajay, Rathore Sanjai Kumar Singh, Srivastava Avanish Kumar
CSIR-CCMB				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
3	Canada	3077750	Biomarkers useful for Detection of Grades of Human Breast Cancer	Dinesh Kumar Lekha, Verma Vinod Kumar, Appukuttan Nair Rekha, Jem Prabhakar, Katoor Jayasree
CSIR-CDRI				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
4	United States of America	11304927	Bioactive Extract, Fraction of Cassia Occidentalis and Formulation Thereof for Bone Regeneration	Chattopadhayay Naibedya, Pal Subhashis, Kumar Sudhir, Eppalapally Ramakrishna, Kumar Padam, Sapana, Gayen Jiaur Rahaman, Riyazuddin Mohammed, Sanyalsabiyasachi, Gurjar Anagha, Mishra Prabhat Ranjan, Mittapelly Naresh, Arya Kamal Ram, Kumar Brijesh, Rath Srikanta, Trivedi Arun Kumar, Maurya Rakesh
CSIR-CGCRI				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
5	United States of America	11407671	A Process of Fabrication of Erbium and Ytterbium-co-doped Multi-Elements Silica Glass Based Cladding-Pumped Fiber for use as a Highly Efficient High Power Optical Amplifier	Paul Mukul Chandra, Dhar Anirban, Das Shyamal, Pal Mrinmay, Bhadra Shyamal Kumar
CSIR-CLRI				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
6	Brazil	BR112018068661-1	A Zero Water Chrome Tanning Process	Rathinam Aravindhan, Palanisamy Thanikaivelan, Gladstone Christopher Jayakumar, Palanivel Saravanan, Jonnalagadda Raghava Rao
7	European Patent Office	EP3704275	A Composition useful for Pre-Treatment in Waterless Tanning	Palanisamy Thanikaivelan, Rathinam Aravindhan, Balaraman Madhan, Palanivel Saravanan, Jonnalagadda Raghava Rao
8	Malaysia	MY-193196-A	A Novel Fluidized Bed Reactor for Treatment of Waste Water	Ganesan Sekaran, Sekar Karthikeyan, Ramasamy Boopathy, Asit Baran Mandal

CSIR-CSIO				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
9	Canada	2966129	Manually Controlled Variable Coverage High Range Electrostatic Sprayer	Patel Manoj Kumar, Ghanshyam C, Kapur Pawan
10	United Kingdom	2563545	A Device for Sensing the Pose and Motion of Human's Arm Hand	Soni Sanjeev, Verma Sanjeev, Pankaj Dinesh, Kumar Amod
CSIR-CSMCRI				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
11	Brazil	BR112018004742-2 B1	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
12	Brazil	112017001289	Preparation of Functionalized Castor oil Derivatives using Solid Acid and Base Catalysts	Kannan Srinivasan, Sivashunmugam Sankaranarayanan
13	Canada	2919820	Novel Ion Exchange Membrane and the Process of Preparation Thereof	Uma Chatterjee, Suresh Kumar Jewrajka, Sreekumaran Thampy
14	Indonesia	IDP000083832	A Process for the Preparation of Potassic Fertiliser From Alcohol Distillery Effluent	Maiti Pratyush, Haldar Soumya, Maiti Subarna
CSIR-IGIB				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
15	European Patent Office	1721283	Computational Method for Identifying Adhesin and Adhesin-like Proteins of Therapeutic Potential	Gaurav Sachdeva, Kaushal Kumar, Preti Jain, Samir Kumar Brahmachari, Srinivasan Ramachandran
16	African Intellectual Property Organization	20750	Method and Kit for Detection of Polynucleotide	Chakraborty Debojyoti, Maiti Souvik, Azhar Mohammad, Phutela Rhythm, Sharma Namrata, Sinha Dipanjali, Sharma Saumya, Mishra Arpit, Ansari Asgar Hussain
CSIR-IHBT				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
17	United Kingdom	GB2590272	Synbiotic Composition for Improving Immune Response and Antioxidant Capacity during Aging	Rohit Sharma, Mahesh Gupta, Madhu Kumari, Ashu Gulati, Yogendra S Padwad
18	United States of America	11440894	Process Development for 5-Hydroxymethylfurfural (5-Hmf) Synthesis from Carbohydrates	Das Pralay, Kumar Ajay, Shaifali
CSIR-IICB				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
19	Australia	2018364807	Purine Based Compounds as Toll-Like Receptor 9 Antagonist	Talukdar Arindam, Ganguly Dipyaman, Mukherjee Ayan, Paul Barnali, Rahaman Oindrila, Kundu Biswajit, Roy Swarnali, Deblina Raychaudhuri

20	Switzerland	3433249	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
21	Germany	3433249	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
22	Denmark	3433249	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
23	European Patent Office	3433249	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
24	France	3433249	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
25	United Kingdom	3433249	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
26	Sweden	3433249	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**
27	Canada	3082972	Indole (Sulfomyl) N-Hydroxy Benzamide Derivatives as Selective HDAC Inhibitors	Srivari Chandrasekhar, Prathama Satyendra Mainkar, Chada Raji Reddy, Srigiridhar Kotamraju, Togapur Pavan Kumar, Muppidi Mohan Venkata Subbarao, Somesh Verma, Ashok Kumar Jha, Prem Kumar Arumugam
28	European Patent Office	3717481	Indole (Sulfomyl) N-Hydroxy Benzamide Derivatives as Selective HDAC Inhibitors	Srivari Chandrasekhar, Prathama Satyendra Mainkar, Chada Raji Reddy, Srigiridhar Kotamraju, Togapur Pavan Kumar, Muppidi Mohan Venkata Subbarao, Somesh Verma, Ashok Kumar Jha, Prem Kumar Arumugam
29	France	3717481	Indole (Sulfomyl) N-Hydroxy Benzamide Derivatives as Selective HDAC Inhibitors	Srivari Chandrasekhar, Prathama Satyendra Mainkar, Chada Raji Reddy, Srigiridhar Kotamraju, Togapur Pavan Kumar, Muppidi Mohan Venkata Subbarao, Somesh Verma, Ashok Kumar Jha, Prem Kumar Arumugam

30	Italy	3717481	Indole (Sulfomyl) N-Hydroxy Benzamide Derivatives as Selective HDAC Inhibitors	Srivari Chandrasekhar, Prathama Satyendra Mainkar, Chada Raji Reddy, Srigiridhar Kotamraju, Togapur Pavan Kumar, Muppidi Mohan Venkata Subbarao, Somesh Verma, Ashok Kumar Jha, Prem Kumar Arumugam
31	United States of America	11306100	Spirooxindole Compounds As GSK3 Inhibitors and Process for Preparation Thereof	Prathama S Mainkar, Mohammad Abdul Sattar, Pitchakuntla Mallesham, Togapur Pavan Kumar, Divya Duscharla, Ummanni Ramesh, Srivari Chandrasekhar
32	United States of America	11344858	Micro-Electrolysis Reactor for Ultra Fast, Oxidant Free, c-c Coupling Reaction and Synthesis of Daclatasvir Thereof	Ajay Kumar Singh, Srihari Pabbaraja, Subhash Ghosh, Mahajan Bhushan, Taufiqueahmed Mujawar
CSIR-IIIM				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
33	Canada	2941412	6-Aryl-4-Phenylamino-Quinazoline Analogs as Phosphoinositide-3-Kinase Inhibitors	Vishwakarma Ram Asrey, Bharate Sandip Bibishan, Bhushan Shashi, Yadav Rammohan Rao, Guru Santosh Kumar, Joshi Prashant
34	Canada	2908084	Rohitukine Analogs as Cyclin-Dependent Kinase Inhibitors and a Process for the Preparation Thereof	Vishwakarma Ram Asrey, Bharate Sandip Bibishan, Bhushan Shashi, Mondhe Dilip Manikrao, Jain Shreyans Kumar, Meena Samdarshi, Guru Santosh Kumar, Pathania Anup Singh, Kumar Suresh, Behl Akanksha, Mintoo Mubashir Javed, Bharate Sonali Sandip, Joshi Prashant
35	United Kingdom	GB2576672	Indolylkojyl Methane Analogues, Process of Preparation Thereof and use as Inhibitor of Cancer Cell Invasion and Metastasis	Debaraj Mukherjee, Anindya Goswami, Deepak Sharma, Debasis Nayak, Shreyans Kumar Jain
36	United States of America	11446346	Gastroretentive Sustained Release Formulations of Bergenia Ciliata	Bharate Sonali Sandip, Singh Rohit, Gupta Mehak, Singh Bikarma, Katare Anil Kumar, Kumar Ajay, Bharate Sandip Bibishan, Vishwakarma Ram
CSIR-IIP				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
37	Japan	7119083	Ecofriendly and Biodegradable Lubricant Formulation and Process for Preparation Thereof	Ponnekanti Nagendramma, Anjan Ray, Gananath Doulat Thakre, Neeraj Atray
38	Nigeria	006744	A Domestic Cooking Burner for Piped Natural Gas	Pankaj Kumar Arya, Satish Kumar, Gananath Doulat Thakre, Amar Kumar Jain, Surendra Pratap
39	United States of America	11318452	A Single Step Process for the Simultaneous Production of Aromatics, Naphthenics and Isoparaffins using Transition Metal Functionalized Zeolite Based Catalyst	Nagabhatla Viswanadham, Anjan Ray, Sandeep Kumar Saxena, Rajiv Panwar
CSIR-IMTech				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
40	Canada	2807749	Protein Fusion Constructs Possessing Thrombolytic and Anticoagulant Properties	Neeraj Maheshwari, Girish Sahni

41	China	ZL 201680078419.6	Cellulase Derived from Metagenomics	Roma Garg, Vijaya Brahma, Lata Verma, Girish Sahni
42	China	ZL 201780031562.4	A Method for o- and s- Glycosylation of Peptides or Polypeptides using a Multifunctional Glycosyltransferase	Alka Rao, Rupa Nagar
43	European Patent Office	3724645	A Method to Screen Cancer	Ashish, Sagar Amin, Badmalia Maulik D, Dhiman Kanika, Yadav Shiv Pratap Singh
44	European Patent Office	3368549	Genetically Modified Cells and Methods for Expressing Clot-Specific Streptokinase and Methods of Purifying Same	Girish Sahni, Kishore Kumar Joshi
45	United Kingdom	3724645	A Method to Screen Cancer	Ashish, Sagar Amin, Badmalia Maulik D, Dhiman Kanika, Yadav Shiv Pratap Singh
46	Japan	7210560	Novel Peptide as Potent Inhibitor of Protein Aggregation	Deepak Kumar Sharma, Arpit Gupta, Gajendra Pal Singh Raghava, Ankur Gautam, Manisha Kumari
47	Japan	7171434	Genetically Modified Cells and Methods for Expressing Clot-Specific Streptokinase and Methods of Purifying Same	Girish Sahni, Kishore Kumar Joshi
48	Qatar	226/2022	Aptamers for Purifying and Quantifying Gelsolin and its Variants	Ashish, Renu Garg, Nagesh Peddada
49	United States of America	11313815	Method for Mycobacterium Tuberculosis Detection using Small Angle X-Ray Scattering Profile of Hair	Ashish, Ashwani Kumar, Amin Sagar
50	United States of America	11485991	A Method for o- and s- Glycosylation of Peptides or Polypeptides using a Multifunctional Glycosyltransferase	Alka Rao, Rupa Nagar
51	United States of America	11561187	A Method to Screen Cancer	Ashish, Sagar Amin, Badmalia Maulik D, Dhiman Kanika, Yadav Shiv Pratap Singh

CSIR-NCL

S No	Country	Patent No	Title of Invention	Inventors
52	Canada	2937511	Efficient Production of Renewable Liquid Fuels and Chemicals from Biomass Over Ruthenium Supported Catalysts	Satyanarayana Vera Venkata Chilukuri, Atul Sopan Nagpure, Nishita Satyendra Lucas
53	Canada	2901930	Fluconazole Analogues Containing 4-(Substituted Phenoxymethyl)-1,2,3-Triazole Moieties as Antifungal Agents and Process Thereof	Borate Hanumant Bapurao
54	Canada	3128861	A Metal Ion Battery Having Ionomer Membrane Separator and Free-Standing Electrode	Meena Ghosh, Vidyanand Vijayakumar, Sreekumar Kurungot
55	Switzerland	3423474	Nucleotide Sequences Encoding Enzymes for Lactone Synthesis	Vidya Shrikant Gupta, Ashish Balwant Deshpande, Pranjali Sidhir Oak, Ashok Prabhakar Giri
56	Germany	3423474	Nucleotide Sequences Encoding Enzymes for Lactone Synthesis	Vidya Shrikant Gupta, Ashish Balwant Deshpande, Pranjali Sidhir Oak, Ashok Prabhakar Giri
57	Germany	3678804	Continuous Flow Production of Metal Nanoforms	Amol Arvind Kulkarni, Jaydeep Bipin Deshpande, Prachi Ashok Kate
58	European Patent Office	3678804	Continuous Flow Production of Metal Nanoforms	Amol Arvind Kulkarni, Jaydeep Bipin Deshpande, Prachi Ashok Kate

59	European Patent Office	3423474	Nucleotide Sequences Encoding Enzymes for Lactone Synthesis	Vidya Shrikant Gupta, Ashish Balwant Deshpande, Pranjali Sidhir Oak, Ashok Prabhakar Giri
60	European Patent Office	88395	Lactic Acid-Isosorbide Copolyesters and Process for Preparation Thereof	Bhaskar Bhairavnath Idage, Susheela Bhaskar Idage, Sivaram Swaminathan
61	Spain	3678804	Continuous Flow Production of Metal Nanoforms	Amol Arvind Kulkarni, Jaydeep Bipin Deshpande, Prachi Ashok Kate
62	France	3678804	Continuous Flow Production of Metal Nanoforms	Amol Arvind Kulkarni, Jaydeep Bipin Deshpande, Prachi Ashok Kate
63	United Kingdom	3678804	Continuous Flow Production of Metal Nanoforms	Amol Arvind Kulkarni, Jaydeep Bipin Deshpande, Prachi Ashok Kate
64	Italy	3678804	Continuous Flow Production of Metal Nanoforms	Amol Arvind Kulkarni, Jaydeep Bipin Deshpande, Prachi Ashok Kate
65	Japan	7071930	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
66	Japan	7146080	Multilayer Non-Porous Membranes Based on Polybenzimidazoles	Ulhas Kanhaiyalal Kharul, Harshal Dilip Chaudhari, Nishina Achuthan Shobhana, Nitin Madhukarrao Thorat
67	Japan	7254033	An Assembly of Porphyrin-Fullerene and use Thereof	Santhosh Babu Sukumaran, Goudappagouda
68	Japan	7143274	A Method for Preventing Rectraction of Aqueous Drops	Guruswamy Kumaraswamy, Manoj Kumar, Mayuresh Arvind Kulkarni
69	Japan	7225217	Continuous Flow Production of Metal Nanoforms	Amol Arvind Kulkarni, Jaydeep Bipin Deshpande, Prachi Ashok Kate
70	South Korea	10-2497069	Continuous Flow Production of Metal Nanoforms	Amol Arvind Kulkarni, Jaydeep Bipin Deshpande, Prachi Ashok Kate
71	Malaysia	MY-190706-A	Direct Processing Of Crude Bioglycerol to Diols and Lower Alcohols Over Nano Structured Catalyst	Chandrashekhar Vasant Rode, Rasika Bharat Mane, Vivek Vinayak Ranade
72	Thailand	88395	Lactic Acid-Isosorbide Copolyesters and Process for Preparation Thereof	Bhaskar Bhairavnath Idage, Susheela Bhaskar Idage, Sivaram Swaminathan
73	United States of America	11439728	A Process for Coating a Biomedical Implant with a Biocompatible Polymer	Abhijit Pravin Shete, Anuya Amol Nisal, Ashish Kishore Lele
74	United States of America	11292716	Photo-Catalytic Splitting of Water using Self-Assembled Metalloporphyrin 2D-Sheets	Santosh Babu Sukumaran, Karayamkodath Chandran Ranjeesh
75	United States of America	11365202	Novel Antimalarial Compounds, Process for Preparation and their use for Drug Resistant Malaria	Asish Kumar Bhattacharya, Eswar Kumar Aratikatla, Pawan Malhotra, Asif Mohmmed
76	United States of America	11352750	Shaped Objects for use in Security Applications	Kadhiravan Shanmuganathan, Premnath Venugopalan, Tushar Ambone
77	United States of America	11427651	Edible Coatings, A Process for the Preparation and Applications Thereof	Kadhiravan Shanmuganathan, Prashant Yadav
78	United States of America	11524996	A Cloning, Expression and Refolding Process for Preparing Antibody Fragments	Rahul Sharad Bhambure, Kayanat Mahammadtaki Gani

79	United States of America	11427661	Fluorescent Polymer for Visual Solid State Sensing of Volatile Organic Compounds	Sarabjot Kaur Makkad, Asha Syamakumari
80	United States of America	11439985	Nitration of Benzene	Shubhangi Bhalchandra Umbarkar, Atul Balasaheb Kulal, Mohan Keraba Dongare
81	United States of America	11305344	An Improved Process for the Preparation of Bimetallic Core-Shell Nanoparticles and their Catalytic Applications	Vinod Chathakudath Prabhakaran, Vysakh Alengattil Bharathan
82	United States of America	11377562	Novel Squaraine Dyes and Applications Thereof	Jayaraj Nithyanandhan, Ananthan Alagumalai, Munavvar Fairoos, Punitharasu Vellimalai
83	United States of America	11479523	A Single Step Oxidation of Alkane or Alkene	Thirumalaiswamy Raja, Shatabdi Porel Mukherjee, Marimuthu Prabhu, Yogita Manikrao Shirke
84	United States of America	11325113	Photostable Composite of Indium Gallium Nitride and Metal Oxide for Solar Water Splitting	Chinnakonda Subramanian Gopinath, Raja Ambal Sivaraman
85	United States of America	11339381	Nucleotide Sequence Encoding 9-Lipoxygenase and Recombinant Constructs Comprising the same	Vidya Shrikant Gupta, Ashish Balwant Deshpande, Hemangi Girish Chidley, Ashok Prabhakar Giri
86	United States of America	11339174	γ- Spiroketal- γ- Lactones and Pharmaceutical Composition Containing Same and Process of Preparation Thereof	Ravindar Kontham, Digambar Abasaheb Kambale
87	United States of America	11456061	A Method for Harvesting 3D Chemical Structures from File Formats	Muthukumarasamy Karthikeyan, Renu Vyas
88	United States of America	11352556	A Process for the Synthesis of Air Stable Metal Sulphide Quantum Dots	Bhagavatula Lakshmi Vara Prasad, Abhjit Bera
89	United States of America	11578122	A Cloning, Expression and Refolding Process for Preparing Antibody Fragments.	Rahul Sharad Bhambure, Kayanat Mahammadtaki Gani
CSIR-NCL+CSMCRI				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
90	United States of America	11319331	A New Regent for Specific Detection of HOCL in Physiological Condition	Firoj Ali, Sunil Babanrao Aute, Anila Hoskere Ashok, Suman Pal, Amitava Das
CSIR-NIIST				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
91	United Kingdom	2586751	Screening Kit for Detection of Precancerous Lesions of Cervix and Process for the Preparation Thereof	Kaustabh Kumar Maiti, Varsha Karunakaran, Kunjuraman Sujathan
92	Japan	7242851	Screening Kit for Detection of Precancerous Lesions of Cervix and Process for the Preparation Thereof	Kaustabh Kumar Maiti, Varsha Karunakaran, Kunjuraman Sujathan
93	United States Of America	11390547	A Bioprocess for Reducing Perchlorate and/or Nitrate	Krishnakumar Bhaskaran, Anupama Vijaya Nadaraja

94	United States Of America	11313074	A Process for the Preparation of Functionalized Weather-Resistant and Slow-Decaying Geotextiles	Vadakkethonippuathu Sivankuttynair Prasad, Padinjareveetil Anju, Methalayil Brahmakumar, Das Anitha Ravindranath, Sebastian Sumy
95	United States Of America	11313860	Screening Kit for Detection of Precancerous Lesions of Cervix and Process for the Preparation Thereof	Kaustabh Kumar Maiti, Varsha Karunakaran, Kunjuraman Sujathan
CSIR-NML				
S No	**Country**	**Patent No**	**Title of Invention**	**Inventors**
96	China	CN110198975	Electrospun Collagen-Graphene-Polymer Composite Nanofibres for Supercapicitors	Suprabha Nayar, Soumya Bhattacharya, Divya Kumari, Muditha Dharshana Senarath Yapa, Chathuri Yatawara, Ganga Iddamalgoda
97	Japan	7086097	Electrospun Collagen-Graphene-Polymer Composite Nanofibres for Supercapicitors	Suprabha Nayar, Soumya Bhattacharya, Divya Kumari, Muditha Dharshana Senarath Yapa, Chathuri Yatawara, Ganga Iddamalgoda
98	South Korea	102508321	Electrospun Collagen-Graphene-Polymer Composite Nanofibres for Supercapicitors	Suprabha Nayar, Soumya Bhattacharya, Divya Kumari, Muditha Dharshana Senarath Yapa, Chathuri Yatawara, Ganga Iddamalgoda
99	Taiwan	I790216	Electrospun Collagen-Graphene-Polymer Composite Nanofibres for Supercapicitors	Suprabha Nayar, Soumya Bhattacharya, Divya Kumari, Muditha Dharshana Senarath Yapa, Chathuri Yatawara, Ganga Iddamalgoda

ANNEXURE IV

Area-wise Top 25 Research Publications by CSIR Labs

Biological Science Laboratories/Institutes			
Sr. No.	**CSIR Lab**	**Publication Details**	**IF-2022**
1.	IGIB	Subissi, L; Von Gottberg, A; Thukral, L; Worp, N; et. al., An early warning system for emerging SARS-CoV-2 variants. *Nature Medicine*, 2022, vol. 28, iss. 6, pp. 1110-1115.	82.9
2.	CCMB	Yengo, L; Vedantam, S; Marouli, E; et. al., A saturated map of common genetic variants associated with human height. *Nature*, 2022, vol. 610, iss. 7933, pp. 704+	64.8
3.	IGIB	Meng, B; Abdullahi, A; Ferreira, IATM; et. al., Altered $TMPRSS_2$ usage by SARS-CoV-2 Omicron impacts infectivity and fusogenicity. *Nature*, 2022, vol. 603, iss. 7902, pp. 706+	64.8
4.	IGIB	Thiruvengadam, R; Awasthi, A; Medigeshi, G; et. al., Thiruvengadam, R; Awasthi, A; Medigeshi, G et. Al., Effectiveness of ChAdOx1 nCoV-19 vaccine against SARS-CoV-2 infection during the delta (B.1.617.2) variant surge in India: a test-negative, case-control study and a mechanistic study of post-vaccination immune responses. *Lancet Infectious Diseases*, 2022, vol. 22, iss. 4, pp. 473-482	56.3
5.	IITR	Ledesma, JR; Ma, JN; Vongpradith, A; et. al., Global, regional, and national sex differences in the global burden of tuberculosis by HIV status, 1990-2019: results from the Global Burden of Disease Study 2019. *Lancet Infectious Diseases*, 2022, vol. 22, iss. 2, pp. 222-241	56.3
6.	CDRI	Pandey, PR; Young, KH; Kumar, D; et. al., RNA-mediated immunotherapy regulating tumor immune microenvironment: next wave of cancer therapeutics. *Molecular Cancer*, 2022, vol. 21, iss. 1	37.3
7	CCMB, IGIB	Mahajan, A; Spracklen, CN; Zhang, WH; et. al., Multi-ancestry genetic study of type 2 diabetes highlights the power of diverse populations for discovery and translation. *Nature Genetics*, 2022, vol. 54, iss. 5, pp. 560+	30.8
8.	IGIB	Gupta, A; Bhoyar, R; Mirza, S; et. al., SARS-CoV-2 vaccine breakthrough infection following a previous infection in a healthcare worker. *Journal of Infection*, 2022, vol. 84, iss. 3, pp. 465-467	28.2
9.	IHBT	Dogra, V; Singh, RM; Li, MP; et. al., Executer2 modulates the Executer1 signalosome through its singlet oxygen-dependent oxidation. *Molecular Plant*, 2022, vol. 15, iss. 3, pp. 438-453	27.5
10.	IIIM	Verma, PK; and Sawant, SD, Unravelling reaction selectivities via bio-inspired porphyrinoid tetradentate frameworks. *Coordination Chemistry Reviews*, 2022, vol. 450	20.6
11.	IMTech	Chopra, T; Sasan, S; Devi, L; et. al., A comprehensive review on recent advances in copper sensors. *Coordination Chemistry Reviews*, 2022, vol. 470	20.6
12.	IGIB	Sharma, S; and Chowdhury, S, Emerging mechanisms of telomerase reactivation in cancer. *Trends in Cancer*, 2022, vol. 8, iss. 8, pp. 632-641	18.4
13.	NBRI, IITR	Sharma, VK; Sharma, M; Usmani, Z; et. al., Tailored enzymes as next-generation food-packaging tools. *Trends in Biotechnology*, 2022, vol. 40, iss. 8, pp. 1004-1017	17.3
14.	IIIM	Yaseen, I; White, SA; Torres-Garcia, S; et. al., Proteasome-dependent truncation of the negative heterochromatin regulator EPE1 mediates antifungal resistance. *Nature Structural & Molecular Biology*, 2022, vol. 29, iss. 8, pp. 745+	16.8
15.	CCMB	Ding, BJ; Yang, S; Schaks, M; et. al., Structures reveal a key mechanism of WAVE regulatory complex activation by RAC1 GTPase. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
16.	CDRI	Verma, A; Singh, A; Singh, MP; et. al., EZH2-H3K27me3 mediated KRT14 upregulation promotes TNBC peritoneal metastasis. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
17.	CDRI	Rice, A; Haldar, S; Wang, ER; et. al., Planar aggregation of the influenza viral fusion peptide alters membrane structure and hydration, promoting poration. *Nature Communications*, 2022, vol. 13, iss. 1	16.6

18.	CFTRI	Mishra, S; Cosentino, C; Tamta, AK; et. al., Sirtuin 6 inhibition protects against glucocorticoid-induced skeletal muscle atrophy by regulating IGF/PI3K/AKT signalling. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
19.	IGIB	Ujjainiya, R; Tyagi, A; Sardana, V; et. al., High failure rate of ChAdOx1-nCoV19 immunization against asymptomatic infection in healthcare workers during a Delta variant surge. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
20.	IGIB	Das, S; Singh, J; Shaman, H; et. al., Pre-existing antibody levels negatively correlate with antibody titers after a single dose of BBV152 vaccination. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
21.	IICB, IGIB	Ray, Y; Paul, SR; Bandopadhyay, P; et. al., A phase 2 single center open label randomised control trial for convalescent plasma therapy in patients with severe COVID-19. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
22.	IICB	Naskar, S; Moi, R; Das, I; et. al., Halogen...Halogen and Halogen...pi Interactions Enabled Reversible Photo-oligomerization of Conjugated Dienones: Visible Light Triggered Single-Crystal-to-Single-Crystal Transformation. *Angewandte Chemie-International Edition*, 2022, vol. 61, iss. 23	16.6
23.	IIIM	Shah, K; Maradana, MR; Delas, MJ; et. al., Cell-intrinsic Aryl Hydrocarbon Receptor signalling is required for the resolution of injury-induced colonic stem cells. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
24.	IMTech	Kumar, G; Chawla, P; Dhiman, N; et. al., RUFY3 links Arl8b and JIP4-Dynein complex to regulate lysosome size and positioning. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
25.	IITR	Gupta, VK; Pandey, A; Koffas, M; et. al., Biobased biorefineries: Sustainable bioprocesses and bioproducts from biomass/bioresources special issue. *Renewable & Sustainable Energy Reviews*, 2022, vol. 167	15.9
26.	NBRI	Ratha, SK; Renuka, N; Abunama, T; et. al., Hydrothermal liquefaction of algal feedstocks: The effect of biomass characteristics and extraction solvents. *Renewable & Sustainable Energy Reviews*, 2022, vol. 156	15.9

Chemical Science Laboratories/Institutes			
Sr. No.	**CSIR Lab**	**Publication Details**	**IF-2022**
1.	CSMCRI	Pramanik, S. K; Sreedharan, S; Tiwari, R; et.al., Nanoparticles for Super-Resolution Microscopy: Intracellular Delivery and Molecular Targeting. *Chemical Society Reviews*, 2022, vol. 51, iss. 24, pp. 9882-9916.	46.2
2.	IIP	Cauwenbergh, R; Goyal, V; Maiti, R; et.al., Challenges and recent advancements in the transformation of CO_2 into carboxylic acids: straightforward assembly with homogeneous 3D metals. *Chemical Society Reviews*, 2022, vol. 51, iss. 22, pp. 9371-9423	46.2
3.	NCL	Das, R; Das, K; Ray, B; et.al., Green transformation of CO2 to ethanol using water and sunlight by the combined effect of naturally abundant red phosphorus and Bi2MoO6. *Energy & Environmental Science*, 2022, vol. 15, iss. 5, Pp. 1967-1976	32.5
4.	IICT	Zhao, Q; Han, R; Marshall, AR; et.al., Colloidal Quantum Dot Solar Cells: Progressive Deposition Techniques and Future Prospects on Large-Area Fabrication. *Advanced Materials*, 2022, vol. 34, iss. 17	29.4
5.	NCL	Bagchi, D; Raj, J; Singh, AK; et.al., Structure-Tailored Surface Oxide on Cu-Ga Intermetallics Enhances CO2 Reduction Selectivity to Methanol at Ultralow Potential. *Advanced Materials*, 2022, vol. 34, iss. 19	29.4
6.	NCL	Mondal, S; Sarkar, S; Bagchi, D; et.al., Morphology-Tuned Pt3Ge Accelerates Water Dissociation to Industrial-Standard Hydrogen Production over a wide pH Range. *Advanced Materials*, 2022, vol. 34, iss. 30	29.4
7	NCL	Haldar, S; Rase, D; Shekhar, P; et.al., Incorporating Conducting Polypyrrole into a Polyimide COF for Carbon-Free Ultra-High Energy Supercapacitor. *Advanced Energy Materials*, 2022, vol. 12, iss. 34	27.8

8.	CSMCRI	Kaushik, A; Marvaniya, K; Kulkarni, Y; et.al., Large-area self-standing thin film of porous hydrogen-bonded organic framework for efficient uranium extraction from seawater. *Chem*, 2022, vol. 8, iss. 10, pp. 2749-2765	23.5
9.	CECRI	Jayachitra, S; Mahendiran, D; Ravi, P; et.al., Highly conductive NiSe2 nanoparticle as a co-catalyst over TiO2 for enhanced photocatalytic hydrogen production. *Applied Catalysis B-Environmental*, 2022, vol. 307	22.1
10.	NCL	Cherevotan, A; Ray, B; Churipard, SR; et.al., Influence of support textural property on CO2 to methane activity of Ni/SiO2 catalysts. *Applied Catalysis B-Environmental,* 2022, vol. 317	22.1
11.	NEIST	Gogoi, D; Karmur, RS; Das, MR; et.al., Cu and CoFe2O4 nanoparticles decorated hierarchical porous carbon: An excellent catalyst for reduction of nitroaromatics and microwave-assisted antibiotic degradation. *Applied Catalysis B-Environmental*, 2022, vol. 312	22.1
12.	NCL	Koner, K; Karak, S; Kandambeth, S; et.al., Porous covalent organic nanotubes and their assembly in loops and toroids. *Nature Chemistry*, 2022, vol. 14, iss. 5, pp. 507+	21.8
13.	CECRI	Vinoth, S; Ong, and WJ; Pandikumar, A, Defect engineering of BiOX (X = Cl, Br, I) based photocatalysts for energy and environmental applications: Current progress and future perspectives. *Coordination Chemistry Reviews*, 2022, vol. 464	20.6
14.	CSMCRI	Sahoo, J; Krishnaraj, C; Sun, JM; et.al., Lanthanide based inorganic phosphates and biological nucleotides sensor. *Coordination Chemistry Reviews*, 2022, vol. 466	20.6
15.	IICT	Bera, MK; Mohanty, S; Kashyap, SS; et.al., Electrochromic coordination nanosheets: Achievements and future perspective. *Coordination Chemistry Reviews*, 2022, vol. 454	20.6
16.	IICT	Rana, P; Singh, N; Majumdar, P; et.al., Evolution of BODIPY/aza-BODIPY dyes for organic photoredox/energy transfer catalysis. *Coordination Chemistry Reviews*, 2022, vol. 470	20.6
17.	IIP	Nandal, N; and Jain, SL; , A review on progress and perspective of molecular catalysis in photoelectrochemical reduction of CO_2. *Coordination Chemistry Reviews*, 2022, vol. 451	20.6
18.	NCL	Joshi, B; Samuel, E; Kim, YI; et.al., Review of recent progress in electrospinning-derived freestanding and binder-free electrodes for supercapacitors. *Coordination Chemistry Reviews*, 2022, vol. 460	20.6
19.	CECRI	Cai, JC; Murugadoss, V; Jiang, JY; et.al., Waterborne polyurethane and its nanocomposites: a mini-review for anti-corrosion coating, flame retardancy, and biomedical applications. *Advanced Composites and Hybrid Materials*, 2022, vol. 5, iss. 2, pp. 641-650	20.1
20.	CECRI	Nasrin, K; Sudharshan, V; Subramani, K; et.al., Insights into 2D/2D MXene Heterostructures for Improved Synergy in Structure toward Next-Generation Supercapacitors: A Review. *Advanced Functional Materials*, 2022, vol. 32, iss. 18	19.0
21.	NIIST	Cherumukkil, S; Das, G; Tripathi, RPN; et.al., pi-Extended Bodipy Self-Assembly as Supramolecular Photonic Security Ink and Optical Waveguide. *Advanced Functional Materials*, 2022, vol. 32, iss. 6	19.0
22.	NIIST	Pious, JK; Muthu, C; and Vijayakumar, C, Organic Spacer Cation Assisted Modulation of the Structure and Properties of Bismuth Halide Perovskites. *Accounts of Chemical Research*, 2022, vol. 55, iss. 3, pp. 275-285	18.3
23.	NIIST, CEERI	Varghese, H; Hakkeem, HMA; Chauhan, K; et.al., A high-performance flexible triboelectric nanogenerator based on cellulose acetate nanofibers and micropatterned PDMS films as mechanical energy harvester and self-powered vibrational sensor. *Nano Energy*, 2022, vol. 98	17.6
24.	NCL	Bagchi, D; Sarkar, S; Singh, AK; et.al., Potential- and Time-Dependent Dynamic Nature of an Oxide-Derived PdIn Nanocatalyst during Electrochemical CO_2 Reduction. *ACS Nano*, 2022, vol. 16, iss. 4, pp. 6185-6196	17.1
25.	CLRI	Yang, J; Ghosh, S; Roeser, J; et.al., Constitutional isomerism of the linkages in donor-acceptor covalent organic frameworks and its impact on photocatalysis. *Nature Communications*, 2022, vol. 13, iss. 1	16.6

26.	IICT, NCL	Jadhav, SB; Dash, SR; Maurya, S; et.al., Enantioselective Cu(I)-catalyzed borylative cyclization of enone-tethered cyclohexadienones and mechanistic insights. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
27.	NCL	Fajal, S; Mandal, W; Mollick, S; et.al., Trap Inlaid Cationic Hybrid Composite Material for Efficient Segregation of Toxic Chemicals from Water. *Angewandte Chemie-International Edition*, 2022, vol. 61, iss. 32	16.6
28.	NCL	Culhane, KJ; Gupte, TM; Madhugiri, I; et.al., Kinetic model of GPCR-G protein interactions reveals allokairic modulation of signalling. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
29.	NIIST	Das, S; Patra, D; Shankar, S; et.al., Photocycloaddition as a Tool for Modulation of the Lower Critical Solution Temperature in a Molecular pi-System to Control Transmission of Solar Radiation. *Angewandte Chemie-International Edition*, 2022, vol. 61, iss. 35	16.6
30.	NIIST	Krishnan, RS; Jana, K; Shaji, AH; et.al., Assembly of transmembrane pores from mirror-image peptides. *Nature Communications*, 2022, vol. 13, iss. 1	16.6

Engineering Science Laboratories/Institutes

Sr. No.	CSIR Lab	Publication Details	IF-2022
1.	NAL	Datta, SJ; Mayoral, A; Bettahalli, NMS; et.al., Rational design of mixed-matrix metal-organic framework membranes for molecular separations. *Science*, 2022, vol. 376, iss. 6597, pp. 1080+	56.9
2.	CGCRI	Patra, P; and Annapurna, K, Transparent tellurite glass-ceramics for photonics applications: A comprehensive review on crystalline phases and crystallization mechanisms. *Progress in Materials Science*, 2022, vol. 125	37.4
3.	AMPRI	Parihar, A; Singhal, A; Kumar, N; et.al., Next-Generation Intelligent MXene-Based Electrochemical Aptasensors for Point-of-Care Cancer Diagnostics. *Nano-Micro Letters*, 2022, vol. 14, iss. 1	26.6
4.	IMMT	Roy, G; Gupta, R; Sahoo, SR; et.al., Ferrocene as an iconic redox marker: From solution chemistry to molecular electronic devices. *Coordination Chemistry Reviews*, 2022, vol. 473	20.6
5.	NML	Yeon, JS; Gupta, N; Bhattacharya, P; et.al., A New Era of Integrative Ice Frozen Assembly into Multiscale Architecturing of Energy Materials. *Advanced Functional Materials*, 2022, vol. 32, iss. 19	19.0
6.	AMPRI	Kumar, P; Dhand, C; Dwivedi, N; et.al., Graphene quantum dots: A contemporary perspective on scope, opportunities, and sustainability. *Renewable & Sustainable Energy Reviews*, 2022, vol. 157	15.9
7	NAL	Adak, D; Bhattacharyya, R; Barshilia, HC; et.al., A state-of-the-art review on the multifunctional self-cleaning nanostructured coatings for PV panels, CSP mirrors and related solar devices. *Renewable & Sustainable Energy Reviews*, 2022, vol. 159	15.9
8.	NEERI, NIIST, IITR	Awasthi, MK; Singh, E; Binod, P; et.al., Biotechnological strategies for bio-transforming biosolid into resources toward circular bio-economy: A review. *Renewable & Sustainable Energy Reviews*, 2022, vol. 156	15.9
9.	SERC	Subbulakshmi, A; Verma, M; Keerthana, M; et.al., Recent advances in experimental and numerical methods for dynamic analysis of floating offshore wind turbines - An integrated review. *Renewable & Sustainable Energy Reviews*, 2022, vol. 164	15.9
10.	AMPRI	Mukhopadhyay, P; Chakraborty, R; Singh, S; et.al., Triacetin additive in biodiesel to reduce air pollution: a review. *Environmental Chemistry Letters*, 2022, vol. 20, iss. 2, pp. 1193-1224	15.7
11.	NEERI	Dutta, D; Arya, S; Kumar, S; et.al., Electronic waste pollution and the COVID-19 pandemic. *Environmental Chemistry Letters*, 2022, vol. 20, iss. 2, pp. 971-974	15.7
12.	NEERI	Pham, CQ; Bahari, MB; Kumar, PS; et.al., Carbon dioxide methanation on heterogeneous catalysts: a review. *Environmental Chemistry Letters*, 2022, vol. 20, iss. 6, pp. 3613-3630	15.7
13.	AMPRI	Mohapatra, RK; Kandi, V; Sarangi, AK; et.al., The recently emerged BA.4 and BA.5 lineages of Omicron and their global health concerns amid the ongoing wave of COVID-19 pandemic – Correspondence. *International Journal of Surgery*, 2022, vol. 103	15.3

14.	AMPRI	Mohapatra, RK; Kandi, V; Tuli, HS; Verma, S; et.al., Emerging cases of acute hepatitis of unknown origin in children amid the ongoing COVID-19 pandemic: Needs attention – Correspondence. *International Journal of Surgery*, 2022, vol. 102	15.3
15.	AMPRI	Patial, S; Raizada, P; Khan, AAP; et.al., Emerging new-generation covalent organic frameworks composites as green catalysts: design, synthesis and solar to fuel production. *Chemical Engineering Journal*, 2022, vol. 433	15.1
16.	CMERI	Shit, S; Bolar, S; Murmu, NC; et.al., Minimal lanthanum-doping triggered enhancement in bifunctional water splitting activity of molybdenum oxide/sulfide heterostructure through structural evolution. *Chemical Engineering Journal*, 2022, vol. 428	15.1
17.	CMERI	Paul, A; Ghosh, S; Kolya, H; et.al., Synthesis of nickel-tin oxide/nitrogen-doped reduced graphene oxide composite for asymmetric supercapacitor device. *Chemical Engineering Journal*, 2022, vol. 443	15.1
18.	CMERI	Chakraborty, D; Bej, S; Chatterjee, R; et.al., A new phosphonate based Mn-MOF in recognising arginine over lysine in aqueous medium and other bio-fluids with "Sepsis" disease remediation. *Chemical Engineering Journal*, 2022, vol. 446	15.1
19.	IMMT	Mittal, Y; Dash, S; Srivastava, P; et.al., Azo dye containing wastewater treatment in earthen membrane based unplanted two chambered constructed wetlands-microbial fuel cells: A new design for enhanced performance. *Chemical Engineering Journal*, 2022, vol. 427	15.1
20.	IMMT	Saeed, T; Majed, N; Yadav, AK; et.al., Constructed wetlands for drained wastewater treatment and sludge stabilization: Role of plants, microbial fuel cell and earthworm assistance. *Chemical Engineering Journal*, 2022, vol. 430	15.1
21.	IMMT	Saeed, T; Miah, MJ; and Yadav, AK, Free-draining two-stage microbial fuel cell integrated constructed wetlands development using biomass, construction, and industrial wastes as filter materials: Performance assessment. *Chemical Engineering Journal*, 2022, vol. 437	15.1
22.	NEERI	Ambika, S; Kumar, M; Pisharody, L; et.al., Modified biochar as a green adsorbent for removal of hexavalent chromium from various environmental matrices: Mechanisms, methods, and prospects. *Chemical Engineering Journal*, 2022, vol. 439	15.1
23.	AMPRI	Agrawal, V; Paulose, R; Arya, R; et.al., Green conversion of hazardous red mud into diagnostic X-ray shielding tiles. *Journal of Hazardous Materials*, 2022, vol. 424	13.6
24.	CMERI	Das, B; Behera, S; Satpati, B; et.al., Layered SnS2/porous nickel foil based Schottky junction: An excellent ammonia sensor at room temperature. *Journal of Hazardous Materials*, 2022, vol. 428	13.6
25.	NEERI	Junghare, S; Kumari, S; Chaudhary, A; et.al., Thermite reaction driven pyrotechnic formulation with promising functional performance and reduced emissions. *Journal of Hazardous Materials*, 2022, vol. 424	13.6
26.	NML	Sinha, S; De, S; Mishra, D; et.al., Phosphonomethyl iminodiacetic acid functionalized metal organic framework supported PAN composite beads for selective removal of La(III) from wastewater: Adsorptive performance and column separation studies. *Journal of Hazardous Materials*, 2022, vol. 425	13.6

Information Science Laboratories/Institutes and CSIR Hqrs			
Sr. No.	**CSIR Lab**	**Publication Details**	**IF-2022**
1.	NIScPR	Aggarwal, R; Hooda, M; Kumar, P; et.al., Vision on Synthetic and Medicinal Facets of 1,2,4-Triazolo[3,4-b][1,3,4]thiadiazine Scaffold. *Topics in Current Chemistry*, 2022, vol. 380, iss. 2	8.6
2.	CSIR-Hqrs	Banerjee, P; Mandhare, A; and Bagalkote, V, Marine natural products as source of new drugs: an updated patent review (July 2018-July 2021). *Expert Opinion on Therapeutic Patents*, 2022, vol. 32, iss. 3, pp. 317-363	6.6
3.	CSIR-4PI	Surendran, S; Anand, KVA; Ravindran, S; et.al., Exacerbation of Indian Summer Monsoon Breaks by the Indirect Effect of Regional Dust Aerosols. *Geophysical Research Letters*, 2022, vol. 49, iss. 20	5.2
4.	CSIR-Hqrs	Alam, MI; Quasimi, H; Kumar, A; et.al., Protective effects of novel diazepinone derivatives in snake venom induced sterile inflammation in experimental animals. *European Journal of Pharmacology*, 2022, vol. 928	5.0

5.	NIScPR	Aggarwal, R; Kumar, S; Virender; Kumar, A; et.al. , Development of heterocyclic 2,7-diamino-3-phenylazo-6-phenylpyrazolo [1,5-a]pyrimidine as antimicrobial agent and selective probe for UV-visible and colorimetric detection of Hg2+ions. *Microchemical Journal*, 2022, vol. 183	4.8
6.	CSIR-4PI	Kallummal, R , Projected engulfment of tropical Indian Ocean by anthropogenical warmpool. *Climate Dynamics*, 2022, vol. 59, iss. 45019, pp. 1161-1173	4.6
7	CSIR-4PI	Rajendran, K; Surendran, S; Varghese, SJ; et.al., TSimulation of Indian summer monsoon rainfall, interannual variability and teleconnections: evaluation of CMIP6 models. *Climate Dynamics*, 2022, vol. 58, iss. 45208, pp. 2693-2723	4.6
8.	CSIR-4PI	Dumka, UC; Kaskaoutis, DG; Khatri, P; et.al., Water vapour characteristics and radiative effects at high-altitude Himalayan sites. *Atmospheric Pollution Research*, 2022, vol. 13, iss. 2	4.5
9.	CSIR-4PI, IICT	Bhimala, KR; Patra, GK; Mopuri, R; et.al., Prediction of COVID-19 cases using the weather integrated deep learning approach for India. *Transboundary and Emerging Diseases*, 2022, vol. 69, iss. 3, pp. 1349-1363	4.3
10.	CSIR-Hqrs	Tripathi, N; Goel, B; Bhardwaj, N; et.al., Exploring the Potential of Chemical Inhibitors for Targeting Post-translational Glycosylation of Coronavirus (SARS-CoV-2). *ACS Omega*, 2022, vol. 7, iss. 31, Pp. 27038-27051	4.1
11.	NIScPR	Lakshmanan, S; and Lingappan, N, Autoxidation of Formaldehyde with Oxygen-A Comparison of Reaction Channels. *ACS Omega*, 2022, vol. 7, iss. 8, Pp. 6778-6786	4.1
12.	NIScPR	Singh, VK; Singh, P; Uddin, A; et.al., Exploring the relationship between journals indexed from a country and its research output: an empirical investigation. *Scientometrics*, 2022, vol. 127, iss. 6, pp. 2933-2966	3.9
13.	NIScPR	Aggarwal, R; Swati; Kumar, V; Singh, R; et.al. , Design, synthesis, and biological evaluation of N-[1-(6 '-chloropyridazin-3 '-yl)-3-(4 "-substitutedphenyl)-1H-pyrazole-5-yl]alkanamides as anti-inflammatory agents. *Drug Development Research*, 2022, vol. 83, iss. 3, pp. 811-822	3.8
14.	NIScPR	Aggarwal, R; Hooda, M; Kumar, P; et.al., Visible-Light-Prompted Synthesis and Binding Studies of 5,6-Dihydroimidazo[2,1-b]thiazoles with BSA and DNA Using Biophysical and Computational Methods. *Journal of Organic Chemistry*, 2022, vol. 87, iss. 6, pp. 3952-3966	3.6
15.	NIScPR	Puri, R; Choudhary, AK; Barman, P; et.al., Two unusual conjugated fatty acids, parinaric acid and alpha-eleostearic acid, are present in several Impatiens species, but not in congener Hydrocera triflora. *Physiology and Molecular Biology of Plants*, 2022, vol. 28, iss. 5, pp. 1109-1118	3.5
16.	CSIR-4PI	Neethu, C; and Ramesh, KV, High-resolution spatiotemporal variability of heat wave impacts quantified by thermal indices. *Theoretical and Applied Climatology,* 2022, vol. 148, iss. 45019, pp. 1181-1198	3.4
17.	CSIR-4PI	Lenka, S; Devi, R; Joseph, CM; et.al., Effect of large-scale oceanic and atmospheric processes on the Indian summer monsoon. *Theoretical and Applied Climatology*, 2022, vol. 147, iss. 45019, pp. 1561-1576	3.4
18.	CSIR-4PI	Devi, R; Gouda, KC; and Lenka, S, Temperature-duration-frequency analysis over Delhi and Bengaluru city in India. *Theoretical and Applied Climatology*, 2022, vol. 147, iss. 44958, pp. 291-305	3.4
19.	NIScPR	Aggarwal, R; Hooda, M; Kumar, P; et.al., Visible-light-mediated regioselective synthesis of novel thiazolo[3,2-b][1,2,4]triazoles: advantageous synthetic application of aqueous conditions. *Organic & Biomolecular Chemistry*, 2022, vol. 20, iss. 3, pp. 584-595	3.2
20.	CSIR-4PI, NAL	Gouda, KC; Gogeri, I; ThippaReddy, AS; et.al., Assessment of Aerosol Optical Depth over Indian Subcontinent during COVID-19 lockdown (March-May 2020). *Environmental Monitoring and Assessment*, 2022, vol. 194, iss. 3	3.0
21.	CSIR-Hqrs	Nilkanth, VV; and Mande, SC, Structure-sequence features based prediction of phosphosites of serine/threonine protein kinases of Mycobacterium tuberculosis. *Proteins-Structure Function and Bioinformatics*, 2022, vol. 90, iss. 1, pp. 131-141	2.9
22.	NIScPR	Manonmani, G; Sandhiya, L; and Senthilkumar, K, A Computational Perspective on the Chemical Reaction of HFO-1234zc with the OH Radical in the Gas Phase and in the Presence of Mineral Dust. *Journal of Physical Chemistry A*, 2022, vol. 126, iss. 51, pp. 9564-9576	2.9

23.	NIScPR	Ray, S, Mental and Psychosocial Health: A Post-COVID Concern in India. *Neurology India*, 2022, vol. 70, iss. 5, pp. 2116-2120	2.7
24.	CSIR-4PI	Vijayan, MSM; and Shimna, K, Detecting aliasing and artifact free co-seismic and tsunamigenic ionospheric perturbations using GPS. *Advances in Space Research*, 2022, vol. 69, iss. 2, pp. 951-975	2.6
25.	CSIR-4PI	Rajana, SSK; Shrungeshwara, TS; Vivek, CG; et.al., Evaluation of long-term variability of ionospheric total electron content from IRI-2016 model over the Indian sub-continent with a latitudinal chain of dual-frequency geodetic GPS observation s during 2002 to 2019. *Advances in Space Research*, 2022, vol. 69, iss. 5, pp. 2111-2125	2.6
26.	CSIR-4PI	Gupta, SV; Parvez, IA; Ankit; Khan, PK; et.al., Site Effects Investigation in Srinagar City of Kashmir Basin Using Microtremor and Its Inversion. *Journal of Earthquake Engineering*, 2022, vol. 26, iss. 7, pp. 3799-3820	2.6

Physical Science Laboratories/Institutes			
Sr. No.	**CSIR Lab**	**Publication Details**	**IF-2022**
1.	CSIO	Narayanan, G; Shen, JL; Matai, I; et.al., Cyclodextrin-based nanostructures. *Progress in Materials Science*, 2022, vol. 124	37.4
2.	CSIO	Singh, H; Sareen, D; George, JM; et.al., Mitochondria targeted fluorogenic theranostic agents for cancer therapy. *Coordination Chemistry Reviews*, 2022, vol. 452	20.6
3.	NPL, NIScPR	Rab, S; Wan, M; and Yadav, S, Let's get digital. *Nature Physics*, 2022, vol. 18, iss. 8, pp. 960-960	19.6
4.	CSIO	Thakur, A; and Devi, P, Paper-based flexible devices for energy harvesting, conversion and storage applications: A review. *Nano Energy*, 2022, vol. 94	17.6
5.	CSIO	Koo, S; Lee, MG; Sharma, A; et.al., Harnessing GLUT1-Targeted Pro-oxidant Ascorbate for Synergistic Phototherapeutics. *Angewandte Chemie-International Edition*, 2022, vol. 61, iss. 17	16.6
6.	NIO	Xu, BQ; Zhang, G; Gustafsson, O; et.al., Large contribution of fossil-derived components to aqueous secondary organic aerosols in China. *Nature Communications*, 2022, vol. 13, iss. 1	16.6
7	NGRI	Morin-Crini, N; Lichtfouse, E; Liu, GR; et.al., Worldwide cases of water pollution by emerging contaminants: a review. *Environmental Chemistry Letters*, 2022, vol. 20, iss. 4, Pp. 2311-2338	15.7
8.	CSIO	Roy, K; Maitra, S; Ghosh, D; et.al., 2D-Heterostructure assisted activation of MoS2 basal plane for enhanced photoelectrochemical hydrogen evolution reaction. *Chemical Engineering Journal*, 2022, vol. 435	15.1
9.	CSIO	Disha; Nayak, MK; Kumari, P; et.al., Functional nanomaterials based opto-electrochemical sensors for the detection of gonadal steroid hormones. *Trac-Trends in Analytical Chemistry*, 2022, vol. 150	13.1
10.	NGRI	De, S; and Raju, PVS; , Mesoarchean terrestrial sedimentation in a continental rift setting and its provenance implications: An example from the Bisrampur Formation, Singhbhum craton, India. *Earth-Science Reviews*, 2022, vol. 234	12.1
11.	NGRI	Mazumder, R; Chaudhuri, T; De, SVBT; et.al., Paleoarchean surface processes and volcanism: Insights from the eastern Iron Ore Group, Singhbhum craton, India. *Earth-Science Reviews*, 2022, vol. 232	12.1
12.	NIO	Sara, G; Mangano, MC; Berlino, M; et.al., The Synergistic Impacts of Anthropogenic Stressors and COVID-19 on Aquaculture: A Current Global Perspective. *Reviews in Fisheries Science & Aquaculture*, 2022, vol. 30, iss. 1, Pp. 123-135	11.5
13.	NIO	Mulitza, S; Bickert, T; Bostock, HC; et.al., World Atlas of late Quaternary Foraminiferal Oxygen and Carbon Isotope Ratios. *Earth System Science Data*, 2022, vol. 14, iss. 6, pp. 2553-2611	11.4

14.	NPL	Jain, M; Khan, SA; Sahoo, A; et.al., Statistical evaluation of cow-dung derived activated biochar for phenol adsorption: Adsorption isotherms, kinetics, and thermodynamic studies. *Bioresource Technology*, 2022, vol. 352	11.4
15.	NPL	Yadav, SK; Dhakate, SR; and Singh, BP; , Carbon nanotube incorporated eucalyptus derived activated carbon-based novel adsorbent for efficient removal of methylene blue and eosin yellow dyes. *Bioresource Technology*, 2022, vol. 344	11.4
16.	NPL	Joshi, P; Dey, S; Ghosh, S; et.al., Association between Acute Exposure to PM(2.5)Chemical Species and Mortality in Megacity Delhi, India. *Environmental Science & Technology*, 2022, vol. 56, iss. 11, Pp. 7275-7287	11.4
17.	NPL	Semalti, P; Sharma, V; and Sharma, SN; , A solution-route processed multicomponent Cu2ZnSn (S1-x Se-x)(4) nanocrystals: A potential low-cost photocatalyst. *Journal of Cleaner Production*, 2022, vol. 365	11.1
18.	NPL, AMPRI	Negi, P; Gupta, A; Singh, M; et.al., Excellent microwave absorbing and electromagnetic shielding performance of grown MWCNT on activated carbon bifunctional composite. *Carbon*, 2022, vol. 198, iss. , pp. 151-161	10.9
19.	CEERI	Chandan; Baig, H; Tahir, AA; Reddy, KS; et.al., Performance improvement of a desiccant based cooling system by mitigation of non-uniform illumination on the coupled low concentrating photovoltaic thermal units. *Energy Conversion and Management*, 2022, vol. 257	10.4
20.	NPL	Haider, SA; Mahajan, KK; Bougher, SW; et.al., Observations and Modeling of Martian Auroras. *Space Science Reviews*, 2022, vol. 218, iss. 4	10.3
21.	CEERI	Adhikari, S; Lem, OLC; Kremer, F; et.al., Nonpolar AlxGa1-xN/AlyGa1-yN multiple quantum wells on GaN nanowire for UV emission. *Nano Research*, 2022, vol. 15, iss. 8, Pp. 7670-7680	9.9
22.	NIO	Bikkina, P; Bikkina, S; and Kawamura, K; , Tracing the biomass burning emissions over the Arabian Sea in winter season: Implications from the molecular distributions and relative abundances of sugar compounds. *Science of the Total Environment*, 2022, vol. 848	9.8
23.	NIO	Bikkina, P; Bikkina, S; Kawamura, K; et.al., Unraveling the sources of atmospheric organic aerosols over the Arabian Sea: Insights from the stable carbon and nitrogen isotopic composition. *Science of the Total Environment*, 2022, vol. 827	9.8
24.	NIO	Silori, S; Biswas, H; Chowdhury, M; et.al., Interannual variability in particulate organic matter distribution and its carbon stable isotope signatures from the western Indian shelf waters. *Science of the Total Environment*, 2022, vol. 844	9.8
25.	NIO	Nayna, OK; Sarma, VVSS; Begum, MS; et.al., Reassessing riverine carbon dioxide emissions from the Indian subcontinent. *Science of the Total Environment*, 2022, vol. 816	9.8
26.	NPL, IHBT	Masiwal, R; Sharma, C; Ranjan, A; et.al., Long-term variability of trace gases over the Indian Western Himalayan Region. *Science of the Total Environment*, 2022, vol. 806	9.8

ANNEXURE V

Summary of Important Audit Observations

(Position as on 31.03.2023)

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.	Chapter 11, CAG Para No. 11.1 (Report No.2 of 2021) titled "Functionality of IT Application System OneCSIR"	Nil	One	Nil	Nil
2	Chapter 4, CAG Para 4.1 (Report 21 of 2022) titled "Irregular grant of incentives and allowances"	Nil	One	Nil	Nil
	Total	Nil	Two	Nil	Nil

ANNEXURE VI

CSIR Governing Body Members (02.03.2020 to 01.03.2023)

1.	**Director General** Council of Scientific & Industrial Research (CSIR) Anusandhan Bhawan, 2, Rafi Marg New Delhi - 110 001.	Chairperson (ex- officio)
2.	**Finance Secretary and Secretary (Expenditure) (Dr. TV Somanathan)** Ministry of Finance, North Block, New Delhi-110 001.	Member- Finance (ex- officio)
3.	**Dr D. Srinivasa Reddy** Director, CSIR- Indian Institute of Chemical Technology, Uppal Road, Hyderabad- 500 007 (Telangana)	Member
4.	**Dr (Mrs.) N. Anandavalli** Director, CSIR- Structural Engineering Research Centre, CSIR Campus, Post Bag No. 8287, CSIR Road, Taramani, Chennai- 600 113 (Tamil Nadu)	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** Former Principal Scientific Advisor to the Government of India, National Centre for Biological Sciences, Tata Institute of Fundamental Research, Bellary Road, Bangalore - 560 065	Member
8.	**Prof. Ajay Kumar Sood** Principal Scientific Advisor to the Government of India, Vigyan Bhawan Annexe, Maulana Azad Road, New Delhi-110 011	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.	**Secretary** **(Dr Samir V. Kamat)** Department of Defence Research and Development (DDRD), and Chairman, Defence Research and Development Organisation (DRDO), Ministry of Defence, New Delhi - 110 001	Member

CSIR Governing Body Members (w.e.f 17.03.2023)

1.	**Director General** Council of Scientific and Industrial Research, Anusandhan Bhawan, 2, Rafi Marg, New Delhi - 110001	Chairperson (Ex-officio)
2.	**Secretary (Expenditure)** Ministry of Finance, North Block, New Delhi-110001	Member-Finance (Ex-officio)
3.	**Dr. Kannan Srinivasan** Director, CSIR- Central Salt & Marine Chemicals Research Institute (CSIR- CSMCRI), Gijubhai Badheka Marg, Bhavnagar - 364002 (Gujarat)	Member
4.	**Dr. Sridevi Annapurna Singh** Director, CSIR- Central Food Technological Research Institute (CSIR- CFTRI), Mysuru - 570020 (Karnataka)	Member
5.	**Shri Dilip Shanghvi** Managing Director, Sun Pharmaceuticals Industries Limited, SUN HOUSE, CTS No. 201 B/I, Western Express Highway, Goregaon (E), Mumbai 400063 (Maharashtra)	Member
6.	**Dr. Nalin Shinghal** Chairman and Managing Director, Bharat Heavy Electricals Limited (BHEL), BHEL House, Siri Fort, New Delhi - 110049	Member
7.	**Shri V.K. Saraswat** Member, NITI Aayog (National Institution for Transforming India), New Delhi-110001	Member
8.	**Prof. Ajay Kumar Sood** Principal Scientific Advisor to the Government of India, Vigyan Bhawan Annexe, Maulana Azad Road, New Delhi-110011	Member
9.	**Prof. Devang V. Khakhar** Professor, Indian Institute of Technology Bombay, Powai, Mumbai -400076 (Maharashtra)	Member
10.	**Dr. Rajesh S. Gokhale** Secretary, Department of Biotechnology, Ministry of Science and Technology, Block-2, 7th Floor, CGO Complex, Lodhi Road, New Delhi - 110003	Member
11.	**Shri S. Somanath** Secretary, Department of Space and Chairman, Space Commission, Antariksh Bhawan, New BEL Road, Bengaluru - 560231 (Karnataka)	Member

ANNEXURE VII

List of 4th Tranche Fast Track Translational (FTT) and Fast Track Commercialization (FTC) Projects under CSIR Themes implemented during FY 2022-23

S. No.	Lab	Project Title	Theme	Category
1	CSIR-AMPRI	Development of Fly Ash based Advanced Geopolymeric Radiation Shielding Concrete utilizing Industrial by products	4M	FTT
2	CSIR-AMPRI	Engineered Shape Memory Polymer-based Portable Heat/ Fire Alarm Devices	4M	FTT
3	CSIR-AMPRI	Up-Scaling & Demonstration of Advanced Brine Sludge-Based Flexible and Mouldable Polymeric Composite Sheets for circular economy	4M	FTT
4	CSIR-CGCRI	1 kW Fiber Laser based System for Additive Manufacturing and Strategic Application	4M	FTT
5	CSIR-CMERI	Development and deployment of hybrid manufacturing (additive subtractive) micro machine for MSME industries and skill development.	4M	FTT
6	CSIR-NIIST	Utilization of Ilmenite Mineral Industrial Sludge from TiO_2 Pigment Industry for making Colored Ceramic Tiles via Low-energy sintering Process	4M	FTT
7	CSIR-IMMT	a. Design and development of a pilot scale paste thickener for eco-friendly tailings disposal in Indian iron and steel industry	4M	FTT
		b. Pellet Bed Thermal Mapper: An instrument for online thermal mapping of pellet bed on a pellet car of a straight grate induration furnace	4M	FTT
8	CSIR-IMMT	Preparation of varieties of calcined alumina as per the demand of ceramic and refractory industries	4M	FTT
9	CSIR-IMMT	Scaling up synthesis and characterization of Ti_3SiC_2 MAX phases and Ti_3C_2Tx Mxene	4M	FTT
10	CSIR-NML	Electrodeposition of corrosion resistant Cr-carbide coatings on SS 316L for Sink Roll applications in Continuous Galvanizing Lines	4M	FTT
11	CSIR-NML	Self-healing coating for corrosion protection of structural steel	4M	FTT
12	CSIR-NML and CSIR-IMMT	Technology development for holistic utilization of red mud for extraction of metallic values & residue utilisation	4M	FTT
13	CSIR-NML	Holistic Utilization of Zinc dross for recovery of high value zinc products	4M	
14	CSIR-NML	Scale up study for the recovery of potash fertilizer and iron oxide from Indian glauconitic rocks	4M	FTT
15	CSIR-NML	Indigenous Development of Benzoic Acid Reference Material for Calorimetry Analysis	4M	FTT
16	CSIR-NML	Development of a Multi-strand sensing device with closed loop feedback control for Real- time ZincCoating weight measurement in GI line	4M	FTC

17	CSIR-AMPRI	Manufacturing red mud waste based X-Radiation Shielding doors/panels in pilot scale for hospital sectors	CIE	FTC
18	CSIR-AMPRI	Design and Development of Aligned Steel Fiber Cementitious composite using Electromagnetic Field along with its Mechanical Characterization	CIE	FTT
19	CSIR-CBRI	A multi usable self-rescue descent device to escape from high rise buildings during disasters	CIE	FTC
20	CSIR-CBRI	Commercialization of Technology on Manufacturing of Internal Fuels Based Eco-Friendly and Energy Efficient Burnt Clay Bricks	CIE	FTC
21	CSIR-CBRI	Development of low toxicity fire retardant intumescent coating for steel and GI duct applications	CIE	FTT
22	CSIR-CBRI	Development and trials of a gantry robot for 3D concrete printing	CIE	FTT
23	CSIR-CBRI	Development of Strengthening and Retrofitting Technique for RC Structures using Hybrid Textile Reinforcement	CIE	FTT
24	CSIR-IMMT	Development and demonstration of commercial process for manufacture of70% content pond ash brick	CIE	FTT
25	CSIR-CECRI	Development of Eco-Efficient Synthetic Lightweight Aggregates (EESLAs) using Coal Refuse Mixed with Industrial By-Products	CIE	FTT
26	CSIR-CMERI	Development of Compact Vehicle Integrated Mechanized Septic Tank Cleaning Machine Forfecal Sludge and Wastewater Management	CIE	FTC
27	CSIR-CMERI	Design and Development of Electric Tractor for Small Agriculture Land Farming	CIE	FTC
28	CSIR-CRRI	Software Development for Optimum Location of Charging Infrastructure of Electric Vehicles in Indian Cities (ChargEV)	CIE	FTT
29	CSIR-CRRI	Development design Guidelines Testing and implement Methodologies for Brick Deck Water proofing (BDWP) over Bridge Deck overlays	CIE	FTT
30	CSIR-CRRI and CSIR-IIP	Development of Bio-binder for construction of Flexible Pavements	CIE	FTT
31	CSIR-SERC	Jut-Cavity Interlocked Cohesive Brick Masonry (JCICBM) System	CIE	FTT
32	CSIR-SERC and CSIR-CGCRI	Fiber optic based wayside Railway Asset Monitoring System (FRAMS)	CIE	FTT
33	CSIR-SERC	Precast Textile Reinforced Concrete U- Drains for Storm Water infrastructure (TRC U-drain)	CIE	FTT
34	CSIR-SERC	High Velocity Multi-hit Resistant Movable Protective Booth/ Shack for Security Personnel	CIE	FTT
35	CSIR-SERC	Development of low cost medium range ultrasonic pulse velocity (UPV) technology for concrete integrity assessment	CIE	FTT
36	CSIR-CIMFR	Development of a system to mitigate the cutter roof related instability in deep underground coal mines	CIE	FTT
37	CSIR-CIMFR	Development of AI/ML-based Geotechnical Instrumentation and Ground Monitoring Analytics (GIGMA) for safe excavations in underground mines	CIE	FTT
38	CSIR-CMERI	Design and Development of a Semi-autonomous Mobile Healthcare Device for Application in Healthcare Sector.	CIE	FTC
39	CSIR-IMMT and CSIR-NAL	Low dielectric loss materials for indigenous development of microwave component	AEISS	FTT

40	CSIR-AMPRI	Graphene Reinforced Metal Matrix Composites through Powder Bed Additive Manufacturing for Aerospace and Defense Applications	AEISS	FTT
41	CSIR-CGCRI	Technology Development on Fabrication of Reaction Bonded Silicon Nitride (RBSN) EM Window for Strategic Applications	AEISS	FTT
42	CSIR-CSIO	Energy Management: A Non-Intrusive Load Monitoring Approach	AEISS	FTC
43	CSIR-CSIO	Indigenous Robot Assisted Vascular Catheterization System (iRAVCath)	AEISS	FTT
44	CSIR-CECRI	Development of Hard Chromium Plating Process using Sulphate based Electrolyte as a Replacement of Existing Hazardous Process	AEISS	FTT
45	CSIR-NIIST	Field Testing and Validation of a Modular Onsite Wastewater Treatment & Resource Recovery Unit	E3OW	FTC
46	CSIR-IICT	Production of High-Quality Mineralized Water in Arid Regions using Indigenous Membrane Integrated Atmospheric Water Generator (AWG) Systems Powered by Solar Energy	E3OW	FTC
47	CSIR-CCMB	Developing DNA based Technologies for Diagnosing Impurities in Fiber used in Pashmina Shawl Weaving Industry	E3OW	FTT
48	CSIR-IHBT	Design and development of Dry Bio-Toilet for Himalayan region (Renamed as Utilization of compost booster for newly designed and developed sanitary dry toilets with the recovery of fertilizer from human urine in the Himalayan region (ComSan-DT)	E3OW	FTC
49	CSIR-NEERI	Low Temperature Adapted Methanogenesis (LTAM) process for sustainable sewage management in Himalayan and Sub-Himalayan climates (LTAM-HIMS)	E3OW	FTT
50	CSIR-IICT	Bio-electrocatalytic Device to Enhance Chemical Wastewater Treatment Efficiency	E3OW	FTT
51	CSIR-NGRI	A fractional gaussian fractal-based seismic inversion package for the high-resolution subsurface image.	E3OW	FTT
52	CSIR-NIIST and CSIR-CRRI	Sustainable Geocomposite Drainage-Root Barrier	E3OW	FTT
53	CSIR-NIO	Up-scaling the production process of bioactive pigments (Beta carotene & fucoxanthin) from marine microalgae	E3OW	FTT
54	CSIR-CFTRI	Value-added products using transglycosylating α-glucosidase	ANB	FTC
55	CSIR-CFTRI	Development of Functional Oleogel based Bakery Products.	ANB	FTT
56	CSIR-CIMAP	Design and Development of Centralized Hybrid Solar Aroma Distillation Unit (500 Kg Capacity) for Enabling Poor and Marginal Farmers Cultivating Aromatic Crops in India	ANB	FTT
57	CSIR-CLRI	Development of an Efficient Enzyme Formulation for Sulfide-Free Dehairing of Hides and Skins	ANB	FTT
58	CSIR-CMERI	Design and Development of Electric Tiller for Small to Medium Scale Farm Operations: An Ergonomic Approach	ANB	FTT
59	CSIR-IHBT	Technology Upscale for Production of Naphthoquinone Red Pigments using Arnebia Euchroma Leaf-Induced Adventitious Roots in Indigenized Bioreactors	ANB	FTT
60	CSIR-IICT	Cost Effective Technology for Making Delignified Rice Straws (DRS) with Improved Digestion for Cattle Feed Applications	ANB	FTT

61	CSIR-NBRI	Preparation of Certified Reference Material of Important Phytomolecules	ANB	FTT
62	CSIR-NBRI	Optimization of Beta 1,3 Glucan Production using Heterotrophic Microalga	ANB	FTT
63	CSIR-NCL	Development of Lateral Flow Test Strips for Detection of Mycotoxins in Food and Feed Products	ANB	FTT
64	CSIR-NIIST	Effective utilization of agro residues for development of biomaterials based leather substitute - Process Optimization and Scale up studies Selected agro residues: 1) plant fibers: corn husk, banana fiber, pineapple leaf fiber, 2) Fruit peels: mango peels, papaya peels, coffee pulp	ANB	FTT
65	CSIR-CIMFR	Slow Release Nitrogenous Fertilizer from Coal Washery Rejects and Fly Ash	ANB	FTT

ANNEXURE VIII

Council of Scientific and Industrial Research (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, Mysuru
CSIR-CIMAP	Central Institute of Medicinal & Aromatic Plants, Lucknow
CSIR-IICB	Indian Institute of Chemical Biology, Kolkata
CSIR-IIIM	Indian Institute of Integrative Medicine, Jammu
CSIR-IITR	Indian Institute of Toxicology Research, Lucknow
CSIR-IGIB	Institute of Genomics & Integrative Biology, Delhi
CSIR-IHBT	Institute of Himalayan Bioresource Technology, Palampur
CSIR-IMTech	Institute of Microbial Technology, Chandigarh
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-4PI	Fourth Paradigm Institute, Bengaluru
CSIR-NIScPR	National Institute of Science Communication and Policy Research, New Delhi

CHEMICAL SCIENCES			
CSIR-CECRI	Central Electrochemical Research Institute, Karaikudi	CSIR-IIP	Indian Institute of Petroleum, Dehradun
CSIR-CLRI	Central Leather Research Institute, Chennai	CSIR-NCL	National Chemical Laboratory, Pune

CSIR-CIMFR	Central Institute of Mining & Fuel Research, Dhanbad	CSIR-NEIST	North-East Institute of Science and Technology, Jorhat
CSIR-CSMCRI	Central Salt & Marine Chemicals Research Institute, Bhavnagar	CSIR-NIIST	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram
CSIR-IICT	Indian Institute of Chemical Technology, Hyderabad		

Units	
CSIR-HRDC	Human Resource Development Centre, Ghaziabad
CSIR-TKDL	Traditional Knowledge Digital Library, New Delhi
CSIR-URDIP	Unit for Research and Development of Information Products, Pune

Innovation Complex
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