सत्यमेव जयते

Department of Scientific and Industrial Research

Ministry of Science and Technology
Government of India

ANNUAL REPORT 2021-22





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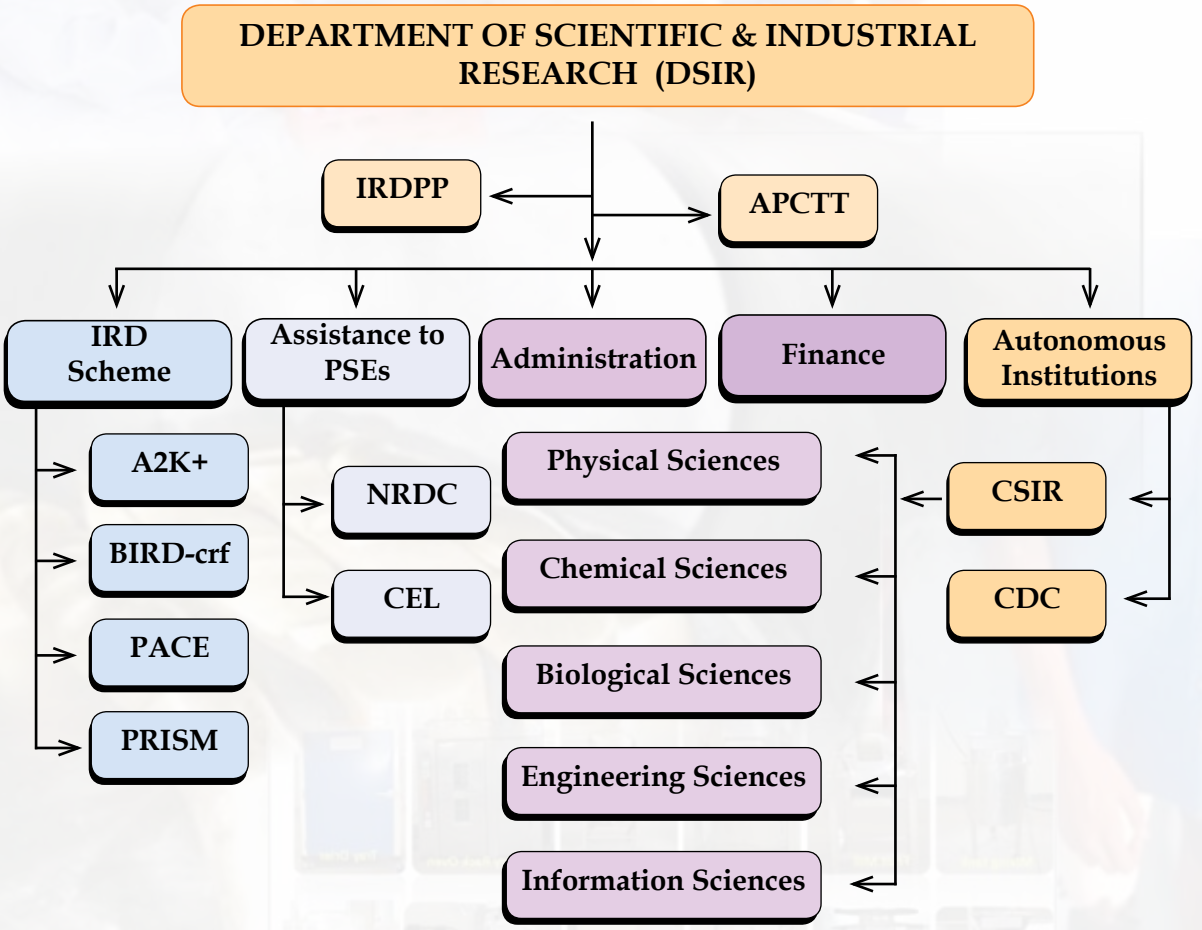
DSIR
ANNUAL REPORT

2021-22

Contents

FUNCTIONAL STRUCTURE



A2K+	Access to Knowledge for Technology Development and Dissemination
IRD Scheme	Industrial Research & Development Schemes
BIRD-crf	Building Industrial Research & Development and Common Research Facility
PACE	Patent Acquisition and Collaborative Research and Technology Development
PRISM	Promoting Innovation in Individual, Start-ups and MSMEs
PSEs	Public Sector Enterprises
NRDC	National Research Development Corporation
CEL	Central Electronic Limited
CSIR	Council of Scientific and Industrial Research
CDC	Consultancy Development Centre
APCTT	Asian Pacific Centre for Transfer of Technology
IRDPP	Industrial Research and Development Promotion Programme

Highlights of Annual Report 2021-22

i. DSIR is the nodal Department for granting recognition/ registration certificates to the In-house R&D centres established by industry. During the period under report, there were altogether **2481** In-house R&D centres of industry with DSIR recognition.

ii. **141** In-house R&D centres were accorded fresh recognition and renewal of recognition was accorded to **465** R&D centres of industry.

iii. Of the total **465** company's granted renewal of recognition during the year, **34** companies incurred an annual R&D expenditure of over Rs. **5000.0** lakhs each, **125** companies incurred an annual R&D expenditure in the range of Rs. **500.0** lakhs to Rs. **5000.0** lakhs and **102** companies incurred an annual R&D expenditure in the range of Rs. **200.0** lakhs to Rs. **500.0** lakhs.

iv. During the period under report, **54** SIROs were accorded fresh recognition. These include 23 cases in the Natural and Applied Sciences, 05 cases in the area of Agricultural Sciences and 03 cases in the area of Social Sciences and 23 cases in the area of Medical Sciences.

v. DSIR is the nodal Department for registration of public funded research institutions (PFRI), Universities, IITs, IISc and NITs for availing concessional custom duty exemption on import of equipment, spares, accessories and consumables for research purposes. During the period under report, **27** institutions were newly registered with DSIR and 162 institutions were granted renewal of registration.

vi. Fresh approvals to 16 companies were accorded u/s 35(2AB) of the IT Act, 1961, wherein the companies become eligible to claim weighted tax deduction @150%. 550 reports valued at Rs. 21,184.33 crores have been forwarded to Chief Commissioner of Income Tax (Exemption) CCIT (E) in Form 3CL, as required under the IT Act, 1961.

vii. Financial support was extended to **16 (sixteen)** new innovative projects of individual innovators during the period under report for PRISM scheme. The department rendered financial support to **2 (two)** ongoing projects and **10 (ten)** PRISM projects have been successfully completed during the tenure.

viii. CRTDH scheme in the fourth phase during 2021-2022, has initiated setting up of three new hubs in various sectors namely Affordable Health, New Materials and Electronics/Renewable Energy. Six proposals are at different stages of processing for possible DSIR financial support for setting up the CRTDHs. Out of six proposals, three new CRTDH have been sanctioned in September 2021 each at Delhi Pharmaceutical Science and Research University, Delhi; National Institute of Technology, Andhra Pradesh and CSIR, National Chemical Laboratory, Pune.

ix. Two ongoing technology development and demonstration projects under the PACE scheme namely "Development of Controlled Release [CR] Formulation

of Natural Highly-Purified Human Chorionic Gonadotropin [hCG]" by M/s Sanzyme Ltd. Hyderabad & ICT Mumbai and "Development and standardization of manufacturing processes for large scale production of valuable secondary metabolites from callus-derived cells of vascular cambial explants of selected woody plant species" by M/s Sami-Sabinsa Group Limited (formerly Sami Labs Limited), Bangalore were monitored for assessing the technical and financial progress in the projects. Five IMPRINT proposals from IITs/IISc/NITs in the two identified sectors (Manufacturing Technologies and Water Resources) have been supported by DSIR during the period under report.

x. 14 A2k+ studies project were completed during the period under report. The Department supported and initiated nine new projects and two Skill Satellite Centres for women under the TDUPW scheme. The two skill satellite centres supported during the period under report are: (a) Creating sustainable livelihood opportunities for the tribal women of Kuchai block, Saraikel district by establishing a Skill Development Centre, by Deepak Foundation Vadodara, Gujarat. (b) Dehydrated Flowers and Foliages for Women Empowerment by CSIR – National Botanical Research Institute, Lucknow.

xi. APCTT delivered and contributed to six demand-driven capacity building activities in four member States (China, India, Islamic Republic of Iran, Uzbekistan) in close collaboration with 52 partner institutions . The Centre reached out to over 500 target participants comprising representatives from science, technology and innovation policy makers, representatives from technology promotion agencies, technology transfer intermediaries, academia, research and development institutions, small and medium enterprises, start-ups and financial institutions. Recently, the organization conducted an International Conference on Fourth Industrial Revolution Technologies for Sustainable Development, 30 November 2021, New Delhi, India (virtual event).

xii. Department has successfully implemented e-Office developed by National Informatics Centre (NIC) under Information Technology e-Governance activity.

xiii. CSIR-IICT assisted Bharat Biotech International Limited (BBIL), Hyderabad to develop a scalable and cost-effective process to make imidazoquinoline, an adjuvant for Covaxin Vaccine.

xiv. CSIR-IGIB and CSIR-CCMB have contributed extensively to the Indian Genomic Consortium (INSACOG) and have assisted in sequencing 50% of the total SARS-CoV-2 genome. CSIR-CCMB alone has sequenced more than 10,000 viral genomes for so far and has contributed in both generation and analysis of viral genomic data to track existing variants, as well as flag new and upcoming variants.

xv. CSIR- CMERI has developed a portable oxygen concentrator. The machine can provide an Oxygen Flow rate 5-10 LPM >90% and can be used for home settings also. It has been certified by TUV and mechanical performance tested. It can be in high altitude areas

and the technology has been licensed to four industry partners. CSIR-NCL has developed Oxygen Enrichment Units with Genrich Membranes, a start-up of NCL and they have been installed in Dr. Naidu Hospital (10 units of 25 lpm and 10 units of 10 lpm capacity) and Navi Mumbai Municipal Corporation's hospital (25 units of 25 lpm capacity) with CSR funding.

xvi. CSIR-NAL has designed and developed Hansa NG 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. This aircraft was certified in the year 2000 when flying clubs needed an advanced trainer aircraft of contemporary class. During the user interaction of Hansa aircraft, the flying community suggested to have significant modifications on Hansa-3 aircraft to make it more useful as a trainer aircraft. The modification suggested to bring out Hansa-NG (New Generation), which will satisfy the requirements of flying clubs for obtaining PPL (Personal Pilot License) & CPL (Commercial Pilot License) by young generation.

xvii. CSIR-CMERI developed indigenous Mechanized Scavenging System and successfully demonstrated at the premises of the National Physical Laboratory, Delhi on 27.10.2021. The developed system is benchmarked with the market available system in India, and a number of features have been added which makes it first of its kind in India. In the developed system, the water collected from the drain is recycled to be used for drain/road cleaning. The 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 system is rigorously tested in the National Institute of Technology, Durgapur, National Power Training Institute, Durgapur, DVC colony, DSP colony in Durgapur. It is used to handle the blockage caused by plastic and other non-biodegradable domestic thrown-away items, debris, intrusion of tree roots, etc. The scavenging system is very economical and an important vehicle in the Swachh Bharat Mission.

xviii. 63 new processes/technologies were assigned to the National Research Development Corporation for licensing and almost 24 technologies were licenced. Corporation's consolidated Lump sum Premia & Royalty income was Rs. 618.38 lakhs as compared to Rs. 691.58 lakhs in the previous year. The Royalty received was from both the NRDC licensees and PATSER projects.

xix. Central Electronics Limited signed two MoUs with Indian Institute of Kanpur (IIT-K) to work on common areas of interest for the development of technology and various indigenous products and signed a technology transfer agreement with Naval Materials Research Laboratory (NMRL DRDO) for production of special grade ferrite based radar absorption material for stealth application. The organization had the highest ever net worth of Rs.105.82 Cr. as on 31.3.2021 with positive reserves.

AN OVERVIEW

An Overview

1.0 INTRODUCTION

The Department of Scientific and Industrial Research (DSIR), under the aegis of the Ministry of Science and Technology, GoI was set up through a Presidential Notification, dated 4th January, 1985 (74/2/1/8 Cab). The mandate of DSIR is to promote industrial research for indigenous technology development, promotion, utilization and transfer.

The Allocation of Business for the Department is as follows:

i. All matters concerning the Council of Scientific and Industrial Research (CSIR).

ii. All matters relating to National Research Development Corporation (NRDC).

iii. All matters relating to Central Electronics Limited (CEL).

iv. Registration and Recognition of R&D Units.

v. Technical matters relating to UNCTAD and WIPO.

vi. National register for foreign collaborations.

vii. Matters relating to creation of a pool for temporary placement of Indian Scientists and Technologists.

DSIR undertakes programmes to facilitate R&D in the industry, supports industrial units develop state-of-the-art competitive technologies, provides an enabling framework for commercialization of laboratory-scale R&D, augments technology transfer capabilities, enhances the share of technology intensive exports in overall exports of the country, strengthen industrial consultancy and establishes a user-friendly information network to facilitate scientific and industrial research in the industry, science research foundations and public funded organizations/ institutes. DSIR has two public sector enterprises, National Research Development Corporation (NRDC) and Central Electronics Ltd (CEL) and two autonomous organizations, Council for Scientific and Industrial Research (CSIR) and Consultancy Development Centre (CDC). The Department also provides host facilities and assistance to a regional institution of the United Nations Economic and Social Commission for Asia and Pacific (UN-ESCAP), Asian and Pacific Centre for Transfer of Technology (APCTT).

2.0 DSIR PROGRAMMES

Industrial Research & Development Promotion Program (IRDPP) of DSIR is a flagship program, where Department envisages to promote Industrial Research in the country through Industry and Institution centric motivational measures and incentives creating an enabling environment for development & utilization of novel technologies and innovations. The specific areas covered under the IRDPP scheme are: (i) In-house R&D in Industry. (ii) Scientific and Industrial Research Organisations (SIROs) and (iii) Fiscal Incentives for Scientific Research.

The Department of Scientific & Industrial Research (DSIR) also operates Central Sector Umbrella Scheme – "Industrial Research & Development" which comprises of the following four sub - schemes:

(i) **Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)** – focuses on supporting individual innovators, start-ups and MSMEs for converting innovative ideas into demonstrable working models / prototypes / processes and assist them to become techno-preneurs;

(ii) **Patent Acquisition and Collaborative Research & Technology Development (PACE)** – This is a scheme which focusses on technology acquisition and its development, demonstration for commercialization.

(iii) **Building Industrial Research & Development and Common Research Facility (BIRD-crf) –** focuses on creation of common research and technology development hubs (CRTDHs) for micro, small and medium enterprises. The other components of BIRD-crf sub-scheme were "Industrial Research & Development Promotion Program", "Information Technology and e-Governance" and "Asian and Pacific Centre for Transfer of Technology(APCTT)" which operated during the 12th Plan. All these three components of the BIRD-crf scheme, Industrial Research & Development Promotion Program", "Information Technology and e-Governance" and "Asian and Pacific Centre for Transfer of Technology (APCTT)" have been de-linked beyond 31.03.2017, effective from the FY 2017-18 and now operates outside this sub-scheme.

(iv) **Access to Knowledge for Technology Development and Dissemination (A2K+)**

This sub-scheme has three components viz: 'Technology Development and Utilization Programme for Women' (TDUPW) which promotes adoption of new technologies by women for greater operational efficiency and reduction of drudgery; 'Support to Studies' which undertakes studies related to analysis of latest developments in the emerging technology areas including those related to preparation of status reports on technologies from public funded institutions ready for commercialization and documents the findings, leanings and outcomes for wider dissemination and 'Support to Events' (seminars, workshops, conferences, exhibitions, Hackathons, virtual events etc.) which provides a platform for exchange of views leading to useful insights and policies on issues relating to industrial research and technological innovation, besides recommending collaborative projects between industry, institutions and academia.

The scheme subsumed the 11th Plan component of scheme on Technology Development and Utilization Programme for Women (TDUPW) and DSIR Building and Infrastructure. Besides, the scheme also supports the approved 11th Plan projects related to Technology Development and Demonstration Programme (TDDP) spilling over from the 11th five year plan.

These sub schemes have been continued beyond 31st March, 2020, for a further period of 5 years till the end of fifteenth finance commission, i.e. 31st March, 2025 (now the Fifteenth Finance Commission duration is 2021-2026).

2.1 MAJOR ACHIEVEMENTS

The major achievements of the various programmes of the Department during the period under report are as under:

2.1.1 Industrial R&D Promotion Programme.

DSIR is the nodal Department for granting

recognition/ registration to the In-house Research and Development (R&D) centres established by Industry in the country. There are currently **2481** DSIR recognized In-house R&D centres of Industry in the country. Of the total **465** company's granted renewal of recognition during the year, **34** companies incurred an annual R&D expenditure of over Rs. **5000.0** lakhs each, **125** companies incurred an annual R&D expenditure in the range of Rs. **500.0** lakhs to Rs. **5000.0** lakhs and **102** companies incurred an annual R&D expenditure in the range of Rs. **200.0** lakhs to Rs. **500.0** lakhs. During the period under report, **141** In-house R&D centres were accorded fresh recognition and DSIR renewal of recognition was accorded to **465** R&D centres.

DSIR undertakes the e-governance initiative through which it is making effort to invite the online applications for Industrial R&D Promotion Programme for greater accessibility and transparency of the Department programmes / schemes. Department issues the barcode generated certificates for recognition, registration to the In-house R&D centres of industries, Scientific & Industrial Research Organizations and Public Funded Research Institutions. Department is making efforts to make the programme paperless in future.

Scientific research foundations in the areas of medical, agriculture, natural and applied sciences and social sciences seek DSIR recognition and registration as Scientific and Industrial Research Organisations (SIROs). The recognized and registered SIROs are eligible for availing Customs Duty exemption on imports required for R&D activities. During the period under report **54** SIROs have been accorded fresh recognition. These include 23 cases in the Natural and Applied Sciences, 05 cases in the area of Agricultural Sciences and 03 cases in the area of Social Sciences and 23 cases in the area of Medical Sciences.

DSIR is the nodal Department for registration of public funded research institutions (PFRI), Universities, IITs, IISc and NITs, for availing concessional custom duty exemption, vide Notification No. 43/2017-Customs dt. 30.06.2017 and corrigendum dated 22.07.2017-Custom Notification no. 43/2017 dt 30.06.2017 amending the main notification No. 51/96- Customs dt.23.07.1996 and amendments thereof. During the period under report, **27** institutions were newly registered with DSIR and 162 institutions were granted renewal of registration.

Secretary, DSIR is designated as the Prescribed Authority under section 35(2AB) of Income-tax Act, 1961. Fresh approvals were accorded to 16 companies by the prescribed authority. Agreements of co-operation for R&D were also signed with these companies. The detailed R&D expenditure of the approved companies was also examined by DSIR and 550 reports valued at Rs. 21,184.33 crores have been forwarded to Chief Commissioner of Income Tax (Exemption) CCIT (E) in Form 3CL, as required under the IT Act.

2.1.2 Information Technology and e-Governance (ITeG)

Information Technology and e-Governance (IT-eG) group was formed during mid of the 10th Plan period in order to create an IT enabled work environment in the Department through accelerated usage of various Information Technology opportunities. Primary aim of ITeG was to convert the existing procedures and processes into citizen centric platform. IT-eG division implements e-Governance in the Department that needs be in conformance to the National eGovernance Action Plan. IT-eG Division operated on a separate IT Budget Head under Secretariat Economic

Services during the FY 2021-2022 for the implementation of activities carried out by the division.

Department has successfully implemented e-Office developed by National Informatics Centre (NIC). e-Office is one of the key IT projects of National Informatics Centre (NIC) aimed at improving internal efficiencies in an organization through electronic administration leading to informed and quicker decision making which in turn results in better public service delivery.

2.1.3 Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)

PRISM (Promoting Innovations in Individuals, Start-ups and MSMEs) scheme aims at to support individual innovators which will enable to achieve the agenda of inclusive development – one of the thrust areas of 12th Five Year Plan (2012-17). The scheme is continuing with its objectives of supporting innovation for inclusive development. It would also provide support to autonomous institutions or organizations or to society registered under the Societies Registration Act, 1860 or Indian Trusts Act, 1882 or other statues leading to development of state-of-art new technology solutions aimed at helping MSME cluster units. The scheme has been extended till 31.03.2026 as a component scheme of Industrial Research and Development (IRD) Programme of DSIR.

The proposals are preferably considered in the following focus sectors: Green technology, Clean energy, Industrially utilizable smart materials, Waste to Wealth, Affordable Healthcare, Water & Sewage Management and any other technology or knowledge intensive area.

The financial assistance under the programme may vary from Rs. 2.00 lakh to Rs. 50.00 lakhs. The department has successfully completed **10 (ten)** PRISM projects supported during the period under report i.e. from 01.12.2020-31.12.2021. Some of the successfully completed projects are Design and Fabrication of cost-effective improved biomass cook stove for domestic utility, GAIT Analysis based patient specific prosthetic polycentric knee joint and socket for trans femoral amputees to improve their walking pattern, Eco friendly Health Pro Reliable Water Purifier,"HyperXs"- a Thumb wearable device with distributed gesture recognition architecture, Novel Silicon Nipple to prevent early childhood caries (dental decay), Modeling and fabrication of security gadget for Tirumala Pilgrims, Development of pucca housing topography using bamboo fiber Ferro cement concrete being, Validation of single device for detection of three most prevalent mosquito borne disease, Automated Wheel Chair for physically challenged, Homemade Bending machine and so on.

The financial support was extended to **16 (sixteen)** new innovative projects of individual innovators during the period 01.12.2020-31.12.2021. The department also rendered financial support to **2 (two)** ongoing projects.

2.1.4 Common Research and Technology Development Hubs (CRTDHs)

The Department of Scientific and Industrial Research (DSIR) is continuing to operate the 12th Five Year Plan scheme on 'Building Industrial Research & Development and Common Research Facilities' (BIRD-crf) with the sole component on Common Research and Technology Development Hubs (CRTDHs) during the period 2017-2020 and afterwards. The earlier components on (i) Industrial Research and Development Promotion Programme (IRDPP) has been de-linked from the BIRD-crf sub-scheme since it is part of the

business allocation of the Department and does not involve funding, (ii) Information Technology & e-Governance (ITeG) has been de-linked from the BIRD-crf scheme since it is mandatory under the National e-Governance Action Plan and should continue irrespective of the performance of BIRD-crf scheme, (iii) Asian and Pacific Centre for Transfer of Technology (APCTT) has been de-linked from the BIRD-crf scheme since it has been moved to another umbrella scheme under the Department. DSIR operates BIRD-crf scheme as a sub-scheme under the Umbrella Scheme – 'Industrial Research & Development'.

Common Research and Technology Development Hubs (CRTDHs) aim to enhance translational research and foster industry - institution interaction targeted towards innovative product development. DSIR extends grants to institutions for setting up of these hubs/centres, which include R&D facilities/infrastructure, analytical test facilities, design centres, pilot plant production facility, demonstration units, product display and centre information etc. The facilities at CRTDHs are used by the Micro, Small and Medium Enterprises (MSMEs), Innovators and start-ups. The CRTDHs evolve a business model for self-sustainability and operate on a cost plus non-commercial basis.

CRTDH program started during the year 2014-15 and had a target to set up five CRTDHs during the period 2017-2020. During 2018-19, the Department invited proposals in the third phase for setting up CRTDHs in five sectors of Affordable Health, Environmental Interventions, Low Cost Machining, New Materials/ Chemical Process and Electronics/ Renewable Energy.

During the earlier two phases, Department had already approved seven CRTDHs in the above five sectors. Out of the seven CRTDHs, three hubs have been approved under the program in the first phase (2014-15) at three CSIR institutions, viz. Centre for Cellular and Molecular Biology (CCMB), Hyderabad; Institute of Himalayan Bio resource Technology (IHBT), Palampur and National Institute for Interdisciplinary Science & Technology (NIIST), Thiruvananthapuram; the first two are in the area of affordable healthcare and the third one is in the area of environmental interventions. The hubs have identified needs of the enterprises through seminars and workshops as well as through interaction with the MSME Development Institutes (MSME-DI), Directorate of Industries (DIC), S&T Councils and other state government bodies. Technological development involving MSMEs and host institutions in project mode has begun and several agreements have been signed with enterprises as well as state government agencies for the benefit of the MSMEs and start-ups.

During 2016-17, the second phase, the Department approved setting up of four new hubs at Central Mechanical Engineering Research Institute (CMERI), Durgapur; Central Electronics Engineering Research Institute (CEERI), Pilani; Indian Institute of Technology, Roorkee and Indian Institute of Technology, Gandhinagar in sectors of Low cost machining, Electronics/ Renewable Energy and New Materials/ Chemical Process respectively. These hubs are currently engaged in activities like procurement of equipment, and setting up of infrastructure and essential facilities for R&D. The hubs have started identifying needs of the enterprises through seminars and workshops as well as through interaction with the MSME-DIs, DICs, S&T Councils, industry representatives and associations and other state government agencies.

CRTDH at Indian Institute of Technology,

Kharagpur, CRTDH at CSIR - Indian Institute of Toxicology Research (IITR), Lucknow, CRTDH at CSIR - Central Drug Research Institute (CDRI), Lucknow and CRTDH at CSIR-Central Scientific Instruments Organization, Chennai Centre (CSIO), CSIR Madras Complex Taramani, Chennai and CRTDH at CSIR- Institute of Minerals & Materials Technology (IMMT), Bhubaneshwar were set up in the third phase (2018-19). These hubs are currently engaged in activities like procurement of equipment, setting up infrastructure and essential facilities for R&D. The hubs have started identifying needs of the enterprises through seminars and workshops as well as through interaction with the MSME-DIs, DICs, S&T Councils, industry representatives and associations and other state government agencies. In the fourth phase, during 2021-2022, DSIR has initiated setting up of three new hubs in various sectors namely Affordable Health, New Materials and Electronics/Renewable Energy. CRTDH Advisory & Screening Committee (CASC) for CRTDH scheme recommended six proposals which are at different stages of processing for possible DSIR financial support for setting up the CRTDHs. Out of six proposals, three new CRTDH have been sanctioned in September 2021 each at Delhi Pharmaceutical Science and Research University, Delhi; National Institute of Technology, Andhra Pradesh and CSIR, National Chemical Laboratory, Pune.

2.1.5 Patent Acquisition and Collaborative Research and Technology Development (PACE)

The DSIR through the PACE scheme provides catalytic support to industries and institutions for development and demonstration of innovative product and process technologies, traversing the journey from proof of concept or laboratory stage to pilot stage, so that they can be launched for commercialization. The scheme supports ingenious work and assists in development of new technologies or creative/innovative application of the existing technologies to solve unmet needs of industry. The scheme also strengthens the interface between industry, R&D establishments and academic institutions by supporting collaborative proposals. The scheme also jointly supports initiatives of other Ministries / Departments aimed at technology development and demonstration, e.g. IMPRINT initiative of Ministry of Human Resource Development and DST, wherein institutions of higher learning are being supported for development and demonstration of technologies.

During the period under report, two ongoing technology development and demonstration projects namely "Development of Controller Release [CR] Formulation of Natural Highly-Purified Human Chorionic Gonadotropin [hCG]" by M/s Sanzyme Ltd. Hyderabad & ICT Mumbai and "Development and standardization of manufacturing processes for large scale production of valuable secondary metabolites from callus-derived cells of vascular cambial explants of selected woody plant species" by M/s Sami-Sabinsa Group Limited (formerly Sami Labs Limited), Bangalore were monitored for assessing the technical and financial progress in the projects. Five IMPRINT proposals from IITs/IISc/NITs in the two identified sectors (Manufacturing Technologies and Water Resources) have been supported by DSIR during the period under report. The following projects are supported under the IMPRINT initiative:

(i) **Development of an innovative process to fabricate ultra-fine grained bimetallic thin sheets for micro-forming applications - IIT Madras**

(ii) **Fabrication and evaluation of atomic force microscope probes with detachable and re-usable tips - Indian Institute of Science, Bangalore**

(iii) **Low-cost Additive Manufacturing Technique for Fabricating Through - Substrate Vias based Three-dimensional Microstructures used in MEMS Applications – IIT Bombay**

(iv) **Designing and fabrication of an aerodynamic lens for nanoparticles of variable size – IIT Hyderabad**

(v) **Continuous discharge measurement in small open channels by using ultrasonic tomography – IIT Kanpur**

2.1.6 Access to Knowledge for Technology Development and Dissemination (A2K+)

The Access to Knowledge for Technology Development and Dissemination (A2K+) – Events programme of DSIR provides a platform for exchange of views among industry, consultancy organizations, academic and research institutions that would lead to useful insights on issues relating to industrial research and technological innovation and help in evolving tools and techniques to remain competitive in today's business climate. The objective of A2K+ Events program is to support the organization of workshops, interactions, training programmes, exhibitions and other events for identification of collaborative projects between academia, institutions and industry participating in the events. Grants were released towards successful organization of the six events on (i) Seminar on Technology Assistance to Food Preservation & Hygienic Packaging organized by Odisha Assembly of Small and Medium Enterprises, Cuttack(ii) National Conference on Agri-smart 2018: Using IoT for driving smart Agriculture organized by Centre for Development of Advanced Computing (C-DAC), Mohali (iii) International Conference on Quality Infrastructure for Clean and Sustainable Development at New Delhi organized by Consulting Engineers Association of India (CEAI), New Delhi (iv) Seminar on School and Conference on Fully Programmable Systems on chip for Scientific Instrumentation organized by Guwahati University, Guwahati (v) National conference on Biomedical Engineering at Chandigarh organized by National Institute of Technical Teachers Training and Research (NITTTR), Chandigarh (vi) International Conference on Advanced Welding Technology and Quality Systems for Developing Economies organized by The Indian Institute of Welding, Mumbai. 14 A2k + studies project were completed during the period under report. Three TDUPW projects were completed during the period. The Department supported and initiated nine new projects and two Skill Satellite Centres for women under the TDUPW scheme during the year 2021-22. The two skill satellite centres supported during the period under report are:

(i) Creating sustainable livelihood opportunities for the tribal women of Kuchai block, Saraikel district by establishing a Skill Development Centre by Deepak Foundation,, Vadodara, Gujarat

(ii) Dehydrated Flowers and Foliages for Women Empowerment by CSIR – National Botanical Research Institute, Lucknow.

3.0 ASIAN PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY (APCTT)

The Department of Scientific and Industrial Research (DSIR), Ministry of Science and

Technology (MOST), Government of India has been the national focal point of Asian and Pacific Centre for Transfer of Technology (APCTT) for India since its inception in 1977. Matters pertaining to APCTT and UNESCAP are dealt with in cooperation with the Ministry of Commerce and Industry and the Ministry of External Affairs, Government of India. DSIR also plays an active role in APCTT's functioning, particularly relating to its policies and programmes. India being the host country has been providing institutional support to APCTT since its inception.

APCTT receives annual institutional support of US$ 200,000 in Indian Rupees (to meet the local costs) from DSIR in addition to funding for building repairs, renovation work, and municipal taxes.

During January to December 2021, the Centre delivered and actively contributed to 6 demand-driven capacity building activities in 4 member States (China, India, Islamic Republic of Iran, Uzbekistan) in close collaboration with 52 partner institutions. The activities included international conferences, regional capacity building workshops and technology facilitation consultative meeting. The Centre reached out to over 500 target participants comprising representatives from science, technology and innovation policy makers, and representatives from technology promotion agencies, technology transfer intermediaries, academia, research and development institutions, small and medium enterprises, start-ups and financial institutions. The Centre organized an international conference on "Emerging Fourth Industrial Revolution (4IR) Technologies for Sustainable Development", on 22 July 2021, Guangzhou, China jointly with the Ministry of Science and Technology, People's Republic of China. APCTT also supported a conference on 3rd International Congress on Water Desalination, Application of Advanced Technologies in Unconventional Water Treatment for Zones under Water Stress, 14-16 September 2021, Tehran, Islamic Republic of Iran (virtual event); International Conference on Fourth Industrial Revolution Technologies for Sustainable Development, 30 November 2021, New Delhi, India (virtual event); Regional Workshop on Innovative Strategies for Research Commercialization and Technology Transfer, 24 November 2021, Tashkent, Uzbekistan (hybrid event); Regional Workshop on Emerging Technologies to respond to Climate Change, 14 September 2021, Kunming, China (virtual event) .

The Centre published 4 issues of Tech Monitor focusing on special themes such as Sustainable energy development – Innovative business models and best practices (Oct-Dec 2020), Science technology and innovation for Sustainable and resilient recovery from COVID-19 crisis (Jan-Mar 2021), Fourth industrial revolution technologies for inclusive and sustainable development (Apr-Jun 2021), and Technologies for adaptation to climate change in Asia-Pacific – Enabling mechanisms and best practices (Jul-Sep 2021).

4.0 RTI ACT 2005

The Right to Information Act 2005, enacted on 15th June 2005, has been implemented successfully in the Department. As per the provisions of the Act, Nodal Officer, Appellate Authority, Transparency Officer, Central Public Information Officer and Central Assistant Public Information Officer are designated.

The proactive disclosures under Section 4 (1) (b) of the RTI Act 2005 enacted on June 15, 2005 are regularly updated [Last Updated on 27/12/2021] and available on the DSIR Website at *http://www.dsir.gov.in*. DSIR has complied with the directives received

from Central Information Commission. RTI Requests and First Appeals received and their responses are available on DSIR Website. DSIR has received **130** Applications during 01/01/2021 to 31/12/2021 and all the Applications were registered and disposed off on RTI Request & Appeal Management Information System at *https://rtinonline.gov.in/RTIMIS*. During 01/01/2021 to 31/12/2021, **7** applications were registered as first appeal and **no** application was registered as second appeal.

5.0 AUTONOMOUS INSTITUTIONS

5.1 COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR)

(i) The Council of Scientific & Industrial Research, constituted in 1942 is an autonomous body which is known for its cutting edge R&D knowledgebase in diverse S&T areas and is a contemporary R&D organization. CSIR has pan India presence through its network of 38 national laboratories which undertake well focused basic and applied research in diverse fields of science and technology. CSIR has also established 39 outreach centres, one Innovation Complex and three units. CSIR's R&D expertise and experience is embodied in about 4000 active scientists supported by about 7000 scientific and technical personnel.

(ii) CSIR has been playing a stellar role in building up the scientific and technological prowess of the country. Through its technological interventions, CSIR has not only provided solutions and innovations for the industry but has also proved to be a catalyst in improving the quality of life of millions of people across the country. CSIR covers a wide spectrum of science and technology – from radio and space physics, 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.

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

(iv) CSIR through its various constituent laboratories is also placing major focus upon creating incubation facilities for spin off and startups. The CSIR would hand hold these companies so as to create a new segment of knowledge enterprises.

(v) CSIR has been focusing in a significant manner on the development of S&T Human Resource and provided the 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.

5.1.1 Significant Events

(i) **CSIR Society Meeting addressed by Hon'ble PM Shri Narendra Modi**

Hon'ble Prime Minister Shri Narendra Modi chaired a meeting of the CSIR Society through video conference. PM Modi remarked that the Corona pandemic has emerged as the biggest challenge of this century. But whenever there was a big humanitarian crisis in the past, science has prepared the way for a better future. The Prime Minister lauded the scientists for the scale and speed at which the vaccines were made within a year, to save humanity from the pandemic. He appreciated the scientists for making India self-reliant on COVID-19 vaccines, testing kits, necessary equipment and new effective medicines in the fight against Corona.

(ii) **India and Denmark exchange bilateral agreements**

CSIR-NGRI & CSIR-TKDL Unit exchanged International agreements under bilateral relationships with Denmark with their counterparts in the presence of Honourable Prime Minister of India and Danish Counterpart H.E. Mette Frederiksen. MoU signed between CSIR-NGRI, Aarhus University, Denmark and Geological Survey of Denmark and Greenland on mapping of ground water resources and aquifers.

Danish Patent and Trademark Office and CSIR, New Delhi entered into a cooperation on the CSIR-TKDL Access through an agreement signed by Mr. Sune Stampe Sorensen, DG, Danish PTO and Dr. Vishwajanani Sattigeri, CSIR-TKDL, India. With this the number of patent offices worldwide that access TKDL for purposes of patent grant rises to 14.

Fig 1 (a) & (b)

(iii) **Release of handbook for zoos**

Hon'ble Vice President, Shri Venkaiah Naidu visited the CCMB's LaCONES (Laboratory for the Conservation of Endangered Species) facility in Hyderabad and released a book along with Central Zoo Authority on Introduction to Genetic Resource Banks for Wildlife Conservation. CSIR-CCMB developed this book to handhold zoos on adoption of efforts to cryopreserve tissues from animals in their zoos.

(iv) **CSIR 80th Foundation Day Celebration**

CSIR, India celebrated its 80th Foundation Day on 26 September 2021 at CSIR National Physical Laboratory of India. The Hon'ble Vice President of India, Sh. Venkaiah Naidu, (Chief Guest), Union Minister for Science & Technology, Dr. Jitendra Singh (Guest of Honour), Principal Scientific Adviser to GoI, Dr. K. Vijayaghavan, Director-General, CSIR & Secretary, DSIR, Dr. S.C. Mande and Director CSIR-NPL, Dr. Venugopal Achanta, and other dignitaries graced the occasion. (Fig. 2)

CSIR Awards were announced on the day

of the occasion, including CSIR Innovation Awards for School Children, CSIR Young Scientist Awards, CSIR Technology Awards, CSIR Award for S&T Innovation for Rural Development (CAIRD) and G N Ramachandran Gold Medal for Excellence in Biological S&T. DG-CSIR, Dr. Shekhar Mande also announced the winners of the prestigious Shanti Swarup Bhatnagar Prize 2021.

Fig. 2 Celebration of 75th year of India's Independence with the rendering of the National Anthem

Azadi ka Amrit Mahotsav was celebrated on the occasion of the 75th year of India's Independence with the rendering of India's National Anthem by the scientific fraternity.

Organised as a mix of physical and virtual events, the occasion witnessed the participation of Dr. Jitendra Singh, Union Minister of State (Independent Charge) Science & Technology & Earth Sciences, Prof K. VijayRaghavan, Principal Scientific Advisor, Professor Ashutosh Sharma, Secretary of Department of Science and Technology (DST) and of Ministry of Earth Sciences (MoES), Dr. Renu Swarup, Secretary Department of Biotechnology (DBT), Dr. Shekhar Mande Director General, Council for Scientific and Industrial Research (CSIR), who were present physically and Shri K N Vyas, Secretary Department of Atomic Energy and Dr. K Sivan, Secretary, Department of Space who were present virtually for the event.

(v) CSIR signs MoU with NCSM for development of Science Museums

CSIR signed MoU with National Council of Science Museums (NCSM), Ministry of Culture in the presence of Hon'ble Minister of Science and Technology (Independent Charge) Dr Jitendra Singh and Shri G. Kishan Reddy, Union Minister of Culture, Tourism and DoNER. The MoU aims at setting up Science Museums at select CSIR Laboratories to promote scientific curiosity and awareness among the common people across all sections of society.

Fig. 3 CSIR signed MoU with National Council of Science Museums (NCSM), Ministry of Culture

(vi) IAGA-IASPEI-2021 Joint Scientific Assembly

CSIR-NGRI hosted the Joint Scientific Assembly of International Association of Gravity and Aeronomy (IAGA)-International Association of Seismology and Physics of the Earth's Interior (IASPEI) (IAGA-IASPEI) successfully during August 21-27, 2021. Scientists from 57 countries participated in this assembly with 850 registered delegates. The conference was organised by 53 symposia, 80 oral and 11 poster presentation sessions. The Joint assembly also conducted 24 IAGA and 20 IASPEI business meetings. During the Inaugural meeting the key note address was delivered by Honourable minister, Dr. Jitendra Singh. Other dignitaries from IAGA and IAPSEI attended the meeting online. Along with Hon'ble Minister, Dr. Jitendra Singh others delegates including Prof.

Ashutosh Sharma, Secretary, Department of Science & Technology and MoES, Dr. Madhavan Nair, Former Secretary MoES, Dr. Shekhar C Mande, DG CSIR and Dr. V.M. Tiwari, Director, NGRI were physically present for the inauguration ceremony.

(vii) Aerial delivery of Covid-19 vaccines using Octacopter drones

Hon'ble Minister, Dr Jitendra Singh launched the first-of-its-kind Drone driven aerial delivery facility to transport Covid vaccine as well as emergency medicines to inaccessible and difficult areas in a short span of time. An indigenously developed Octocopter was used for the delivery launch that was conducted from CSIR-IIIM, Jammu to Government Sub-District Hospital, Marh, Jammu in 15 minutes covering a distance of 15 kilometres. Hon'ble Minister said the drone delivery of vaccines will go a long way in fulfilling Prime Minister's **"Har Ghar Dastak"** campaign for house-to-house Covid-19 vaccination drive.

Fig. 4 Octocopter used for Drone delivery of Vaccines

(viii) Inauguration of Heliborne Survey for Groundwater Management in Arid regions of NW India

Hon'ble Union Minister of Jal Shakti, Shri. Gajendra Singh Shekhawat and Hon'ble Union Minister of State (IC) of the Ministry of Science and Technology & Earth Sciences, Dr. Jitendra Singh inaugurated the state-of-art Heliborne survey technology for groundwater management in arid regions on 5th October, 2021 at Jodhpur, Rajasthan. The Inaugural program was successfully organized jointly by CSIR-NGRI and CGWB authorities. Heliborne geophysical survey started from Jodhpur-Jaisalmer survey block.

Fig. 5 Heliborne Survey for Groundwater Management

(ix) India's first Virtual Science Lab for children launched by Hon'ble Minister Dr Jitendra Singh

Hon'ble Minister Dr Jitendra Singh launched India's first Virtual Science Lab for children under CSIR Jigyasa programme which will also connect students with scientists across the country. Describing the Virtual Lab as a huge new beginning, Dr Jitendra Singh said this will not only take science to all segments of students in every corner of the country, but it is also in tune with the National Education Policy (NEP) where students are allowed to choose any subject and the concept of streams has been disbanded. CSIR has partnered with IIT Bombay to develop a Virtual Lab platform under CSIR Jigyasa programme which facilitates classroom learning with laboratory research for school students. The target audience for the Virtual Lab platform is students of the standard VI to

XII (11-18 years) who would like to explore science using different activities, experienced researchers and faculties on the subjects of Science, Mathematics, Biology and IT.

(x) **Visit by Colombian Health Mission in India**

High-level "Colombian Health Mission in India" delegation headed by the Minister of Health of Colombia and a high-level delegation from the Republic of Colombia visited CSIR-CCMB on 29th of September 2021. They explored the life sciences research landscape particularly in genomics & proteomics, wildlife conservation and the Indian experience in fostering startups.

Fig. 6 Colombian Health Mission in India

(xi) **Azadi ka Amrit Mahotsav, "Fit India Freedom Run 2.0"**

As a part of the FIT INDIA Movement, several CSIR institutes including CSIR-CBRI, CSIR-CRRI, CSIR-CSMCRI, CSIR-IHBT, CSIR-IICT, CSIR-IITR and CSIR-IIP organised Fit India Freedom Run 2.0 / Walk to comemorate the Azadi Ka Amrit Mahotsav celebrations.

Fig. 7 Fit India Freedom Run 2.0

xii) **Merger of CSIR-NISCAIR and CSIR-NISTADS into a new institute CSIR-National Institute of Science Communication and Policy Research (CSIR-NIScPR), New Delhi**

Former Union Minister of Science & Technology, Earth Sciences and Health & Family Welfare Dr Harsh Vardhan, inaugurated a new institute of CSIR-National Institute of Science Communication and Policy Research (CSIR-NIScPR). The new institute was established consequent to the merger of two prestigious institutes of CSIR, namely, CSIR-NISCAIR and CSIR-NISTADS which work at the interface of S&T and Society, Science Communication and Policy Research.

5.1.2 Significant S&T Achievements

(A) Mitigation of Covid-19

CSIR has undertaken several initiatives towards mitigation of Covid-19 which are enumerated below:

(i) **Modular UV-C Air Disinfectant System:** The UV-C Air Duct Disinfection System -V 1.06 is designed as a retrofittable unit into existing HVAC Air Ducts using customizable sliding mechanisms. It consists of a slide mechanism, regulated UV light source and sensors. This is based on the fact that UV-C Light source emits

light having high energy photons that inactivates virus / bacteria contained in the air flowing through the air duct. The UV-C light intensity is carefully controlled to give the required dosage to the given air flow to inactivate any virus & bacteria present. The mechanism allows user to position the light source in place easily and easy removal as and when maintenance or cleaning is required. Importantly, the UV exposure required to kill the coronavirus was tested and validated at CSIR-IMTech using SARS-CoV-2 viral cultures. The system can be installed in hospitals, malls, schools etc. The system has been deployed at the Parliament. The technology has been transferred to 30 industries.

(ii) **CSIR-NAL's Multicopter Drone for COVID vaccine delivery:** CSIR-NAL has teamed with Department of Health & Family Welfare, Govt. of Karnataka for aerial delivery of COVID-19 vaccines in remote area using drones. The Octocopter drone successfully delivered 50 vials of COVID-19 vaccines along with syringes in a special container from Chandapura PHC to Haragadde PHC on 13th November 2021. Further, more recently the Multicopter delivered vaccines in Jammu too, in presence of Hon'ble Minister of S&T and ES, Dr Jitendra Singh and will help in delivery of vaccines and other essential items in remote and difficult terrains.

(iii) **Oxygen Concentrator/Enrichment Unit:** A Medical Grade Oxygen Concentrator has been developed by CSIR-IIP, based on advanced PVSA technology. This is suitable for 24/7 operation in hospitals and has a scalable design, 100-500 litres per minute (lpm). It can cater to 20-100 patients @5lpm/ patient. It has a small area requirement. CSIR-IIP and DRDO together were entrusted in setting up oxygen plants. The CSIR-IIP technology licensed industry partners have set up 108 plants throughout the country funding from PM-CARES. In addition to the static Oxygen Concentrator of CSIR-IIP, a portable oxygen concentrator has been developed by CSIR-CMERI. The machine can provide an Oxygen Flow rate 5-10 LPM, >90% and can be used at home setting too. It has been certified by TUV and mechanical performance tested. It is also useful in high altitude areas and the technology has been licensed to four industry partners. CSIR-NCL has developed Oxygen Enrichment Units with Genrich Membranes, a start-up of NCL and they have been installed in Dr. Naidu Hospital (10 units of 25 lpm and 10 units of 10 lpm capacity) and Navi Mumbai Municipal Corporation's hospital (25 units of 25 lpm capacity) with CSR funding.

(iv) **Mobile Sequencing Lab at Airport:** CSIR-IGIB had set up mobile sequencing lab at Delhi Airport with Spice Health as an industry partner for quick and effective testing. Portable sequencers were deployed at airport to save time and reduce transmission risk by identification of variants within 2-3 days.

(v) **Set up a 44-bedded makeshift hospital at Safdarjung Hospital, New Delhi**

CSIR-CBRI under the aegis of Union Ministry of Science & Technology has set up a 44-bedded makeshift hospital at Safdarjung Hospital, New Delhi. This will provide further convenience in management of Covid-19 patients.

(vi) **Himalayan Centre for Virus Diagnostics (HCVD) – Extension with FELUDA**

Tata MD partnered with CSIR-IIP for CRISPR based Covid-19 testing technology to serve Uttarakhand State., to provide fast, specific and sensitive service. Testing capacity drastically increased, 800-1000 samples/day. Testing possible in mobile van Suitable for Covid-19 testing in remote and hilly areas.

(vii) **Covid-19 testing laboratory inaugurated in CSIR-NEIST**

A new Covid-19 testing laboratory has been established on 30 May 2020 in the Jorhat Campus of CSIR-NEIST. Dr Himanta Biswa Sarma, then Minister of Health and Family Welfare, Finance, Education (Higher, Secondary and Elementary), Transformation and Development, PWD, Govt. of Assam, inaugurated the laboratory. A total of 6777 samples were tested at CSIR-NEIST COVID-19 testing Laboratory during 2020-21.

(viii) **Phase III Clinical Trial of Umifenovir**

A team at CSIR-CDRI carried out randomized, double-blind, placebo-controlled, multicenter, phase III trials involving adult (18-75 years), non-severe COVID19 patients, randomized 1:1 on placebo or Umifenovir (800 mg BID, maximum 14 days) respectively along with standard-of-care. The primary endpoint for Asymptotic-mild patients was time to nasopharyngeal swab RT-PCR test negativity. For Moderate patients, the average change in the ordinal scale from the baseline scores on the eight-point WHO ordinal scale was assessed. The study has shown encouraging results and data has been submitted to regulator for review.

(ix) **Adjuvant for Covaxin Vaccine:** Bharat Biotech International Limited (BBIL), Hyderabad in order to produce the vaccine in bulk scale, required imidazoquinoline molecule in larger quantities as part of the adjuvant component. CSIR-IICT assisted BBIL to develop a scalable and cost-effective process to make this molecule in the desired quantities. The molecule (IMDG) is a heterocyclic, complex molecule and has critical synthetic transformations to achieve the purity and manufacture the molecule on the required scale. CSIR-IICT, working in the area of chemistry and chemical technology, took up the challenge and successfully delivered the molecule using indigenous chemicals. The same is being used in the production of Covaxin.

(x) **SARS-CoV-2 genome surveillance:** The Delta variant (lineage B.1.617.2) that led to a huge spurt of cases in India has highlighted the crucial need to sequence and track viral variants to stay vigilant. CSIR labs, CSIR-IGIB and CSIR-CCMB have contributed extensively to the Indian Genomic Consortium (INSACOG) and have contributed to about 50% of the total SARS-CoV-2 sequencing done. CSIR-CCMB alone has sequenced more than 10,000 viral genomes so far, and contributed significantly in both generation and analysis of viral genomic data to track existing variants, as well as flag new and upcoming variants. In addition to being a part of the national INSACOG consortium, CSIR-CCMB also leads several large

scale viral genome sequencing as well as waste-water based surveillance for monitoring SARS-CoV-2 variants. An open access research article has been published on CSIR's study in collaboration with other institutes on "*SARS-CoV-2 B.1.617.2 Delta variant replication and immune evasion*" in Nature and another collaborative research article on "*Genomic characterization and epidemiology of an emerging SARS-CoV-2 variant in Delhi, India*" has been published in Science Journal.

(B) **Other Scientific Achievements**

(i) **Detection and potential early warning of catastrophic flow events with regional seismic networks**

Early warning is a critical potential tool for mitigating the impacts of large mass wasting and flood events, a major hazard in the Himalaya. CSIR-NGRI in collaboration with GFZ German Research Centre for Geosciences conducted study to detect and track a fatal rockslide to mass flow to flood cascade using data from a dense seismic network in Uttarakhand, India and examined the potential for regional networks to provide early warning for extreme flow events. With the existing network, a seismic monitoring system could detect all event phases from up to 100 kilometres and provided downstream warnings within minutes of event initiation. The study has been published in Science.

(ii) **Waste to Wealth: Biogenically derived Biomaterials**

The use of biogenic (natural materials such as fish scales, egg shells, seashells, animal bone, corals, etc) structures and materials to produce calcium phosphate (CaP) powder, collagen, etc. using various synthesis techniques is gaining importance. It is observed that CaP ceramics derived from such resources is safe and contain various essential trace elements like, Sr,Mg, Si,Na etc. Similarly, the collagen and/or membrane obtained from such biogenic sources including fish skin, egg shell, are also potential materials for biomedical applications in bone fillers, scaffolds, coatings, wound healing etc. A present initiative at CSIR-CGCRI have developed processes to synthesize CaP and collagen from fish waste (scale and skin, respectively) and assessed their physical, chemical and biological properties in the form of powder and electrospun collagen-doped bioactive glass composite mats. A cost-effective process technology at validation level to produce bioactive CaP based powders from fish scale for biomedical applications has been perfected.

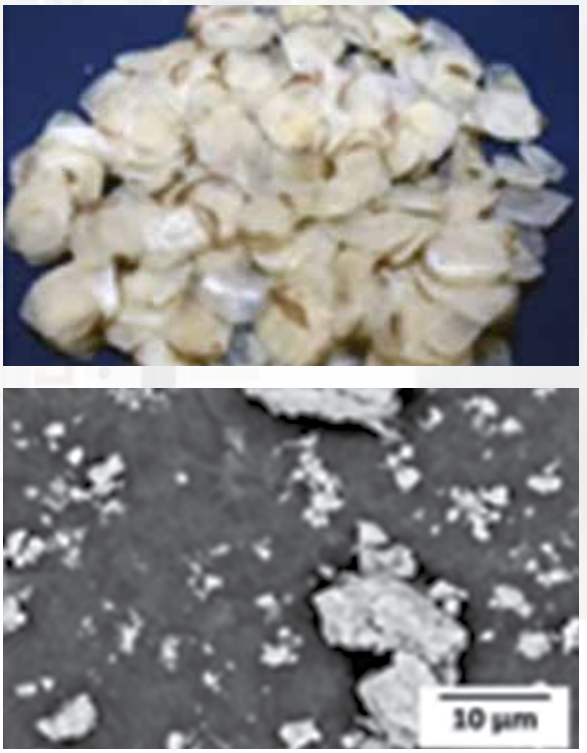


Fig. (1)

(iii) **Development of Gasification Technology**

Gasification and Catalysis Research Group of CSIR-CIMFR has developed and installed an "Oxy-blown Pressurized Fluidized Bed Gasification Pilot Plant Facility" having 1.5 TPD coal feed rate with in-house expertise. Indigenously developed 1.5 TPD PFBG facility is a milestone achievement as a part of "Methanol Economy Program" and an important step towards "Atmanirbhar Bharat Abhiyan" of Govt. of India. This facility will be utilized for successfully establishing operation with high ash Indian coal as well as maximization of performance by optimizing design, operating parameters and blending with biomass feed stock. The outcome from this program and experience gained by CSIR-CIMFR will be utilized to take decision about utilization prospects of PFBG to handle high ash coal. Further, the PFBG facility will dictate techno-economics, gasification performance vis-à-vis utilization prospects of the high ash Indian coal.

Fig.. (2) 1.5 TPD PFBG

(iv) **Mechanized Scavenging machine**

CSIR-CMERI developed indigenous Mechanized Scavenging System and successfully demonstrated at the premises of the National Physical Laboratory, Delhi on 27.10.2021. The developed system is benchmarked with the market available system in India, and a number of features have been added which makes it first of its kind in India. In the developed system, the water collected from the drain is recycled to be used for drain/road cleaning.

The CSIR-CMERI developed 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 system is rigorously tested in the National Institute of Technology, Durgapur, National Power Training Institute, Durgapur, DVC colony, DSP colony in Durgapur. It is used to handle the blockage caused by plastic and other non-biodegradable domestic thrown-away items, debris, intrusion of tree roots, etc. The scavenging system is very economical and an important vehicle in the Swachh Bharat Mission.

(v) **Development of Electromechanical Field Density Gauge**

A non-nuclear, non-destructive, portable equipment has been designed and fabricated for measurement of dry density of compacted soils. The developed equipment has a potential for applications in different civil engineering construction works specially Roads, Dams and Railways. The developed equipment is cost effective, non destructive, fast, reliable, portable, and non nuclear. As the equipment is non nuclear, the equipment does not need license

certificates from BAARC, and thus avoids health hazard. The equipment is Indigenously developed and is much cheaper and cost about 25% of imported similar type of equipment.

Fig. (3) Development of Electromechanical Field Density Gauge

(vi) **An Intelligent Warning System for Detecting the Presence of Wild Animals near Railway Tracks**

An intelligent wild animal detection and alert system comprising of two technologies (ele Seis Alert and ele Therm Alert) alongwith a web-based GUI has been designed by CSIR-CSIO. Seismic vibrations caused due to wild animal locomotion has been explored for detection of pachyderms in the vicinity of the railway track passing through Rajaji Tiger Reserve, Uttarakhand for reduction of elephant-rail accidents. Due to the locomotion of elephants (*Elephas maximus*), the footsteps generate seismic signals that propagate through the earth surface. These vibrations are sensed using an array of electromagnetic seismic sensors and processed at an edge IoT enabled Seismic Activity Sensing Node (SASN). The detected events i.e. signal windows are further used to calculate the time and frequency-based statistical features. These features aid to differentiate the uniqueness in events using suitable machine learning (ML) algorithms. The seismic system (ele SeisAlert) automatically sense any movement of wild animals near the railway track and raises alert through a cloud server. The system is further augmented with edge processing based thermal sensors (ele ThermAlert) for looking over the railway track for any possible animal crossings. A web based GUI frontend indicating the sensors triggered, health status of systems and data analytics.

Fig. (4)

(vii) **High resolution remote sensing for medicinal, aromatic and commercially important crops**

Drone based multispectral remote sensing was used for non-destructive biomass and Nitrogen (N) estimations in *Stevia rebaudiana* at CSIR-IHBT, which are conventionally done by harvesting of crops. This will help farmers to understand available biomass at the time of its harvesting

and for precise prediction of nitrogen level requirement of crop.

Fig. (5)

(viii) **Integrated bio-refinery for converting paper mill waste into chemical wealth (waste-2-wealth)**

India produces huge amounts of waste from its paper manufacturing industries. This waste is lignocellulosic material, which could be a valuable raw material for biotechnological conversion to bio-based chemicals and materials. Valorisation of this waste would bring investment to the poorer rural parts of India and provide opportunities for employment and economic growth. The project aimed to build a demonstrator bio refinery from these waste streams to manufacture the fragrance linalool and the amino acid lysine for which there are major global markets. The bio refinery is built from partner expertise in i) valorisation of waste feedstock (India); ii) use of bioengineered strains for fragrance production at industrial levels, and feedstock utilisation (UK); iii) commercial expertise in this market sector (UK/India). The innovation is found in unifying existing technologies to form the bio refinery concept, enabling distributed, green, scalable and sustainable manufacture of chemicals from major paper mill waste streams. The bio refinery will drive inward investment to strengthen India's economic position, address major waste challenges and tackle poverty prevalence through job creation.

CSIR-IIP has been working on thermochemical conversion of lignin and residual lignin generated from paper fines treatment to produce bio oils with selective product distribution. The applications of bio oils for antimicrobial applications are in progress.

(ix) **Development of Lubricating Oil (HALRC-35M) for Helicopter Transmission Gear Box**

The research envisages to upgrade the extreme pressure (EP) performance of the lubricating oil (HALRC-35M) for Helicopter Transmission Gearboxes as per RC/ALH/TS/TS/0386. The present lubricating oil in use is primarily synthetic oil, with poor lubrication performance and need to be modified by booster dosing of compatible additives. The lubricant is to be blended with S, Cl free ash less additives. The developed lubricant should have 315 kgf (Min) weld load and 0.40 mm (Max) wear scar dia. The oil should pass 10th stage FZG micro pitting test with type C gears.

Suitable commercial and in-house synthesized additives have been studied for their compatibility and performance enhancement in the existing oil. It has been observed that the Polysulphides are able to provide the desired performance when blended in minor concentrations. With blending of these compounds the Weld load of

320 kgf and wear scar dia. of 0.36 mm has been obtained.

(x) **Hansa NG - Two Seater Trainer Aircraft**

CSIR-NAL has designed and developed Hansa NG 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. This aircraft was certified in the year 2000 when flying clubs needed an advanced trainer aircraft of contemporary class. During the user interaction of Hansa aircraft, the flying community suggested to have significant modifications on Hansa-3 aircraft to make it more useful as a trainer aircraft. The modification suggested to bring out Hansa-NG (New Generation), which will satisfy the requirements of flying clubs for obtaining PPL (Personal Pilot License) & CPL (Commercial Pilot License) by young generation. The major modifications proposed were changing analogue instruments to digital state-of-the art fully glass cockpit display system, reducing the pilot load by changing the mechanically operated flaps to electrical operations, economically designed doors for better ingress and egress, increasing the fuel capacity for higher range and endurance, bubble canopy for excellent aerial view, and easy to fly with good handling quality and low operations and maintenance cost.

With the above modifications to Hansa, the programme was launched in the latter half of 2018 and the Hansa-NG was rolled out on 31st March 2021. CSIR-NAL has received Letter of Intent (LoI) for about 65 aircraft from 7 flying clubs/flight training school. A MoU was signed between CSIR-NAL & Indira Gandhi Rashtirya Uran Academi (IGRUA) on 31st March 2021 for Hansa-NG to be the possible launch customer. Hansa-NG made its successful first flight on 3rd September 2021 and has completed 10 successful flights as on date.

Fig (6) . Rollout of Hansa NG. DG-CSIR, Chairman-HAL, JS-MoCA and other dignitaries witnessed the event

(xi) CSIR AROMA Mission

Dr. G Narahari Sastry, Director, CSIR-NEIST inaugurated the ninth Multi-Locational Trail & Regional Research Experimental Field at Khehoyi, Dimapur, Nagaland on 18th September 2021. CSIR-NEIST, Jorhat has embarked on making plans to fructify the vision

of our honourable Prime Minister in doubling the farmer's income in the next few years.

(xii) Seismological rockslide warnings in the Himalaya.

On 7 February, a glaciated ridge of Ronti mountain in the western Himalaya failed at 5600 m above sea level, causing a rockslide that induced a debris flow and flooding in the tributaries of the river Ganga. The events destroyed two hydroelectric projects and claimed more than 100 lives. Himalayan countries urgently need a robust early warning mechanism for rockslides and triggered flow cascades such as debris flow and flash floods. These flows move at up to tens of meters per second. In contrast, the elastic waves they generate have speeds of a few kilometres per second, arriving quickly at different seismic stations and potentially providing advance notice of disasters. A dense seismological network could be the key to a successful early warning system.

(xiii) **Underwater Bioluminescence Detection System**

Bioluminescence is the production and emission of light by organisms for defense, predation or communication purposes. Increased activity of bioluminescence can be an indicator of environmental pollution or some activity/disturbance underwater. The bioluminescence detection system is described for detecting the intensity of the light emitted from marine organisms. The system uses Silicon Photomultiplier (SiPM) to detect very low levels of light, even to a single photon level. The incoming electrical signal is sampled and stored within the system.

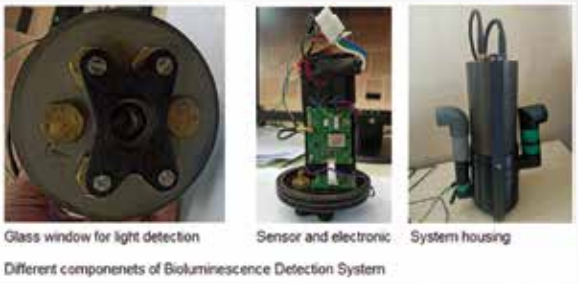


Fig. (7)

(xiv) Benthic Chambers for mesocosm experiments

Corals grow by building their calcium carbonate skeleton. The rate of laying down the calcium carbonate is called coral calcification. Calcification is a measure of coral growth and a crucial parameter for the health assessment of coral reefs. The standard method for measuring coral calcification involves staining a live coral colony using a red-coloured dye. However, this method sacrifices the animal at the end of the study, which is prohibited in India (Wildlife protection act 1972).

CSIR-NIO incubate the corals in situ in closed and transparent chambers and assess the calcification by measuring changes in the alkalinity (using titration) and calcium ion concentration (using ion-chromatography) in the incubated seawater. The benthic chamber provides an enclosure and allows the corals to be incubated in their natural environment. Based on the above requirements, Marine Instrumentation Division at CSIR-NIO designed a set of benthic chambers capable of logging, DO, temperature, PAR, every 5 seconds and operating a thruster to churn the water every 30 minutes. The system is designed for continuous operation for 96 hours without recharge. The system was designed to allow the water sample

collection from the chambers without disturbing.

Fig. (8)

(xv) NPL's Remote Atmospheric Monitoring Station: Monitoring of trace gas concentrations in western Himalayan region

The air quality not only influences the health of the people living in a particular region or area but also influences the economy of a nation. A high altitude site provides the values of pollutant species which can be used to assess the baseline scenario that would help in understanding the atmospheric chemistry & physics besides providing valuable inputs to decision making system to improve the air quality. CSIR-National Physical Laboratory has established a remote atmospheric monitoring station in the campus of CSIR-Institute of Himalayan Bio resource Technology (IHBT), Palampur, Himachal Pradesh (32.12°N, 76.56°E) at 1347 m Above Mean Sea Level (AMSL). The four-year continuous measurement data for the period 2016 to 2019 monitored at this high altitude site was used to understand the variability of these trace gases over the Indian western Himalayan region. A significant variability in the mixing ratios of the trace gases have been observed due to natural and anthropogenic influences

Fig. (9) CSIR-NPL's Remote Monitoring Station

Skill Development cum Awareness

Various CSIR laboratories participated in CSIR's flagship programmes on Skill India and Jigyasa – Student Scientists Connect program to empower large number of Indian youths through industry oriented skill trainings and popularize science, technology & innovation and to inculcate scientific temper among school students and ignite the minds of teachers. Different training, awareness, and educational programs in various fields of biological, chemical, engineering, information and physical sciences were conducted throughout the year by CSIR laboratories.

1.1.3 Scientific Excellence

CSIR has published 5043 research papers during the period under report in SCI journals of repute. The new knowledge generated from CSIR laboratories is reflected in terms of high average Impact Factor (4.481).

1.1.4 Excellence in Intellectual Property

CSIR has filed 174 patents abroad and 208 patents in India during the period, and it has been granted 206 patents abroad and 318 patents in India.

CSIR's Copyright Filing: CSIR has filed 72 Copyright applications. The Copyright

applications filed by CSIR subsist in different categories such as literary work, software and artistic work.

1.1.5 Value Generation through External Cash Flow (ECF)

CSIR has generated External Cash Flow of Rs. 1599.46 crore during 2020-21, by working with various Govt./ non-Govt. Indian and foreign organisations.

ECF (Rs in crore)	
Government	512.692
PSU	808.104
Private	267.293
Foreign	11.373
Total	1599.46

5.2 CONSULTANCY DEVELOPMENT CENTRE (CDC)

Consultancy Development Centre (CDC) is an Autonomous Institution of the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India set up for promotion, development and strengthening of consultancy skills and capabilities in the country including enhancement of export of consultancy and professional services. During the financial year 2020-21, expenditure of Rs 307.40 lakhs was incurred compared to Rs 345.93 lakhs in the FY 2019-20 and total revenue generation from various programmes and activities during the year was Rs. 133.72 lakhs compared to Rs 141.95 lakhs in the FY 2019-20. During the period under report, CDC undertook consultancy projects for (i) Study on "Need based interventions for better marketability of Handicraft Clusters in Uttar Pradesh (Wooden crafts in Nagina and Zari / Zardozi crafts in Varanasi)" and (ii) Study on "DC-MSME schemes for MSME Sector –with focus on North Eastern Region including Sikkim O/o DC-MSME, New Delhi. Report submitted.

6.0 PUBLIC SECTOR ENTERPRISES

6.1 NATIONAL RESEARCH DEVELOPMENT CORPORATION (NRDC)

National Research Development Corporation (NRDC) is a Government of India enterprise, under the Administrative control of Department of Scientific & Industrial Research (DSIR), established in 1953 as a section 25 company (as section 8 of the Companies Act, 2013). The main objective of the organization is to promote, develop and commercialize technologies/ know how/ inventions/ patents/ processes emanating from various national R&D institutions. The Corporation offers its services through-out the country in improving the Nation's manufacturing base with innovative technologies especially suitable for the entrepreneurs and conditions. It acts as an effective interface for translating R&D results into marketable products. Over the last more than six decades of its existence, the Corporation has forged strong links with various R&D organizations both within the country and abroad and pursued bringing inventions and innovations to commercial fruition. The Corporation is recognized as a repository of a wide range of technologies and has licensed technologies to over 5000 entrepreneurs spread over almost all areas of industry and has provided assistance for filing of 1800 patents. During the financial year 63 new processes/technologies were assigned to the Corporation for licensing and almost 24 technologies were licenced. Corporation's consolidated Lump sum Premia & Royalty income was Rs. 618.38 lakhs as compared to Rs. 691.58 lakhs in the previous year. The Royalty received was from both the NRDC licensees and PATSER projects.

6.2 CENTRAL ELECTRONICS LIMITED (CEL)

Central Electronics Limited (CEL) is a profit making public sector enterprise under the Department of Scientific and Industrial Research (DSIR), Ministry of Science & Technology, Government of India. It was established in 1974 with an objective to commercially exploit indigenous technologies developed by National Laboratories and R & D Institutions in the country. CEL is one of the companies that utilized home grown technologies during all these years of its existence. The company is primarily engaged in production of strategic components for defence applications of national importance, equipment for railway safety and solar photovoltaic modules and systems. The company has developed a number of products for the first time in the country through its own R & D efforts and in close association with the premier National & International Laboratories including Defence Laboratories. In recognition of all these efforts, CEL not only have the distinction of being a DSIR recognized R & D Company, but also has been honoured a number of times with prestigious awards including "National Award for R & D by DSIR". The organization had the highest ever net worth of Rs.105.82 Cr. as on 31.3.2021 with positive reserves. CEL signed two MoUs with Indian Institute of Kanpur (IIT-K) to work on common areas of interest for the development of technology and various indigenous products and signed a technology transfer agreement with Naval Materials Research Laboratory (NMRL DRDO) for production of special grade ferrite based radar absorption material for stealth application.

CHAPTER 1: INDUSTRIAL R&D PROMOTION PROGRAMME (IRDPP)

INDUSTRIAL R&D PROMOTION PROGRAMME (IRDPP)

DSIR through its flagship program i.e. "Industrial Research & Development Promotion Program (IRDPP)" has vision to promote Industrial Research in the country through Industry and Institution centric motivational measures and incentives creating an enabling environment for development & utilization of novel technologies and innovations.

1.0 OBJECTIVES

The broad objectives of the Industrial Research and Development Promotion Programme (IRDPP) is to:

- Bring in-house R&D into sharper focus
- Strengthen R&D infrastructure in industry and Scientific and Industrial Research Organisations (SIROs)
- Promote R&D initiatives of the industry and SIROs
- Ensure that the contributions made by the in-house R&D centres and SIROs dovetail adequately in the overall context of technological and industrial development.

1.1 AREAS OF COVERAGE

The specific areas covered under the component scheme are:

In-house R&D in Industry.

Scientific and Industrial Research Organisations (SIROs) and

Fiscal Incentives for Scientific Research.

Activities and achievements in each of above areas are presented below:

1.2 IN-HOUSE R&D IN INDUSTRY

1.2.1 Recognition of In-house R&D Centers

A strong S&T infrastructure has been created in the country. This covers a chain of national laboratories, specialized R&D centers, various academic institutions and training centers, which continuously provide expertise, technically trained manpower and technological support to the industry. Various policy measures have been introduced from time to time, to meet the changing industrial and technological requirements of the industry. The Government has been giving special attention to promotion and support to industrial research in industry. Several financial benefits have also been provided which encourage and make it financially attractive for industrial units to establish their own in-house R&D units.

A scheme for granting recognition to in-house R&D center of the industry is operated by the DSIR. A number of incentives and support measures are made available to in-house R&D units of industry to strengthen the technological base. Ministry of Finance issue notifications amending the basic notifications under Customs and Goods & Service Tax (GST). As per the amendments, DSIR recognized & registered in-house R&D units other than hospitals can avail customs duty exemption and concessional GST on their procurements for research.

The in-house R&D center qualifying for recognition are expected to be engaged in

research and development activities related to the line of business of the firm such as development of new technologies, design and engineering, process/ product/design improvements, developing new methods of analysis and testing; research for increased efficiency in use of resources such as capital equipment, materials and energy; pollution control, effluent treatment and recycling of waste products.

The R&D activities are expected to be separate from routine activities of the firm, such as production and quality control. The in-house R&D units should have staff exclusively engaged in R&D and headed by a full-time R&D manager who would have direct access to the chief executive or to the board of directors depending upon the size of the unit. The in-house R&D centers are also expected to maintain separate identifiable infrastructure and R&D accounts.

Number of in-house R&D centers recognized by DSIR increased steadily from around 100 in 1973 to around 275 by 1975, to over 700 by 1980, around 925 by 1985, over 1100 in 1990, over 1200 in 1995 and thereafter hovering between 1200 to 1250; 1361 in March 2010; 1618 in December 2011, 1767 in December 2012, 1797 in December 2013, 1762 in December 2014, 1800 in December 2015, 1900 in November 2016, 1997 in November 2017, 2052 in November 2018, 2238 in December 2019, 2340 in November 2020 and 2481 in December 2021. Of these nearly 2042 are in the private sector and the remaining units are in public/joint sector. The last 'Directory of Recognized In-house R&D Units' till 31.03.2021 has been released and next updated directory be released in April 2022. Directory provided information on recognized in-house R&D units, giving registration number, name and mailing address of the company, location of the in-house R&D unit(s) and validity of DSIR recognition.

To promote entrepreneurship in biotechnology sector, the three year existence of the company for according short term fresh recognition was relaxed to Biotech Start-ups established in Incubation Centre or Technology Park with effect from July 2015. DSIR refers the applications received from start-up companies in the biotechnology sector to the Department of Biotechnology (DBT), being the nodal Department for promoting biotechnology in the country for their views and comments. Based on recommendations received from DBT and keeping the guideline relaxation in view, the application is considered for recognition. The relaxation of three years of existence of the companies for other sectors has been proposed for consideration.

A detailed guidelines for the Recognition of In-house R&D centre are available on Department's website. The applications received are scrutinized for their completeness in the department and are then circulated for comments to various other departments/ agencies, concerned administrative ministries such as MSME, MNRE, CSIR, ICAR, ICMR, MoEF, CCRAS, AYUSH, DBT, DST, SERB, TDB, TIFAC, DC&PC, MeitY, DoP and NRDC. The applicant industries seeking recognition are pre-screened and invited for presentation and discussion in DSIR and may be visited by a team of experts and DSIR representatives. The applications along with comments from outside nodal departments/ organizations, visit reports, and the Department's own evaluation are considered by an Inter-Departmental Screening Committee constituted by the Secretary, DSIR. The Committee meeting is scheduled every month/ bimonthly to consider the applications and makes recommendations for recognition & registration to the Secretary, DSIR.

During the period under report, the Screening Committee met **13** times and **252** applications received for recognition. During the period under report, the screening committee considered **283** applications including new application and deferred cases and total cumulative disposal were for **263** applications, of which **141** R&D units were granted fresh recognition based on their satisfactory R&D Infrastructure, Qualified Manpower and Programs; **2** applications were deferred and **140** applications were closed in its present form due to either withdrawal by the company or not eligible for consideration under existing guideline of IRDPP scheme. A statement giving month-wise receipt, disposal and pendency of applications for recognition of in-house R&D units is given at **Annexure 1**.

During the period under report, more than 182 discussions/meetings were held with heads/ representatives of in-house R&D centers. Also, a number of visits of In-house R&D centers were organized along with domain experts through VC/Skype/MS-Teams.

1.2.2 Renewal of Recognition

DSIR recognition to the in-house R&D centers of the industry is granted for a period ranging from 2 to 5 years. The companies having the R&D units recognized by the Department are advised to apply for renewal of recognition well in advance (3 months prior to the date of expiry of the recognition). The applications are examined in DSIR by the Research and Review Group (RRG) comprising of representatives from CSIR, NRDC, DSIR and DST constituted by the Secretary DSIR. The RRG takes into account recommendation for renewal of recognition based on satisfactory R&D performance of the R&D centers of industry since the last recognition based on the research indicators like the R&D expenditure, R&D assets, R&D manpower, R&D achievements (new products and processes developed, technologies commercialized, patents filed, research papers published etc.) and the ongoing and future R&D programs. Sometimes, the RRG may seek clarification/suggestions from the industry for strengthening their R&D activities. After obtaining the necessary information from the industries, the cases which have been accorded DSIR recognition are considered for renewal of recognition.

As of 1st April 2021, in-house R&D units of 687 companies were due for renewal of recognition beyond 31.03.2021 out of which 523 applications were received till 27th December, 2021. During the period under report, the Research Review group (RRG) met ten times. Based on the evaluation of the performance of the R&D units, renewal of recognition was granted to 465 company's having recognized R&D units. Total of 164 companies were not be renewed during the period under report because of the reason that their application was not received in the department. 02 companies were not provided renewal of recognition beyond 31.03.2021 because of the reason that the R&D performance was not up to the mark. A total of 56 applications are being processed currently in the department. A statement showing month-wise receipt, disposal and pendency of the cases of renewal of recognition of the R&D units is given in **Annexure 2**

1.2.3 R&D Expenditure

The R&D expenditure incurred by in-house R&D units in industry has steadily increased. During 1980-81, it was of the order of Rs. 300.00 crores. In 1985-86, it was of the order of Rs. 500.00 crores. It is estimated that the present R&D expenditure of the 2481 recognized in-house R&D units is of the order of about Rs. 44030.00 crores per annum. The

share of public and joint sector is about 20 per cent and that of private sector about 80 per cent. The representative list of Companies spending over Rs. 5000.0 lakhs per annum on R&D, Rs. 500.0 lakhs to Rs. 5000.0 lakhs per annum on R&D and between Rs. 200.0 lakhs to Rs. 500.0 lakhs each per annum on R&D is given in **Annexure 3, 4** and **5** respectively.

1.2.4 R&D Infrastructure

The in-house R&D centers have created State of art design & simulation facilities, Prototyping, Validation & Testing facilities meeting regulatory requirements and compliance with National/International Laboratory certifications. The laboratories of In-House R&D centers are equipped with sophisticated analytical equipment, design software's, predictive testing and advanced raw material characterization facilities for carrying out their research activities.

The major equipment include : Mini Atomizer with accessories, Atomic absorption spectrophotometer, optical metallurgical microscope, Scanning electron microscope, HPLC system, Rotavapor Vaccum pump, Spectrophotometers, Agilent 6890 GC System, Spectrometer NMR, Hardness Tester, Die Punch Cutter, Viscometer, Chiller, Oil vacuum pump, Autoclave, High Performance Liquid Chromatography, Electro spinning machine, Freeze dryer, Upright Metallurgical Microscope & Camera, Universal Testing Machine, Abrasive cut off Machine, Milling Machine, Oil fired Furnace, Xilinx FPGA Software Development Board, Power supplies : Var Tech System 3005B-3, G-suite, Picoscopes: Pico Tech 6404D and 2408B, RT-PCR, PCR, ELISA analyzer, micro centrifuge, Deep freezer, NGS servers, Adiabatic Reaction Calorimeter Y 2020, Mass Spectrometer, Coulometric moisture analyser, Fluorescence microscope, Hot embossing machine, Nano Photometer / Spectrometer, Freezer, Humidification chamber, Eddy Current Dynamometers, Engine Test Controller, Orbit-E Test Automation System, Tablet multi punching machine, Blender, Continuous inkjet printer, Tablet coating machine, Rheometer, Mooney viscometer, twist tester, Texture tester, Fatigue Testing Machine-INSTRON, Fatigue testing M/C-RUMUL, Fatigue testing M/C-CRIMS, Chain test rig with D.C Motor system, Automotive drive chain test rig, Microprocessor kit, Digital Multimeter, Digital Clamp meter, Digital LCR meter, Digital storage oscilloscope, Laminar Air flow unit, CO_2 Incubator, -20 Freezers, Nano coating machine, High temperature Pin-on-disc machine, Fully automatic Rockwell hardness testing machine, Micro hardness tester with software, Portable microscope with software, High-Throughput submarine Electrophoresis systems, Gel Doc XR+molecular imager system-bio-rad, Semi Auto pipe bending machine, Swaging machine with tool sets, Fiber laser Cutting machine, AVIII 600 MHz Spectrometer – Ascend ULH magnet exchange, Falling Ball Viscometer, Brookfield Viscometer, High Voltage Tester, Bench scale wall mounted glass herbal extractor, Horizontal autoclave, Cultivation Equipment, Germinator, Pressure reactor 1L, Cryogenic Bath (-70°C) etc.

1.2.5 R&D Manpower

There has been a steady increase in R&D manpower employed by the in-house R&D units. By 1975-76, about 12,000 R&D personnel were employed by the recognized in- house units and by 1981-82, the figure was over 30,000. The estimated manpower for the 2481 in-house R&D units is over 1,98,867.

1.2.6 Achievements of In-house R&D Units

Agricultural Sciences:

i. Development of new products such as NS 5018 (16HT-126) This superior yielding hybrid produces smooth, oblate shaped fruits of 90g and acidic in taste. Fruits are light green shoulder when unripe and very early maturing hybrid with high level TyLCV tolerance.

ii. Development of new products such as Developed hybrids in major vegetable crops.

iii. Development of extracts of few very promising & potential cultivars; Bt Cotton, Soyabean, Paddy, Tamato, Okra.

iv. Development of New Products/ varieties such as pearl millet, maize, single-cut sorghum, sunflower, cotton.

v. Development of CMS lines in Cauliflower and Radish for heterosis, Breeding, Developed and Characterised tomato Lines.

vi. Development of Microtrace formulation for trace elements as Conventional micronutrients are basically salts. Nano technology based micro trace elements employs reduction based chemical technology. When compared to the Mineral Ions the bioavailability of microencapsulated trace elements is high. The microencapsulated trace elements are absorbed easily in plant system either by foliar spray drip irrigation.

vii. Development of new improved varieties of Cotton, Chilly, Bitter Gourd, Tomato, Cucumber, Watermelon, Brinjal.

viii. Development of new hybrid and varieties of castor, mustard, watermelon, ridge gourd.

ix. Development of new products as Groundnut, Coriander, gram, paddy, Bajara, Cucumber, okra, Water melon.

Biological / Biomedical Sciences/ Pharmaceuticals:

i. Development of New proprietary synthetic routes and processes for synthesis of Stearyl isocyanate-65, 3-Isopropyl-4-amino-1,2, 4-triazol-5-one, 5-Methoxy-1, 4-thidiazol-2(3H)-one, p-Toluenesulfonyl isocyanate.

ii. Development of Moxifloxacin + Loteprednol Ophth Suspension, Everolimus Tabs, Etophylline + Theophylline anhydrous + Salbutamol sulphate Sustained Release Tablets, Dexamethasone Tablets, Lignocaine ointment.

iii. Development of new products such as Tetramethyl-a, 6-Diamino hexane, 6-Bromohexyl trimethylammonium bromide, Carboxy butyl triphenyl phosphonium bromide, Diallyldimethyl ammonium chloride, 2,3-Dimethyl-1-(4-methylbenzyl)-1H-imidazol-3-ium chloride.

iv. Development of Brucella abortus live vaccine, Rabies Veterinary Vaccine.

v. Development of new products such as LBC self sample collection kit, HPV DNA RT PCR kit, TB-RT-PCR Kit, HLA B27 RT-PCR kit, Covid VTM kit, Nucleic Acid Extraction kit.

vi. Development of diagnostic test for Thyroid function Test (T3, T4 abd TSH) on the ACIX100 platform, Development of ELISA test for detecting antibodies against COVID19.

vii. Development of new products such as Oseltamivir D3 acid, Tauro obeticholic

acid, 15 epi travoprost, Ezetimibe Benzyl Diol Impurity, Lapatinib D4, Orlistat impurity A, Abemaciclib impurity 27, Ivacaftro D4.

Chemical Sciences:

i. Development of process for finer grade Magnesium Powders in different mesh sizes by introducing a special type of grinding system and also with PLC controlled semi-automation process, which on formulation with oxidizers and donors act as a capable energy source in pyro fireworks industries for developing a spectrum of colors, glittering effect & sparkling effect in sparklers, stars, twinklers, regular color-effect aerial shots etc.

ii. Development of new products such as Bake Oven paper, Greaseproof 7K (WS), Greaseproof SE (9K), Warp (Uncoated), Crystal MTW (LD), Print Base (Colors), Glassine (NS), Bowl Paper etc.

iii. Development of Flame retardant epoxy laminating resin for railways, Bisphenol A based Benzozazine resin, Trifunctional epoxy resin based on trishydroxy phenyl methane, release coating for shaft during VPI, pre-pregging resin for nomex composites for electrical application, hardener for marine coating, epoxy resin for sports goods, silicone foam for ASL.

iv. Development of new products such as 3-Ethyl-4-methyl-3-pyrrolin-2-one, 2-Chlor Diphenyl Ether, ChloroHexanone 6-hloro-2-hexanone, 4,4-Dimethoxy-2-butanone, (R)-3-(Carbamoylmethyl)-5-methylhexanoic Acid, 3,5-Dichlorobenzoyl chloride.

v. Development of Mono sodium salt of dicarboxlic acid, Butene dioic linear short chain ester.

Engineering / Information Technology:

i. Development of new products for the Bioactive collagen peptide for diabetes management, bioactive collagen peptides for osteoarthritis, collagen peptide formulations of sports nutrition, fitness nutrition, high protein drink, collagen daily products – collagen protein shake, collagen tomato soup, collagen rasam.

ii. Development of GigaMesh Backhaul Radio (World's first multi-beam radio in E-band).

iii. Development of new products such as Austempering process for drive chain plates, 15.875 pitch standard drive chain for automotive application, Drive chains plates surface finish improvement, 12.70 mm pitch drive chain life improvement with pin coating application, Non-heating grease for drive chain application, chain oil for chain lubrication purpose, 12.70 mm Pitch 'O' ring drive chain or automotive application, Four point riveting for sealed chains.

iv. Development of High efficency eddy current clutches for diesel locomotives, Efficient lower KW SR drive, Automated file retreiving system, DC chopper controller for electric vehicle application, Helicopter traversing system.

v. Development of PRP Module for GPS clock, E1 2.048MHZ Ouput module dual compartment flame proof temperature transmitter, MC-2 NTP server / Client, CR-2450/ HT 16u, TC 596-TC548E ON-OFF PID temperature controller, MFT20 Multi-Function Transducer, TC 12+ Temperature calibrator, 409-W Strain Gauge Indicator 9000C-SOP CE

mark, TT7S11S CE Mark, Tap Position Transmitter, TC5396, PID 5040-XP, 409-6IN.

vi. Development of new process for products such as Pentoxifylline, Etoricoxib, Teneligliptin, Caffeine.

vii. Development of new products Low dia (1.6mm) FCAW hardfacing wire (EWAC O-810, 810 Mo, 964, 720. 564, 540, 521, 870, 516, 571 P, 512, 6320, 972), Higher dia (2.4mm) hardfacing wires O-9306, O-6436.

viii. SMAW electrodes for ralway applications like reconditioning of MCI insert (MCI 250), in-situ repair of ralway points and crossings – Electrodes BU 380, CP TOP 90, FCAW wires EWAC O-550 and EWAC O-650, FCAW wire for forging die rapair and build-up G572 P-SF, G572P-KF, G571D-VE.

ix. Development of new products such as 105m 24 knots Offshore Patrol Vessel, 105m Advance Offshore Patrol Vessel for Export, 115m Survey vessel platform, 50m Coastal Patrol Vessel.

x. Development of new products such as 12mm Gen 2 Condenser Internal, Heat Exchanger – IHX, High corrosion durabillty-Customer, TAF 38/50, Radiator 22mm, 16mm Gen 2 Condenser, Cold plate for Electic Vehicles, Battery cooling system for electric vehicles.

xi. Development of new products such as Rotary Air Lock Valve (200mm) Mild Steel, Knife Gate Valve (200mm), 40HP Centrifugal Blower, Wet Scrubber up to 5000 m^3/hr, Oil Mist Collector up to 1500 m^3/hr, 5HP Flame proof vacuum cleaner, Downdraft Table (3Mtr 15HP), RDC10LFPJC9, Vacuum Loader for 2 ton/hour capacity, Industrial vacuum cleaner.

xii. Development of new products such as API X-70, PSL2 grade plates, RSP Customized IS 2062 E 250C / E 410 C Grade Plates (54 J at-20), RSP Boilder Grade IS 2002 Gr3, Plates, RSP SAILARM (ASP-RSP Route), ASP RSP ISH 5986 Gr 590R Plates.

1.2.7 Imports Made by In-house R&D Units

The recognized in-house R&D units have imported a variety of equipment, raw material and reference standards for their R&D activities. These include: Resin Powder, Mechanical / Thermal Designs, Components, PCB Boards, Specialty chemical & solvent, R&D Consumables, Seed Strain of Vibrio cholerae, Tungsten Carbide Fragment, Fused Tungsten Carbide Powder, 3DH inducer lines CIM2GTAIL – P1, P2 & P3, L-4-Nitrophenylalanine methyl ester hydrochloride, Abiraterone, 3-Hydroxycarbazole, Voriconazole, Pyrazole, 4-Fluoro benzaldehyde, Ethyl 2 3 dicyano propionate, 2,6-Dichloro-4-(trifluromethyl) aniline etc.

1.3 SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATIONS

1.3.1 Recognition of Scientific and Industrial Research Organizations (SIROs)

The DSIR had launched a scheme of granting recognition to SIROs in 1988. The SIROs recognized by DSIR are eligible for customs duty exemption and concessional GST under notification no. 51/96-customs dated 23.07.1996; notification no. 24/2007-customs dated 01.03.2007; notification no. 43/2017-customs dated 30.06.2017; notification no. 45/2017-central tax (rate) & 47/2017-integrated tax (rate) dated 14.11.2017;

notification no. 9/2018-central tax (rate), notification no. 09/2018-union territory tax (rate) &notification no. 10/2018-integrated tax (rate) dated 25.01.2018; and state tax (rate) as applicable and all notification, as amended from time to time.

The DSIR has brought out Guidelines for Recognition of SIROs, which gives procedural details and application proforma for seeking recognition under the SIRO Scheme. Functional SIROs having broad based governing council, research advisory committee, research personnel, infrastructural facilities for research, well defined, time bound research programmes and clearly stated objectives of undertaking scientific research, are considered eligible for recognition by DSIR. The investments of surplus funds not needed for immediate research should be in accordance with the Income-tax Act, 1961.

Applications for seeking recognition under the SIRO scheme are considered in DSIR by a common Inter-departmental Screening Committee constituted for both In-house R&D Units (RDI) of Industries and Scientific and Industrial Research Organizations (SIROs) schemes with members from Council of Scientific and Industrial Research (CSIR), Indian Council of Medical Research (ICMR), Indian Council of Agricultural Research (ICAR), Indian Council of Social Sciences Research (ICSSR) and Department of Biotechnology (DBT), National Research and Development Corporation (NRDC), Ministry of Environment, Forest & Climate Change, Department of Chemicals and Petrochemicals (DCPC), Ministry of AYUSH, Department of Pharmaceuticals (DOP), Ministry of Electronics & Information Technology (MeiTY), Ministry of New and Renewable Energy (MNRE), Ministry of Micro, Small and Medium Enterprises (MSME) and Technology Development Board (TDB). The recommendations of the Screening Committee are put up for approval of Secretary, DSIR. The recognition is effective from the date of the Screening Committee meeting. Retrospective approval is not granted.

During the period December 2020 to November 2021, the Screening Committee met 7 times and recommended 54 cases for recognition as SIROs. These include 23 cases in the Natural and Applied Sciences, 05 cases in the area of Agricultural Sciences and 03 cases in the area of Social Sciences and 23 cases in the area of Medical Sciences. The sector-wise list of these SIROs is furnished at **Annexure - 6**. Out of the 54 recognized SIROs, 28 SIROs were issued registration certificates for obtaining customs duty exemptions and GST waiver.

1.3.2. Renewal of Recognition of SIROs

Recognition granted to SIROs is for duration ranging from 1 to 3 years. The SIROs are advised to apply for renewal of recognition well in advance (3 months prior to the date of expiry of recognition). Such applications received for renewal of recognition are examined by Research Review Group (RRG) by involving representatives from DST, ICAR, ICMR, CSIR, ICSSR, NRDC and UGC depending on the area of research. Based on the evaluation made by the RRG, renewal of recognition is granted to SIROs. During the period December 2020 to November 2021, RRG met 4 times and recommended 257 SIROs for renewal of recognition beyond 31.03.2020 and 31.03.2021 excluding the cases under consideration. Out of the 257 recognized SIROs, 148 SIROs were issued registration certificates for obtaining customs duty exemptions and concessional GST.

As present, there are 782 SIROs duly recognized by DSIR; of these, 382 are in the

area of natural and applied sciences, 289 are in the area of medical sciences, 42 are in the area of agricultural sciences and 69 are in the area of social sciences.

The SIROs have employed qualified scientists and researchers and have also established good infrastructural facilities for research. They have developed new processes, procedures, techniques and technologies and also filed several patents. They have also organized seminars/ symposiums/ workshops and published research papers / reports / books.

1.4 FISCAL INCENTIVES FOR SCIENTIFIC RESEARCH

Government has evolved, from time to time, fiscal incentives and support measures to encourage R&D in industry and increased utilization of locally available R&D options for industrial development. New incentives to encourage investments in R&D by industry are announced in the Union Budget. Fiscal incentives and support measures presently available include:

- Income-tax relief on R&D expenditure (capital & revenue);
- Weighted tax deduction U/s 35(2AA) of IT Act 1961 for sponsored research programs in approved national laboratories, universities and IITs;
- Weighted tax deduction u/s 35(2AB) of IT Act, 1961 on In-house R&D expenditure for any company engaged in the business of biotechnology or in any business of manufacture or production of any article or thing not being an article or thing specified in the list of the eleventh schedule of IT Act, having R&D facility approved by Secretary, DSIR.
- Customs Duty exemption on capital equipment, spares, accessories and consumables imported for R&D by approved institutions/SIROs;
- Customs Duty exemption on specified goods (comprising of analytical and specialty equipment) for use in pharmaceutical and biotechnology sector;
- Accelerated depreciation allowance on plant and machinery set-up based on indigenous technology;
- Customs Duty exemption on imports for R&D projects supported by Government.

Information on some of these fiscal incentives implemented by DSIR is given in the following paragraph.

1.4.1 Depreciation Allowance on Plant and Machinery Setup Based on Indigenous Technology

Secretary, DSIR, Ministry of Science and Technology, is the Prescribed Authority to certify expenditures where higher rate of depreciation is to be allowed for the plant and machinery installed for the manufacturing of products using indigenous know-how as per provisions of rule 5(2) of IT Rules. Guidelines have been issued for making application for obtaining the aforesaid certificate. All such applications received are examined in the department, and discussions and visits by experts to verify the claim are made to the plants by expert teams. Based on a detailed examination, certificates in deserving cases are issued for eligible expenditure.

1.4.2 Reference on expenditure on scientific research under Section 35 (3) of Income Tax Act, 1961.

Section 35(3) of Income-tax Act, 1961 provides

that if a question arises as to whether and, if so, to what extent any activity constitutes or constituted or any asset is or was being used for scientific research, the Central Board of Direct Taxes would refer the question to the Prescribed authority. Chief Commissioner Income-tax in concurrence with Secretary, DSIR is the Prescribed Authority for deciding such cases.

1.4.3 Approval of In-house R&D Centers under Section 35(2AB) of IT Act 1961

In order to encourage R&D initiatives of industry, the finance bill 1997 introduced a sub section (2AB) in section 35 of the IT Act, 1961. The provision introduced initially was for select sectors of industry i.e. drugs, pharmaceuticals, electronic equipment, computers, telecommunication equipment, chemicals and provided weighted deduction of 125 per cent on expenditure on in-house research and development facility as approved by the prescribed authority i.e. Secretary, DSIR. Subsequently, a number of other sectors were added to the list of eligible sectors. From the year 2009 the benefits have been extended to all sectors of industry with a select list of non-priority items. Rate of weighted tax deduction was raised from 125 per cent to 150 per cent subsequent to the year ending March, 2000. The rate of weighted tax deduction was further enhanced to 200% from 1st April 2010. Initially the provision was introduced up to 31st March, 2000. The provision was extended from time to time initially till 31st March, 2005 and then up to 31st March, 2007, further up to 31st March 2012. In the Union Budget 2012, the provision was extended up to 31st March 2017. In the Union Budget 2016, the provision has been further extended up to 31st March 2020. The rate of weighted tax deduction has been lowered from 200% to 150% from 1st April 2017. The expenditure on scientific research (not being expenditure in the nature of cost of any land or building) on in-house research and development facility is incurred in assessment year beginning on or after the 1st day of April, 2021, the deduction under this clause shall be equal to the expenditure so incurred. During the period from January 2021 to November 2021, new approvals in Form 3CM were accorded to 16 companies under Section 35(2AB) of Income Tax Act, 1961. A list of such companies is furnished in **Annexure 7** Further, reported R&D expenditure of Rs.21,184.33 Crores for 550 approved companies in Form 3CL were also issued to CCIT as prescribed in IT Act, 1961.

1.4.4 Customs Duty Exemption to Recognized & Registered SIROs

All SIROs recognized and registered by DSIR (other than hospitals) are eligible for customs duty exemption on import of equipment/instruments and their spares and consumables; under notification No. 51/96-Customs dated 23.07.1996, No. 24/2007-Customs dated 01.03.2007 & No. 43/2017-Customs dated 30.06.2017, as amended from time to time. The department was issuing essentiality certificates to SIROs for obtaining customs duty exemption. As per notification No. 24/2007-Customs dated 01.03.2007, the Director or Head of the Institute/organization is empowered to sign the essentiality certificate.

1.4.5 Concessional GST to Recognized & Registered SIROs

The SIROs recognized & registered by DSIR (other than hospitals) are eligible for concessional GST on purchase of equipment/ instruments including computers, apparatus, accessories and their spares and consumables; computer software, CD-ROM, recorded tapes, microfilms, microfiches, under

notification nos. 45/2017-central tax (rate) & 47/2017-integrated tax (rate) dated 14.11.2017; Notification No. 9/2018-central tax (rate), Notification No. 09/2018-union territory tax (rate) & Notification No. 10/2018-integrated tax (rate) dated 25.01.2018; and state tax (rate) as applicable and all notification, as amended from time to time. As per the notification no. 45/2017-central tax (rate) dated 14.11.2017, the Director or Head of the Institute/organization is empowered to sign the essentiality certificate.

1.4.6 Customs Duty Exemption and concessional GST benefits to Recognized & Registered in-house R&D units

Ministry of Finance has issued Notification No. 51/96 – Customs dated 23.07.1996; Notification No. 24/2007 – Customs dated 01.03.2007; Notification No. 43/2017 - Customs dated 30.06.2017; Notification No. 45/2017 – Central Tax (Rate) & 47/2017 – Integrated Tax (Rate) dated 14.11.2017; Notification No. 9/2018 – Central Tax (Rate); Notification No. 09/2018 Union Territory Tax (Rate) & Notification No. 10/2018 – Integrated Tax (Rate) dated 25.01.2018; and State Tax (Rate) as applicable and all notification as amended from time to time.

As per the above amendments, all DSIR recognized in-house R&D units other than hospitals can avail customs duty exemption and concessional GST on their procurements for research purposes. All the eligible in-house R&D units recognized by DSIR have been issued the certificates of registration.

1.4.7 Other Benefits Availed by the Recognized R&D Units

The Department provides assistance to recognized in-house R&D units in a number of ways, such as cases of industrial R&D units requiring allotment of special controlled materials for R&D, permission to export of specialized products reserved for small scale industries by medium scale industries for test marketing in other countries and disposal of imported R&D equipment/instruments and pilot plant produce are examined for making suitable recommendations to concerned agencies.

1.4.8 Registration of Public Funded Research Institutions, Universities etc.

Public funded research institutions, universities, IITs, IISc., Bangalore; Regional Engineering Colleges (other than a hospital) are eligible for availing concessional customs duty exemption on import of equipment, spares and accessories and consumables for research purposes through a simple registration with the DSIR. The heads of the public funded research institutions / organizations duly registered with DSIR can certify the R&D goods for customs duty exemption vide Notification No. 43/2017-Customs dt. 30.06.2017 and corrigendum dated 22.07.2017-Custom Notification no. 43/2017 dt 30.06.2017. Ministry of Finance has amended the main notification No. 51/96-Customs dt.23.07.1996 from time to time.

Coinciding with the presentation of Union Budget for the year 2004, Ministry of Finance amended the notification No. 51/96-customs vide notification No. 28/2003-Customs dt.1.3.2003. As per the amendment, departments & laboratories of central government and state governments (other than a hospital) are not required to register with DSIR for availing the concessional customs duty exemption. They can clear the consignments by producing a certificate from the Head of the institution certifying that the said goods are required for research

purposes only. Another significant change in the notification is that Regional Cancer Centers have been included in the list of institutions eligible for DSIR registration for importing goods for research purposes at a concessional rate of customs duty.

The Union Government of India enacted 'The Constitution (101st Amendment) Act, 2016 w.e.f. 16th September 2016, as introduction of Goods and Services Tax required amendments in the constitution to concurrently empower the Centre and States to levy and collect Goods and Services Tax (GST). Central Government vide Notification No. 03/2017-Central Tax, dt. 19-06-2017 has notified Central Goods and Services Tax Rules, 2017 w.e.f. 22nd June 2017. The introduction of Central Goods and Services Tax Act, 2017(No. 12 of 2017) on 1st July, 2017 was a very significant step in the field of Indirect Tax Reforms in India. After introduction of CGST Act, 2017 (No.12 of 2017) from 1st July, 2017, import of goods would be treated as inter-state supplies and would be subject to integrated tax (IGST) in addition to the applicable customs duties. For latest update visit http://www.cbec.gov.in/htdocs-cbec/gst/index.

Central Government vide Notification 47/2017-Integrated Tax (Rate) dt. 14.11.2017 and Notification No. 45/2017- Central Tax (Rate) dt. 14.11.2017, Notification No. 45/2017- Union Territory Tax (Rate) dt. 14.11.2017, as amended from time to time has granted concessional GST benefits to Public funded research institutions, universities, IITs, IISc., Bangalore; Regional Engineering Colleges (other than a hospital).

Application for registration / renewal of registration of Public Funded Research Institutions (PFRIs) and details about the schemes are available on Department website (www.dsir.gov.in). The complete applications are considered by an Inter-Departmental Screening Committee constituted by the Department for considering the requests from various institutions. Presently the committee is chaired by a former Director, CSIR –NPL.

The Screening Committee met twice during the period under report and considered 41 applications received from various public funded research institutions. 27 registration certificates were issued to such public funded research institutions for availing Customs Duty exemption on import of scientific equipment, spares and accessories, consumable items and to avail concessional GST benefits for purchases meant for scientific research and purpose. There are about 619 PFRIs registered with DSIR. The registration to public funded research and other institutions is granted for a maximum period of five years. The registered institutions are advised to apply for renewal of registration well in advance before the date of expiry of their registration.

During the period under report, 273 institutions were due for renewal of registration. The department received 198 renewal applications. These were processed on individual files and approval of Competent Authority was obtained and 162 renewal certificates were issued.

CHAPTER 2: PROMOTING INNOVATIOS IN INDIVIDUALS, START-UPS AND MSMEs (PRISM)

PROMOTING INNOVATIOS IN INDIVIDUALS, START-UPS AND MSMEs (PRISM)

1.0 PREAMBLE

Department of Scientific and Industrial Research (DSIR) has launched a new programme viz. Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM) during 12th Five Year Plan. The Scheme has now been extended till 30.03.2026. The programme aims at to support individual innovators having original ideas to convert them into working models, prototype etc. It also aims at supporting autonomous institutions or organizations or registered society for developing state-of-art new technology solutions aimed at helping MSME units in industrial clusters. PRISM Scheme is now a component scheme of Industrial Research and Development (IRD) Scheme of DSIR. The Department has supported **16 (sixteen)** new projects during the period under report i.e. from 01.12.2020 to 31.12.2021 and rendered financial support to 0**2 (two)** ongoing projects. The details of the new projects and ongoing projects supported under PRISM are given in **Annexure-8.** The Department has also successfully completed **10 (ten)** PRISM projects during the period under report i.e. from 01.12.2020 to 31.12.2021 and the details of the completed projects supported under PRISM scheme are given in **Annexure-9.**

2.0 HIGHLIGHTS OF SOME OF THE COMPLETED PRISM PROJECTS

2.1 DESIGN AND FABRICATION OF COST-EFFECTIVE IMPROVED BIOMASS COOK STOVE FOR DOMESTIC UTILITY

The PRISM project "**Design and Fabrication of cost-effective improved biomass cook stove for domestic utility"** is executed by the innovator, Shri Narayan (Shambhu) Pandit S/o Shambhu Pandit, Honnavara, Karnataka through the TOCIC (TePP Outreach cum Cluster Innovation Centre) at SPMVV, Tirupati. The innovator designed and developed a novel cook stove based on the principle of forced direct combustion of biomass. In the prototype, the closing plates are used to avoid escape of flame, pyrolyzates and flue gas from the chamber into the atmosphere thus allowing the secondary combustion at elevated temperature and thus enhancing the thermal efficiency of the cook stove. In addition, a flue gas treatment unit with porous carbon material is aligned to increase the thermal efficiency and to decrease the pollutant emission by capturing CO2. The innovation is expected to provide cleaner cooking energy solution to the society. It will also help to minimize the climate change by reducing particulate matter and other emission resulting from traditional cooking. The project has been successfully completed.

Fig. 1 Biomass cook stove

2.2 GAIT ANALYSIS BASED PATIENT SPECIFIC PROSTHETIC POLYCENTRIC KNEE JOINT AND SOCKET FOR TRANS FEMORAL AMPUTEES TO IMPROVE THEIR WALKING PATTERN

The PRISM project "**GAIT Analysis based patient specific prosthetic polycentric knee joint and socket for trans femoral amputees to improve their walking pattern"** is executed by the innovator, Dr. S.Kanagaraj, Guwahati through the TOCIC (TePP Outreach cum Cluster Innovation Centre) at IIT Guwahati. The innovator designed and developed patient specific socket and prosthetic polycentric knee joint having many advanced features like equal gait pattern of prosthetic leg and sound leg, reduced metabolic cost of the amputees, increased acceptability of the devices. The innovation relates to indigenous design & development of different versions of the prosthetic knee joint with improved features and economic specially for N-E Region. The joint has been tested on patients to substitute exported prosthetics. The innovation is expected to help patients with disabilities through application of prosthetic knee joint. The developed joint will be indigenous, economic & import substitute. The project has been successfully completed.

Fig. 2 Patient specific prosthetic polycentric knee joint and socket for trans femoral amputees

2.3 ECO FRIENDLY HEALTH PRO RELIABLE WATER PURIFIER & ENHANCER

The PRISM project "Eco Friendly Health Pro Reliable Water Purifier & Enhancer" is executed by the innovator, Shri Subhojit Ray S/o Shri Debabrata Ray, Udaipur through the TOCIC (TePP Outreach cum Cluster Innovation Centre) at College of Technology and Engineering, Maharana Pratap University of Agriculture and Technology), Udaipur. The innovator has designed and developed Eco Friendly Health Pro Reliable Water Purifier & Enhancer of 250-500 LPH capacity with the advantages like conservation of RO reject water, long term health security, and constant TDS drinking water irrespective of input quality. The product was tested at M/s Pyritech Electronic Pvt. Ltd., Udaipur. The innovator has filed one patent also. The project has been successfully completed.

Fig. 3 Eco Friendly Health Pro Reliable Water Purifier & Enhancer

2.4 "HYPERXS"- A THUMB WEARABLE DEVICE WITH DISTRIBUTED GESTURE RECOGNITION ARCHITECTURE

The innovation developed by Shri Ajitsing Sudesh Patil, Jalgaon, (Maharashtra) has been supported under PRISM Scheme of DSIR. The proposal was scouted and mentored by TOCIC, CTAE, Udaipur and DSIR. The proposal aimed at designing a workable thumb wearable device prototype with gesture recognition and demonstration of gesture performing various navigations on a paired device such as a computer. The wearable electronic device of a ring like shape that fits on a user finger with a gesture recognition area where user can perform gestures and interact with a digital device without being in physical contact with it while doing other activities such as running, cooking or driving and allows interaction even when they're physically occupied with another task. The Electronic wearable device comes with Bluetooth communication with a paired device, Central processing unit that processes the gestures performed by the user and communicates them with the paired device, a Gesture recognition area with sensors that detect gestures performed by the user. Following is the prototype of device developed:

Fig. 4 The device has been tested with different users:

2.5 NOVEL SILICON NIPPLE TO PREVENT EARLY CHILDHOOD CARIES (DENTAL DECAY)

The innovation developed by Dr. S. Samuel Raj, Chennai (Tamil Nadu) has been supported under PRISM Scheme of DSIR. The proposal was scouted and mentored by TOCIC, University of Madras, Chennai and DSIR. In this innovation, artificial silicone nipple used for feeding young infants up to the maximum age of three perpetrates the accumulation of milk around the upper front teeth because of its design. It acts as a mechanical device which simultaneously cleanses the upper teeth thereby preventing decay. This innovation can save the child's tooth which has to remain in the oral cavity for at least 7-11 years; thereby preventing expenditure towards complicated dental procedures under general anesthesia, pain, improves the quality of life of the child and enables sound health. The novel design of

silicone nipple enables that tooth is securely housed in the indentation. In the front (facial), there is a projection to increase the length of the indentation to cover the tooth beyond the gums (till attached gingiva) and in the back (lingual) aspect it extends till the tooth following the design of the nipple to allow smooth flow of the drink and simulate a natural nipple. The additional protection is provided by the rough mechanical texture (miniature projections) provided on the inner lining of the depression (defect) to act as a mechanical scrub to simultaneously clean the tooth during suckling by moving up and down. Though the seepage of the fluid within the space cannot be completely eliminated, but this device will surely limit exposure of these teeth towards the fluid (milk/sugared drinks) as compared to a conventional nipple. Moreover, the rough surface design prevents the formation of tenacious plaque on the tooth which initiates decay (caries) through its constant motion in correspondence to the child suckling the bottle.

Fig. 5 Final Nipple prototype

2.6 MODELING AND FABRICATION OF SECURITY GADGET FOR TIRUMALA PILGRIMS

The innovation developed by Dr. Chandrasekhar C., Tirupati (Andhra Pradesh) has been supported under PRISM Scheme of DSIR. The proposal was scouted and mentored by TOCIC, SPMVV, Tirupati and DSIR. The innovation aimed at designing an electronic gadget for the security of Tirumala pilgrims using ARDUINO microcontroller tied up with a set of smart sensors like PIR sensor and Pulse rate sensor. A PIR sensor is interfaced to the controller to detect the presence of animal in the forest area and immediately Gadget will send a message to the concerned authorities by using GSM technology along with GPS location of the user and also a buzzer alert is given to intimate others. A Pulse rate sensor is also present at this end to find out increase in Pulse rate and intimate family members with a message to their mobile and also helpful in monitoring the health of the pilgrim. The proposed system uses MEMS Technology and promises to be simple, cost effective and flexible device suitable for providing security to pilgrims on the Tirupati -Tirumala foot way to avoid the animal and human conflicts and as well monitor the health parameters of the pilgrims. Such a device would be suitable different diverse scenarios where large gathering are considered to happen across the country. The device was developed and tested in lab practical environmental condition, and was later tested in the Footsteps of the Tirupati-Tirumala pathway near to the Zoo/animal conservative area which was monitored with the heart rate and message base receipts were recorded. Its initial prototype design that is a wearable device with the 3D printed encapsulation is as follows:

Fig. 6 Security gadget for Tirumala Pilgrims

2.7 VALIDATION OF SINGLE DEVICE FOR DETECTION OF THREE MOST PREVALENT MOSQUITO

BORNE DISEASES (MALARIA, CHIKUNGUNYA AND DENGUE)

The innovation developed by Dr. Binita Srivastava Tunga, Bangalore has been supported under PRISM Scheme of DSIR. The proposal was scouted and mentored by TOCIC, SPMVV, Tirupati and DSIR. The proposal aimed at developing assured Combo kit for diagnosis of Malaria, Chikungunya and Dengue. The device was designed based on vertical flow immunoassay with multiplexing capabilities to detect more than two antigens. For easier visualization, the device was coupled with gold and gold nano urchin conjugate, displaying red and blue colours respectively. The final device was designed using 3D printing and spotting machine, mould prepared for the device and filter cup design, adsorption pad and membranes that were tested individually and in combination to determine its suitability.

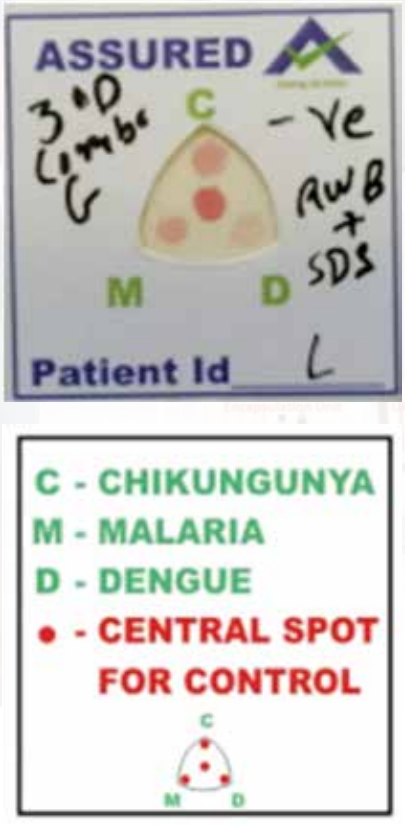


Fig. 7

Thus, innovator has developed an eco-friendly device prototype for early stage detection of malaria, chikungunya & dengue infections on the first day of symptom from a drop of blood. The device is a first of its kind COMBO kit wherein the antigens are indigenously made and are recombinant, it's a first antigen based kit for chikungunya, it is a completely equipment free RDT that can Detect Co-infection. The device is claimed to have good level of sensitivity and specificity and the device is proposed to have a shelf life of 18 months at ambient temperatures. The project has been successfully completed.

2.8 AUTOMATED WHEEL CHAIR FOR PHYSICALLY CHALLENGED

The PRISM project "**Automated Wheel Chair for physically challenged"** is executed by the innovator, Dr. Priyanka Mishra, Jaipur through the TOCIC (TePP Outreach cum Cluster Innovation Centre) at CTAE, Udaipur. The innovator designed and developed automated wheel chair for physically challenged. The design is to control the motor rotation of wheel chair based on head movement of physically challenged person. In order to facilitate physically challenged people with their independent movement, an accelerometer device based transmitter is fitted at person's head. Based on the head movements the transmitter will generate command signals which will be received by receiver fitted on the back of the chair. The receiver after receiving signal will drive the motor fitted to the wheel chair. The wheel chair can be driven in any of the four directions. Programmable Integrated Circuit (AVR) is used as a switch to control the movement of wheel chair based on the head gesture as an input with installing two DC motor as the driving force. This automatic wheel chair also helps people who have various other disabilities to sit on the chair and

just hold the accelerometer and move it over to control the vehicle movement. The wheel chair has been claimed to have designed at low price and high level of modularity. This chair can be retrofit with several different types of standard electric wheelchairs. The project has been successfully completed.

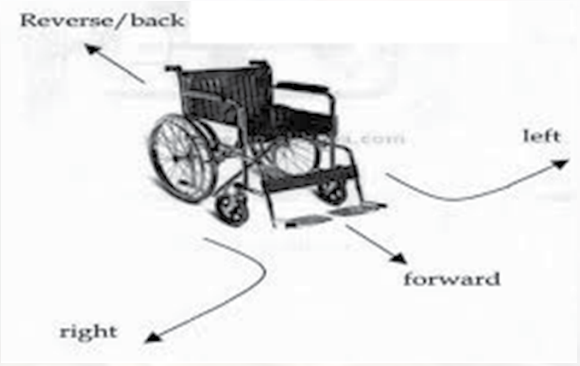


Fig. 8 Automated wheel chair for physically challenged

2.9 HOME MADE BENDING MACHINE

The PRISM project "**Home Made Bending Machine"** is executed by the innovator, Shri Dulu Moni Das, Guwahati through the TOCIC (TePP Outreach cum Cluster Innovation Centre) at IIT Guwahati. The innovator designed and developed Home-made Bending Machine. Generally, bending of the pipe is done by hammering at small scale because of which the finishing of the product is not good. Hence, in this project, a new device is designed to bend the pipes of diameter up to 6cm. It is used for generally to make round shaped pipes. It will reduce the physical effort of the worker. This device was initially designed for manufacturing flower pot stand. In this metal bender machine, 4 bearing is to be used as a roller. Different rods of varying radii can be bended. The proposed product can be used by anyone irrespective of age and gender. It can be used by small scale industries and workers to bend the pipes with less effort. This product will be modified considering the ergonomics. The project has been successfully completed.

Fig. 9 Home Made Bending Machine

3.0 OTHER ACTIVITIES

3.1 A number of other activities / programme, were organized / participated by DSIR along with TOCICs during the year to sensitize academia, disseminate information on PRISM to the larger mass of the populace network partners and impact generation among common masses.

3.2 To further expand the reach of PRISM programme among common masses an **"Alignment and Awareness event for Publicity of Department of Scientific and Industrial Research - Promoting Innovations in Individuals, Start-ups and MSMEs (DSR-PRISM)"** was organized on March 30, 2021 at IIT Delhi in association with Unnat Bharat Abhiyan (UBA), Ministry of Education; Rural Technology Action Group (RuTAG), IIT Delhi and Smart Indian Hackathon (SIH), Ministry of Education.

CHAPTER 3: PATENT ACQUISITION AND COLLABORATIVE RESEARCH AND TECHNOLOGY DEVELOPMENT

PATENT ACQUISITION AND COLLABORATIVE RESEARCH AND TECHNOLOGY DEVELOPMENT (PACE)

1.0 PREAMBLE

The Department of Scientific and Industrial Research (DSIR) through its "Patent Acquisition and Collaborative Research and Technology Development (PACE)" scheme provides catalytic support to industries and institutions for development and demonstration of innovative product and process technologies, traversing the journey from proof of concept or laboratory stage to pilot stage, so that they can be launched for commercialization. The scheme supports ingenious work and assists in development of new technologies or creative/innovative application of the existing technologies to solve unmet needs of the industry. The scheme also strengthens the interface between industry, R&D establishments and academic institutions by supporting collaborative proposals. The scheme jointly supports initiatives of other Ministries / Departments aimed at technology development and demonstration e.g. IMPRINT initiative of Ministry of Human Resource Development/ DST, wherein institutions of higher learning are being supported for development and demonstration of technologies. Support is provided for proposals which give clear evidence of existence of proof-of-concept and aim at developing an innovative content for fulfilling an unmet need. Development and demonstration of technologies can be undertaken by industries alone (such as in-house R&D centers of the industry recognized by DSIR) or in collaboration with universities, public funded research institutions or academic institutions. The technology development projects supported under the scheme aim at development of a new product or a process with attractive market potential which will result in significant benefits to the industry concerned in terms of raising its technological level, turnover, energy and material savings/recovery, export sales etc.

2.0 OBJECTIVES

The objectives of the scheme are:

i. To support development and demonstration of indigenous product / process technologies, either by industry or by R&D organizations/ academic institutions/ universities aimed at commercialization of new products and processes.

ii. To jointly support initiatives of other Ministries / Departments aimed at technology development and demonstration, e.g. IMPRINT initiative of Ministry of Human Resource Development and DST, wherein institutions of higher learning are being supported for development and demonstration of technologies.

iii. To support collaborative research between Indian Industry and R&D organizations/ academic institutions/ universities for development and demonstration of lab scale technologies, aimed at commercialization of new products and processes.

3.0 ONGOING TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROJECTS DURING 2021-22

3.1 DEVELOPMENT OF CONTROLLED RELEASE [CR] FORMULATION OF NATURAL HIGHLY-PURIFIED HUMAN CHORIONIC GONADOTROPIN [HCG] – M/S SANZYME LTD. HYDERABAD & ICT MUMBAI

A project entitled "Development of Controlled Release (CR) Formulation of Natural Highly - Purified Human Chorionic Gonadotropin (hCG)" has been supported to M/s Sanzyme Ltd., Hyderabad in collaboration with Department of Pharmaceutical Science & Technology, Institute of Chemical Technology, Mumbai under PACE-TDD scheme.

Natural highly purified hCG (99%) is used as a surrogate for LH (Luteinizing Hormone) for triggering ovulation and maintenance of pregnancy. However, recent reports showed that the role of hCG is not restricted to infertility treatment alone but has wider applications in the field of metabolic disorders such as Diabetes and other clinical conditions where hCG is being used for a process known as angiogenesis in the fields of vascular surgery and CNS surgery. hCG is available in two variants either as highly purified form or the recombinant version of hCG. Despite recombinant being available, only a single dosage form is available for clinical use. The natural, highly purified version is available in a number of strengths ranging from 500 IU to 10000 IU. Despite the availability of recombinant hCG, only a single dosage form for multiple injections is available for clinical use. Moreover, clinical studies conducted and published in journals have shown no great advantage of natural vs recombinant, the latter being more expensive as compared to natural form of hCG. Therefore, researchers at Sanzyme explored to improve patient compliance and reduce the frequency of injections to make the treatment more affordable and available to masses by developing CR-release hCG formulation using nano technology with release rates of either 15 or 30 days.

Project involved formulation development of microspheres at lab scale batches of around 0.5 g - 1 g size, scale up to 0.5-4g and 4 g to 10 g size. M/s Sanzyme and ICT Mumbai identified the effect of scale up batches on hCG loaded PLGA microspheres characteristics such as particle size, encapsulation efficiency, and *in-vitro* release and no significant difference was noted in particle size and encapsulation efficiency of microspheres produced in 4g-10g batches. *In-vitro* release studies of HCG loaded PLGA microspheres also showed no significant change in release profile of formulation 503 B-52 and 503 B-54. Also, the reproducible batch (503 B-52) of 4 g batch size of HCG PLGA microspheres showed the similar release profile as of the 503 B-49 batch (4 g batch size). As per the progress report, optimization of scale up batches 10g -50 is in progress.

Project has demonstrated high serum level of hCG loaded PLGA microsphere formulation as compared to marketed formulation in pre-clinical animal studies. Researchers also studies acute subcutaneous toxicity study on Wistar rats and concluded that hCG-PLGA microspheres were tolerable without causing any mortality at 190000IU/kg body weight after single and repeated dose (28 days) administration. Even after repeated dose administration, hCG-PLGA did not induce any toxicity and abnormal changes in body weight, feed consumption, clinical signs, clinical pathology and histopathology etc.

except some degenerative and inflammatory changes in female reproductive organs at lower levels. Over all it is concluded that the no observed adverse effect level (NOAEL) of hCG injection is 95000 IU/kg b. wt. Stability studies performed using gel electrophoresis indicated intact single band of hCG in the formulation as similar as standard hCG. In addition, bioassay study of hCG loaded PLGA microsphere formulation in animal model showed bioactive nature of hCG. Project is currently looking forward to devise a method to scale up and latter commercial application.

The project has been supported by DSIR with a soft loan of Rs. 52.50 Lakhs to M/s. Sanzyme Ltd., Hyderabad and a grant of Rs. 52.24 lakhs to ICT, Mumbai out of a total project cost of Rs. 159.55 Lakhs. So far DSIR supported Rs. 32.50 lakhs to M/s. Sanzyme Ltd., Hyderabad as loan and Rs. 32.50 lakhs to ICT, Mumbai as grant-in-aid. The Project is under progress.

Fig 1. Pilot plant scale up facility of microspheres

3.2 DEVELOPMENT AND STANDARDIZATION OF MANUFACTURING PROCESSES FOR LARGE SCALE PRODUCTION OF VALUABLE SECONDARY METABOLITES FROM CALLUS-DERIVED CELLS OF VASCULAR CAMBIAL EXPLANTS OF SELECTED WOODY PLANT SPECIES

M/s Sami-Sabinsa Group Limited (formerly Sami Labs Limited), Bangalore has undertaken to develop and standardize the manufacturing processes for large scale production of valuable secondary metabolites from callus-derived cells of vascular cambial explants of six selected woody plant species and established a 20 litres suspension culture pilot plant facility. The company is currently manufacturing the targeted secondary metabolites by direct extraction methods and the current project proposes to upscale and optimize the procedure developed at lab level through a new route of continuous perfusion of in vitro cambial tissue cultivation for commercial production of secondary metabolites from cambial explants of six medicinal plants. The new technique is expected to lead to cost reduction, reduction in energy consumption /emissions and would have positive impact on environment by sparing the medicinal plants from destruction.

Project team were able to extract the cambium layer, able to grow it in varied solid medium and were able to sub-culture it for further proliferation. They were also able to extract secondary metabolites via solvent extraction method and performed standard analytical test to confirm the metabolite.

During the period under report, project team was able to produce two folds higher Arjunolic acid metabolite from *Terminalia arjuna* from 20L bioreactor compared shake flask. Teams were also able to perform shake flask culture and extraction of Salacinol from Salacia sp, oroxylin -A from *Oroxylum indicum*. Remaining two explants were under media standardization. The project has been supported by DSIR loan amount of Rs.150.00 lakh out of a total project cost of Rs.329.65 lakh. The Project is under progress.

4.0 TECHNOLOGY DEVELOPMENT PROJECTS UNDER IMPRINT INITIATIVE

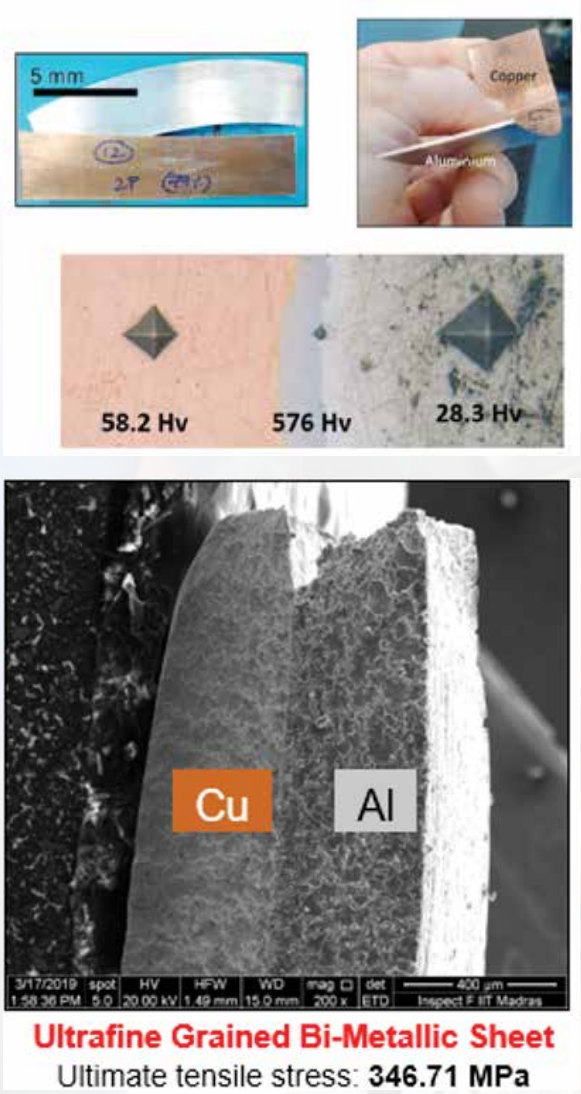
IMPacting Research INnovation and Technology (IMPRINT), the first-of-its-kind Pan-IIT and IISc joint initiative, is a Ministry of Education (MoE) and DST initiative to address major engineering challenges that the country must resolve to enable, empower and embolden the nation for inclusive growth and self-reliance. Department of Scientific and Industrial Research has partnered with MoE in implementing this program. In order to pursue the mandates of IMPRINT, **ten** technology domains as grand engineering challenges have been identified. DSIR is contributing in two sectors, viz: Manufacturing Technology and Water Resources. Five IMPRINT proposals from IITs/IISc/NITs in the two identified sectors (Manufacturing Technologies and Water Resources) have been supported by DSIR. The details of IMPRINT projects supported under PACE scheme are as follows:

4.1 DEVELOPMENT OF AN INNOVATIVE PROCESS TO FABRICATE ULTRA-FINE GRAINED BIMETALLIC THIN SHEETS FOR MICRO-FORMING APPLICATIONS - IIT MADRAS

The project aims to develop micro deep drawn components made up of bimetals with ultrafine grained microstructure. Such micro-components have potential application in many industries such as consumer electronics, telecommunication, micro electro-mechanical system (MEMS), aerospace and defence. For this purpose, a novel approach involving combination of cryorolling (CR), warm roll bonding (RB) and asymmetric rolling (AR) have been used, aimed to fabricate thin bimetallic sheet, with equiaxed ultra-fine grained (UFG) microstructure. Possible advantages of using such material in micro-forming are: (i) Improved microform ability by engineering desirable texture (ii) Overcoming challenges associated with size effect as observed during micro-manufacturing (iii) Strong interfacial bonding at bimetallic interface (iv) Excellent mechanical strength due to presence of UFG microstructure.

Under the project, UFG Al-Cu bimetallic thin sheets have been successfully developed by adopting a novel hybrid manufacturing process comprising of cry rolling, accumulative roll bonding and asymmetric rolling. The UFG Al-Cu bimetallic sheet has superior bond strength compared to the coarse-grained bimetallic sheet as observed by peel test of the material. The UFG Al-Cu bimetals shows a much thicker and richer interface due to effective protrusion of the Nano metric grains resulting a stronger mechanical bond. Due to its unique nano-grained structure, the UFG Al-Cu bimetal shows significantly improved formability compared to the conventional coarse-grained Al-Cu bimetals. Project has successfully established a manufacturing route to develop ultrafine grained (UFG) Al/Cu sheets. The developed UFG Al/Cu sheets showed excellent static strength, bond strength compared to the coarse-grained bimetallic sheet as observed by peel test of the material. As an additional activity, a new manufacturing route to manufacture conventional Al/Cu Bimetallic sheets with a key objective to achieve excellent interfacial bonding has also been successfully explored and patent filing for the same is in the process. A modular tool for micro deep drawing of metallic thin sheets with integrated localized heating capability has also been developed under the project and this study is in final stage of patent filing.

01 research paper has been published under the project, 2 research papers are in submission stage and 03 under preparation. Some key results of this work are shown below:



Custom Designed and Developed Roll Bonding Set up (Designed at IIT Madras, developed at Industry and housed at IIT Madras)

Fig. 2. Photographs, Strength properties and Interfacial bond strength of developed UFG Al-Cu bimetallic sheets (10 times higher interfacial hardness (576 Hv) than the parent high strength core material (Cu); Significantly higher tensile properties (~350 MPa than the existing literature (230 MPa).

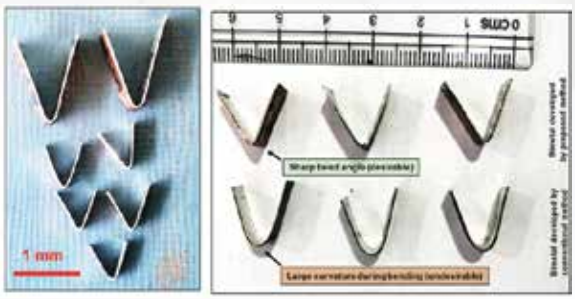


Fig.3. Micro-components developed from the UFG bimetals shows much sharper bent angle and lower undesirable curvature indicating their superior formability compared to the conventional CG bimetallic sheets

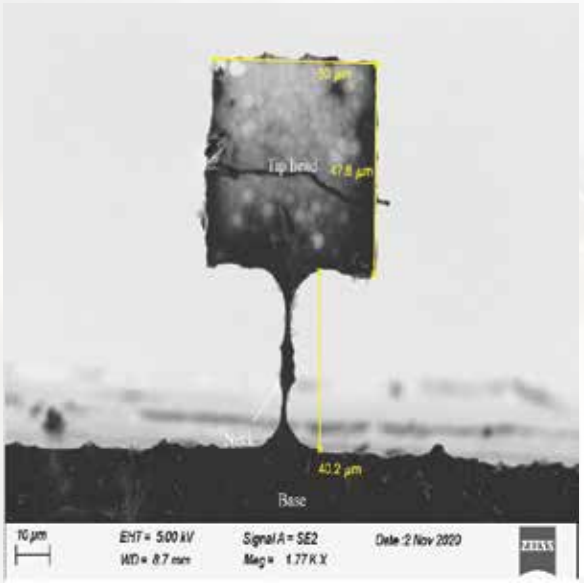
The project has been supported by DSIR with a grant of Rs. 83.46 Lakhs out of a total project cost of Rs. 166.92 Lakhs. The objectives laid under the project have been successfully achieved and data analysis is ongoing for publications.

4.2 FABRICATION AND EVALUATION OF ATOMIC FORCE MICROSCOPE PROBES WITH DETACHABLE AND RE-USABLE TIPS - INDIAN INSTITUTE OF SCIENCE, BANGALORE

The project aims to batch fabricate array of detachable probe-tips at significantly greater densities than in batch-fabricated conventional AFM probes, batch fabricate tip-less AFM probes capable of picking up the probe-tips with precise control of their position and orientation by employing a liquid-meniscus micro-gripper and evaluate AFM tip pick-up, gripping and re-use while performing high-resolution AFM imaging in contact-mode and dynamic-mode AFM of nano-materials using detachable tips, demonstrate automatic detection of tip wear and replacement of worn-out tips during AFM imaging.

A free-standing array of AFM tips has been developed and is currently being fabricated.

The head of a detachable AFM tip has also been fabricated. The tips picked up were evaluated by imaging a standard calibration grating in both contact mode and tapping modes of operation. The evaluation was done in commercial AFM. Further, they were evaluated both in air and in water. In all cases the image obtained was found to be identical to that obtained using a conventional AFM (Fig.4). The measured step height matched the manufacturer's specification of 180nm to within 0.5%.



SEM image of a detachable tip

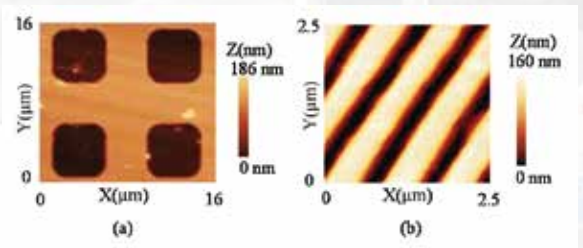


Fig. 4: (a) AFM image of a scanned calibration grating in water. (b) AFM image of a scanned DVD grating in water

The automated tip-exchange module has also been successfully demonstrated to replace tips during nano-indentation experiments

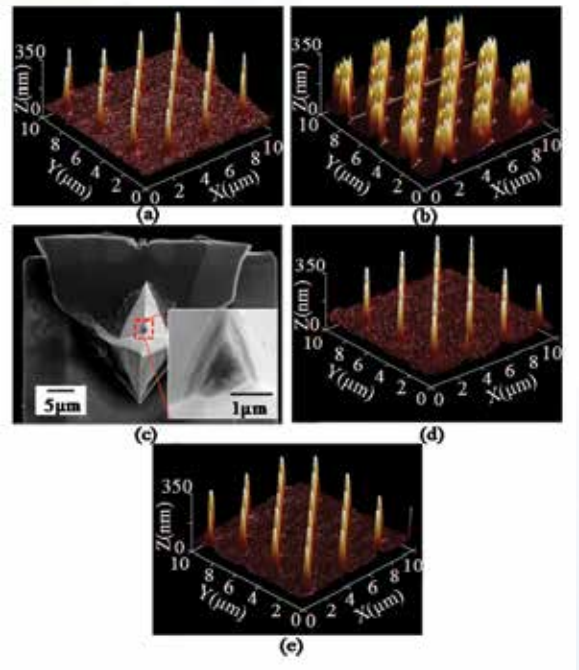


Fig. 5. AFM image of the standard sample: (a) using the sharp tip, (b) using the fractured tip. (c) SEM image of the tip after performing indentation, (d) AFM image of the standard sample with the replaced tip in contact mode, where the normal force was regulated at 26 nN and the tip was raster scanned at 0.756 Hz, and (e) AFM image of the standard sample with the replaced tip in tapping mode where the excitation was at 19.26 kHz while the oscillation amplitude was regulated at 34 nm and the tip was raster scanned at 0.730 Hz. The AFM images were acquired using Dimension Icon AFM (Bruker).

An artifact that enables determination of the sharpness of the AFM tip has been employed to detect tip quality and subsequently initiate automatic tip exchange. (Fig. 6)

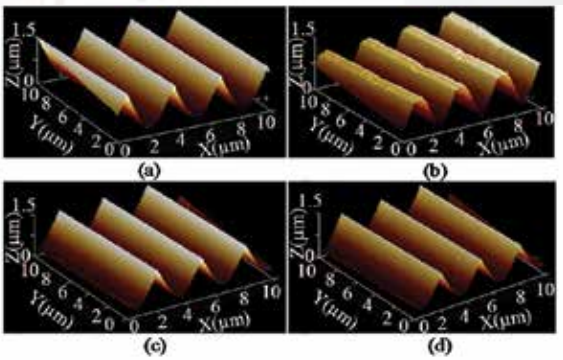


Fig. 6. AFM image of a standard sample: (a) using the sharp tip, (b) after repeated imaging, (c) using

replaced new tip in contact mode where the normal force was regulated at 26 nN and the tip was raster scanned at 0.756 Hz, and (d) using replaced new tip in tapping mode where the excitation was at 19.28 kHz, the oscillation amplitude was regulated at 36 nm and the tip was raster scanned at 0.730 Hz. The AFM images were acquired using Dimension Icon AFM.

The project has been supported by DSIR with a grant of Rs. 18.075 Lakhs out of a total project cost of Rs. 36.15 Lakhs. The Project is under progress.

4.3 LOW-COST ADDITIVE MANUFACTURING TECHNIQUE FOR FABRICATING THROUGH - SUBSTRATE VIAS BASED THREE-DIMENSIONAL MICROSTRUCTURES USED IN MEMS APPLICATIONS – IIT BOMBAY

This research project aims to develop and demonstrate a cost-effective manufacturing technique to make miniaturized components in non-conductive substrates like fused silica, alumina, borosilicate glass, applicable in radio-frequency, microelectromechanical systems (MEMS) applications. At present, the formation of various features such as blind/through-holes in these hard and brittle materials is carried out either by plasma etching or by laser ablation. Both of these techniques require expensive infrastructures and thus, are not easily accessible to the academic and research community.

A cost-effective electrochemical discharge (ECDM) technique is used for the first time to create multiple through-holes at the predefined locations on a fused silica wafer simultaneously. ECDM is a hybrid process that combines the principles of electrochemical machining (ECM) and electro-discharge machining (EDM). During the ECDM process, discharges are generated between the tool electrode (cathode) and the electrolyte when a potential difference is applied between a tool electrode and a counter electrode (anode). The material removal occurs by melting and vaporization of the work piece due to the discharges and high-temperature chemical etching by the electrolyte. Although the ECDM has been earlier reported for glass machining, only a single tool electrode has been used so far, which results in a single hole formation at a time. In applications where a large number of through-holes are required, this serial approach not only increases the overall process time but also results in alignment error. A novel multi-tip array tool electrode is used for the first time to overcome the existing issues. In this innovative method, simultaneous machining of multiple holes in a single run is demonstrated to reduce the overall process time.

An experimental 3-axis prototype, capable of linear positioning accuracy of 1 µm, was in-house developed (Figure 7). A customized multi-tip array tool electrode was made up of stainless steel by using wire-EDM. The size, length, and number of tips in the tool electrode can be varied as per the required design. The customized tool electrode was used to create through-holes having an average diameter of 400 µm in a 500 µm thick, 2″ diameter fused silica substrate (Figure 2), which was later filled with copper by using bottom-up electrodeposition technique and thus forming Through-glass vias (TGV). The average electrical resistance of these TGVs was 270 mW. This is the first-time demonstration of copper-filled TGVs by using a simple ECDM technique. These TGVs acts as an electrical interconnection between the front and back-side surfaces of the substrate. In order to demonstrate the capability of 3D devices, front and back-side redistribution lines (RDL) were formed by

copper electrodeposition (Figure 8). Similarly, 3D spiral inductors were also fabricated in which there were only two vias in a single die. Copper-filled TGV-based 3D spiral inductors in the fused silica substrates were successfully demonstrated for the first time by a simple, cost-effective ECDM technique. The process demonstrated can also be used in creating different kinds of micro channels required in the biomedical and microfluidics domain. Due to the transparent nature of the substrate, the ongoing chemical/biological reactions can be easily monitored.

Based on this project work, 20 research articles have been published in high impact factor journals, including the Journal of Materials Processing Technologies, Journal of Manufacturing Processes, Precision Engineering, etc. The research work has also been presented in prestigious international conferences like 46th/ 47th NaMRC, USA, 70th IEEE ECTC, USA, and 21st IEEE EPTC, Singapore.

Fig 7: In-house developed 3-axis ECDM prototype

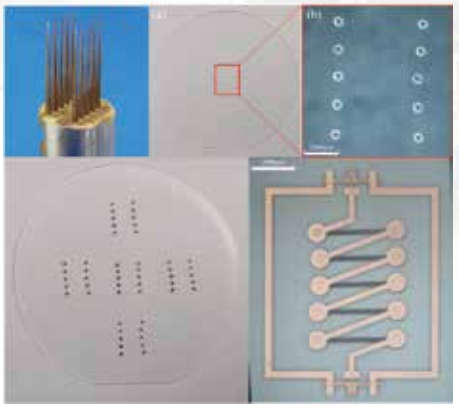


Fig 8: Optical images showing multi-tip tool electrode, Fused silica wafer having through-holes made by the ECDM, copper-filled through holes, and fabricated 3-D toroidal inductor

Fig 9: Optical images showing tool electrode having 2x2 tips (left), which was used to create through-holes in fused silica. Fabricated spiral inductors are also shown.

The project has been supported by DSIR with a grant of Rs. 72.69 Lakhs out of a total project cost of Rs. 145.38 Lakhs. The Project is under progress.

4.4 DESIGNING AND FABRICATION OF AN AERODYNAMIC LENS FOR NANOPARTICLES OF VARIABLE SIZE – IIT HYDERABAD

The main objective of the project is to design and fabricate an instrument (aerodynamic lens) to tightly collimate beams of nano/ microparticles and fabricate a high-resolution mass and imaging spectrometer for real-time analysis of the chemical composition of aerosols with designed mass resolutions of $m/\Delta m$ of ~ 700, up to a mass of 800 amu., with fast response rates up to 10 Hz or better. The project also aims to develop a large through put method to fabricate microstructures with resolutions of better than 0.5 mm using the aerodynamic lens system.

An imaging mass-spectrometer coupled with the aerodynamic lens has been successfully developed, same has been characterized and tested for air content and Xenon Isotope analysis. Signal decoupler electronics and data acquisition code has been also developed in house under the project. The current work led to open a start-up where a portable mass-spectrometer for nutrition analysis is being developed. It utilizes aerodynamic lens as an

innovative sample delivery system. The first of its kind aerosol mass-spectrometer for the air quality monitoring under make-in-India initiative has been developed under the project. The same spectrometer can be used to study malnutrition level in small kids and the same set-up can further be utilized to examine the air-quality near defence mining area.

Fig. 10. An aerosol mass spectrometer and spectrum

The project has been supported by DSIR with a grant of Rs. 25.60 Lakhs out of a total project cost of Rs. 51.20 Lakhs.

4.5 CONTINUOUS DISCHARGE MEASUREMENT IN SMALL OPEN CHANNELS BY USING ULTRASONIC TOMOGRAPHY – IIT KANPUR

The project aims to develop a continuous real-time discharge monitoring system for small open channels (width 1 to 50 m) by tomographic reconstruction of ultrasonic transit-time measurements. The system designed will be accurate, cost-effective, field deployable, easy to calibrate and capable of unattended real-time data transmission. The developed system will be tested under laboratory and field conditions and determine its range of measurement errors under different channel geometry and flow conditions. The developed system will be a user-friendly commercial product.

Small rivers and channels dominate Indian rural and urban landscape. Monitoring discharge in them has direct utility in managing water-resource distribution issues prevalent in India today. The infrastructure for discharge data collection in small rivers is either absent or greatly limited by manual methods that use current-meters, floats, and gauges. The continuous discharge monitoring instruments that are readily available in the market like Acoustic Doppler Current Profiler (ADCP) and Laser Doppler Anemometer (LDA) are too expensive for multiple deployments. The motivation is to fill this gap by developing a discharge measurement system that is inexpensive, easy to deploy, operate and maintain, and requires minimum calibration. The scope of this project is to develop and test an ultrasonic transit-time discharge measurement system for small channels (width 1 to 50 m). The configuration of the ultrasonic transducers will be designed to get a cost-effective

flowmeter with measurement error of less than 5%.

An ultrasonic transit time flowmeter for pipes is developed. It was calibrated in an in-house test facility and compared with commercially available flowmeters. The developed flowmeter received ISO-4185 certification and is now commercially manufactured by the industry partner, Kritsnam Technologies (Figure 11). The flowmeter offers some unique features to the Indian market and has found applications in groundwater monitoring, water & wastewater treatment plants, commercial and residential water distribution networks etc.

Fig 11: Ultrasonic pipe flowmeters developed with the support of project funds. The flowmeters now commercially manufactured.

Two prototypes – a laboratory scale (Figure 12a) and a field scale (Figure 12b) - are developed for continuous discharge measurement in open channels. A data acquisition system is designed for measuring vertical velocity profile, which is compared with theoretical velocity profiles and velocity profiles obtained from Particle Image Velocimetry (PIV, Figure 13). The commercialization of the developed flowmeter would be done after field testing.

Fig 12: (a) A laboratory-scale and (b) a field-scale prototype for open channel ultrasonic flowmeter

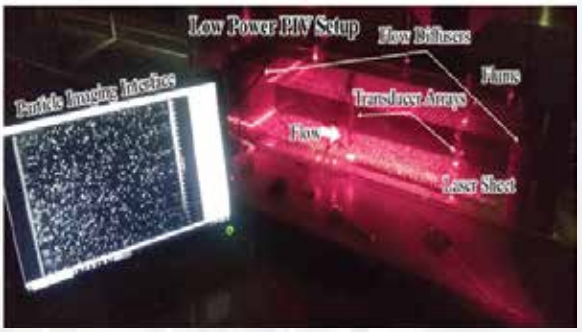


Fig 13: PIV setup for measuring velocity profile in open channel

The project has been supported by DSIR with a grant of Rs. 57.84 Lakhs out of a total project cost of Rs. 115.68 Lakhs. The project is under progress.

CHAPTER 4: COMMON RESEARCH AND TECHNOLOGY DEVELOPMENT HUBS (CRTDH)

COMMON RESEARCH AND TECHNOLOGY DEVELOPMENT HUBS (CRTDH)

Building Industrial Research & Development and Common Research Facilities (BIRD-CRF)

This scheme focuses on creation of Common Research facilities for micro and small enterprises i.e. CRTDH (Common Research and Technology Development Hubs) with an aim to enhance translational research and foster industry institution interaction targeted towards innovative product development.

1.0 PREAMBLE

Micro, Small and Medium Enterprises (MSMEs) play a pivotal role in the overall economy by promoting equitable development in India. They need to be sensitized towards translation of public funded R&D into products and processes. Their higher involvement, especially in application-oriented R&D is expected to enhance the private sector's share in national R&D expenditure. Common Research and Technology Development Hubs (CRTDHs) aim to enhance translational research and foster industry institution interaction targeted towards innovative product development. DSIR extends grants to institutions for setting up of these hubs/centers, which include R&D facilities/infrastructure, analytical test facilities, design centers, pilot plant production facility, design engineering and prototype development, demonstration units, product display center etc. The facilities at CRTDHs are used by the Micro, Small and Medium Enterprises (MSMEs), Innovators and startups. The CRTDHs evolve a business model for self-sustainability and operate on a cost plus non commercial basis.

1.1 AIMS AND OBJECTIVES

The CRTDH programme is aimed at creation of common research facilities equipped with analytical equipment and pilot plant facilities to facilitate and encourage innovators, startups and micro, small and medium enterprises for R&D and technology development. The highlights of objectives of the CRTDHs established in different phases are summarized below.

1.2 CRTDHS SET UP IN FIRST PHASE (2014-15)

Three hubs set up in first phase have identified the needs of the enterprises through seminars and workshops as well as through interaction with the MSME Development Institutes (MSME-DI), Directorate of Industries (DIC), S&T Councils and other state government bodies. Technological development involving MSMEs and host institutions in project mode has begun and several agreements have been signed with enterprises as well as state government agencies for the benefit of the MSMEs and start-ups.

1.2.1 CRTDH at CSIR- Centre for Cellular and Molecular Biology (CCMB), Hyderabad

The CRTDH at CCMB, Hyderabad was set up in the fully air conditioned area of around 10,000 sq. ft. (that can physically

accommodate 6-10 incubatee companies) to support and nurture product development in the field of health care and biotechnology covering inter alia, diagnostics, biopharma and medical devices with the following objectives -

a) To establish a dedicated CRTDH in CCMB for affordable health for benefit of MSEs.

b) To carryout quality R&D in the frontier areas of healthcare for diagnostics and biopharmaceuticals for cancer, infectious diseases etc.

c) To encourage SMEs to participate in R&D to convert innovative ideas to proof of concept.

d) To establish collaborations with MSEs for joint projects and funding in healthcare.

e) To disseminate R&D knowledge to convert the innovations into valuable products/process.

The products and technologies that were targeted, relate to development of DNA based diagnostic kits for screening of eye infections, acute encephalitis, septicemia, antibiotic resistance etc.

Fully functional CRTDH at CCMB has all the essential facilities including modular lab tables, discussion tables, chairs, cubicles / partitions, modular movable tables with granite top and wheels, staff sitting room, a conference hall with sitting space for 30 people, band width of 8 Mbps and a video conferencing facility. The area has open lab facilities with access to industrial biological equipment such as super speed centrifuge, Sorvall Lynx 6000, SU8Station, (Photolithography), Micro fluidic controllers, Stereomicroscope with Camera, Class 1000 clean room etc.

During the tenure of the project, ten start-ups/MSMEs working on process/product/ technology development with defined targets and deliverables were incubated in the CRTDH under the mentorship of CCMB scientists and were offered with technical support for using the facility at a nominal charge. Thirty one people from ten incubating companies worked at CCMB CRTDH facility. More than 60 MSMEs have utilized the sophisticated research and testing facilities available at CRTDH- CCMB, Hyderabad. In addition to providing the equipment and analytical services, the CRDTH also extended mentoring, training, regulatory & intellectual support to the industry partners.

The start-ups/MSMEs incubated at CCMB-CRTDH worked on various sectors in the area of biotechnology and biopharmaceuticals, filed patents and secured grants during their period of stay at CRTDH. M/s Oncosimis Biotech Pvt. Ltd. worked on cell engineering to produce protein drugs and was awarded Department of Biotechnology (DBT)/ Biotechnology Ignition Grant (BIG) of Rs. 50.0 lakhs, filed 7 patents and 3 trademarks for two technologies. This company is also a recognized as start-up in biotechnology sector from DSIR. M/s Althion Tech Innovations Pvt. Ltd. worked on a novel process for production of medical grade water and was also awarded DBT/BIG grant of Rs. 50.0 lakhs. M/s Bioartis Pvt. Ltd. working on proof of concept (POC) based on DNA amplification for a virus on prawns has received a grant of Rs. 2.0 Crores from National Fisheries Development Board. M/s Virupaksha Lifesciences Pvt. Ltd. working on production of peptide drugs for diabetes has filed 2 patents on an improved process for preparation SMW protein/peptide. Earlier, one of the incubate company, M/s Theranosis Lifesciences Pvt. Ltd., was also DBT/BIG Grantee and raised US$ 500 K (~ Rs.

3.5 Cr.) from Mumbai Angels and successfully exited CRTDH. Some success stories of CRTDH-CCMB includes development of IoT enabled novel pure water unit for Type I & Type II Water for R&D purposes and Haemodialysis purposes by Althion Tech. This machine has been installed at 4 plants in Karnataka, Andhra Pradesh & Telangana and served 20,000 patients for their dialysis needs. Another intervention is design and development of automated nucleic acid extraction system integrated with Real-time PCR by Sirf Bio. Products developed by the incubatees and is shown in figure 1(b) . Some other performance indicators of CRTDH-CCMB includes generation of 14 IPRs, 4 awards to MSEs, revenue generation of more than Rs.1.0 crore etc.

Figure 1

During the unprecedented times of COVID-19, CRDTH aided MSMEs continued to be innovative and came up with temporal solutions such as development of low-cost COVID-19 rapid diagnostic kit by M/s Huwel Lifescience, High Throughput Screening & Rapid Drug Repurposing to Combat SARS-CoV-2 by M/s Kommareddi Biopharma, RT-PCR based Diagnostic Kit for SARS-COV-2 by M/s BioArtis, Bi-layer Photo Interferometry based Rapid 2019-nCoV Detection Kit by M/s Oncosimis etc. These examples demonstrate the success of CRTDH-CCMB in bridging the gap between translational research and industry-institute interaction.

The CRTDH center has been constantly sensitizing industry to engage with it through different workshops/seminars and outreach events, which includes "Technology showcase", "Café Mandala – On Technology Transfer in Govt. R&D Institutes", "Dagar – City Camp – IP clinic & Regulatory clinic by BRBC", Venture Centre, NASI (National Academy of Sciences, India) – Technology Showcase at ICMR- NAARM during the current year to publicize the facilities available at CRTDH. More than 60 MSMEs actively engaged with CRTDH team during the event, some of whom have already contacted the team. The CRTDH was visited and appreciated by the Hon. Vice-President of India, Shri. Venkaiah Naidu. In addition, many eminent persons such as Mr. Ratan Watal (Member-Secretary, NITI AAYOG), Rajeswara Rao (Advisor, Economic Advisory Council to Prime Minister) etc visited the facility and appreciated the work undertaken under CRTDH. The project completed in March 2021 and a self sustainability model has been developed to continue its support and services to MSMEs.

1.2.2 CRTDH at CSIR - Institute of Himalayan Bio resource Technology (IHBT), Palampur

The CRTDH at IHBT, Palampur in the sector affordable healthcare was set up to cover unmet needs of MSMEs in the Himalayan region by utilizing institute's expertise in development of value added products such as thermo-stable enzymes, zero-calorie sugar substitutes etc. The hub aimed to catalyze development of bio-pharmaceutical ingredients such as black carrot anthocyanin, beetroot betaine, mango peel carotenoids etc. by industries located in its vicinity.

Under the CRTDH project, CSIR-IHBT has designed and fabricated pilot scale machinery and established pilot plant facility natural

plant product division, which is now fully functional. IHBT-CRTDH purchased various required equipment, developed prototypes and processes, tested and validated various products developed, undertook quality testing and stability studies of the products developed. A complete ready to eat canning unit and crispy fruit manufacturing facility were installed for incubates and start-ups in the incubation center. CRTDH-IHBT is now an empaneled incubator under Himachal Pradesh CM start-up scheme, which is fully functional and compliments the facilities available under CRTDH for food processing.

Fig 2 Equipment available at CRTDH facility at IHBT, Palampur

Fig. 3 Food Processing Unit

CRTDH-IHBT organized various industrial meets/training//demonstrations to sensitize stakeholders, where industry participants visited the facilities available at CRTDH and incubation centre. CRTDH has also designed a brochure showcasing facilities at CRTDH to encourage the entrepreneurship development using incubation center of CSIR-IHBT. As a result of this, CRTDH established linkages with total of 250 industry/individuals/ MSME and 16 number of MSMEs/start ups/ innovators engaged with CRTDH during the period of project.

The CRTDH project supported to IHBT is successfully completed with the following outcomes:

i. Different processes have been standardized at CSIR-IHBT, Palampur, its technology has been transferred to various start-ups and these processes have been scaled up at incubation centre.

ii. Total 16 MSMEs/Start-ups /Innovators engaged with CRTDH through various modes of engagement (Workshops, trainings, usage of facilities etc.).

iii. Six technology partners were incubated

at the facility and the technologies developed by commercialized through CRTDH.

iv. CRTDH is now an empaneled incubator under HP CM start-up scheme.

v. CSIR-IHBT has taken FSSAI registration for development of various health care food products (FSSAI-Lic No. 20916004000965).

vi. CRTDH has filed 2 patents during the period of project: a) Kangri Dham, Ready to eat foods (Patent File Reference No. 0039NF2016) and b) Extraction of natural compounds for various applications as colorant and nutraceuticals (File No. WO/2010/109286)].

vii. Several products in the area natural colorant, nutraceuticals and functional food such as stevia drops (marketed in the states of HP and Punjab), Kangra tea, ready to serve beverage, premium juices with about 2 months shelf-life, dal-chawal-aloo ready to eat packs, Nutri Bar, Crispy fruits and vegetables etc. have been developed in the CRTDH facility.

viii. Signed technology transfer and licensing agreements with 07 enterprises in food processing sector.

ix. Training and demonstration of pilot scale processing of colorant and nutraceutical ingredients for MSE's cluster development in the selected region.

1.2.3 CRTDH at CSIR - National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram

The objective of CRTDH at NIIST, Thiruvananthapuram is to develop products and technologies addressing environmental issues. The institute's experience in technologies related to odour control, anaerobic treatment, nitrification treatment, water quality analysis and others are being used to provide R&D solutions to MSME's to improve their environmental performance. The CRTDH project is relevant for the state of Kerala as it has many small industries in areas of cashew, plywood, fisheries, spices etc., that require S&T interventions especially in solving the environmental issues that are being taken up by the CRTDH team at NIIST, Thiruvananthapuram. Through the CRTDH scheme of DSIR, CSIR-NIIST was able to establish important facilities discussed below:

(i) Dioxin Research & Monitoring Laboratory : CSIR-NIIST got its earlier dioxin analysis facility revamped under the CRTDH project and developed expertise in testing of dioxins, furans, dioxin- like PCBs and non-dioxin-like PCBs in varied sectors. With no earlier analytical facilities for the research and monitoring of dioxins, CSIR-NIIST got various steps involved in the analysis such as extraction, clean up, concentration and GC-MS/MS determination validated, which has resulted in getting NABL accreditation as per ISO/IEC 17025: 2017. The facility is recommended by Ministry of Environment, Forest and Climate Change as a referral laboratory for dioxin analysis for environmental clearances.

(ii) Odour measurement facility: India's first odour testing laboratory was established under the DSIR- CRTDH project for technological interventions and to provide analytical testing support to MSMEs in the region.

As odour remains at the top of air pollution complaints in many countries and Odour pollution measurement & identification is a key and difficult matter for odour pollution study management and control. Under this facility, the Scentroid SS400 Six Station Portable Odour Lab with portable six (6) panel olfactometer with full automation and data processing performs the various odour analysis.

(iii) **Water and Wastewater quality testing laboratory:** The Water and Wastewater quality testing laboratory with its automated state of the art continuous flow analyzer (CFA), analyzes multiple parameters such as ammonia, total kjeldahl nitrogen, orthophosphate, total phosphate, nitrite, nitrate, total phenol and total sulphide in water and wastewater samples. The lab is NABL accredited for testing and analysis of water/waste water samples ranging from surface water to industrial effluents and for the analysis of Dioxins, Furans and Poly Chlorinated Biphenyls (PCBs). Beneficiaries include industries, hospitals, Govt. Departments & Ministries, regulatory agencies like pollution control boards, hotels, resorts, healthcare units etc.

iv) **Heavy metal analysis lab :** Inductively coupled plasma (ICP) mass spectrometry (MS) is routinely used in many diverse research fields such as environmental, pharmaceuticals, Ayurveda drugs/formulations, life and forensic sciences and in food, material, chemical, semiconductor and nuclear industries. The facility is able to analyze separate and quantify As (III), As (V), arsenobetaine, Hg (II), methyl- Hg, Cr (III), Cr (VI) etc. The instrument is serving the ongoing R & D activities of the institute as well as the clients from industries, regulatory bodies etc. In addition, the institute facility has been extensively utilized for meeting the requirement of several R & D programs/ EIA/ Consultancy projects in various divisions of the institute and for other academic/ research organization in Kerala.

(v) **Other facilities** like laboratory scale/ pilot plants & emission factor determination facilities and open burning testing facility (OBTF), simulated incineration testing facility (SITF) and Analytical facility have also been created under this project.

Over the support period of 5 years, three technologies were developed and the same were licensed and were installed at fields. These developed technologies have benefitted many MSME clusters in an around the CSIR-NIIST establishment. The developed technologies had benefitted MSMEs in the sector of Rice mills, Ice cream factories, Common effluents treatment plants, Desiccated coconut industries, Fish meal factories, Shrimp feed factories, fish mart, Cashew Roasting Sector, Municipal Sewage water treatment plants, Plywood sector.

The established facility became self-reliant in drawing consultancy projects from Ministry of Science Technology, Ministry of Food Processing Industries and from Department of Environment and Climate Change, Govt. of Kerala. The facility has scientific Collaboration with BARC, Mumbai & CSIR-NEERI, Nagpur. The project was completed in October, 2021.

1.3 CRTDHS SET UP IN SECOND PHASE (2016-17)

In the second phase, during 2016-17, the

department approved setting up of four new hubs in the sectors of Low cost machining, New Materials/ Chemical Process and Electronics/ Renewable Energy. These hubs are currently engaged in activities like procurement of equipment and setting up infrastructure and essential facilities for R&D. The hubs have started identifying needs of the enterprises through seminars and workshops as well as through interaction with the MSME-DIs, DICs, S&T Councils, industry representatives and associations and other state government agencies.

1.3.1 CRTDH at CSIR - Central Mechanical Engineering Research Institute (CMERI), Durgapur

CRTDH in the sector Low Cost Machining was established in the second phase at CSIR-CMERI, Durgapur and was inaugurated by the Secretary, DSIR. The objective of the CRTDH at CSIR-CMERI is to meet the R&D requirements of MSMEs regarding improvements in product design & manufacturing involving sizing & shaping, patterns & finishing, special purpose machines, CAM for ensuring product conformity and automation. Approximately 2160 sq.ft area at ground floor has been provided for installations of machines and around 2017sq.ft area has been allocated at first floor area for conducting CAD training and lecture sessions.

The CRTDH located inside CSIR-CMERI is striving towards establishing itself as a manufacturing hub. For this purpose, CRTDH has interacted with various target clusters such as Makhana cluster in North Bengal, Bargachia Cluster of Metal Product Manufacturers, Howrah; Surgical Instruments Industry Cluster, Baruipur, 24-Parganas; Shuttlecock Manufacturing Cluster, Uluberia, Howrah; Fan Manufacturers Cluster Foundation of Bansdroni, Kolkata; Metal Casting Foundry Cluster, Howrah; Zari Embroidery Cluster, Sankrail, Howrah; Gems and Jewellery Cluster and Imitation Ornaments Cluster, Domjur, Howrah; Brass Cluster of Goghat; Oil expelling cluster of Dinajpur etc. The center proposes to adopt a cluster approach for improving the manufacturing competence of these enterprises.

Under the CRTDH, several projects are on-going such as design and development of special slitting machine for reduction of production cycle time for anchor bolts. A special slitting machine in order to reduce the production cycle time for anchor bolts in association with Bargachia Spare Parts Manufacturing Cluster is under development. The production cycle of manufacturing of anchor bolt involves various machining operation like blanking, facing, drilling, threading and slotting. The machining time for each operation has been studied and details and the objective is reduce the overall cycle time by incorporating specially designed machine.

Second intervention includes a machine shop facility and near-net-shape manufacturing facility for Metal Injection Moulding (MIM). This facility has been utilized to develop copper nozzle for gas cutting/welding torch mainly targeting Bargachia Cluster of Metal Product Manufacturers. The copper nozzles are being developed through metal injection moulding (MIM) route in a single step, whereby machining time, material wastage and ultimately cost will be saved substantially. The process is ready for implementation in the Bargachia Cluster.

CRTDH Building at CSIR-CMERI

Injection Moulding Machine

Copper nozzle (prepared with copper powder and binder)

Sintered Copper nozzle

a) Debinding Furnaces b) bulk of copper nozzles

Fig 4

Third technological and important intervention under this CRTDH is manufacturing of two most useful surgical tools such as Artery Forceps and Needle holders for Baruipur Surgical Instruments Manufacturers Welfae Apex Association (BASIMAA). CRTDH-CMERI has also demonstrated Makhana popping machine for Makhana Cluster in North Bengal, through DIC Maldah. These will be used by the MSMEs for small production batches for market seeding.

Artery Forceps Tip Needle Holder Tip

Fig 5

CRTDH-CMERI has continued to attract Startups & MSMEs in Design and Manufacturing where MSMEs (i) can utilize sophisticated testing facilities, equipment & infrastructure along with R&D support, necessary to test and validate their ideas (ii) can get initial hand holding through training and skill development programs (iii) can get access to already developed technologies available at CSIR-CMERI for taking their ideas to market.

CMERI has undertaken several training/skill development Programs on Computer aided Drawings (CAD) and showcased facility to stakeholders. Major events organized by CMERI-CRTDH had participation of around 182 stakeholders.

1.3.2 CRTDH at CSIR - Central Electronics Engineering Research Institute (CEERI), Pilani

The CRTDH at CSIR- CEERI, Pilani is dedicated to MSMEs/ Start-ups to help them conduct their research and development

activities including testing of innovative products and technologies in Advanced Electronic Systems, Power electronics and Renewable energy. The CRTDH facility may enable meet the unmet R&D and technology development needs of MSME cluster like non-availability of infrastructure, workspace, state of the art R&D equipment, technologies and design solutions in electronics and renewable energy sector.

Solar grid tied inverter testing facility would be tenth in India upon NABL accreditation. The facility has also completed ISO 17025:2017 lab quality manual. Product design & fabrication facility has been created to address PCB designing, 3D printing & prototyping. Centre has also developed analytical testing facilities for dairy products, water testing and general spectral characterization for MSME. Other facilities include design engineering facility, intervolved incubation unit and Centre of Eminence for skill development.

Six startups were incubated and MSME regularly use the facilities at CRTDH. The centre undertakes workshops & trainings to sensitize industries, NGO's, Start-ups, professional teachers, students and innovators under the various specialized themes. The few specialized themes recognized by the CRTDH Hub for training and workshops are Milk Adulteration Detection System; Smart Solar Tree, Mercury Free Plasma -UV lamp & Supply Chain Management of Milk.

The CRTDH centre was instrumental in carrying out 4 technology transfer agreements to M/s REIL Pv, Jaipur; M/s Qboids IOtech Pvt Ltd, Gurugram; M/s. Parappadi Technologies Pvt. Ltd, Trivandrum; M/s Raytrig Innovation Pvt. Ltd., Jaipur.

1.3.3 CRTDH at Indian Institute of Technology, Roorkee (IIT Roorkee), Roorkee, Uttarakhand

The seamless integration of high speed digital communication systems and the ever increasing usage of the mobile phones demand the shielding of harmful electromagnetic radiation which has an adverse effect on the human body. The objective of the CRTDH at IIT Roorkee is to work towards development of microwave absorbing materials and its characterization for social, stealth and electronics applications. With the creation of such facilities under CRTDH, the institute is expected to meet growing challenges of enterprises regarding testing of microwave absorbing materials that have potential for various applications in the commercial as well as defense space. Material testing and characterization proposed in this CRTDH requires isolated space for each instrument / set up. Therefore, IIT Roorkee allocated 2500 sq. ft. of isolated space for DSIR-CRTDH and the same has been renovated as per approved layout plan. The website for the center has been developed and deployed at: crtdh.iitr.ac.in. The following facilities have been established at the centre i) Free Space Measurement for Transmission and reflection loss of EM wave in microwave region ii) Thermal absorption of camouflage network and Radar Imaging iii) Vector Network Analyzer Measurement of complex-Coaxial Waveguide, Coaxial Probe Liquids & Rectangular Waveguide iv) Camouflage Net Testing – Reflection Loss & Transmission Loss and vi) Material Characterization for their electrical properties. The facilities for materials Testing, Measurement of complex permittivity and permeability from 2-18 GHz, Camouflage Net Testing, Antenna Characterization have also been created at the CRTDH Center. The project activities undertaken at the center are i) E-waste based Composite Microwave Absorbing Material ii) Parametric Analysis of Frequency-Selective Surface Based on Cross-Dipole Array and iii) Development of Frequency Selective Surfaces based Absorber. The CRTDH hub

has successfully established a large database of advanced radar absorbing materials. The characterization and performance evaluation facility are also available with the hub. The fifth edition of "National Symposium on Microwave Absorbing Materials" as a part of the CRTDH center program was held on August 24th, 2021 through online mode and thirty five participants attended the webinar.

Fig . 6 (a) CRTDH Center at IIT Roorkee
(b) Measurement setup for sample preparation
(c) Bistatic measurement setup

1.3.4 CRTDH at Indian Institute of Technology, Gandhinagar, Gujarat

Dyes and dye intermediates is one of the core chemical industries in India and are mostly located in Gujarat. The waste generated from this sector is highly toxic/hazardous, difficult to treat and very large in quantum. The objective of the CRTDH at IIT Gandhinagar is development and customization of R & D requirements of different dye industries for both waste minimization and waste treatment. With the creation of facilities under CRTDH, the IIT Gandhinagar has endeavored to engage dye industries in nearby clusters and cater to their technical and R&D needs for management of dye effluent including testing requirements.

The Centre has performed 100L textile effluent scale up treatment in the pilot plant using in-house developed technology and has achieved more than 90% COD reduction, which would be further be scaled up to 500L in the pilot facility. The CRTDH is also developing micro bubble technology for wastewater treatment with promising results after trials on STP and a few ETP wastewater samples. Centre is also studying the role of micro bubbles on ammonia removal from waste stream.

Skid mounted 1KL STP was donated by Industry members to CRTDH centre at IITGanhinagar which would enable centre to evaluate the use of treated sewage water in process plants. While another industry member has donated ozonator for STP water treatment and centre is working to scale up the ozonation process further.

CRTDH facility is regularly used by several industry members and Universities for testing and to characterize their products, raw materials while industries are utilizing the CRTDH facility through the project mode.

The centre has interacted with 87 industries and helped them to optimize the product performance testing in different effluent from STP from 1 L to 0.38 MLD. Centre has developed catalyst for Catalytic Fenton process (advanced oxidation) for COD reduction in wide pH range > 90% for textile effluents, which was scaled up to 20 L. Additionally centre has developed strategy for Cr (+6) reduction for effluent from chrome plating industry and achieved batch to continuous dye manufacturing process in three consecutive CSTRs.

1.4 CRTDHS SET UP IN THIRD PHASE (2018-19)

In the third phase, during 2018-19, the department approved setting up of five new hubs in various sectors. These hubs are currently engaged in activities like procurement of equipment, setting up infrastructure and essential facilities for R&D. The hubs have started identifying needs of the enterprises through seminars and workshops as well as through interaction with the MSME-DIs, DICs, S&T Councils, industry representatives and associations and other state government agencies.

1.4.1 CRTDH at Indian Institute of Technology, Kharagpur

A CRTDH has been set up at IIT, Kharagpur in the area of affordable health in an earmarked space for the pilot plant at Dr. BC Roy Institute of Medical Sciences & research (upcoming Super-Specialty Hospital at IIT Kharagpur) and additional space at the Diamond Jubilee building at IIT Kharagpur. The team of CRTDH also finalized the necessary drawing, design and infrastructure for the space. This CRTDH is focused to develop a research and innovation hub for healthcare system which covers the areas such as medical devices and diagnostic, sensors materials and healthcare, system modeling, technology for affordable healthcare, digital convergence in medical technology, interconnection of bio systems, system modeling etc. The hub aims to develop novel portable devices that can be deployed at rural healthcare centres, for affordable quick and reliable diagnosis, taking the above products from bench to bedside (rural health kiosks) and provide training and consultancy to the MSE for skill development and augmenting technical knowledge. Thus CRTDH facility will be used to support entrepreneurs, startups and MSEs to conduct their research and development activities.

The CRTDH aims to collaborate with MSE to design and develop new diagnostic devices and healthcare services related to point-of care diagnosis for detection of multiple blood constituents, development of image-based diagnostic device integrated with a tele-control smart chair for diagnosing multiple health conditions, developing telemedicine software and systems etc. A meeting with 25 MSMEs from the region and senior Government officials (Director, MSME Development Institute, Head, MSME Tool Room, Kolkata etc. was organized to create and take forward the CRTDH initiative. The CRTDH team has identified an initial list of Ten (10) technologies being worked upon by the team (till prototype stage) that could be offered to MSMEs for technology transfer. These technologies include a paper-based device for colorimetric detection of blood hemoglobin level, a generic paper based device for simultaneous detection of multiple diseases using a single drop of blood, a CD-based microfluidic device for disease detection using colorimetric techniques, a diagnostic device for noninvasive evaluation of oral/skin cancer or pre-cancer using thermal imaging etc. Under CRTDH, institute is also setting up the pilot plant facility

for CD based devices, design engineering centre, bio safety labs in the allocated space at Diamond Jubilee at IIT Kharagpur. The team has procured various medical devices and trained rural health assistants prior to starting clinical validation study across rural locations in Kolkata.

During the time of COVID-19 pandemic, the CRTDH worked on the development of diagnostic kits for the diagnosis of COVID-19. One is paper-based colorimetric test kit for low cost rapid detection of Corona virus named 'COVIRAP' and the other one is for effective early screening of COVID-19 patient and constant monitoring of the patient at the hospital called 'COVICUBE'. Out of these, COVIRAP has been approved by ICMR, New Delhi and also licensed to few companies. Moreover, CRTDH also worked on preparation of low-cost Hand Sanitizer according to WHO recommended formulation and triple layer fabric face masks. CRTDH has done several field trials at different villages in West Bengal and trained 20 Health Workers for early screening of COVID-19 and trained more than 70 rural youths (majorly women) working as Frontline Health Worker at remote villages in West Bengal on paper-based Plasma Sugar Hemoglobin devices, production of low cost hand sanitizer, triple layer fabric masks. Six online and eight hands on training workshops were conducted for knowledge transfer to MSMEs and other organizations. Meetings with MSMEs were organized for technology transfer and showcased various technologies developed at CRTDH-IIT, Kharagpur. Three companies have been incubated in the facility, which are availing the infrastructure set up at CRTDH whereas 8 MSEs are working as partners with CRTDH. Following are the major activities carried out under CRTDH during the period of report:

1. 4 diagnostic camps and 3 awareness camps were organized at digital health clinics in the different villages in West Bengal.
2. 5 MSME demonstration and training (online and hands-on) were conducted
3. Motor boat based floating digital health center inaugurated at Sundarbans which is operating 6 days/ week in 7 different islands (First of its kind)
4. Lateral Flow Assay manufacturing set up was completed
5. Electronic System Design and Manufacturing (ESDM) Unit has been set up at CRTDH lab for prototype development for the MSMEs
6. Two Bio Safety Labs (Level 2) have been set up
7. Over 1500 Covid tests was conducted on COVIRAP device (developed at CRTDH lab) at BC Roy Technology Hospital, IIT Kharagpur
8. CoviCube device was validated and 20 prototypes were developed for digital clinics
9. 2nd phase of development for telemedicine software was completed and deployed
10. Two new innovations (Oxysaver and SpO_2 feedback-based oxygen supply) were added to the technology basket and the first prototype was developed
11. Technology transfers for COVIRAP, paper-based Hemoglobin device were completed
12. 5 new MSMEs were incubated and facilitated at CRTDH lab
13. Over 200 litres of sanitizers and more than 300 face masks were manufactured

by women entrepreneurs in villages (Balpai and Barhra, WB)

Fig. 7

1.4.2 CRTDH at CSIR - Indian Institute of Toxicology Research (IITR), Lucknow

CRTDH in the sector Environmental Intervention and Monitoring has been set up at IITR, Lucknow. This Environmental Monitoring and Intervention Hub is fully functional and will promote and mentor R&D startups/MSEs as well as develop trained human resource with the following objectives:

a) Drinking water disinfection and water quality assessment technologies

b) Technologies for treatment of industrial effluent from Pulp & Paper industries

c) Build predictive models including source apportionment for air quality as well as pollution abatement.

d) Develop customized training programs / workshops for specific cluster to generate trained human resource

CRTDH is expected to meet the R&D requirements of MSMEs regarding the clean air/water and effluent management sector to develop indigenous & effective solutions for environmental monitoring, water treatment, and effluent management. Under CRTDH, IITR has procured various capital equipment as per the project plan and purchase procedure is still underway. Major facility developed at CRTDH includes Anaerobic workstation, 3D Printing Portable Fine Dust Aerosol Spectrometer (FIDAS), Cirrus Sound Level Meter (model: CK -152B) etc. and currently two facilities viz. instrumentation laboratory and analytical facility are established for the use of testing services and training programs.

Fig. 8 Various instruments/equipment set up at CRTDH Indian Institute of Toxicology Research (IITR), Lucknow

CRTDH is researching and providing support to MSMEs under the main categories such as water treatment sector, effluent treatment sector and air pollution abatement and skill development and training. Under water treatment sector, commercial models of continuous water treatment technology have been developed by the institute and is available for non-exclusive licensing. Another intervention includes lignin based bio absorbant gel for the treatment of industrial waste water. Under effluent treatment sector, pilot Scale 2000L Bioreactor plant has been deployed at M/s Yash Pakka Limited, Ayodhya for pulp and paper mill effluent treatment through a non-disclosure agreement signed between M/s Yash Pakka Limited, Ayodhya and CSIR-IITR, Lucknow. Under air pollution abatement, a device and technique for air quality monitoring & management has been developed and patent filled vide App No. – 202011048084.

Fig. 9 (a) Fig. 9 (b)

Some prototype technologies ready for scaling up and commercialization includes Bio char based treatment technology (for textile and paper and pulp waste water treatment), device for air quality monitoring & management, Lignin Based hydrogel and Green Process (microbial Immobilization technology for waste water treatment) etc. Various other technologies such as "Oneer" (an electronic device for the disinfection of drinking water), Lab scale and Pilot-scale (2000 L) bioreactor; portable water analysis kit, Remediation and Reclamation of Hexachlorocyclohexane (HCH) etc. have been developed and deployed.

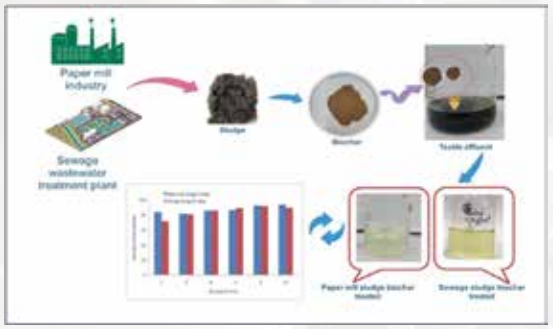


Fig. 10. Bio char prepared from sewage and paper mill sludge for the treatment of Textile effluent

CRTDH has conducted 14 seminars/ workshops and 3 international conferences to create awareness about the CRTDH facility and promoted the activities to MSMEs. So far CRTDH has served 26 Industry/Startups/ MSME through various services and technology support and trained more than 370 persons.

1.4.3 CRTDH at CSIR - Central Drug Research Institute (CDRI), Lucknow

The focus of this CRTDH is to develop and operate a Pharmaceutical Formulation Development and National Clinical Trial Batch Production Facility (via Quality by Design (QbD)) to support industrially-scalable process-cum-product technology packages for different dosage forms (oral, topical and sterile products) and manufacture batches of drug products and corresponding placebos for Phase I and Phase II clinical trials under Form 29 license from State Licensing Authority of UP. The hub also aims to establish and operate a Unit for Good Laboratory Practices GLP-compliant Pre-clinical and Clinical Bioanalysis Pharmacokinetics (PK), Bioavailability (BA), Bioequivalence (BE) and Drug Testing Laboratory (DTL) that will undertake activities pertaining to generation of chemical and pharmaceutical information on Active Pharmaceutical Ingredient (API) and formulations, quality assurance, monograph and final/batch release specifications including Stability Studies, *in-vitro* pharmacokinetics and metabolism, preclinical pharmacokinetics, absorption, distribution, metabolism and excretion, and bioanalysis for clinical pharmacokinetics, including bioavailability and bioequivalence.

CRTDH has procured several equipment and installation of pharmaceutical manufacturing equipment is in progress. The application for a Form 37 License for the Drug Testing Laboratory (DTL) component of the CRTDH was prepared in compliance with the provisions of the Drugs and Cosmetics Act 1940 and Rules, 1940 including Good Lab Practices (GLP). The application was submitted to the Uttar Pradesh Food Safety and Drugs Administration (UPFSDA) and the Central Drugs Control and Standard Organisation (CDSCO)—North Zone and was approved for joint inspection by the two regulatory authorities. Four employees were trained to appear for examination by the relevant UP FSDA Technical Committee for formal approval prior to taking up

testing activities and issuing Certificates of Analysis. The examination, inspection and grant of license is awaited before the activities of the DTL can commence. Micro-scale, GMP-compliant (per Schedule M) manufacturing equipment for tablets, capsules, liquid orals, topical preparations (gels, ointments, creams) and dry powder inhalations have been procured. The installation, commissioning and validation is expected to be completed soon following which an application for a Form 29 License for production of "Centinhale" dry powder inhalation for clinical trials will be submitted to the UPFSDA and CDSCO. The application in Form 30 is ready for submission.

Awareness regarding capabilities and activities was spread through the offices of the Uttar Pradesh Drug Manufacturers Association (UPDMA) and various other workshops/seminars. As a result of this, in-depth discussions were carried out (online) with nine MSMEs, three large Indian corporations and one large company located in Moscow regarding various aspects of development of formulations, analytical methods, pharmacokinetic analysis and modeling during the period of reporting. The list of formulations/applications/indications discussed is as follows:

1. Tablets/capsules/syrup of Umifenovir (COVID-19)—M/SE
2. Dry powder inhalation of Favipiravir (COVID-19)—SE (two firms)
3. Dry powder inhalation of Remdesivir (COVID-19)-- ME
4. Preclinical pharmacokinetics of Favipiravir (COVID-19)—SE
5. Improved version of Sanotize®--formulation and PK: S/ME
6. Nasal COVID-19 vaccine—Large Indian firm
7. Prophylactic formulation for healthy contacts of tuberculosis patients—Large Indian firm
8. Preclinical PK of generic formulations—Large Indian firm
9. Dry powder inhalation of undisclosed COVID-19 drug—Large Russian firm.

This CRTDH facility will continue to support MSMEs through creating awareness programs, hands-on training and workshops, site visits and webinars.

Fig. 11 Disintegration, Dissolution, Friability and Hardness testing apparatus

1.4.4 CRTDH at CSIR-Central Scientific Instruments Organization, Chennai Centre (CSIO), CSIR Madras Complex Taramani, Chennai

The objective of the CRTDH at CSIR-CSIO, Chennai is to provide technical support, infrastructure and sophisticated analytical as well as advanced research equipment facilities to the MSMEs for carrying out technological research with a view to translate new idea into marketable products as well as to scale-up already developed technologies available with CSIR-CSIO for taking them to market. The Center has proposed to create the facilities for testing of Solar Inverters & Solar Panels and similar electronic systems including MPPT, UPS, Charge controllers etc. The Center has created a Brochure/ Pamphlet for CRTDH and Website for CRTDH: https://crtdh.csio.res.in/. CRTDH has recently installed a testing service facility for 30 kVA solar inverter manufacturers in India. The laboratory can test solar PV inverters with a rating of up to 30 kW with an integrated setup comprising of solar array simulator, grid simulator, RLC load and power meters. The CRTDH is capable of conducting following test through this setup: i) Testing of Power Efficiency of Solar Inverter (as per IEC 61683 :1999) ; ii) Testing of Static MPPT Efficiency of Solar Inverter (as per EN 50530 :2010); iii) Testing of Dynamic MPPT Efficiency of Solar Inverter (as per EN 50530 :2010) and iv) Testing for Characteristic Interface of Solar Inverter (as per IEC 61727 :2004). CRTDH is in the process of setting up solar PV testing laboratory whose function is to evaluate solar panels for its performance, which could help solar project owners and operators to capitalize on the production. CRTDH conducted series of Technologist – Industrialist Meet & Expos" which sensitized around 70 industrial participants from different parts of India in the areas of Energy and Energy Infrastructure Instrumentation. This also facilitated the opportunity for industries & users to know about the technologies & facilities of CRTDH. CRTDH has planned a series of hands on programs on "Calibration and Uncertainty Measurements as per NABL Requirements and ISO- IEC 17025: 2017" as part of post pandemic schedule for MSEs. During the pandemic, the CRTDH team at CSIO had given advisory on design, operation and testing of UVC based electronic disinfection systems for surface and room disinfection for efficient reduction of SARS CoV-2 virus. CRTDH had implemented an optical sensor setup and dark room setup for measuring the irradiance, dose, temporal stability and leakage of the UVGI systems at various planes and heights according to the type of the systems and developed Standard Operating Procedures (SOPs) for testing & validating the same.

Fig. 12 Testing service facility for 30 kVA solar inverter manufacturers

1.4.5 CRTDH at CSIR- Institute of Minerals & Materials Technology (IMMT), Bhubaneshwar

The CRTDH centre was established in January, 2019 in the area of "New materials & Chemical Processes" to address concerns of large number of MSEs working on processing of metal, alloy & materials,

chemical processes that require R&D inputs/ interventions to meet the emerging market needs and for their own sustenance. The areas of innovation driven intervention being developed by CSIR-IMMT are Mineral Processing, Industrial Waste Utilization, Coatings & Surface Engineering, Chemical Processes, Metallurgical Processes, New Materials, Testing & Quality Assurance Services.

During the reported period, Industrial shed for providing incubation facilities to Start-ups measuring around 7000 sqft has been completed. Mobilization of MSMEs under different categories along with necessary R&D support is under progress and over this period 37, MSMEs have been sensitized/ engaged.

CRTDH signed an agreement with a Startup for Beneficiation of Ores by Flotation. Work on Chemicals for reduction of drag and viscosity for hydraulic transportation was ongoing, while prototype was developed for Automated Chemical Dosing System & Wireless Temp Sensing and Recording.

The prototype development was underway for utilization of E-waste for making building materials, while agreement was to be signed for utilization of aluminum dross for making alumina. Licensing agreement signed towards technology transfer and demonstration to M/s Indian Plant Feeds, Cuttack was processed for 'Nutrient enriched biochar for organic based fertilizer', while process was established for the 'Production of SiC from rice husk'.

Under Powder Metallurgical Process prototype development for Materials like WC-Co, TiC-Ni, TiC-Fe, Al_2O_3-TiC for making cutting tools was ongoing.

In terms of surface engineering & coating application prototype development is underway for work on 'Thin gold track coating on ceramic substrates for use as RF transmitters/receivers'. Prototype for 'Development of Erosion-resistant Coatings by Electrophoretic & thermal spray deposition for boiler tube industries' was under evaluation.

During the period under report, nine enterprises/ state Govt. Agency were engaged and nine industries/ innovators were sensitized. Centre was able to conduct five awareness programmes related to CRTDH. Additionally, 10 know-hows on sanitizer, disinfecting device, hospital assistive device, personnel protective device have been transferred to 14 MSMEs, while progress on further scale-up and /or commercialization is underway.

1.5 CRTDHS SET UP IN FOURTH PHASE (2021-22)

In the fourth phase, during 2021-2022, DSIR initiated setting up of three new hubs in various sectors namely Affordable Health, New Materials and Electronics/Renewable Energy. These hubs will be engaged in activities like procurement of equipment, and setting up infrastructure and essential facilities for R&D. The hubs have started identifying needs of the enterprises through seminars and workshops as well as through interaction with the MSME-DIs, DICs, S&T Councils, industry representatives and associations and other state government agencies. CRTDH Advisory & Screening Committee (CASC) for CRTDH scheme recommended six proposals which are at different stages of processing for possible DSIR financial support for setting up the CRTDHs. Out of six proposals, three new CRTDH have been sanctioned in September 2021 each at Delhi Pharmaceutical Science and Research University, Delhi; National

Institute of Technology, Andhra Pradesh and CSIR, National Chemical Laboratory, Pune.

1.5.1 CRTDH at Delhi Pharmaceutical Sciences and Research University (DPSRU), New Delhi

The focus of Delhi Pharmaceutical Sciences and Research University (DPSRU), New Delhi project is to undertake research of both fundamental and applied nature and enhance the capabilities of MSMEs in the sector affordable health by establishing a center for advanced formulation technology under CRTDH. The proposed center will not only cater the needs of pharmaceutical companies but also assist in developing advanced formulations to biopharmaceutical, herbal, ayurvedic, cosmetic and nutraceutical companies present in Delhi-NCR region. DPSRU will emphasize on improving health by enhancing the efficacy and safety of new drugs and imaging agents through the discovery and application of innovative methods of drug delivery and by offering broad range of services, including the formulation development, Good Manufacturing Practices (GMP), analysis and extensive evaluation of advanced formulation and nano formulations including but not limited to liposomes, solid lipid nanoparticles, lipid nano carriers, polymeric nanoparticles, inorganic nanoparticles, multi particulates, micro, nano emulsions, nano suspensions, nanocrystals as solid, liquid or semisolid products for oral, ocular, transdermal, intranasal, pulmonary, parenteral, rectal and targeted delivery. Thus, it is expected to inculcate capacity building through providing the unique platform to MSMEs/ individuals/organizations to validate their proof of concepts to scale-ups and ultimately commercially viable sustainable solutions.

The successful translation of advanced formulation technology requires effective co-ordination and exchange of information and collaboration between academic institutions, universities and industry and a very clear understanding of regulatory pathways which is the need of the hour for these innovations. Thus, to maneuver translation of advanced and innovative healthcare formulations DPSRU proposes DSIR-CRTDH at DPSRU. Advanced formulations not only enable the manufacturer to be more economical but also help to generate intellectual property and to extend patent life span.

The DSIR-DPSRU-CRTDH celebrated the Constitution Day and Azadi ka Amrit Mahotsav from November 26 to November 29, 2021 at the Delhi Pharmaceutical Sciences and Research University, New Delhi. The programme began with a competition for logo designing for the DSIR-DPSRU-CRTDH. The celebrations continued on November 29, 2021. Guests, faculties and students joined the event via offline as well as online mode. The workshop for "Triggering Ideas for Solving Technical Challenges in Herbal Drug Formulations" was organized to discuss the challenges of producing herbal medications, as well as the importance of knowing regulatory requirements. Companies such as Remedium, Vytals Wellness, Dabur India, Alniche, Systopic, Multani Pharma, and Aimil Pharma actively participated and presented their views and suggestions at the workshop. Active discussions took place between the stakeholders from industry as well as academia in order to harmonize their efforts towards cultivating a productive environment for development of phyto pharmaceuticals.

1.5.2 CRTDH at National Institute of Technology, Andhra Pradesh (NIT-AP)

A new CRTDH has been set up at NIT, Andhra Pradesh based on the identified unmet R & D & Technology development needs of the clusters in AP region. This CRTDH is focused to support MSE's research pursuits towards ideation, evaluation, design, development and testing of innovative products/process in the sector of electronic and renewable energy with following objectives -

- To help in expanding/ starting of new MSE's/startups in developing products/software in renewable energy sector.
- To help MSEs' in adapting Internet of Things (IoT), edge computing, artificial intelligence (AI) driven for increase in productivity or better service or improved security or enhanced reliability or reduced cost in smart integration of renewable systems.
- To improve skill sets of MSE's towards knowledge/application of best technology in product manufacturing process/ product/ service by conducting workshops, certification course/ short term programs.
- To facilitate on-demand learning facilities to institutes/researchers interested to work in Electronics/ Renewable energy sector and encouraging collaborative
- To develop/design power converter topologies of renewable power generation.

There are few specific areas, the proposed CRTDH is intended to work includes

- Designing and development of intelligent micro-grid using renewable energy systems, developing battery management systems.
- Testing/Analyzing/charactering the renewable energy system/components.
- Design for reliability in meeting industry demands and development of power converter topologies for renewable applications.
- Development and deployment of intelligent systems in meeting demands of respective interest of renewable based MSE's.

- Micro-Hydel plant potential identification erection.

Expected outcome of this CRTDH is to cater 100 number of MSE's, organising 15 number of capacity building programmes and raising 05 start-ups.

1.5.3 CRTDH at CSIR- National Chemical Laboratory (NCL), Pune

The CRTDH Centre was established in September, 2021 in the area of "New materials & Chemical Processes" to address the unmet needs of MSE in the areas of polymer synthesis and the methods of synthesizing functionalized nanoparticles at a large scale through the unique flow processes developed at CSIR-NCL. CRTDH has proposed to focus on MSME clusters located at MIDC areas in Pune, Ahmednagar, Satara, Solapur, Mahad (Raigad), Thane and GIDC areas like Vatva, Vapi, Bharuch etc. for pigments and polymeric films.

The overall objectives of the CRTDH at CSIR-NCL would be to undertake research of both fundamental and applied nature so as to meet the industrial requirements for synthesis of functional materials, their composites and processes for polymer scale-up & polymerization. Objectives further include rheological characterization of the new materials and printed objects for various applications. Additional objectives include organizing training sessions, review meetings with MSME industry and annual conclave to showcase developed technologies.

In terms of anticipated outcomes/ deliverables it is expected to develop a state-of-the-art facility for MSEs in polymer manufacturing, processing industry and dyestuff manufacturing industries besides catering to unmet needs of enterprises. The facility at CRTDH is expected to be used by 100 MSEs, training of manpower and also to provide space for start-up/ micro and small entrepreneur.

CHAPTER 5: ACCESS TO KNOWLEDGE FOR TECHNOLOGY DEVELOPMENT AND DISSEMINATION (A2K+)

1.0 **Technology Development and Utilization Programme for Women (TDUPW)**

2.0 **A2K+ /Studies**

3.0 **A2K+/ Events**

ACCESS TO KNOWLEDGE FOR TECHNOLOGY DEVELOPMENT AND DISSEMINATION (A2K+)

Access to Knowledge for Technology Development and Dissemination (A2K+) scheme has three components viz: '**Technology Development and Utilization Programme for Women' -** promotes adoption of new technologies by women for greater operational efficiency and reduction of drudgery; **'Support to Studies'** – undertakes study and analysis of developments in the emerging technology areas and documents the findings, learnings and outcomes for wider dissemination including preparation of status reports on technologies from public funded institutions ready for commercialization and '**Support to Events'** (seminars, workshops, conferences, exhibitions etc.) - provides a platform for exchange of views leading to useful insights on issues relating to industrial research.

1.0 TECHNOLOGY DEVELOPMENT AND UTILIZATION PROGRAMME FOR WOMEN (TDUPW)

The program is aimed to meet the specific needs of women and to enhance their technological capabilities. The objectives of the programme are:

- Promoting adoption of new technologies by women.
- Awareness creation and training of women on technology related issues with regard to women related occupations.
- Promoting Technology up gradation (through technologies developed by scientific establishments) of micro, small and medium enterprises run by women Self Help Groups (SHGs) / entrepreneurs.
- Showcasing of appropriate technologies developed by scientific establishments and organizing demonstration programmes for the benefit of women.
- Design and development of products, processes (e.g. by utilizing waste) beneficial to women.
- Deployment of technologies developed by scientific establishments for reduction of drudgery and empowerment of women.

The department has supported and initiated nine new projects and two Skill Satellite Centres for women during the year 2021-22 as listed in **Annexure 10.**

The department has successfully completed following three TDUPW projects during the year:

a) Technical Skill Training in the field of Assembly of Scientific Instruments and their quality control by Instrument Design Development & Facilities Centre (IDDC), Ambala Cantt,, Haryana.

b) Women empowerment and skill development through technological intervention in cooking stove by Department of Energy, Tezpur

University, Napaam, Sonitpur, Assam

c) Adding Value to Fish: A Potential Livelihood Option for Rural Women of Odisha undertaken by ICAR-Central Institute for Women In agriculture, Bhubaneshwar

1.1 HIGHLIGHTS OF ONGOING PROJECTS UNDER TDUPW PROGRAMME:

The following projects are in progress:

1.1.1 Empowerment of women through silk and cocoon based handicrafts (Wealth from Sericulture Waste) undertaken by Department of Biosciences and Sericulture, Sri Padmavati Mahila Visvavidyalayam (Women's University), Tirupati

The main objective of the project is to impart training to women in preparation of handicrafts from silk waste and cocoons. The project aims to enhance the economic standard of women by imparting skill upgradation and facilitation for marketing the end products to enable women to become entrepreneurs. The venue for training programs was identified based on the number of trainees concentrated in the area, conveyance facility available to reach the venue and where necessary local resources were available to conduct the training programmes. Seven training programs were conducted at various places of Chittoor district and approximately 191 women with around 25-30 women per programme were trained. The seven locations of i) Govinda Nagar, Tirupati ii) V. Kota iii) Penumuru iv) Madanapalle v) Palamaner vi) Tirupati and vii) Srikalahasti were selected for the training programme. The selected women were given training on preparation of cocoon-based handicrafts. The duration of each training program was fifteen days. As a part of training program, exposure visits were arranged to cocoon handicraft preparation centres. After completion of the training program, the trainees were monitored for helping them to solve their practical problems in taking up the activity. The training programs conducted at different places provided women with the entrepreneurial skills in seri-craft and inculcated a sense of dignity of labour by means of rewarding them with a handful of income source. The trainees were made aware of entrepreneurship development and various ways of marketing (including digital marketing) of the handicrafts. Consumer sale points were established at exhibitions conducted at different places on various occasions and trainees were guided to exhibit and market their products. Documentation in the form of hand book on Seri-crafts in local language and audio-visual cassettes on preparation of cocoon based handicrafts were developed as ready reference to the trainees.

Fig. 1: Hand on training on Handicraft (Seri-craft) preparation

1.1.2 Skill up-gradation of women potters in fabricating fine terracotta pottery products in Tirunelveli District, Tamil Nadu

The project aims to upgrade the existing status of the rural women potters and train them in advanced technology of clay body formation, methods of fabrication, firing techniques by utilizing affordable mechanical devises evolved through a series of experiments. The overall effort is to equip the women potters with adequate technical skill and to help them in availing financial assistance to make them successful entrepreneur in the pottery trade. Diversified red clay pottery products are having expanded market not only in local area but also in other states. The upgraded technology in pottery improved the quality of the products eventually adding to the income of women potters. Various products adopted by the women includes decorative items, utensils etc. Around hundred women beneficiaries were trained on pottery technologies and fabrication of fine terracotta pottery products in four batched (25 No. women in each batch) in four villages Mavadi, Melacheval, Subramaniyapuram, Kattalai of Kalakad Block, Dist. Tirunelveli, Tamil Nadu. Various new designs of the consumer oriented products were introduced in the market and permanent market outlets were created and strengthened the existing channels. 55 individual entrepreneur units and two common production units (13 beneficiaries) were established under the project.

Exposure program

Products designing

Products fabricated by pressing method.

Products fabricated by casting method.

Fig:2 Exposure program and training activities towards Skill up-gradation of women potters

1.1.3 Building Capacity of Tribal Women Farmers in Production of a Farm Based Nutritious Food Product for Tackling Malnutrition, Drudgery Reduction and Income Generation through Enterprise

The main objective of the project is to build capacity of 742 tribal women farmers so that they can earn a better livelihood through food processing. Cluster of 20 Villages in Naswadi block of Chhota Udepur District of Gujarat were selected based on the survey conducted in the project area. Total 756 number of women were trained by skilled and experienced trainers on various aspects during the two years of the project tenure. Trainings were imparted on dal mill operation to 23 women; 20 women were trained on processing unit operation; 60 women on marketing & account management; 491 women on FPG management; 44 women on FPG leadership & enterprise development for leaders; 10 women on FPC Board of Directors on compliances; 18 women on flour mill operation; 18 women on masala mill operation; 18 women on processing of custard apple; 18 women on processing of tomato; 18 women on grading, sorting and cutting of vegetables for vegetable selling business and 18 women on packaging within stipulated time period. During the project period, 70 women were engaged in one or more income generation activities linked to DSIR trainings and they were also engaged in marketing and selling of their products such as instant meal mix – Khichadi, custard apple pulp, spices, tomato ketchup, nutritious ladoos etc. at various business platforms like Yellow Ribbon NGO Fair- Pune, Saras Mela – Ahmedabad, Maker Fest- Vadodara, Exhibitions at IIM-A and IRMA- Anand, Statue of Unity- Narmada, Gujarat and Samaj Suraksha Sankul- Vadodara, Gujarat, Farmers Market- Vadodara and at many exhibitions such as Delhi Haat in New Delhi; Bhasha Festival, Vasant Mahotsav, Upaj, Fresh Mela and Chhota Udepur's Tribal Arts & Crafts in Vadodara. To promote the marketing of products at scale, the FPC premium product 'instant Khichdi' is sold through digital platform of Amazon India and Qtrove. This innovation of FPC was covered in an article by 'The Better India'.

Processes before milling grains

Practical demonstration on flour mill operation

Practical on packaging

Practical on packaging

Fig: 3 Training being imparted Tribal Women Farmers in Production of a Farm Based Nutritious Food Product

1.1.4 Dissemination of Bio-energy Technology through Bio-coal Preparation from Waste Green Coconut Shell as an Energy Rich and Smokeless Cooking Fuel among Rural Women in Puri District of Odisha undertaken by Socio Cultural Development Centre, Jagatsinghpur, Odisha

The project has been taken up with a view to derive useful energy from the most underutilized and neglected biomass i.e. green coconut shells available abundantly in the coconut growing regions. The main objective of this project is to build the capacity of women of Konark block of Puri district of Odisha in the preparation of biocoal from green coconut shell. The project also envisages to enhance the entrepreneurial skills of the women as a source of livelihood. The briquetted char (bio-coal) from green coconut shell through the evolved technology in this project would become an effective substitute for fossil coal for its various applications in domestic and industrial sector. The area chosen for this project is Puri District in the state of Odisha where coconut is the major horticultural crop. Thirteen Skill oriented training cum demonstration programmes have been conducted for training of 423 women identified from 08 SHGs (149 Women) and 274 women identified from 25 Villages of Eight (08) Grampanchayats of Konark Block, Puri District to prepare biocoal from green coconut shell. The training is creating awareness among the coconut growers and vendors regarding the effective utilization of used and discarded green coconut shell; popularization of solar greenhouse dryer among the beneficiary women for not only quick and safe drying of green coconut shell but also for other perishable agricultural produces available in the proposed area; developing skills among the women beneficiaries regarding the use of a low cost charring drum for carbonization of biomass and optimization of burning time and charring time for effective and better recovery of char from the biomass.

The women participants of the programme have been convinced to earn by preparing biocoal (briquetted char) from waste green coconut shell through hand press method technology using a 30 kg capacity charring drum. The activities have been initiated to establish linkage with (i) Mahila Samities (ii) Pollution Control Board of the State (iii) Coconut Development Board of the state and (iv) Local Krishi Vigyan Kendra for wider dissemination of technology. The training to the other identified women is in process.

Bio-coal prepared from char of tender coconut shell

Fig: 4 Training of women Bio-coal Preparation from Waste Green Coconut Shell

1.1.5 Training of Rajasthan rural women on use of biofertilizer for crop productivity enhancement undertaken jointly by Amity Institute of Microbial Technology, Amity University, Noida and Arid Forest Research Institute (AFRI), Jodhpur, Rajasthan

The main objective of this project is to train Rajasthan rural women farmers on benefits of bio fertilizers based on the endophyte *Piriformospora indica.* The social and economic roles of women are interdependent and thus it is important to measure both economic and social (well-being) outcomes to understand women's economic empowerment. Likewise, it is important to measure effects at both the individual and community levels, considering the broader context of women's well-being within the household. The training focuses on capacity building of the rural women in remote villages of Rajasthan for application of bio fertilizers specifically to those who grow Sonamukhi (*Cassia angustifolia*) and Isabgol (*Plantago ovata*). To identify the women beneficiaries and select the trainees the details of the training program was publicized through local newspapers and the same was intimated to Central and

State Departments and women groups, seeking their help in identifying women with entrepreneurial zeal. Three locations: i) Tiwari Tehsil, (Mathania Block), Vill. (4): Ramsagar, Kachan, Pipalki, Mathania ii) Falodi Tehsil: Vill. (4): Amla, Bapini, Batiyali, Jaloda and iii) Bilara, Vill. (4): Harsh, Deval, Karmavas and Bilara of Jodhpur district, Rajasthan were selected to conduct the training programmes. The bio fertlizer preparation process was standardized and optimized. 80Kg of bio fertilizer was prepared from imparting the training at identified block of Jodhpur Dist. The skill up-gradation training focuses on the application of bio-fertilizer to increase the crop yield and impart value addition to plants. Training on dose of application, methods of application and the beneficial effect of bio fertilizer etc. was provided to 72 women farmers.

Fig: 5 Imparting training to rural women farmers on application of bio-inoculants under the project

1.1.6 Promotion of Stevia- A gift of Nature "0" calorie bio sweetener- for Income Generation of Female Farmers in Chandrapur District, a backward District of Maharashtra and sugar alternative to diabetic population of India undertaken by AFORD, Bramhapuri, District Chandrapur, Maharashtra

The project started off with the objectives to form Women Stevia Growers Group (WSGG) and empower them through adaptation of stevia crop for better income opportunities towards doubling the farm income, to impart training on the stevia cultivation and management, to establish complete value chain from cultivation to marketing of the produce by providing training and guidance during cultivation and buyback option for the produce. A nursery for Stevia Cultivation has been established. Around hundred women farmers were trained on land preparation, preparation of raised beds and planting of sapling. Fifty women in five groups each have been provided hands-on training on plastic mulching, harvesting at five different locations. Training on drying and packaging of the stevia leaves was also imparted to the participants on farm.

Plastic Mulching

Transplantation

Harvesting

Drying

Fig:6 Women participants in Chandrapur district being trained for various techniques under the Project

1.1.7 Enhancing the livelihoods of tribal and rural women through technological intervention of trainings on postharvest handling and value addition of custard apple and Ber fruits undertaken by ICAR-Indian Agricultural Research Institute, Pusa, New Delhi

The main objective of the project is to impart training to rural and tribal women farmers of Junagad (Gujarat) district in order to make livelihood through processing of custard apple and ber fruits. Four Villages (Dhanfulia, Koyli, Thanapipli, Vanthali) from Tehsil - Vanthli, Dist:- Junagadh; two Villages (Bandhala & Khalilpur) from Tehsil – Junagadh, Dist:- Junagadh and two villages (Khimpadar & Manpur) from Mendarda Tehsil, Dist:- Junagadh Gujarat were identified to promote dissemination of scientific technologies through trainings on postharvest handling and product value addition for custard apple and Ber Fruits. Women would be trained on S&T interventions in activities such as identifying maturity for harvest, harvesting, application of harvesting tools (use of clipper), collection, manual sorting, grading and packaging of Custard Apple and Ber fruits. Training on drying, dehydration & processing of different grade fruits into pulp, candy, glaze and powder will also be imparted. The project aims to train three hundred women participants from the above identified villages in Gujarat. The process of familiarization of stake holders and functionaries involved in the chain has been initiated.

1.2 SKILL SATELLITE CENTRES:

The main aim of this component of TDUPW programme is to set up Skill Satellite Centres to enhance the quality of life of women by imparting knowledge and skills in or near their home. Women thrive when their

community values women's work both at home as well as in the public sphere and therefore, this initiative of DSIR is committed to working towards gender parity and making women's work visible at all levels of development. DSIR supports proposals for setting up "Skill Satellite Centres" in close vicinity of rural/tribal or other needy groups of women which would be different from the usual vocational training centres for women established by various other organizations. In addition to the skills training, all the women enrolled with the satellite centres will also be trained on financial literacy and enterprise development. This will ensure that after completion of the training, they are not only financially independent but can also face social challenges more effectively. The programme has been launched and the Department has supported following two proposals for setting up Skill Satellite Centres for women:

a) Creating sustainable livelihood opportunities to the tribal women of Kuchai block, Saraikel district by establishing a Skill Development Centre by Deepak Foundation, Vadodara, Gujarat

b) Dehydrated Flowers and Foliages for Women Empowerment by CSIR – National Botanical Research Institute, Lucknow.

1.3 OUTREACH AND AWARENESS ACTIVITY:

For popularization / promotion of the programme and its new component, Skill Satellite Centres, three webinar were conducted with corporate foundations and women focused Institutes. About hundred participants from various foundations and Institutions participated in these webinars and were inspired to develop solutions towards economic and social upliftment of women. Webinars were also used as a platform to discuss in detail the mandate and objective of the programme, funding eligibility and the process and expected outcomes from the funding proposals and Skill Satellite Centres.

1.4 E-SERVICE DELIVERY:

Being a welfare program, the TDUPW program is covered under Direct Benefit Transfer (DBT). The program has been integrated with Service Plus Platform developed as part of Panchayat Enterprise Suite (PES) under e-panchayat Mission Mode Project (MMP). The TDUPW program is now launched on Service Plus Platform managed by Ministry of Panchayati Raj (MoPR) and is live for the Citizens at the url: https://serviceonline.gov.in/dbt. Those interested in submitting proposal for financial support under TDUPW program of DSIR are required to register at this portal and submit the proposal online. In addition, the non-government voluntary organizations are also required to submit Organization's Unique ID in NGO Darpan Portal while registering at service Plus Platform for filing online application.

2.0 A2K+ /STUDIES

ACCESS TO KNOWLEDGE FOR TECHNOLOGY DEVELOPMENT AND DISSEMINATION (A2K+) – STUDIES

2.1 PREAMBLE

The objectives of A2K+ Studies program is to support studies in emerging areas of technology aimed at providing useful information and knowledge base to industry, industry associations, academia, research institutions, consultants, entrepreneurs, research students and policy makers for

doing any further work in these areas; to study and analyze the developments in the emerging technology areas and document the findings, learning's and outcomes for wider dissemination and preparation of status reports on technologies from public funded institutions that are ready for commercialization with a view to catalyze the translation of research output from institutions to market.

2.2 STUDY THEME AREAS

DSIR has supported the A2K+studies in the following 8 key theme areas:

i. Commercialization status of technologies developed at public funded research institutions.

ii. Building industrial capabilities for adoption of state of the art technologies that will dominate the industrial scenario in the near future.

iii. Enabling linkages amongst academia, R&D and industry for building a strong and thriving innovation ecosystem.

iv. Enhancing depth in manufacturing and value addition in industry.

v. Technology brand building.

vi. Conformity to Standards by industry.

vii. Emerging requirements of MSME sector with reference to globalization and technological advancement.

viii. Support system for knowledge enterprises and microenterprises.

2.3 HIGHLIGHTS OF THE STUDIES COMPLETED DURING THE PERIOD UNDER REPORT

2.3.1 Effective Grain storage for better livelihoods of Indian Farmers for food and nutritional security in the new millennium by Indian Institute of Food Processing Technology (IIFPT)

Pulses are considered as an important food crops due to higher protein content. It has about 20 to 25 per cent protein by weight which is double the protein content of wheat and three times that of rice. India is the largest producer of pulses in the world growing majority of the pulses. Major pulses grown in India includes chickpeas (gram), pigeon pea (tur or arhar), moong beans, urd (black matpe), masur (lentil), peas and various kinds of beans. Insect pests cause considerable amount of damage to the pulses and reduce the nutritive value of the stored grains. Grain storage plays an important role in preventing losses which are caused mainly by insect pests, pathogens and rodents. It is estimated that 60-70% of food grain produced in the country is stored at home level in indigenous storage structures. The non-scientific storage practices and post-harvest operations results in quantitative and qualitative losses. Grains harvested during rainy seasons, wide variation in temperature and RH levels during storage and poor storage methods are the draw backs of traditional storage. Also, there is no standard safe storage guidelines available for the storage of pulses under Indian conditions. The present study helps to determine the rate of deterioration at different moisture and temperature conditions and the safe storage duration that can be used for developing safe storage guidelines. Fumigants used for the management of pulses resulted in development of resistance and residues in the treated grains. Considering the food safety and feasibility, eco-friendly safe storage structures with provisions for physically eliminating insect pests are developed for the benefit of pulse growers, small scale enterprises, retailers and FPO's and the

result of the study is transferred to various stakeholders through training programs. With this rationale, the study was supported to IIFPT with the following objectives –

(i) To determine safe storage guidelines based on moisture, temperature and quality of pulses for tropical weather conditions with special emphasis on the coastal regions of Tamil Nadu;

(ii) To design and develop eco-friendly safe storage structures with provisions for physically eliminating insect pests to store pulses for small scale enterprises, retailers, rural livelihoods, pulse growers, millers and farmer producer organizations;

(iii) To disseminate the technology to small and medium enterprises and to pulse growers in the coastal regions of Cauvery Delta.

Results of the study showed that (i) hermetic storage is found to be the eco-friendly safe storage method for pulses without altering the quality parameters and the usage of chemicals and pesticides. (ii) UV light insect traps helps to monitor pulse beetle population and mechanically eliminate insects during storage of pulses. (iii) natural insect repellents in addition to light is also possible to attract more number of insects in short span. (iv) in-bin trap can be made according to the size of the bin**.** The study also developed safe storage guidelines for the black gram and red gram with respect to the grain moisture content and temperature. Use of UV light traps help to monitor pulse beetle population.

2.3.2 Formulating a suggestive model for India for facilitating university-industry linkages in research by PHD Chamber of Commerce & Industry (PHDCCI)

The study on formulating a suggestive model for India for facilitating university- industry linkages in research was aimed to prepare a model for India for an enabling environment to facilitate university-industry linkages for research in India. The study objectives was to (i) assess the problems in "The Protection and Utilization of Public-Funded Intellectual Property (PUPFIP) Bill" and to suggest changes in it (ii) suggest a model for India on lines of Bayh Dole Act of USA for building a strong and thriving innovation ecosystem in the country.

A range of key observations and recommendation have been made about the PUPFIP Bill through the preparation of the questionnaire, identification of the stakeholders to be surveyed for the study, pilot testing of the questionnaire and finally the dissemination of questionnaires and stakeholder consultations on understanding the requirements of Universities and Industry for developing an effective model for creation of public funded research in the country.

Bayh-Dole Act was introduced in the US, which led to great benefit for the country and many other countries have benefited by adopting a similar legislation. On the line of Bayh-Dole Act, Protection and Utilization of Public-Funded Intellectual Property (PUPFIP) Bill was developed and later withdrawn from the Parliament. So far, India does not have legislation in place to facilitate University-Industry Linkages in Research.

Based on the stakeholders feedback, this study has provided pinpointed recommendations on PUPFIP Bill and provided inputs for a suggestive model for commercialization of publicly funded research in India. With

due considerations to the concerns and apprehensions of both University and Industry, the preparation of the model for India on lines of Bayh Dole Act of USA would help build a strong and thriving innovation ecosystem in the country.

2.3.3 Role of Branding in Enhancing Competitive Growth for MSME Sector by All India Management Association (AIMA)

The MSME sector is an important pillar of Indian economy as it contributes greatly to its growth with a vast network of around 46 million establishments and creating employment of about 106 million people directly and indirectly. MSME's have been contributing to expansion of entrepreneurial culture through several innovations. With this background, the study was supported to AIMA to assess (i) the role of branding in growth of MSME sector; (ii) explore the key branding strategies for MSMEs in India (iii) assess the acceptability of branding for MSMEs in India (iv) suggest the way forward for MSMEs to create their brand.

The study was conducted in five zones: North, South, East, West, Central and minimum two states from each zone were selected through the stratified random sampling. While conducting the study 30 MSME case studies were also analyzed for better understanding.

It was found that branding is well acceptable by MSMEs in India, since it leads to increase in revenue and support in expansion of market. It is revealed that majority of the MSME's considered that branding provides a competitive edge to the business. On studying further, it was found that increase in return on investment, sales growth, expansion of market was considered as criteria's for the increase in competitive growth of MSME. But MSMEs also feel that there are certain enablers and hurdles which make impact on acceptability of branding like availability of funds, time management, awareness about branding and schemes like limited liability partnership and comparison with MNC branding Act as enabler which support MSMEs to build their brand strategy.

To summarize, this study may provide an insight to MSME's about branding their products and services within modest budget and help MSME's in becoming successful in the current challenging economic environment. The study may also help MSME's to understand their business strength, USP's & skills for leveraging their strengths and guide SME's in establishing a brand for their products. As a result, study may help in increasing the acceptability of the products developed by MSME globally which would lead to enhancement of export earnings.

Fig 1: Role of Branding in Enhancing the Competitive Growth of MSME Sector

2.3.4 Qualitative study of technologies designed using Artificial Intelligence for improving healthcare services in the Indian context by Centre for Development of Advanced Computing (C-DAC), Mohali

As Artificial Intelligence area is an emerging area and it could be deployed to improve healthcare services as well as bridge the healthcare divide in urban and rural areas. The study focused on the aspects of Artificial Intelligence applicability in Healthcare.

With AI and associated machine learning algorithms, technology can be used to assist healthcare practitioners in (i) diagnosing the disease quicker (ii) forecast the spread of the disease, and (iii) design customized treatment plans for patients even for those situated remotely. Therefore, the study supported to C-DAC, Mohali addresses the technologies designed using Artificial Intelligence for improving healthcare services in the Indian context with the objectives to (i) identify technologies in the area of Healthcare based on Artificial Intelligence (ii) facilitate collaboration amongst industries and start-ups working in Artificial Intelligence- Health to improve healthcare services in India.

The study has identified and provided details on the technologies being developed by academic institutions and R&D labs. The outcome of the study may be useful for various R&D labs, industrial organizations including start-ups, which can adopt and build upon the identified technologies and roll out to the Indian populace. The study generated a review paper on AI based technologies in healthcare services.

2.3.5 Demand, opportunities and challenges for development and deployment of Ultra Precision Machining Technology in India by Central Manufacturing Technology Institute (CMTI), Bangalore

The study was supported to CMTI, Bangalore with objectives to - (i) explore the demands of assimilation for Ultra Precision Machining Technologies (ii) identify the technology gaps (Machine & machining technologies, process developments, measurements) in Ultra Precision Technologies (iii) identify indigenous development works required and (iv) study the challenges in development and deployment of indigenous technology for Ultra Precision Machining Technology. This study has reviewed Indian scenario of UPMT, conducted questionnaire based survey, workshops/webinars and interaction and interviews to achieve the study objectives. The study has shown that (i) 40% wanted to adopt UPMT due to growing demands and opportunities while 34% indicated to become technology leader. Other were not planning to venture into this (ii) 30% respondents felt that heavy capital investment is a major challenge to establish UPMT, 26% thought its lack of indigenous technology while other 24% believed that lack of skilled manpower is biggest challenge. 11% and 9% participants indicated small market opportunity and global player's competition respectively. Several challenges such as sustainability in mass production, process modelling and development of export quality components and machines etc. were reported. This study also lists the products in demand under this sector, organizations willing to invest in next five years to establish own set up and those willing to contribute to central research facility and study mentions that setting up a UPM product industry or a UPM service industry for MSME's is more favourable as the number of risks involved are Low. In conclusion, the study has identified emerging requirements of Ultra Precision Machining Technology, gaps & challenges in development and deployment of indigenous technology in the Indian market scenario.

Fig 2: User meet conducted at CMTI to deliberate on Ultra Precision Machining Technology in India

2.3.6 Inventorization of microbe based technologies developed in National Agricultural Research System (NARS) for catalysing their effective translation from lab to land by ICAR-National Bureau of Agriculturally Important Microorganisms (NBAIM), Manjunath, UP

The role of microorganisms in soil health and crop production is well established. Different organizations have developed various microbial technologies for use in agriculture but unfortunately only a few of them have been commercialized. Till date, neither we have any comprehensive record of such technologies nor do the industries have an organized access to such information. Therefore, the study supported to NBAIM was focused on the inventorization of microbe based technologies developed in National Agricultural Research System (NARS) for catalysing their effective translation from lab to land. The study objectives were to (i) document and develop user-friendly database for microbe based technologies developed/available at different ICAR institutes and State Agricultural Universities (SAUs) (ii) evaluate selected potential technologies for commercialization (iii) identify key issues in commercialization of microbe based technologies (iv) prepare a status report/policy paper for catalysing the commercialization of microbe based technologies. During the period of study, NBAIM collected technologies and created a database containing all relevant information on microbe based technologies available in different NARS institutes/universities.

NBAIM developed a database of 130 microbe-based technologies originating from 30 different organizations. Various categories of microbe-based technologies inventoried includes Bio fertilizers (39%), Biocontrol agents (21%), Plant growth promoters (7%), Composting agents (7%), Mycorrhiza (5%), Abiotic stress alleviators (5%), Nutrient fortifiers (1%) and others (15%). Among the 130 technologies inventoried, 32 technologies were commercialized and only 9 technologies were either applied for or granted patents. 87 technologies were field validated of which 56% were from southern part of India and 35% were from northern part with west contributing 9% and none from eastern part of India.

The database contains brief information like name of the technology, microorganisms used, advantages, target crops, patenting/ commercialization, contact of developers etc. on 130 microbe-based technologies. The technology readiness levels (TRL) like field evaluated or evaluated under All India Coordinated Research Project (AICRP) have also been included for ready reference for the industries. This database has been made searchable using different keywords such as bio fertilizer, bio pesticides, *Pseudomonas* or *Trichoderma* etc. The database is available at www.agrimicrotech.com (as shown below).

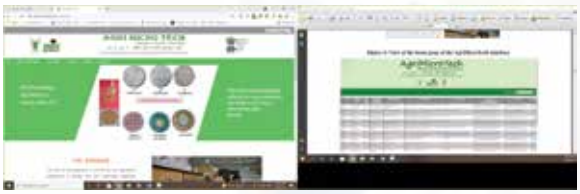


Fig 3: Website, www.agrimicrotech.com developed for database on microbe based technologies developed in National Agricultural Research System (NARS)

NBAIM also organized a workshop to discuss/ identify key issues in commercialization of microbe based technologies and tried to work out possible solutions to maximize the commercialization of the technologies. Policy paper written during this study also highlights recommendations on research and development and regulatory and policy issues for commercial success and effective farmer's outreach of bio fertilizers and bio pesticides. The study concluded that a strong collaboration between industry and R&D institutes is urgently required along with few policy modifications to ensure their successful commercialization and adoption by farming community. This study has also prepared a policy paper.

2.3.7 Technology forecasting and projecting market trends for agricultural machinery manufacturing Sector for India by ICAR-Central Institute of Agricultural Engineering (ICAR-CIAE), Bhopal

Farm machinery manufacturers play an important role in advancement of the agricultural implements. Most of the agricultural implements are being manufactured by small and medium level manufacturers in India. Therefore, the study was supported in technology forecasting and projecting market trends for agricultural machinery manufacturing sector to understand manufacturer's capability to get quality output and meet future demand. The objectives of the study are to assess the present status of agricultural machinery manufacturing Industries in India and to forecast the potential demand for agricultural machinery manufacturing sector. The survey was conducted in five states (Punjab, Tamil Nadu, Chhattisgarh, Odisha and Gujarat) from different zones of India (North, South, Central, Eastern and Western) using a questionnaire.

The study showed that the farm machinery manufacturing sector plays a vital role in production and promotion of the agricultural implements in India. The analysis indicated that medium manufacturers had about 50 percent share of the total population while Small and large manufacturers contributed 25 percent share each. Large and medium agricultural implements manufacturers are focusing more on tractor operated implements like combine harvesters, rotavators, potato cultivation implements, paddy cultivation implements, maize threshers, laser land leveller, reapers and combine, based on the demand of the country. General implements like threshers, trolleys, seed drill, mould board plough, disc harrow, weeders and manual equipment based on local need is being manufactured by all categories of manufacturers. In general, the forecasted data suggested that the demand of implements in all the surveyed states is increasing but some common machines used by the state since long time showed negative trend (e.g. cone weeder and laser land leveller in Tamil Nadu, potato digger, chaff cuter and reaper in Punjab, pedal thresher, cone weeder and hand winnower in Odisha, rotavator, potato planter and potato digger in Gujarat). Several interaction meets were conducted to discuss the current status of agriculture machinery manufacturing sector in India.

The study concluded that the size of manufacturing units and their turnover

are the crucial factors determining the skill improvement and quality up grade for the developed products. However, exposure to improved technical knowhow, interaction amongst the manufacturers, research agencies, farmers and support from the government will improve quality of implements manufactured in India for domestic use and export.

2.3.8 Access to Energy Efficiency Technology Information for Indian Industries by The Energy and Resources Institute (TERI), New Delhi

The study entitled "Access to Energy Efficiency Technology Information for Indian Industries" aimed at providing technology information on energy efficiency improvement in Indian industry sub-sectors like Iron & Steel and Pulp & Paper. The consolidate information on proper analysis will highlight available energy efficient technologies being used and practiced in both the sectors and shall enable industry and plant professionals/research labs, researchers, academia, government and other stakeholders to identify and know the best available energy efficient technologies and practices that improve energy efficiency and reduce CO_2 emissions.

The study presents the process path followed in Indian Iron & Steel industries in the (i) Primary route viz., Blast furnace (BF)–Basic Oxygen Furnace (BOF) and (ii) Secondary route viz., Electric Arc Furnace (EAF) and Electric Induction Furnace (EIF) with or without captive direct reduced iron production facilities. The study explains the BF-BOF as a two-stage process of Steel making encompassing iron making followed by steel making. Steel making through DRI-EAF/EIF as well as stand-alone EAF and EIF is also explained in the study at length. Production and energy efficient technologies have been grouped based on both the primary and secondary steel making routes with each technology containing technology description, energy savings, environmental aspects, investment cost and source details.

One hundred and six emerging and energy efficient technologies have been compiled and consolidated under seven broad BF-BOF process steps viz. (i) Iron Ore Preparation (ii) Coke making (iii) Iron (Hot metal) making (iv) BOF/LD converter steel making (v) Casting (vi) Rolling (Hot Rolling and Cold Rolling), and (vii) Processing/finishing operations and six broad DRI-EAF/EIF routes viz. (i) Coal-based DRI making, (ii) Gas-based DRI making, (iii) EAF steel making, (iv) EIF steel making, (v) Casting, (vi) Rolling and Finishing lines. Benefits in terms of energy saving, CO_2 emissions reduction etc. in respect of integrated steel plants (BF-BOF Route) as well as gas-based DRI-EAF steel making route have been consolidated largely from international/national literature as well as in consultation with domain experts, industry professionals/ stakeholders. These are referred to as international benchmarks relating to energy saving and efficiency parameters in relation to the existing best global standards.

Information highlighting energy efficient processes and technologies used in the Indian paper industry highlighting 52 main steps from raw material preparation to paper making have been consolidated in consultation with domain experts and as per the published literature. The data classification has been made based on the three types of raw materials viz. (i) Wood-based, (ii) Agro-based, and (iii) Recycled Cellulose Fibre (RCF)- with each process containing technology/process description, energy savings, environmental aspects and information source details.

As an outcome, a web portal was designed to provide all the necessary information related to the energy efficient technology to the stakeholders. The web portal of this study (managed and maintained by TERI) has been launched by the Secretary, DSIR for wider dissemination. Stakeholders may visit the website using link www.ieetech.org.

Fig 4: A web portal designed to provide all the necessary information related to the energy efficient technology to the stakeholders and screenshot of its launch by Secretary, DSIR

2.3.9 The Role of Standards in Diffusion of Emerging Technologies: Internet of Things (IoT) by Indian Council for Research on International Economic Relations (ICRIER), New Delhi

The study was supported to understand the role of Standards in Diffusion of Emerging Technologies: Internet of Things (IoT). This study was set to analyze the complex process of standardization of an emerging technology viz: the 'Internet of Things' and specifically understand the role of Standard Setting Organizations (SSO) and the industry in setting and conforming to standards. The study provided policy suggestions for designing an efficient ecosystem, which will allow the Industry, SSOs and the State to better coordinate and collaborate towards enabling an IoT environment. It also explores the features of an efficient architecture of standards and SSOs that promote conformity, competition and efficiency of the IoT industry. The study made following observations -

- Despite having the third largest start-up ecosystem, Indian start-ups fail to contribute to standard development despite the nascent presence of Centre of Excellences (CoE). Participation of start-ups in the standardization process will help kick-start innovation,
- India is currently a follower and not a contributor to the IoT Standards ecosystem. However, the case study indicates that stakeholders understand the exigency of standardization for IoT.
- Standardization efforts in India were led by countries of foreign origin and very little input from Indian origin MNCs
- Case Studies indicate that the uptake of Industrial IoT will be faster than Consumer IoT in India
- Most Indian organizations have adopted global standards that may not cater to local needs. Industry collaboration, experiences from global engagements and learnings from other countries can help India develop an innovation – driven approach to IoT.

2.3.10 Emerging requirement of Nano coating in the fields of Automotive, Aerospace, Machine tool, Healthcare & sanitization sectors in the Country

and the means to achieve it by Central Manufacturing Technology Institute (CMTI), Bangalore.

The surface engineering sector in India encompasses a diverse range of capital goods sector. One of the important areas of surface engineering is Nano coating. Nanotechnology has the ability to improve energy consumption efficiency, help clean the atmosphere, improve customer experience through consumer goods and solve significant health issues. It is also claimed that it is capable of massively rising production performance at drastically reduced costs. Therefore, the study titled emerging requirement of Nano coating in the fields of automotive, aerospace, machine tool, healthcare & sanitization sectors in the country was supported to understand India's readiness to assimilate and implement nano-coatings at a commercial scale. The objectives of the study were to (i) understand the requirement of MSME in different sectors in Nano coatings (ii) understand the problems faced due to existing coating techniques and address the issues faced by interaction with industries (iii) understand the technologies required for addressing various problems of coating by industries in country and find the availability of such facilities in public domain and (iv) organise demand aggregation workshops and allow industry personal to speak on the coating issues faced by them.

This study analysed the filled questionnaire received from 350 participants of which 62.36% respondents were from Govt./PSU/ academia while remaining responses were from MSME's. The study noted that 68% participants were already a user of nano coatings or were interested in using nano coatings for their applications, 20% were nano coating service provider and 12 % were equipment manufacturers. Improvement in product life thereby increasing sales was one of the important reasons for the shift towards nano coatings. As per the CAGR report 2015-2023, the forecast for nano coatings is predicted to be greater than 22%. However, few challenges such as continual investment in R&D, huge capital investment, skill and necessary qualifications etc. were noted. After interviewing various industry personnel, the study identified major concerns that various sectors have faced with respect to nano coating (Fig.5).

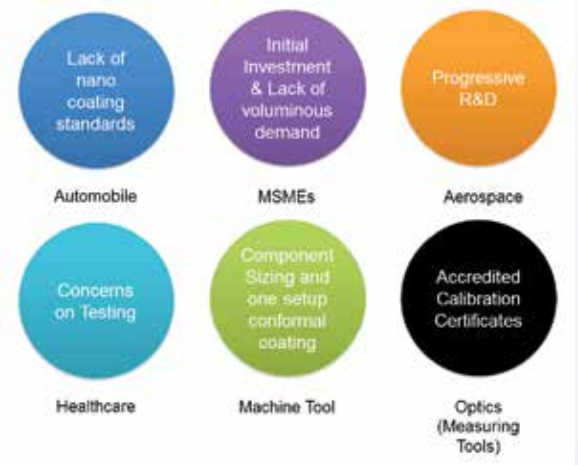


Fig 5: Top few concerns for industries with respect to nano-coating

2.3.11 Alternative materials for improving response and damping properties of machine tool structure by Central Manufacturing Technology Institute (CMTI), Bangalore.

High Precision Machine Tool producing high precision components at high productivity rate needs very good damping stability. The machine tool structures must possess high damping and high structural stiffness along with dimensional and geometrical stability. High operating speed generates more vibration between tool and work piece which reduces surface finish on machined components and leads to reduction in life of machine tool. Therefore, the study entitled "Alternative materials for improving response and damping properties of machine

tool structure" was supported to CMTI, Bangalore. The study objectives were to (i) explore the demands of alternate damping materials for machine tool structure & beds (ii) identify the technology gaps (fabrication methods, material properties & characteristics) (iii) identify indigenous development works required. A survey questionnaires was developed for data gathering which was utilized to collect, analyse and interpret the different views of a group of people from a particular manufacturing sector. An expert group interaction with industrialists was organised to fulfil the objectives of the study.

The study has identified some of the prominently used materials in the Machine Tool Industry such as Epoxy Granite, Polymer Concrete, Mineral Casting, Ferro Cement etc. for the development of Machine Tool Structures as shown in Fig.6. List of different materials being researched in the market along with their properties, advantages and disadvantages have been recorded in the report to provide a helpful insight into the different materials available. The study also mentions few concerns such as unavailability of suitable foundries for MSME's, shortage of demand for the components made out of alternate materials (due to scepticism about quality of product), requirement of testing facilities etc. and few recommendations for stakeholders.

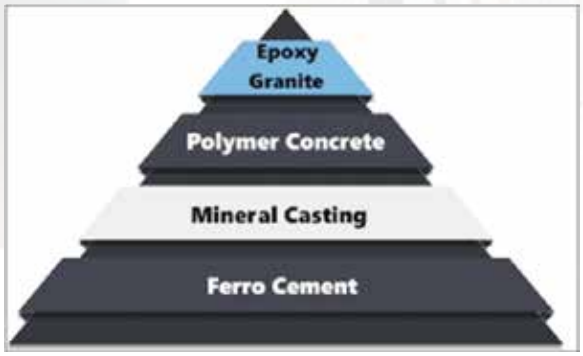


Fig 6

2.3.12 Developing a framework for Commercialization of technologies developed at public funded research institutions by CSIR-Central Scientific Instruments Organization (CSIR-CSIO), Chandigarh

The study was supported to develop a framework for Commercialization of technologies developed at public funded research institutions. The objectives of the study were to (i) find the status of commercialization of technologies developed at public funded research institutes (PFRIs) (ii) identify lacuna in the commercialization process (iii) develop a framework to strengthen commercialization process. The study was focused on technologies in the areas of biomedical instrumentation, agri-instrumentation (post-harvest and pre-harvest), waste-to-wealth transferred by PFRIs in the region Chandigarh, Punjab and Haryana. A questionnaire was developed and circulated to all CSIR laboratoty's and twelve other PFRIs in the northern region. Responses received were analysed by SPSS (Statistical Package for the Social Science), Amos Software and Structural Equation Model (shown Fig.7) for technology commercialization effectiveness. The study identified that the national Support, transferee characteristics, transferor characteristics and technology absorption and adaption capabilities greatly affects the success of technology commercialization. The details of study along with the recommendations to stakeholders for enhancing commercialization of technologies is covered in the report.

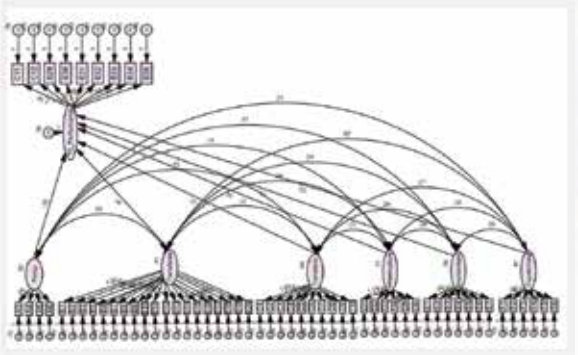


Fig 7: SPSS (Statistical Package for the Social Science) Amos Software and Structural Equation Model developed for technology commercialization effectiveness

2.3.13 Feasibility study on commercial scale coating on copper alloys, using radio-frequency plasma technology by Institute of Advanced Study in Science & Technology (IASST), Guwahati

The study entitled "Feasibility of commercial scale coating on copper alloys, using radio-frequency plasma technology" was undertaken to find out the prospective market segment for which technology can be successfully optimized. The main objectives were to (i) study the techno-commercial status of surface protection of bell metal and brass in the main production centres of India (ii) find the proper mechanism for transferring the developed technology of surface coating.

Brass & Bell metal were found to be the largest art metal exported from India which would further get an edge in the international markets due to deployment of plasma coating. Therefore, the study finalized few products such as house-hold puja items, Kerala Deep, Temple & Church items, locks for export market, door handles and decorative items which may have potential to go for commercialization. The study also highlights the comparative analysis of prevalent coating technologies with the plasma based coating technology developed by IASST. Items coated using plasma technology developed by IASST are shown in Fig.8 below. It was found that plasma coating technology developed by IASST is commercially feasible for high value decorative items and other pooja items, door handle etc. This study has paved the way for commercially viable Plasma Coating on copper alloys, either via private enterprises or via Common Facilitation Centres at manufacturing clusters.

Fig 8: Coated copper alloys using radio-frequency plasma technology

2.3.14 To assess the commercialization status of the technologies from Government funded national Institutions by Amity University, Noida

The study supported to Amity University, Noida was intended to assess the commercialization status of the technologies from Public funded institutions of India with the objectives to (i) assess the state of the commercialization of patented technologies from public funded research institutes (ii) study the incubation level of maturity of technologies in IITs and NITs (iii) assess the type of technologies, which have received joint development support from industry (BIRAC, DST, DBT, etc.) (iv) assess the status of patenting facility in the institutions (v) understand launching of product or services in the market based on the technology developed by public funded institutions (vi) assess critical elements of a successful technology transfer and commercialization process of a research organization. Study covered public funded higher educational institutions and National labs. It was found that large number of technologies have been transferred by IIT Bombay and IIT Delhi in comparison to the other Institutes. Chemical and Pharmaceutical sectors were found to be predominant sectors of research and technology development with 75 % patents filed in these areas. Large numbers of technologies in this sector have been transferred by IIT Bombay and CSIR labs.

2.4 HIGHLIGHTS OF THE ON-GOING STUDIES

2.4.1 Technologies Strategies and Branding Manifestations for better firm performance – A comprehensive study from the year 2000 to 2019 after phases of liberalization of the Indian Economy by Symbiosis School of Media and Communication, Bangalore.

The study entitled "Technologies Strategies and Branding Manifestations for better firm performance - A comprehensive study from the year 2000 to 2019 after phases of liberalization of the Indian Economy" has been granted to Symbiosis School of Media and Communication, Bangalore. The objectives of the study are (i) to study the impact of technology strategies on branding and marketing outcomes of durable companies in India (ii) to study the effect of technology based branding on market and financial performance of Indian and foreign firms (iii) to study the impact of technology policy variables of GoI on branding strategies and performance outcomes of these firms.

This study may provide information on the (i) drivers of good performance of the Indian companies and how are they different from the MNCs approaches and (ii) best technology and branding strategies to improve the performance of consumer durable companies in India.

2.4.2 Speeding up the Lab to Market Journey: Repurposing Drugs for COVID-19 by Entrepreneurship Development Centre (EDC), Pune

Coronavirus disease 2019 (COVID-19), a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first identified in Wuhan, China, in December 2019 and spread worldwide leading the World Health Organization (WHO) to declare this as the global public health emergency with an international concern. Since the pandemic began, India has substantially contributed to drug development and clinical research. Therefore, an important and useful project entitled "Speeding up the Lab to Market Journey: Repurposing Drugs for COVID-19" for the government and scientific community during this pandemic has been supported to Entrepreneurship Development Centre. The objectives of the study are to (i) track and collect information on technology development efforts on repurposing of drugs in India and abroad (ii) create an advisory group that reviews the data, helps prioritize the leads, identifies barriers and provides a learned opinion of the same when asked (iii) create a virtual network of technology development, translation and commercialization to stakeholders so as to help increase speed to market (to engage with academia, research organizations, industry, regulators etc. as needed and to "connect dots" and identify useful collaborations) (iv) leverage the office of PSA to facilitate the journey to market and use by doctors (v) contribute to getting practical solutions in use for COVID-19. In order to fulfil the objectives, the study constituted an interdisciplinary advisory group of at least twenty experts such as clinicians, scientist, regulatory and clinical trial experts, IP experts etc. Website (https://nclinnovations.org/covid19/) showcasing data related to study has been developed.

The project is still ongoing and the key outcomes of this study include detailed and carefully curated information on drug candidates, assessment and ranking frameworks that can be used for any suggested molecule, comparative charts assessing different drug molecules, setting up a virtual translation network to support drug developers. All this was done in consultation with an Advisory Group. The outcomes of this study may guide the National strategy on repurposing drugs in the early stages of the pandemic.

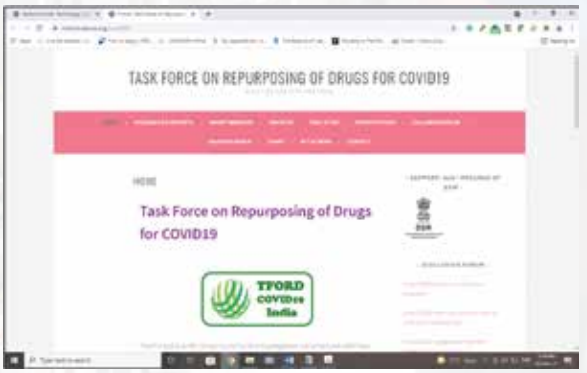


Fig 9: Website (https://nclinnovations.org/covid19/) showcasing data related to study

2.4.3 An assessment study of the commercialization of already developed technologies of the Public Funded Research Institutes established in Madhya Pradesh and to evaluate their relevance in synchrony to the technical requirement of the

local industries by Rabindranath Tagore University, Raisen, MP

The support for this study has been granted to Rabindranath Tagore University, Raisen, MP with the objective to (i) study and assess the status of the technologies developed at the public funded institutes with respect to their commercialization (ii) study the relevance of the developed technology in relation to local specific problems (iii) analyze the gap between the existing industrial requirements and ongoing researches in these regional institutes (iv) map local industry based on their requirement to relevant government funded R & D institute of MP. Currently, the study is ongoing. The study is expected to draw out complete picture of the technology transfer and commercialization of the public funded research institutes in MP. The study will also highlight the major technical requirement of the regional industrial clusters. In addition, study will identify the challenges and problems of both industry and academia regarding technology commercialization.

2.4.4 Studies on Technology & Innovation Management by CSIR-Institute of Himalayan Bioresource Technology (IHBT), Palampur

Financial assistance to the project entitled "studies on technology and innovation management" has been extended to IHBT, Palampur with follwoing objectives (i) study the extent of linkages (collaborative, sponsored, consultancy, transfer of technology, incubation etc.) amongst academia, R&D and Industry (ii) study the innovation policies of various academia, R&D institutes and industry of the region and its mechanism for industrial research, IPRs and transfer of technology (iii) study the R&D needs of Industry and the extent of in-house R&D and technology out sourcing. The study will also focus on two case studies (success/ failure) for linkages amongst academia, R&D and Industry. Possible outcomes out of this study includes - recommendations for strengthening the linkages of industry with Academia and R&D Institutes, sharing of Good practices, new avenues for collaboration and support in policy framing. The study is on-going.

2.5 To strengthen A2K+ Studies scheme further, the Department communicated with 65 Ministries/ Departments, to seek inputs on the specific technological requirements of allied industry and their stakeholders. 130 topics/themes were received from line Ministries/Department. Their recommendations were considered for undertaking studies which are more outcome oriented and with measurable parameters and would be useful for the translation of technologies into usable products and processes. The Department advertised 18 topics/ themes and 13 new study proposals were recommended by Technical Advisory Committee for funding in FY 2021-22 under these topics/themes. Grants were released for following four new projects recommended and approved:

S. No	Proposal Title & Organization	Theme Area
1	Forecast Model to Predict Leather Footwear Trade data for the year 2030 using Artificial Intelligence Approach by CSIR-Central Leather Research Institute, Chennai	Use of AI in improving Trade Data Analytics

S. No	Proposal Title & Organization	Theme Area
2	Study of specific areas registering high failure rate of distribution transformers to analyse the cause of failure and suggest a solution to overcome this problem by applying IT technology and integrating it with metering solutions by PDPM Indian Institute of Information Technology, Design and Manufacturing Jabalpur	Study of specific areas registering high failure rate of distribution transformers to analyse the cause of failure and suggest a solution to overcome this problem by applying IT technology and integrating it with metering solution
3	Studies on air ventilation in central Air-conditioning units in post COVID-19 scenario guided by machine learning and artificial intelligence technique by Indian Institute of Technology, Delhi	Filter technology for air ventilation in central Air-conditioning Units in post COVID-19 scenario
4	Studies on the implementation of stainless steel fabricated by additive manufacturing and computational forecasting technique for high temperature application by Indian Institute of Technology, Jammu	Technology Foresight studies on advanced materials as the new technology horizon for the Industry in the future

3.0 A2K+/ EVENTS

The Access to Knowledge for Technology Development and Dissemination (A2K+)/ Events programme of DSIR provides a platform for exchange of views among industry, consultancy organizations, academic and research institutions that would lead to useful insights on issues relating to industrial research and technological innovation and help in evolving tools and techniques to remain competitive in today's business climate.

The objective of A2K+ Events program is to support the organization of workshops, interactions, training programmes, exhibitions and other events for identification of collaborative projects between academia, institutions and industry participating in the events.

Grants were released towards successful organization of the following events:

S. No.	Title of the Event	Organisation
1	Seminar on Technology Assistance to Food Preservation & Hygienic Packaging	Odisha Assembly of Small and Medium Enterprises, Cuttack
2	National Conference on Agri-smart 2018: Using IoT for driving smart Agriculture	Centre for Development of Advanced Computing (C-DAC), Mohali
3	International Conference on Quality Infrastructure for Clean and Sustainable Development at New Delhi	Consulting Engineers Association of India (CEAI), New Delhi
4	Seminar on School and Conference on Fully Programmable Systems on chip for Scientific Instrumentation	Guwahati University, Guwahati

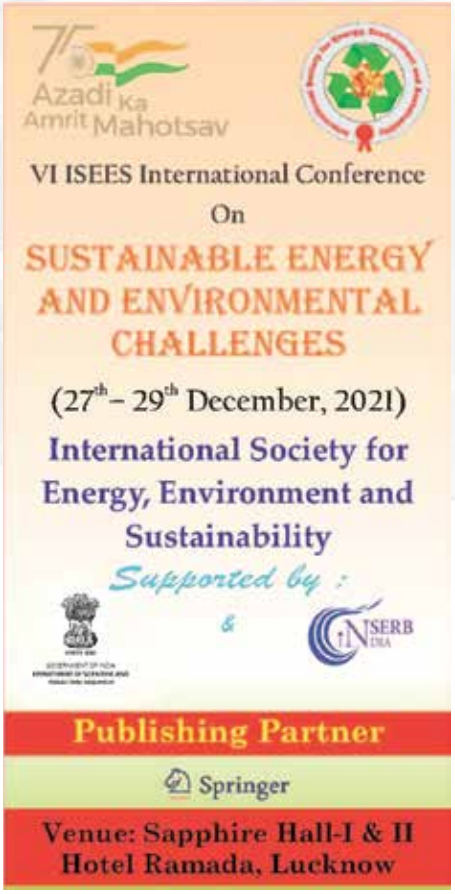
S. No.	Title of the Event	Organisation
5	National conference on Biomedical Engineering at Chandigarh	National Institute of Technical Teachers Training and Research (NITTTR), Chandigarh
6	International Conference on Advanced Welding Technology and Quality Systems for Developing Economies	The Indian Institute of Welding, Mumbai

The Technical Advisory Committee recommended six events for funding under A2K+/Events scheme in November, 2021. Out of these six events, the following two events were approved during December 2021 by DSIR:

1. A brainstorming conclave on Transforming North East through Science and Technology Intervention was organized by North East Centre for Technology Application and Reach (NECTAR) under DST GoI during 21-22 December, 2021 in Guwahati, Assam.

The objective of the brainstorming conclave was to provide platform to connect technology providers with technology seekers in the Northeast Region to ensure exchange and cross learning among different stakeholders viz. state governments, academicians, scientists, innovators, working towards the development and adaption of technologies, to showcase their work on socially & economically relevant know-hows for the Northeast Region, encourages entrepreneurs, start-ups and organizations to take solution to field. The conclave will also emphasize students centric events like start-up ideation and expositions, which aid to nurture innovative ideas and make them future technopreneurs. The broad subject areas covered are agro & food processing, communications, geo spatial technologies, bamboo-based technologies, livelihood and skill development of NER.

2. 6th ISEES International Conference on "Sustainable Energy and Environmental Challenges" (VI-SEEC) was organized by International Society for Energy, Environment, and Sustainability, Kanpur in Lucknow, U.P. during 27-29 December 2021.



The conference was organized to promote research and outreach programme in India through scientific deliberations like keynote addresses and oral presentations. The SEEC brought together engineers, scientists, researchers, students, and other professionals in order to address and discuss emerging sustainable energy and environmental issues. It provided platform for physicist, mathematicians, chemists, engineers and biologist for critical discussion in key areas of energy and environmental sciences. The conference aimed to promote high-quality research in the broad areas of energy and environmental sustainability. The broad subject areas covered were Sustainable Transport, Spray and Combustion, Renewable Energy, Biotechnology, Power generation, Sustainable Energy from Carbon Neutral Sources, Waste Treatment, Bioenergy, and Environmental Preservation.

CHAPTER 6: ASIAN PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY (APCTT)

1.0 Preamble

2.0 Introduction

3.0 Summary of Capacity Building Activities in 2021

4.0 Details of Activities Carried out by the Centre in 2021

Asian Pacific Centre for Transfer of Technology (APCTT)

1.0 PREAMBLE

The Asian and Pacific Centre for Transfer of Technology (APCTT) is a regional institution of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) servicing the Asia-Pacific region. APCTT promotes an enabling environment for innovation, transfer and commercialization of technologies in 53 member states and 9 associate members of ESCAP. All member states and associate members of the United Nations ESCAP are de facto members of APCTT.

The Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India has been the national focal Department, on behalf of India, for APCTT. Matters pertaining to APCTT and ESCAP are dealt in cooperation with the Ministry of Commerce and Industry and the Ministry of External Affairs, Government of India. DSIR plays an active role in APCTT's functioning, particularly relating to its work programmes and initiatives. India, being the host country for APCTT, has been providing institutional support to the Centre since its inception in 1977.

2.0 INTRODUCTION

1. APCTT assists member States to strengthen their capabilities to develop and manage national innovation systems; develop, transfer, adapt and commercialize technologies; improve the terms of transfer of technologies; and identify and promote the development and transfer of technologies relevant to the region.

2. The Centre has been fostering inclusive partnerships between governments, research and development institutions, academia, international organizations, private sector and civil society for transfer, dissemination and diffusion of environmentally sound technologies between countries in the Asia-Pacific Region.

3. The Centre supports development of partnerships and creation of enabling environment for innovation and technology transfer. The activities of the Centre not only contributes towards the Sustainable Development Goal 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation) and Sustainable Development Goal 17 (Strengthen the means of implementation and revitalize the global partnership for sustainable development), but also supports the other Sustainable Development Goals related to the Centre's programme of work.

3.0 SUMMARY OF CAPACITY BUILDING ACTIVITIES IN 2021

4. APCTT's primary focus areas in 2021 were as follows:

(a) Enhancing technology transfer and science, technology and innovation capacity to harness technology innovations for sustainable development.

(b) Capacity building and enhance

knowledge on science, technology and innovation policy, technology cooperation and transfer, intellectual property management with focus on emerging technologies, climate change adaptation and mitigation technologies, and technologies to combat the COVID-19 pandemic.

(c) Enhancing technology intelligence through production and dissemination of knowledge products on science, technology and innovation policy, technology transfer and commercialization, intellectual property management, new and emerging technologies and other related areas.

(d) Facilitating regional cooperation and networking in science, technology and innovation, and cross-border technology transfer, particularly focusing on the technologies and innovations to address the challenges of COVID-19 pandemic and climate change.

5. During January to December 2021, the Centre delivered and actively contributed to 6 demand-driven capacity building activities in 4 member States (China, India, Islamic Republic of Iran, Uzbekistan) in close collaboration with 52 partner institutions (Annexure 11). The activities included international conferences, regional capacity building workshops and technology facilitation consultative meeting. The Centre reached out to over 500 target participants comprising representatives from science, technology and innovation policy makers, and representatives from technology promotion agencies, technology transfer intermediaries, academia, research and development institutions, small and medium enterprises, start-ups and financial institutions.

6. The Centre benefited from participation of experts from 24 Asia-Pacific member States namely Azerbaijan, Bangladesh, Bhutan, Cambodia, India, Indonesia, Islamic Republic of Iran, Kazakhstan, Lao People's Democratic Republic, Philippines, Malaysia, Nepal, Pakistan, Papua New Guinea, People's Republic of China, Philippines, Republic of Korea, Republic of Uzbekistan, Singapore, Sri Lanka, Thailand, Turkey and Viet Nam. The experts shared their domain knowledge, experiences, and best practices with the target participants. The Centre's activities also benefited from participation of experts from Asian Development Bank, Association of Southeast Asian Nations Centre for Energy, and Economic Research Institute for ASEAN and East Asia, International Solar Alliance, and World Economic Forum.

7. APCTT's online periodical 'Asia-Pacific Tech Monitor' delivered latest information on: technology trends and developments; science, technology and innovation policies; technology market; technology transfer and commercialization; intellectual property management; technologies for climate change adaptation and mitigation; and new and emerging technologies including the fourth industrial revolution technologies (Annex II).

8. The Centre contributed to strengthening the capabilities of stakeholders from countries with special needs such as Afghanistan, Bangladesh, Bhutan, Cambodia, Lao People's Democratic Republic, Nepal, and Papua New Guinea.

9. The Centre expanded the outreach of its capacity building activities to Central Asian countries such as Republic of Azerbaijan and Republic of Uzbekistan.

4.0 DETAILS OF ACTIVITIES CARRIED OUT BY THE CENTRE DURING JANUARY TO DECEMBER 2021

A. TECHNOLOGY TRANSFER AND SCIENCE TECHNOLOGY AND INNOVATION CAPACITY ENHANCED

10. APCTT provided capacity building support to strengthen national innovations systems of the member countries. Following are the key activities carried out and/or contributed by the Centre:

(a) International Conference on Emerging Fourth Industrial Revolution (4IR) Technologies for Sustainable Development, 22 July 2021, Guangzhou, China (virtual event): The Centre organized this international conference jointly with the Ministry of Science and Technology, People's Republic of China. It was hosted by the Asia- Pacific Regional Innovation Knowledge Network for 4th Industrial Revolution Technologies and the Secretariat Office at Guangzhou University, People's Republic of China. The conference deliberated on the challenges, opportunities and strategies for harnessing fourth industrial revolution technology innovations for sustainable development; collaborative research, innovation and transfer of 4IR technologies in the Asia-Pacific; and regional cooperation to promote development and innovations of such technologies. Fifteen experts from eight member States namely, Azerbaijan, China, India, Islamic Republic of Iran, Philippines, Malaysia, Republic of Korea and Uzbekistan shared experiences, key challenges and the lessons learnt. They provided suggestions on how to enhance the pace of development and uptake of emerging fourth industrial revolution technologies for sustainable development through regional cooperation. The conference brought together 135 participants from 15 member States, namely Afghanistan, Azerbaijan, Bangladesh, Bhutan, Cambodia, India, Islamic Republic of Iran, Malaysia, Nepal, People's Republic of China, Pakistan, Philippines, Republic of Korea, Sri Lanka, and Uzbekistan. The participants included government officials, policymakers and representatives from research and development institutions, universities, private sector, technology intermediaries, small and medium enterprises and other relevant stakeholders involved in

emerging technologies, innovation and technology transfer.

Picture 1: International Conference on Emerging Fourth Industrial Revolution (4IR) Technologies for Sustainable Development, 22 July 2021, Guangzhou, China (virtual event)

Picture 2: 3rd International Congress on Water Desalination, Application of Advanced Technologies in Unconventional Water Treatment for Zones under Water Stress, 14-16 September 2021, Tehran, Islamic Republic of Iran (virtual event)

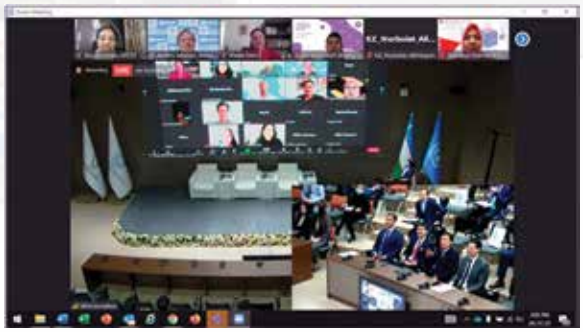
(b) 3rd International Congress on Water Desalination, Application of Advanced Technologies in Unconventional Water Treatment for Zones under Water Stress, 14-16 September 2021, Tehran, Islamic Republic of Iran (virtual event): The Centre supported this conference organized by the Iranian Research Organization for Science and Technology, Islamic Republic of Iran. The international congress deliberated on the treatment of unconventional waters including reclamation of wastewater, brackish and seawater desalination, wastewater, water loss reduction, deep groundwater uptake, rainwater/stormwater collection and treatment, as well as the related technologies for supplying clean water to the water-deprived zones. The Centre facilitated sharing of experience and good practices from India in technology applications for rainfall and stormwater collection and treatment with the case study of Bangalore city in India.

(c) Regional Workshop on Emerging Technologies to respond to Climate Change, 14 September 2021, Kunming, China (virtual event): The Centre organized this regional workshop jointly with Yunnan Academy of Scientific and Technical Information, People's Republic of China. Twelve policymakers and experts from India, Islamic Republic of Iran, Nepal, People's Republic of China, Sri Lanka, Asian Development Bank, and Association of Southeast Asian Nations Centre for Energy, and Economic Research Institute for ASEAN and East Asia, discussed on the key enablers that can catalyze the promotion, development and deployment of emerging technologies to combat climate change. Role of digital innovations, stimulating policy options, access to finance and mechanisms for cross border transfer of climate technologies were discussed. The participating representatives from member States and international experts shared their views and experiences on the policy tools, strategies

and best practices from the Asia-Pacific region that have proved successful towards promotion of emerging technologies for climate change adaptation and mitigation and sharing of ideas for regional cooperation for promotion of such technologies. The workshop contributed to enhancing the knowledge, skill and capabilities of 126 participants from 14 member States, namely Fiji, India, Indonesia, Islamic Republic of Iran, Lao People's Democratic Republic, Malaysia, Nepal, Pakistan, Papua New Guinea, People's Republic of China, Republic of Korea, Sri Lanka, Thailand and Viet Nam. The participants included policymakers, government officials and regulators, research scientists, private sector representatives, technology intermediaries, small and medium enterprises, and other relevant stakeholders from various sectors.

Picture 3: Workshop on Emerging Technologies to respond to Climate Change, 14 September 2021, Kunming, China (virtual event)

(d) **Regional Workshop on Innovative Strategies for Research Commercialization and Technology Transfer, 24 November 2021, Tashkent, Uzbekistan (hybrid event)**: This regional workshop was jointly organized with the Ministry of Innovative Development, Republic of Uzbekistan. The regional workshop deliberated on new and emerging policy frameworks and tools, issues related to intellectual property management and technology licensing, opportunities for industry-academia-government collaboration and regional collaboration networks for technology transfer and commercialization. The workshop brought together international and national experts to deliberate on key challenges, opportunities, strategies, and good practices that are critical for technology transfer and commercialization. About 130 participants (comprising of policymakers, government officials, managers of technology licensing/transfer offices and technology-based enterprises, technology intermediaries, universities, research and development institutions, academia, innovators, private sector representatives and other relevant stakeholders) attended the regional workshop. The regional workshop was held in conjunction with the virtual InnoWeek.uz 2021 expo, organized by the Ministry of Innovative Development, Uzbekistan.



Picture 4: Regional Workshop on Innovative Strategies for Research Commercialization and Technology Transfer, 24 November 2021, Tashkent, Uzbekistan (hybrid event)

(e) **International Conference on Fourth Industrial Revolution Technologies for Sustainable Development, 30 November 2021, New Delhi, India (virtual event):** The international conference is jointly organized with the Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India. The conference aimed to facilitate awareness on the development and utilization of fourth industrial revolution technologies for sustainable development, particularly in the post COVID-19 era. The conference brought together about 150 participants from APCTT's Governing Council member States and observer countries (namely Bangladesh, China, India, Indonesia, Islamic Republic of Iran, Malaysia, Nepal, Pakistan, Philippines, Republic of Korea, Singapore, Sri Lanka, Thailand, Uzbekistan and other member States), including government officials, science, technology and innovation professionals, representatives from the private sector, and experts involved in various aspects of fourth industrial revolution technologies. The conference deliberated on: 4IR technologies to achieve Sustainable Development Goals (SDGs) - opportunities and challenges; 4IR technologies to combat COVID-19 and strengthen healthcare systems; 4IR technologies for climate change mitigation and clean energy; harnessing 4IR technology for sustainable production and resilient economic recovery from the COVID-19 pandemic; and panel discussion to deliberate on strategies for regional cooperation on 4IR technologies to promote sustainable development. The main recommendations of the conference include: facilitating regional cooperation for transfer of knowledge and technologies; creating a collaborative platform for innovation, transfer and diffusion of 4IR technologies; developing a database of 4IR technologies; and organizing capacity building activities, regional workshops and outreach activities.

Picture 5: International Conference on Fourth Industrial Revolution Technologies for Sustainable Development, 30 November 2021, New Delhi, India (virtual event)

B. REGIONAL TECHNOLOGY COOPERATION STRENGTHENED

11. The Centre organized the following capacity building activities:

(a) **Technology Facilitation Consultative Meeting to address the Challenges of COVID-19 Pandemic, 23 August 2021, New Delhi, India (virtual event):** The Centre organized this regional consultative meeting jointly with the Department of Scientific and Industrial Research, Ministry

of Science and Technology, Government of India. The meeting deliberated on the needs and availability of reliable and cost-effective healthcare technologies for responding to the pandemic. It provided a platform for member States to identify opportunities of collaboration and explore modalities to share their technology, expertise and experiences. The participating representatives of member States discussed about the indigenous technologies and innovations developed to respond to COVID-19 pandemic such as nanotechnology solutions, sterilization products and ventilators, among others. The representatives also highlighted some of the key areas where support is required and could be areas of potential collaboration. The meeting brought together 54 participants from 8 member States, namely Bangladesh, India, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka and Thailand. The participants included the Centre's national focal points, representatives from government agencies, research and development institutions, experts from medical associations and other relevant stakeholders nominated by the participating member States. Modalities of gainful collaborations in the identified sectors and areas will be explored further by member States for collectively addressing the challenges of the pandemic.

Picture 6: Technology Facilitation Consultative Meeting to address the Challenges of COVID-19 Pandemic, 23 August 2021, New Delhi, India (virtual event)

Picture 7: Technology Facilitation Consultative Meeting to address the Challenges of COVID-19 Pandemic, 23 August 2021, New Delhi, India (virtual event)

(b) **Project component under the 'Eleventh Tranche of the UN Development Account' to promote inclusive technologies and innovations and development of roadmap for a technology database for 3 member States (Bangladesh, Bhutan and Nepal):** The Centre, along with the Trade, Investment and Innovation Division of ESCAP, has been jointly implementing the project titled "Evidence-based innovation policy for effective implementation of 2030 Agenda for Sustainable Development in the Asia-Pacific region". Under this project, the Centre is assisting three member States in South Asia, namely Bangladesh, Bhutan and Nepal aimed at strengthening

their capacity to promote inclusive technologies and innovations and development of roadmap for a technology database. The interventions include: analytical assessment/ study of the technology needs and mapping of available technologies as per Sustainable Development Goals categories; creation of a strategic roadmap, including blueprint, for development of database on inclusive innovations and technologies; and dissemination of the knowledge products (report on technology needs and mapping, and strategic roadmap for database) among relevant policymakers and stakeholders and promote. regional cooperation through cross-border learning and networking.

C. TECHNOLOGY INTELLIGENCE ENHANCED THROUGH PUBLICATIONS

12. The Centre disseminated information on recent technological trends and developments through its periodicals and publications. The Centre's periodicals and publications have been used widely by the policymakers, institutions, and technology transfer intermediaries and other experts. The online periodical *Asia-Pacific Tech Monitor* (https://www.apctt.org/techmonitor) features articles on the latest technology trends and developments, technology policies, technology market, innovation management, technology transfer and new products and processes. The list of the Centre's publications during the reporting period is provided as Annexure 12

13. The Centre published 4 issues of Tech Monitor focusing on special themes such as Sustainable energy development – Innovative business models and best practices (Oct-Dec 2020), Science technology and innovation for Sustainable and resilient recovery from COVID-19 crisis (Jan-Mar 2021), Fourth industrial revolution technologies for inclusive and sustainable development (Apr- Jun 2021), and Technologies for adaptation to climate change in Asia-Pacific – Enabling mechanisms and best practices (Jul-Sep 2021) (Annexure 12). The Tech Monitor issues featured 13 special articles contributed by 21 authors and experts from member States such as Bangladesh, China, India, Indonesia, Nepal, Thailand, Singapore, and organizations such as Asian Development Bank, and Research Institute for ASEAN and East Asia, Indonesia. The articles presented data and analysis on critical issues related to the respective special themes and included case studies and best practices from the region and outside. The periodical also disseminated short articles on- useful guides; best practices for start-ups and small and medium enterprises; and 43 selected technology offers and requests from eight countries, namely Bangladesh, China, Germany, India, Indonesia, Hungary, Sri Lanka, and Thailand.

14. The Centre shared its online Asia-Pacific Tech Monitor with readers from the member countries and outside the region as well. During the reporting period, the web-version of the Tech Monitor was distributed to 1489 key stakeholders and e-subscribers from the member countries. The Centre also disseminated the e-periodicals through

social media platforms such as Twitter and Facebook.

15. The Centre developed a publication titled "*Intellectual Property Management and Technology Licensing - Guide for Policymakers and Managers of Research and Development Institutes*". The publication covers key topics such as: identification and protection of intellectual property assets, intellectual property strategy and management tools, intellectual property commercialization, technology transfer, enforcement strategy and dispute resolution, and intellectual property policy options and recommendations for research and development organizations. The target users of the publication and the training manual are policymakers, managers of technology licensing and transfer offices of research and development institutes, and the private sector enterprises.

16. The Centre brought out three theme papers related to innovation, transfer and diffusion of fourth industrial revolution technologies for sustainable development, healthcare, and climate change mitigation, for circulation at the international conference on fourth industrial revolution technologies for sustainable development, 30 November 2021.

D. SUPPORT TO INTER-GOVERNMENTAL MEETINGS OF ESCAP

17. **Seventy Seventh Commission Session of ESCAP, 26-29 April 2021, Bangkok, Thailand:** The Centre provided substantive support and submitted the report on the sixteenth session of its Governing Council, held in China. The following are the outcomes of the 77th Commission session on the Centre's work programme:

(a) The Commission endorsed the report of the Governing Council of the Asian and Pacific Centre for Transfer of Technology on its sixteenth session (ESCAP/77/10) (Decision 77/5).

(b) The Commission took note of the overview of partnerships, extrabudgetary contributions and capacity development (ESCAP/77/23) and expressed its appreciation for the following contributions pledged by members and associate members for 2021. They are Bangladesh - $7,000, India - $870,000, People's Republic of China - $27,000, Macao, China - $5000, Republic of Korea - $ $26202 and Thailand - $15000. (Decision 77/11).

(c) The representative of India noted his Government's support for the Asian and Pacific Centre for Transfer of Technology and encouraged member States to increase voluntary contributions to the Centre. (ESCAP/77/29).

18. **Seventeenth session of the Governing Council of Asian and Pacific Centre for Transfer of Technology, 1-2 December 2021, New Delhi, India (Virtual):** The Centre organized and serviced the seventeenth session of its Governing Council hosted by India and held in virtual mode on 1-2 December 2012. The session was attended by the representatives from all eleven member States of the Governing Council: Bangladesh, People's Republic of China, India, Islamic Republic of

Iran, Nepal, Pakistan, Republic of Korea, Sri Lanka, Thailand, and the Republic of Uzbekistan. In addition, the representatives of Philippines, Malaysia, Viet Nam and the Climate Technology Centre & Network attended as observers. The following are the outcomes of the Governing Council session:

(a) The Governing Council took note, with appreciation, of the report on the activities of the Centre for the period December 2020 to November 2021, and the report on the administrative and financial status of the Centre during the period January to October 2021, including resource mobilization for upcoming projects and/or activities.

(b) The Council requested the Centre to continue providing demand-driven policy advice, analytical and capacity building support for strengthening national innovation systems, technology innovations and transfer, and promotion of regional technology cooperation for the achievement of Sustainable Development Goals.

(c) The Council adopted the proposed programme of work of the Centre for 2022.

(d) The Council requests the Centre to include concrete proposals, on the areas of cooperation with the Centre, presented by the member States as well as observers into the Governing Council report.

(e) The Council adopted the report of its seventeenth session on 2nd December 2021

Picture 8: Seventeenth session of the Governing Council of Asian and Pacific Centre for Transfer of Technology, 1-2 December 2021, New Delhi, India (Virtual)

E. COOPERATION WITH INTER-NATIONAL ORGANIZATIONS AND OTHER PARTNERS

19. The Centre jointly delivered activities/ worked closely with international organizations including Asian Development Bank, Association of Southeast Asian Nations Centre for Energy, and Economic Research Institute for ASEAN and East Asia and World Economic Forum while implementing capacity-building activities in the Member States.

F. DIGITAL OUTREACH

20. In 2021, the Centre continued to extend its outreach to stakeholders, policy makers and institutions through digital tools including Facebook (facebook.com/UNAPCTT) and Twitter. The Centre coordinated with Communications and Knowledge Management Section of ESCAP to disseminate information about its activities and outputs through ESCAP newsletters and twitter updates.

CHAPTER 7: INFORMATION TECHNOLOGY AND E-GOVERNANCE

INFORMATION TECHNOLOGY AND e-GOVERNANCE (ITeG)

1.0 INTRODUCTION

Information Technology and e-Governance (IT-eG) group was formed during mid of the 10th Plan period in order to create an IT enabled work environment in the Department through accelerated usage of various Information Technology opportunities. Primary aim of ITeG was to convert the existing procedures and processes into citizen centered. IT-eG division implements e-Governance in the Department progressively that needs be in conformance to the National eGovernance Action Plan. IT-eG Division operates on a separate IT Budget Head under Secretariat Economic Services during FY 2021-2022 for the implementation of activities carried out by the division.

2.0 IT ACTION PLAN

For IT and e-Governance activities a comprehensive IT-Action Plan in the department as formulated in line with the Government directions issued from time to time.

- Infrastructure Development: Provide and maintain Personal Computers (PCs) and other essential IT- equipment and software to all the functionaries.
- Networking: Up gradation, extension and maintenance of the Local Area Network (LAN).
- Office Automation: Implement various applications software that not only maintain records of receipt, issue of letters and movement of files but also offer enhancement in accountability, responsiveness and transparency in governance.
- IT Training: Provide relevant training courses to the officers/ staff that enable them to work on computers by using application software developed.
- e-Reports: Convert the Acts, Rules, Circulars and other published materials of interest or relevance to the public in the electronic form.
- DBT Mission: Online integration of schemes of DSIR with DBT Mission portal
- Website: Enrich the contents of the DSIR website by including downloadable forms and guidelines relevant to various citizen services that Department provides.

3.0 IMPLEMENTATION OF e-OFFICE IN DSIR

Department has successfully implemented e-Office developed by National Informatics Centre (NIC) at *https://dsir.eoffice.gov.in*. e-Office is one of the key IT projects of National Informatics Centre (NIC) aimed at improving

internal efficiencies in an organization through electronic administration leading to informed and quicker decision making which in turn results in better public service delivery. It is a complete digital work place solution for Government offices and is based on Central Secretariat Manual of e-Office Procedures (CSMeOP) formulated by Department of Administrative Reforms & Public Grievances (DAR&PG) e-Office provides a convenient way for officials to access information related to every aspect of their working and knowledge sharing by presenting a single gateway to information and services.

4.0 DSIR WEBSITE

The DSIR Website (Bilingual) has been made compliant to the Guidelines for Indian Government of Websites (GIGW). The website has been regularly updated and has been visited more than **4.15 Lakhs times since 6 August 2018.**

https://www.dsir.gov.in

https://www.dsir.gov.in/dsirhindi/

The new website for DSIR with integration of Content Management Framework (CMF) at http://164.100.166.67, the migration of the current to new website is coordinated by NIC, CMF team and the Department of Scientific & Industrial Research is in its final phase of development.

CHAPTER 8: IMPLEMENTATION OF RTI Act 2005

IMPLEMENTATION OF RTI Act 2005

The Right to Information Act 2005, enacted on 15th June 2005, has been implemented successfully in the department. As per the provisions of the RTI Act 2005, following officers are designated:

Appellate Authority	Ms Kamini Mishra, Scientist 'F' Department of Scientific and Industrial Research Room No 20, S&T Block 3, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26529753, 26590455 Fax: 26960629 ksm[at]nic[dot]in
Transparency Officer	Dr Prabhat Kumar Dutta, Scientist 'F' Department of Scientific and Industrial Research Room No. 43, S&T Block 3, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26534823, 26590394 Fax: 26960629 pkdutta[at]nic[dot]in
Nodal Officer and Central Public Information Officer	Shri Vimal Kumar Varun, Scientist 'F' Department of Scientific and Industrial Research Room No 14-B, S&T Block 1, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26516078, 26590416 TeleFax: 26516078 vkv[at]nic[dot]in

The proactive disclosures under Section 4 (1) (b) of the RTI Act 2005 enacted on June 15, 2005 are regularly updated [Last Updated on 27/12/2021] and available on the DSIR Website at *http://www.dsir.gov.in*. DSIR has complied with the directives received from Central Information Commission. RTI Requests and First Appeals received and their responses are available on DSIR Website.

http://www.dsir.gov.in/#files/rti-dsir.html

http://www.dsir.gov.in/dsirhindi/#files/rti-dsir.html

DSIR has received **130** Applications during 01/01/2021 to 31/12/2021 and all the Applications were registered and disposed off on RTI Request & Appeal Management Information System at *https://rtinonline.gov.in/RTIMIS*. During 01/01/2021 to 31/12/2021, **7** applications were registered as first appeal and **no** application was registered as second appeal.

The Division provided technical support by way of lectures on 'RTI Act 2005 and its Implementation' covering RTI Act 2005, Proactive Disclosures under Section 4 (1) (b) of the RTI Act 2005, RTI Online Portal, RTI Annual Return Information System and Transparency Audit during

- Talk on **Right to Information Act: An Overview** during *Induction Programme for Newly Recruited Scientists* organized by Council of Scientific and Industrial Research-Human Resource Development Centre (CSIR-HRDC), Ghaziabad during 8 March 2021 on online using MS Team.
- Talk on **Right to Information: Technicalities Effective Implementation** organized by Council of Scientific and Industrial Research-Indian Institute of Petroleum (CSIR-IIP), Dehradun during on 18 October 2021 on online using MS Team.

DSIR has been effectively using various IT applications like RTI Request & Appeal Management Information System at *http://rtionline.gov.in/RTIMIS,* RTI Annual Return Information System at *https://dsscic.nic.in/users/pn-login* wherein quarterly returns were uploaded regularly.

CHAPTER 9: AUTONOMOUS BODIES

AUTONOMOUS BODIES

1. COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR)

1.1 MAJOR COVID-19 CONTRIBUTIONS

CSIR, with its strong network of 37 laboratories across India and multifarious portfolio of technologies and interventions, has deployed its might to tackle the outbreak of SARS-CoV-2 in India. CSIR has been working in five interdisciplinary verticals in close synergy with other government departments, and with Industry, MSMEs, and others for scale-up, delivery, and implementation of technologies on the ground.

CSIR's five technology verticals for addressing the emerging situation due to pandemic have been need-based and span multiple research labs and disciplines and draw upon the strength of scientists, students, and harness it for the fight against Covid-19. The five technology verticals are:

- **Digital and Molecular Surveillance**
- **Rapid and Economical Diagnostics**
- **New Drugs / Repurposing of Drugs**
- **Hospital Assistive Devices and PPEs**
- **Supply Chain and Logistic Support**

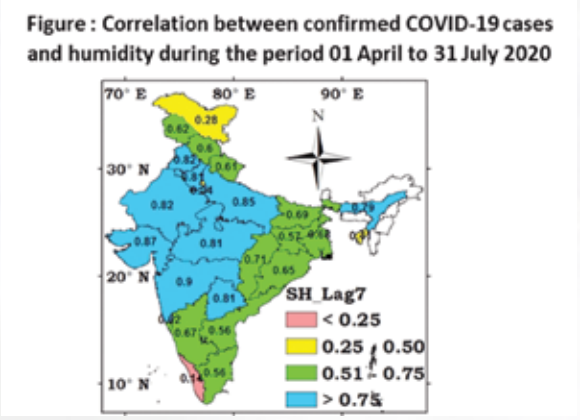
Besides, CSIR is also working on promoting rural employment and providing ready to eat food to migrants and other outreach programs.

Digital and Molecular Surveillance

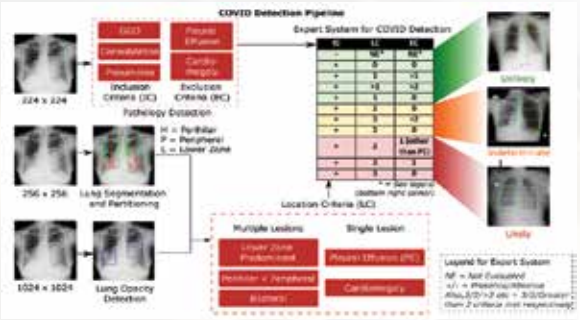
Development of Weather Integrated deep learning model for COVID-19 case prediction for India.

The COVID-19 pandemic has become a severe public health issue all over the globe including India. Airborne transmission is one of the principal modes by which people are infected with SARS-CoV-2 due to the inhalation of very fine respiratory droplets and aerosol particles. Environmental factors like temperature and humidity can influence the spatial and temporal distribution of the virus in India due to the wide variety of climatic conditions. The correlation analysis was performed by CSIR-4PI to understand the relationship between the humidity and COVID-19 cases over different states in India. We have also developed a forecasting model using the weather data and a deep learning model of LSTM (long short-term memory). The study found that the specific humidity has a strong positive correlation, whereas there is a negative correlation with maximum temperature, and a positive correlation with minimum temperature was observed in various geographic locations of India. The study observed that the specific humidity played a crucial role in improving the forecast skill majorly in the West and northwest region of India. Similarly, the temperature played a significant role in model enhancement in the Southern and Eastern regions of India.

Figure : Correlation between confirmed COVID-19 cases and humidity during the period 01 April to 31 July 2020



Validation of expert system enhanced deep learning algorithm for automated screening for COVID Pneumonia on chest X rays



SARS-CoV2 pandemic exposed the limitations of artificial intelligence based medical imaging systems. Earlier in the pandemic, the absence of sufficient training data prevented effective deep learning (DL) solutions for the diagnosis of COVID-19 based on X-Ray data. Here, addressing the lacunae in existing literature and algorithms with the paucity of initial training data; we describe CovBaseAI, an explainable tool using an ensemble of three DL models and an expert decision system (EDS) for COVID-Pneumonia diagnosis, trained entirely on pre-COVID-19 datasets. The performance and explainability of CovBaseAI was primarily validated on two independent datasets. Firstly, 1401 randomly selected CxR from an Indian quarantine center to assess effectiveness in excluding radiological COVID-Pneumonia requiring higher care. Second, curated dataset; 434 RT-PCR positive cases and 471 non-COVID/Normal historical scans, to assess performance in advanced medical settings. CovBaseAI had an accuracy of 87% with a negative predictive value of 98% in the quarantine center data. However, sensitivity was 0.66–0.90 taking RT-PCR/ radiologist opinion as ground truth. This work provides new insights on the usage of EDS with DL methods and the ability of algorithms to confidently predict COVID-Pneumonia while reinforcing the established learning; that benchmarking based on RT-PCR may not serve as reliable ground truth in radiological diagnosis. Such tools can pave the path for multi-modal high throughput detection of COVID-Pneumonia in screening and referral.

Rapid and Economical Diagnostics

Commercialization of RNA extraction free one step RT-PCR method of COVID-19 testing

A diagnostic method has been developed by CSIR of collecting nasal swab in dry mode (Dry Swab) and direct RT-PCR without the step of RNA isolation. Omission of RNA isolation and proceeding directly to RT-PCR gives comparable results to routine RT-PCR and this method has been approved by ICMR. The first commercial kit of CSIR-CCMB's RNA extraction free one step RT-PCR has been launched by Meril Diagnostics in Sept, 2021. This method particularly helps in transportation and sample handling and cuts down the time and cost significantly, also eliminating inventory requirements related to RNA isolation and Viral Transport Media while enhancing the safety of testing personnel from infected samples that might have leaked in transit. Around 150 labs have been trained by CSIR-CCMB in COVID-19 diagnostics using the RNA extraction free one step RT-PCR method.

Culturing of SARS-CoV-2 and discovery of potent SARS-CoV-2 inhibitors assisted by high throughput antiviral screening and testing facility

CSIR-CCMB has been actively involved in isolating and culturing SARS-CoV-2 from Indian patients. Using these viral isolates, we have established cell-based assays to screen potential antiviral compounds/solutions. In addition, we also isolate and culture SARS-CoV-2 variants circulating in the country. Based on our data, CCMB has identified few hits that have shown promising antiviral activity in our assays. CSIR-CCMB has supported other CSIR labs and extended our support to the ongoing drug discovery efforts for other Indian academic institutions and industries which is an essential step in drug discovery.

Development of Indigenous qRT-PCR Diagnostic Kit (INDICoV) for COVID-19 with MAKE-IN-INDIA Ingredients

A team of CSIR-CDRI designed and synthesized known and new fluorescent probes, quenchers and their oligonucleotide conjugates useful for RT-PCR and lateral flow assay based diagnosis of COVID-19. Subsequently, under Public-Private partnership mode, in collaboration with M/s. Biotech Desk Pvt Ltd, Hyderabad, CSIR-CDRI team developed technology for novel fluorescent dye and quencher. Industry partner has developed real-time PCR Kit for COVID-19 Detection, which has been submitted to ICMR for validation and approval.

COVID Sample Testing Service

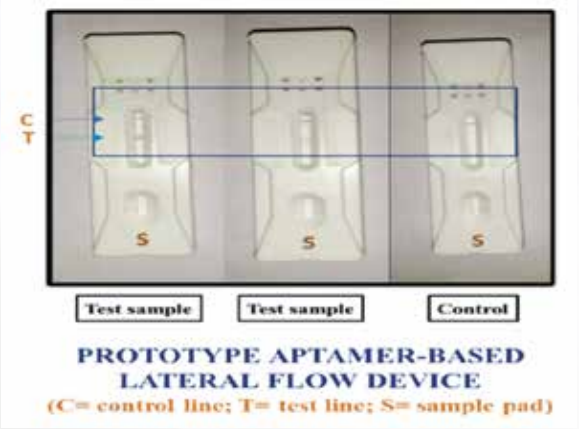
Several CSIR labs across the country have carried out RT-PCR testing in the country. As many as 20 lakh samples were tested by CSIR labs from the beginning of the pandemic. In addition to testing CSIR labs have supported state governments by training and capacity building

Multi-institutional collaborative project titled "Rapid, Specific and Sensitive Electrochemical Biosensor for COVID-19 Infection"

The project has been carried out by CSIR-CECRI in association with ICMR-NIRT, Chetpet and Dr. M.G.R Educational & Research Institute, Chennai funded by DBT. Cost-efficient disposable screen-printed electrode modified with durable redox-active sensor element suitable for point-of-care analysis has been fabricated. As-developed indigenous oligopeptide based biosensor platform showed promising selectivity, and sensitivity for real COVID-19 sample detection and quantification.

Objectives of the work includes design and development non-invasive electrochemical biosensor platform for selective tracing of SARS-CoV-2 protein, antigenic region, without complex sample pre-treatment at affordable cost convenient for decentralized hospital zone utility. Validate the electrochemical biosensor in detection of SARS-CoV-2 infection in clinical specimens and detecting the sensitivity and specificity of biosensor.

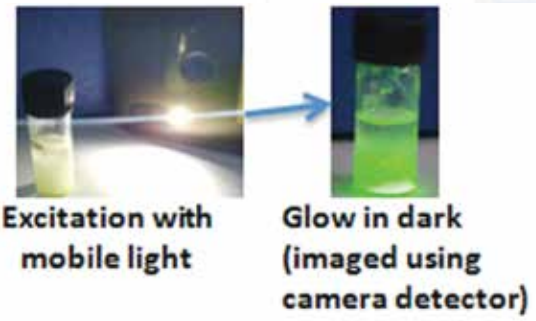
Development of aptamer for recombinant SARS-CoV-2 spike glycoprotein S1



Codon optimized recombinant S1 protein of SARS-CoV-2 was successfully expressed in Pichia pastoris. DNA aptamers against the viral antigenic protein were generated using a novel SELEX protocol. A prototype aptamer-based lateral flow device has been developed in collaboration with Industrial partner. Presently, the prototype is being validated by CSIR-CFTRI with real samples for its application in Covid 19 diagnostics.

Development of PCR free, facile luminescence based kit for ultra-sensitive detection of Covid-19

CSIR-NIIST is carrying out a DBT project on design, synthesis and characterization of pcMNP (poly - (amino ester) with carboxyl groups- (PC)-coated magnetic nanoparticles), ALNPs (after glow nano particle), custom primers and ALNP tagged primers.



Repurposing of Drugs, Vaccine and Convalescent Plasma Therapy

Vaccine and therapeutics development by CSIR-CCMB

BPL-inactivated SARS-CoV-2 particles were mixed with FCA and injected intramuscularly into the equines. Immunization was repeated on the days mentioned in the scheme. Plasma collected from the immunized animals were pooled, their antibody response was assayed, and virus neutralization titer was quantified by microneutralization assay. Subsequently, IgG was purified from the pooled plasma, digested with pepsin and the F(ab')2 fragment was purified. Neutralization titers of these purified and concentrated fragments were also assayed. (B) Neutralization capacities of F(ab')2 generated from pooled antisera against different variants of SARS-CoV-2. Micro neutralization assays were and the data are represented as CCID50.

Development of Non-Infringing Process for Camostat Mesylate at 25 g scale

CSIR-CSMCRI has achieved the process for two key intermediates of camostat mesylate, 4-hydroxyphenylacetic acid N, N-dimethyl carbamoyl methyl ester (Int –I) and 4-guanidinobenzoic acid hydrochloride (Int –II) successfully. The present process is very much clean giving excellent yield and purity for both the compounds of Int -I and Int –II. The present process is cost-competitive as it utilizes low-cost starting materials, reagents and solvents. The process is consistently reproducible and easily scalable up to multi gram level providing comparable yields and purity, hence, reliable to industrial applications. Both Int-I and Int-II have been prepared at 50 g batch and are ready at 100 g level with purity >99% each.

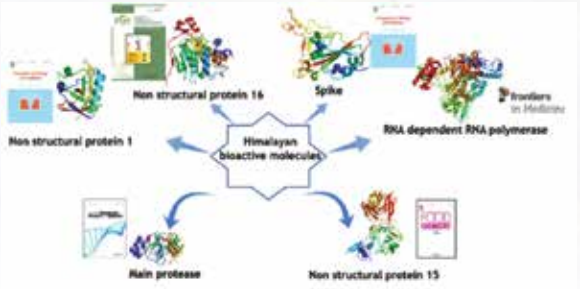
The coupling of 4-hydroxyphenylacetic acid N, N-dimethylcarbamoylmethyl ester (Int-I) and 4-guanidinobenzoic acid hydrochloride (Int-II) is performed by modifying the literature procedure. Demonstration at 10 g scale is ready with a minimum purity of 97% with respect to camostat mesylate

Identification of potential plant bioactive as SARS-CoV-2 Spike protein and human ACE2 fusion inhibitors

The Spike receptor binding domain (S-RBD) from SARS-CoV-2, a crucial protein for the entrance of the virus into target cells is known to cause infection by binding to a cell surface protein. Hence, reckoning therapeutics for the S-RBD of SARS-CoV-2 may address a significant way to target viral entry into the host cells. Herein, through in-silico approaches (Molecular docking, molecular dynamics (MD) simulations, and end-state thermodynamics), we aimed to screen natural molecules from different plants for their ability to inhibit S-RBD of SARS-CoV-2. We prioritized the best interacting molecules (Diacetylcurcumin and Dicaffeoylquinic acid) by analysis of protein-ligand interactions and subjected them for long-term MD simulations. We found that Dicaffeoylquinic acid interacted prominently with essential residues (Lys417, Gln493, Tyr489, Phe456, Tyr473, and Glu484) of S-RBD. These residues are involved in interactions between S-RBD and ACE2 and could inhibit the viral entry into the host cells. The in-silico analyses indicated that Dicaffeoylquinic acid and Diacetylcurcumin might have the potential to act as inhibitors of SARS-CoV-2 S-RBD. The study has been carried out by CSIR-IHBT.

Identification and validation of potentially bioactive molecules from Himalayan bioresources against SARS-CoV-2

CSIR-IHBT has a rich Himalayan plant repository that has been screened using biocomputational tools to identify potential plant-based molecules having strong activity against SARS-CoV-2 proteins including main protease (Mpro), spike protein, non-structural proteins (NSP1, NSP15, and NSP16), and RNA dependent RNA polymerase. The inhibition potential of some of the molecules was validated by performing in-vitro interaction studies of these molecules with main protease (Mpro) and Spike proteins of SARS-CoV-2. Some of these molecules were further tested against the live virus in collaboration with CSIR-CCMB, Hyderabad. A tea molecule was identified as a potential inhibitor of SARS-CoV-2 and its detailed mechanism of action on viral proteins was studied (Manuscript under communication). The anti-SARS-CoV-2 potential of Cissampelos pareira L. (commonly known as "Patha" or "Laghupatha" in Ayurveda) was also studied in a collaborative manner with CSIR-IGIB and CSIR-CCMB. The root extract, whole plant extract and its molecule pareirarine exhibited 97%, 98%, and 83% viral reduction at concentrations of 200 µg/ml, 200 µg/ml, and 200 µM, respectively. One of the molecules from Himalayan plants exhibited 99% inhibition of SARS-CoV-2 at a concentration of 6.5 µM.



Process Development of Drugs Repurposed for COVID-19

Process developed for Nitazoxanide, EIDD 1931 & EIDD 2801 by CSIR-NIIST. Non-infringing routes developed for the APIs. Nitazoxanide is currently under clinical trials in Mexico. EIDD 2801 is currently under clinical trials in USA & UK

Hospital Assistive Devices and PPEs

AMPRICARE: Instantaneous hypochlorite generator using kitchen salt

The device produces disinfectant solution that can be used to clean the surfaces and make them free from viruses, bacteria. The device has wide application in the hospitals, local offices like banks, post offices, schools where surfaces needs to be frequently cleaned. The device is very useful in COVID 19 fight.

HVAC Ducting System for Integration of Covid-19 Disinfection Solutions

Various labs of CSIR have developed technologies to dis-infect Covid-19 Virus. CSIR – CSIO has developed a dis-infection based on UVC light of 254 nm spectrum to inactivate the RNA molecules of the Covid-19 virus. CSIR – NEERI has developed Indoor air purification scrubber system. Similarly CSIR – CIMAP and CSIR – CFTRI have developed Essential Oil based Disinfectant solutions. However the efficacy of these disinfectant solutions for their applications in real buildings is not validated. To validate the efficacy of these technologies, CSIR – CBRI has developed a HVAC Ducting System to integrate various dis-infectant technologies into the HVAC ducts of buildings.

In order to overcome the Technical challenges a HVAC Ducting System has been designed and developed at CSIR – CBRI to scale up the various Covid-19 Disinfection solutions developed by various CSIR laboratories.

(i) CSIR-CBRI, Roorkee team along with team of CSIR-CSIO and CSIR HQ retrofitted the UVC in Lok Sabha Hall and Central Hall of Parliament House, New Delhi. (ii) Team CSIR-CBRI and CSIR CSIO has retrofitted UVC in auditorium of CSIR Hq, New Delhi. (iii) The NDA has been signed between CSIR and EESL for the deployment of the disinfectants solutions developed by CSIR for commercialization to various hospitals, schools and other commercial buildings. (iv) RDSO, Lucknow and MCF Lalganj, U.P have expressed interest to deploy the Covid-19 disinfectant solution technologies in the HVAC system of the train coaches. Signing of NDA is in process.

Fig: HVAC Ducting System a) Air Handling Unit and b) Duct system with integrated Disinfectant solutions

Air Disinfection & Purification System for Indoor Applications

An air disinfection and purification system is developed to disinfect the air from various micro-organisms as well as purify the air from various air pollutants inside indoor spaces. The apparatus developed by CSIR-CBRI includes an outer frame, a co-axial cylindrical structure and base plate where in the fan draws the supply air from the inlet ports on the outer frame, and then from the tangential inlet ports into the co-axial cylindrical structure, and finally delivers purified and disinfected air into the indoor space. The tangential inlet ports make the supply air to swirl inside the co-axial cylindrical structure increasing the retention time of supply air flow inside the device. The UV chamber formed due to radial curvature walls of the co-axial cylindrical structure promote multiple UV reflections and thus significantly increasing the UV dosage inside the UV-C chamber. Similarly, in some other embodiments, the UV-C chamber is also converted as Photo-catalytic reactivity chamber where in, the external walls of the UV-C chamber are provided with substrates coated with photo catalytic oxidation materials. The reaction efficiency of the photo catalytic reaction chamber is increased due to increased retention time, centrifugal force exerted by supply air on the substrate and enhanced UV-C dosage and thus significantly improving the efficiency of air disinfection and purification system. Main outcome of the present invention is to provide a low cost Air Disinfection and Purification System for Indoor Applications with Enhanced Retention Time, UV Dosage for Disinfecting Virus and Airborne Pathogens.

CIM-RespCool

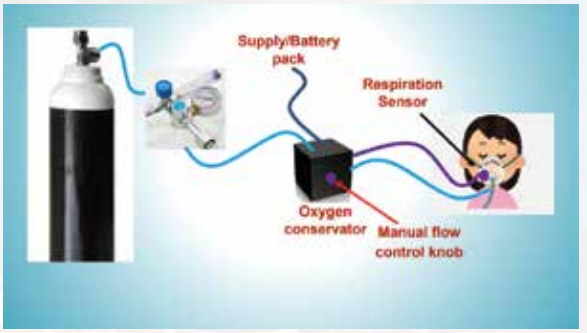
CSIR-CIMAP has developed diffuser formulation, which incorporates 5 essential oils from traditionally used herbs and spices, however, the selection is based on the text mining of the anti-viral activity possessed by the molecules present in these essential oils. These plants and (or) essential oils are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

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

Oxygen Optimiser (Oximiser)

As India battled during the second wave of COVID-19 pandemic, huge demand for medical oxygen has underlined the importance of Oxygen generation and its optimal use during the treatment. In order to keep the oxygen levels of patient within the desired normal range, the medical oxygen is provided continuously while breathing i.e. inhalation and exhalation pha se. The developed device incorporates a technique to save and use the oxygen optimally during the treatment of the patient. It is an active oxygen conservation device to reduce the wastage of oxygen during exhalation time of the patient undergoing oxygen therapy. It senses the inhale / exhale cycle of the patient and controls the oxygen supply in the mask accordingly. The device helps in reduced oxygen consumption as it is available at the mask during the inhalation cycle only thereby saving the oxygen being released to the mask and wasted during exhale cycle. It has a low cost indigenous disposable Breath sensor and mask combination.

There is provision of user adjustable continuous oxygen flow parallel line for delivering constant amount of oxygen in the mask during the exhale cycle. The device can provide continuous 100% oxygen supply in case of any malfunction.The technology has been developed by CSIR-CSIO.



V-Treat Breathing and Scavenging Device

WHO in the beginning of Year 2021 declared COVID 19 virus as air borne, making it clear the increased infection of COVID in

crowded and poor ventilated spaces, and also clearly explain super spreader events. Moreover, improper ventilation in ICUs further increase the risk of virus infection amongst medics. Even with good HVAC, the virus may be pushed by air flow to humans instead of getting dispersed, and definitely not killed instantly. The PPE worn by Medics especially N95 cause discomfort in breathing and feeds back build up CO2. On the other hand, mutants multiplying at a faster rate with more deadly mutants causing Covid-19 calamity waves. For the safety of front liners, it is important that they should be given a breathing solution while discharging their duty. In line to this, CSIO and Ideamines Pvt. Ltd. has co-developed pressurized purifying breathing and virus destruction device. The present device use three stage disinfection mechanics, namely, UVC 254 action and filtration. The 3-liter wearable device is designed to provide enough dosage and treatment to air to disinfect the air from virus. The device can be operated at 6 LPM and up to ~56 LPM. Currently, there are two version of the device i.e. (a) Dry Unit and (b) Wet Unit. The dry unit is for doctors and wet unit is for patients. The wet unit is for virus destruction from the patients exhale air uses an additional treatment of air with a chemical formulation. The technology has been developed by CSIR-CSIO.

Testing Facility for IR Forehead Thermometer

CSIR-NPL has successful developed Testing facility for IR Clinical Thermometers as per International Standards and tested about 70 Models for Department of Legal Metrology by March 2021. Supported about 6 MSMEs who are manufacturing the thermometers in India by standardizing their blackbodies.

Supply Chain and Logistics Support Systems

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

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

Development of Portal

CSIR COVID-19 Portal (https://covid19csir.urdip.res.in/) - To showcase CSIR India's contributions towards fight against

COVID-19, CSIR-URDIP had developed a dedicated portal. This provides information about CSIR India's strategy, products, technologies and other social initiatives in fight against COVID-19.

Patentability Assessment, Freedom to Operate and Prior Art Reports

1. URDIP has suggested to have technical advancements on the following areas:
    - Method for oxygen enrichment in terms of the way of arrangement of the system & use
    - Effect of pressure/vacuum swing adsorbents on concentration and purity of end product.
2. URDIP FTO report on ""Hybrid Adsorption-Membrane Separation System for Enriching Medical Grade Oxygen from Air"" has found that, the technology disclosed by CSIR-IIP/ NCL has not been found in claims of any active high and medium relevant Indian patents. Hence this technology may be practiced in India.
3. Provided an overview on the closest prior art references and assessed the patentability aspects for "The process for preparing the active pharmaceutical ingredient EIDD 1931" which CSIR-NIIST aims to reposition and use for treating COVID-19.

1.2 AREA-WISE SIGNIFICANT S&T CONTRIBUTIONS

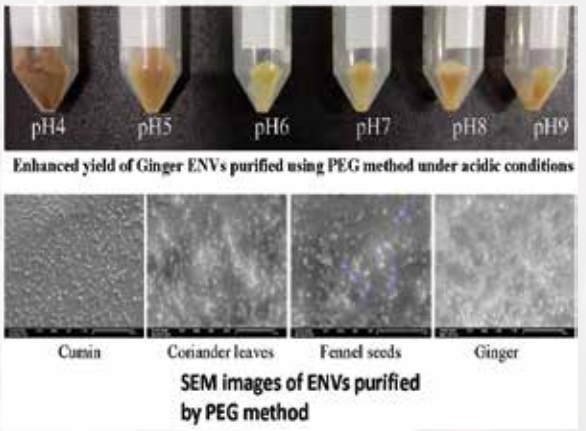
1.2.1 Biological Sciences

Development of guidelines for DNA research

Rapid growth of ancient DNA research and its impact on archaeology and other fields has prompted the need for developing universally acceptable ethical standards to govern such research. These discussions have led the scientific community to consider best practices for sampling of human remains and carrying out scientific analysis in a way that is aligned with the various stakeholder groups. However, appropriate approaches to working with human DNA differ across world contexts.

This has led a diverse set of 64 scholars from 31 countries who are actively involved in ancient DNA research to develop a set of guidelines. The diversity of authors has been an effort towards embracing the complexities across the world. The guidelines have been published in the science journal Nature. CSIR-CCMB and DBT-Centre for DNA Fingerprinting and Diagnostics, offered inputs from an Indian perspective in developing the guidelines.

Cost effective process development for the purification of edible nano vesicles from ginger rhizomes



Edible nanovesicles (ENVs) are exosome-like vesicles found in dietary plants. ENVs contains plant bioactives in bioavailable form. Conventionally ENV purification requires differential ultracentrifugation which is not a scalable method. CSIR-CFTRI developed cost-effective polyethylene glycol (PEG6000)

based method to purify ginger ENVs under acidic condition.

An exploratory trial of food formulations with enhanced bio accessibility of iron and zinc aided by spices

Iron deficiency anaemia and zinc deficiency have continued to be major nutritional problems in developing countries in all age groups including children. Poor bioavailability of minerals from plant foods due to presence of phytic acid is identified to be the major etiological factor. Complementary food mixes (CFM) and Indian flat bread mixes (IFBM) comprising of cereals and pulses were formulated in the Institute. Bio accessibility of iron and zinc was enhanced by dephytinisation of the mixes by thermal treatment and further promoted by addition of acceptable spices at 1-2% level. Among the spices tested, cumin enhanced the in vitro protein digestibility to the maximum extent followed by fennel, cumin and ajwain. Ajwain and fennel enhanced the bio accessibility of iron in CFM and cumin in IFB to a significant extent. Fennel enhanced the bio accessibility of zinc to a maximum extent in both the products. On the whole, spices enhanced the bio accessibility of iron by 3-6 fold in CFM and 1.7-2.5 fold in IFBM and zinc bio accessibility was enhanced by 1.2-2.0 fold in both the products. The increased bio accessibility of iron and zinc in the products can be attributed to degradation of phytic acid, release of minerals entrapped in the food matrix by thermal treatments and improved digestibility of starch and protein hydrolysis by the spices. Addition of spices to these formulations at sensorial acceptable levels is a promising food based approach for alleviation of iron and zinc deficiencies.

Establishment of Aarogya Vatika in Lucknow

Aarogya Vatika programme was jointly started by CSIR-CIMAP and Nav Bharat Times (NBT), Lucknow with the help of Lucknow municipal board, Lucknow. In this plantation drive mission programme, several important medicinal and aromatic plants of authentic variety were planted in various parks, government offices, academic institutions and police commissioner ate office including 40 police stations of the Lucknow city. In this programme Director CSIR-CIMAP, ministers, Mayor of the Lucknow, scientific & academic dignitaries, social workers, News &TV reporters, NBT reporters & their team and residents participated actively.

In this Arogya vatika, people can get information about the herbs for their medicinal values, health and environmental benefits. More than 100 Arogya Vatikas were established in vicinity of the Lucknow city with the aims to create awareness about the pivotal role of the plant in the wellness of the human body.

Plantation of Dalchini

CSIR-IHBT introduced Dalchini (*Cinnamomum verum*) for the first time in H.P. at Village Kholin, Distt. Una. This was a step towards its organized cultivation and making India Aatam Nirbhar in its production. This project is being implemented in association

with ICAR-Indian Institute of Spice Research and Dept. of Agriculture, H.P.

Plantation of Dalchini started at village Kholin and Tanoh, Una on September 29, 2021 in the presence of Minister of Rural Development, Panchayati Raj, Agriculture, Animal Husbandry, Fisheries, Govt. of Himachal Pradesh and Dr. Sanjay Kumar, Director, CSIR-IHBT, and Department of Agriculture along with progressive farmers of the region were also present at the time of plantation.

Prickle morphogenesis in rose is coupled with secondary metabolite accumulation and governed by canonical MBW transcriptional complex

Rose is an economically important flowering plant holding an essential place in cut flower, medicinal, and aromatic industries. Though prickles have a role in protection against herbivory, they present a barrier for harvesting and transportation of this plant. Attempts have been made to select natural prickle less cultivars, however it yielded only chimeric cultivars. To resolve this issue, CSIR-IHBT attempted to unveil the molecular components involved in prickle morphogenesis, which could be targeted to develop genetically engineered prickle-less roses. It has been revealed that prickles are vasculature less epidermal outgrowths resembling trichomes, and accumulate secondary metabolites, especially lignin and flavonoids, during morphogenesis. Transcriptome analysis during developmental demonstrated that upregulation of a hormone-regulated transcriptional activation-inhibition network, known to govern trichome morphogenesis, likely triggers the differentiation of epidermal cells to outgrow into prickle. Further characterization of identified transcriptional module is underway.

CSIR's Sickle Cell Anaemia Mission

CSIR-CCMB has developed a comprehensive protocol for screening, treating and counselling sickle cell anaemia carriers and patients among school children in Maharashtra, Chhattisgarh, Madhya Pradesh and Jharkhand. Efforts are underway to establish Sickle cell institute of Chhattisgarh as the base centre for sickle cell anaemia related activities in Chhattisgarh. CCMB has a tripartite collaborative agreement with Nagpur Municipal Corporation and SMMEWF, a charitable trust to expand the activities in sickle cell research in Maharashtra. So far, they have screened 4 lac children, found 40,000 carriers and 4000 newly identified patients of sickle cell anaemia.

CSIR-Aroma Mission –II

With the launch of second phase of Aroma mission at CSIR-IHBT, area extension under aromatic crops was further consolidated to 1008 ha particularly targeting the hill regions of the country and enhancing indigenous production of aromatic oils (11.21 tonnes) in 2021 leading to revenue generation of 5.49 crores. Hand-holding and support to the farmers growing aromatic crops (51 farmer groups in form of registered societies involving 997 farmers) through end-to-end technologies in form of quality plant material (QPM), trainings on cultivation practices and processing of aromatic crops for the production of aromatic oils and establishing new linkages between farmers and industries for a ready market access of the produce.

Twenty-five lakh rooted plants and one thousand three hundred and fifty kg of seeds was generated and supplied to the farmers. Eight new field distillation units were provided in the farmers' fields for extraction of essential oils in Himachal Pradesh, Uttarakhand and union territory of Jammu & Kashmir. All the fifty distillation units installed during the first phase of the Aroma mission program are also functional. On account of institute's interventions, Himachal Pradesh is the highest producer of wild marigold oil in the country with production potential of 6.5 tonnes of oil annually.

CSIR Floriculture Mission

Under Floriculture Mission, 102 ha area brought under cultivation of flower crops, benefitting around 350 farmers in Himachal Pradesh, Uttarakhand, Punjab and Ladakh states. Area covered by different flower crops like marigold, gladiolus, chrysanthemum, gerbera, carnation, lilium tuberose, loose rose, Limonium, gypsophila and calla lily.

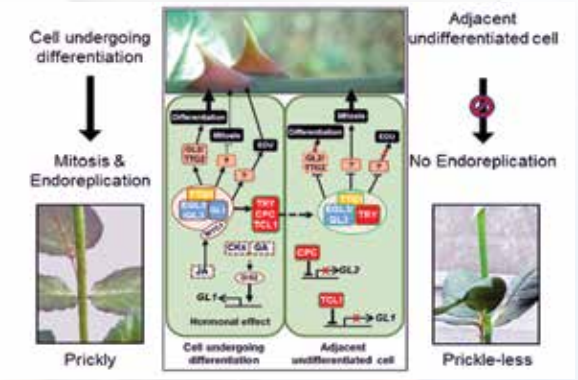
India is eighth largest producer of honey and exports approximately 61 million metric tons globally worth Rs. 800 crores annually. The honey market in India is estimated to reach Rs. 2800 crores by 2024 at compounded annual growth rate of 10.2%. Conventional honey production involves series of extraction steps that uses heat and dehumidification assisted with centrifugal extraction process. This involves several manual and semi-automatic steps leading to uncertain quality standards. In addition, traditional methods are time consuming, labour intensive and cause high mortality of honey bees leading to poor honey quality fetching lower market price. This necessitates development of improved bee hive with inbuilt mechanisms for hygienic honey extraction. In this context, CSIR-IHBT in collaboration with CSIR-CSIO developed improved bee hive for hygienic extraction of honey. Several value added products also developed around honey like Honey chocolate syrup, Honey powder, Honey Rosgulla & Gulab Jamun, Honey Tea concentrate, Honey fruits Preserve, Honey Jelly (lemon & Chocolate), Honey fruit Barfi and Honey Khamboocha. Checking these

advantages, CSIR has identified apiculture and honey production as industry of national importance and dedicatedly put these activities in CSIR-Floriculture and Aroma Mission.

1.2.2 Chemical Sciences

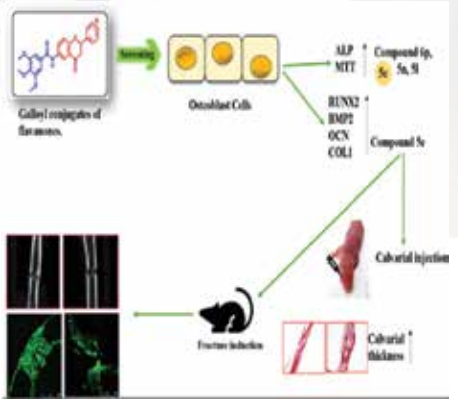
Synthesis and Evaluation of Galloyl Conjugates of Flavanones as BMP-2 Upregulators with Promising Bone Anabolic and Fracture Healing Properties

The molecular hybridization concept led us to design a series of galloyl conjugates of flavanones that have potent osteoblast differentiation ability in vitro and promote bone formation in vivo. An array of in vitro studies, especially gene expression of osteogenic markers, evinced compound 5e as the most potent bone anabolic agent, found to be active at 1 pM, which was then further assessed for its osteogenic potential in vivo. From in vivo studies on rat calvaria and a fracture defect model, we inferred that compound 5e, at an oral dose of 5 mg/(kg day), increased the expression of osteogenic genes (RUNX2, BMP-2, Col1, and OCN) and the bone formation rate and significantly promoted bone regeneration at the fracture site, as evidenced by the increased bone volume/tissue fraction compared with vehicle-treated rats. Furthermore, structure–activity relationship studies and pharmacokinetic studies suggest 5e as a potential bone anabolic lead for future osteoporosis drug development.



Development of Thermal Barrier Coatings for Casing material of Box Furnace / M/s. GAIL (India) Limited, Noida

Study of the hot spot formation time on mild steel GAIL ceramic module using a standard test method for steady- state heat flux measurement (ASTM C 177). Study on the root cause analysis on the formation of openings in thermal insulation. Study of the effect of thermal barrier coatings on the hot spot formation rate or time on mild steel box furnace.



Application of high temperature filler materials to join the ceramic modules and study the effect of filler materials on the detachment or opening of joined ceramic modules. Introduction of molybdenum or cerium nano-particles to the high temperature filler materials and join the ceramic modules and study the effect on nanoparticles addition to the filler materials on the detachment problem. Demonstration of temperature drops with the role of nanoparticles containing high temperature filler materials and thermal barrier coatings.

Installation of corrosion monitoring sensors and initial measurements at NTPF, NFC. / M/s. Hindustan Dorr Oliver, Hyderabad

Preparation of indigenous corrosion monitoring sensors as per HDO ltd at CSIR-CECRI. Installation of above sensors at NTPF, NFC Hyderabad, Initial measurements on the newly installed sensor.

Based on the measurement taken from the earlier installed sensors and available leads present in the junction boxes (JB), the remaining sensors is to be installed. To take the lead from rebar & installed sensors by means of drilling and refilling the concrete structure with the approval of NFC, Hyderabad, The approval is obtained by the client i.e. HDO to carry the work at site. Provide a cabling, ducting and junction box (JB) at site.

Printed Electrochemical Sensor: Design, Development and Qualification on 2D Surfaces and Flexible Fabric materials / M/s. HCL Technologies Ltd., New Delhi

Selection of materials (conductive, Biocompatible. Enzymes, Buffering agents. Etc.), Pattern designing & fine tuning. Baselining activities for Printed Sensor design, qualification protocol. Understanding the electrical properties printed electrochemical sensors. Functional testing & qualification of fabricated sensors as per test protocol. Printing the electrochemical sensor with flexibility, conductivity, sensitivity. Optimizing the curing conditions of printed electrochemical sensor. Sensors calibration in buffered solution. Understanding the chemical and mechanical stability of the printed sensor. Testing printed sensor performance in real-world samples or simulated real-samples (like blood/serum/sweat/environmental water samples).

Development of 1.5 TPD oxy-blown pressurized fluidized bed gasifier with required operational

A 1.5 TPD oxy-blown pressurized fluidized bed gasifier with required operational philosophy to handle Indian coal, biomass has been developed by CSIR-CIMFR. Experience gained and data generated under this development will be utilized for installation of demo scale coal to methanol plants at different mine mouth locations.

Optimization of the spontaneous adsorption of Food Colors from Aqueous Medium using functionalized Chitosan/ Cinnamaldehyde hydrogel.

Bio-inspired hydrogels were formed using Cinnamaldehyde (natural defensive compound) and Chitosan (natural occurring bio-macromolecule). Hydrogels are considered as practical and proficient materials in adsorption and removal of soluble lethal molecules from aqueous system. The prepared hydrogel exhibited excellent adsorption activity towards food dyes, Carmoisine and Tartrazine. The adsorption performance was thoroughly screened at CSIR-CSMCRI by varying the pH, ChC dosage, dye concentration, contact time and temperature in aqueous system. Thermodynamic and Kinetics study suggest the natural tendency of adsorption with

a good reusability up to 3 cycles. These hydrogels have potential approach to control the toxicants for the water-pollution and water-preservation.

Process for the recovery of high purity salt from crudes containing sodium chloride and sodium sulphate

Tannery wastes processing results in solid residue (salt mixture) rich in mineral salts (primarily sodium chloride and sodium sulphate). In similar lines the solar salt produced in Rajasthan region is contaminated with sodium sulphate and thus is not suitable for edible or industrial purposes. In this context, a process to recover high purity salt (NaCl) and sodium sulphate (Na2SO4.10H2O) from crudes such as solid waste from tannery effluents and common salt produced from Rajasthan Lakes (India) containing sodium sulphate has been developed and demonstrated by CSIR-CSMCRI. The technology has been transferred. One plant has been installed at Didwana (Rajasthan). Installation of plant is in process at Common Effluents Treatment Plants of Tamil Nadu.

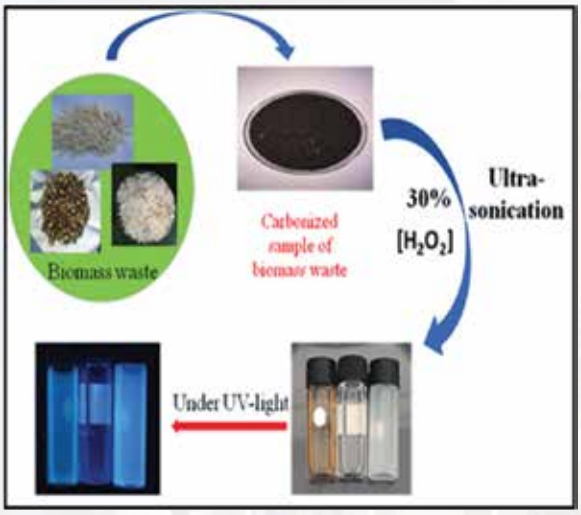
Rice straw (Oryza sativa L.) biomass conversion to furfural, 5-hydroxymethylfurfural, lignin and bio-char: A comprehensive solution

A sustainable, easy to operate, scalable, and chemically pre-treatments free method has been explored for rice straw (RS) biomass conversion to furfural, 5-hydroxymethylfurfural (5-HMF), lignin and bio-char production. Initially, the RS has been dipped into liquid nitrogen in a thermos flask and grinded easily to fine powder for better handling of biomass under reaction conditions in a reactor. The process also reduces the volume of biomass and enhances the surface area of RS biomass which has been analysed by SEM, TEM, IR, TGA and DSC, and further validated by its fruitful conversion to furfural, 5-HMF, lignin and bio-char synthesis in satisfied yields. The developed acidic process has been performed at 130 °C for 6 hrs under a closed reaction system in reflux conditions. The ultra-performance liquid chromatography (UPLC) purity of furfural and 5-HMF has been measured to >90% without additional purification technique. Moreover, the method has also been examined in 250-gram scale and found to perform well.

Blue-emitting fluorescent carbon quantum dots from waste biomass sources and their application in fluoride ion detection in water:

Carbon quantum dots (CQDs) are the most feasible allotropes of carbon-based nanomaterials which have unique characteristics of photoluminescence, bio-compatibility, and high stability. A green and eco-friendly approach has been propagated at CSIR-NEIST in the production of carbon quantum dots from biomass waste like sugarcane bagasse, garlic peels, and taro peels by ultrasonic-assisted wet-chemical-oxidation method. Biomass waste is considered to be a major pollutant to living beings when they get contaminated with land and water. The fabricated CQDs

have been characterized by High Resolution Transmission Electron Microscopy (HR-TEM), Fourier Transform Infrared (FT-IR) spectroscopy, X-ray Diffraction (XRD), and X-ray Photoelectron spectroscopy (XPS), The synthesized CQDs showed the characteristic photo-physical properties as confirmed from the UV-visible and fluorescence (FL) spectroscopy analysis. The synthesized CQDs are highly water soluble, possess strongly blue fluorescence under UV light with a quantum yield around 4-27 %. In addition, the resultant CQDs-Eu3+ nano probe have been promisingly used for fluoride sensing in water.



Transforming environmentally threatening hazardous industrial wastes into high value building materials

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

Abundance and characteristics of microplastics in commercially important bottom dwelling finfishes and shellfish of the Vembanad Lake, India

The Vembanad Lake, an ecologically and economically significant system, is vulnerable to pollution by various anthropogenic inputs, particularly by plastics. Study at CSIR-NIO revealed the occurrence of high concentration of MPs in the water column and also indicated widespread ingestion by bottom dwelling finfishes and shellfish in the VL. As sediments are the ultimate sink for all pollutants present in the water column, deposit and filter feeders are highly vulnerable to MPs. Fibres and fragments with size less than 1.5 mm were the dominant morphotype of MPs obtained from water, finfish and shellfish samples. This implies the high bioavailability of MPs. As benthic invertebrates are the major component of some fish diets it could have a cascading effect in the higher trophic levels including humans.

1.2.3 Engineering Sciences

Development and Characterization of Lamb Wave Transducers with Adaptive Tunability and High Directionality using Piezo Wafers and Patches for Health Monitoring of Metallic Aircraft Structures

Fabrication of customized, sufficiently thin, defect free PZT wafers and fiber patches have been done at CSIR-CGCRI and the structural and electrical characterization are in progress.

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

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

Solar Energy Based Cooking System (Solar Chulha)

Solar energy based cooking is the simplest, safest, most convenient way to cook food without consuming fuels or heating up the kitchen. Also cost of LPG is very high. Hence this can be alternative for cooking. The development of solar energy based cooking system may provide a good alternative to mitigate the LPG consumption and greenhouse gas emission. The features are easy to use; all types of cooking like boiling, steaming and frying can be done; cooking can be done any time during day and night; high and low temperature cooking; safe to use as it operates in direct current (DC); inverter less direct operation; properly insulated cook stove reduce heat loss and makes it convenient to use; provides cleanest cooking environment; single household system can give CO_2 savings ~ 1 ton/year.

Tractor operated Iron ore dust collecting machine

Dust collector is powered by the tractor PTO and the storage tank is provided with vertical filtration system. The machine is provided with a suction hose which can be used for suctioning material lying on the places outside the cleaning path of the machine. It can collect the dust in both the forward and reverse motion of the tractor. It has an easy height adjustable suction duct to increase or decrease according to the ground clearance. The basic components of the developed technology are the Pneumatic blower with impeller, Polyster bag filter, Bevel gear box, Plummer Block with Bearings, Pulleys, Belt drives, Lead screw, Corrugated Suction Pipes etc.

Sustainable Road Pavements in High Altitude Regions Using Geosynthetics

The Himalayan region has extremes of climatic conditions, complex and unsafe terrains and topography. Design and construction of roads in high altitude of Himalayan region poses more difficulties than in plain terrain. One of the major problems is non availability of good quality road construction materials, which compels for use of locally available materials, which may not be of required standards. To alleviate this problem, engineers are required to adopt specialized techniques. Research addressed the using of locally available materials and enhancing their performance by means of geo synthetics, an alternative solution to such adverse situations. The Indigenously developed Repeated load apparatus has been used to study the effect of Geo synthetic confinements provided in pavement layers (at Laboratory scale) and quantified the improvement in load carrying capacity of local materials. Study focuses to improve and increase the road assets by economically and environmentally viable methods. This is expected to have far reaching impact on social development of the region by improving the life style of people by providing better connectivity. Test Sections have been laid in two Himalayan states – Himachal Pradesh and Arunachal Pradesh. Field Performance of these laid trial sections carried out by using Falling weight Deflect meter.

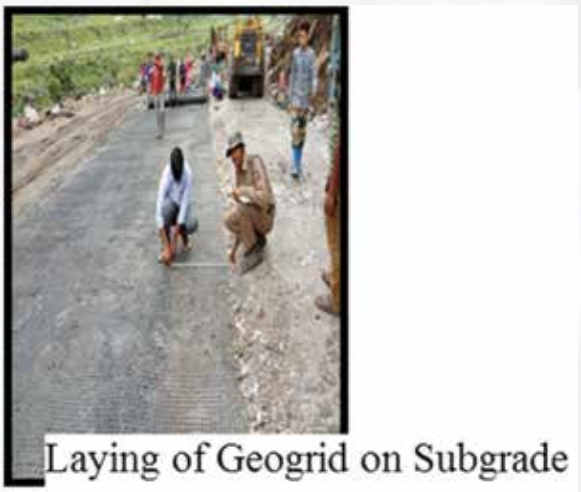


Fig.: Test Section with *Geogrid placed on Subgrade* **(Tenga Valley, Arunachal Pradesh)**

Performance of cement composite embeddable sensors for strain-based health monitoring of in-service structures

There is a growing need to develop sensors which can be embedded into the structures during the construction stage itself for developing smart structures. It is preferred to develop these kinds of sensors with the material same as that of material used in construction for the sake of compatibility and better capturing the actual state of distress in the structure. Towards this, cement based piezo-resistive sensors are developed with the help of conductive nano-fillers (Carbon Nanotubes (CNTs)) at CSIR-SERC. Since the sensors are cement based, and porous in nature, the characteristics of the sensor will vary due to water penetration into the sensor. As the structures with such embedded sensors have to perform for years, understanding the variations in the characteristics of the sensor due to pore structure is very important. In this regard, the conductivity of the sensor is assessed where the effect of dosage of CNTs, functionalization of CNTs, type of electrical conductivity measurement (both DC and AC) and pore water are the parameters. The strain sensitivity of the sensors under cyclic

stress is also investigated and reported in the present study. The findings of this study will help in developing continuous health monitoring strategies using highly sensitive embeddable cement-based nanocomposites.

Saras Mk2 – An Indigenous 19 seat Light Transport Aircraft under development

The main aim has been to design and develop 19 pax prototype aircraft (19 Seat LTA-SARAS Mk2) with a pressurized cabin and carry out flight tests towards certification, based on the experience gained at CSIR-NAL during the development of SARAS aircraft.

A certified, pressurised 19pax Light Transport Aircraft designed and developed indigenously for the first time in the country, meeting the requirements of Indian Air Force, state of the art light transport category aircraft, fuel efficient and capable of carrying up to 19 pax for regional connectivity between Tier-II and Tier-III cities. Possible multi-roles such as postal cargo, coast guard, surveillance, weather and atmospheric research and as a flying test bed for other national programmes. Availability MMEs/ SMEs with production capabilities as Tier-2 supplier towards manufacture of airworthy components. Paving the way for knowledge generation, design and development of 50-70 seat aircraft.

Saras Mk II 19-seat Light Transport Aircraft.

UAV for Agriculture Applications

Precision agriculture makes use of satellite and aerial imagery to monitor crop health. With an increase in the practical application of UAV's in the agricultural industry and to provide an end to end solution in the agricultural domain (from crop monitoring to pesticide spraying) CSIR-NAL has developed a modular Oct-Copter UAV system that can carry a maximum payload of 20 Kg and fly for the endurance of around 20 min. The Oct-Copter has a provision to house either a hyperspectral camera for crop health monitoring or a fertilizer tank for fertilizer spraying. In this year one unit of Oct-Copter UAV has been delivered to CSIR-CIMAP. First field demonstration of NAL's Oct-Copter has been demonstrated to the farmers of Alur APMC, Bengaluru and the UAV has received a very positive response.

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

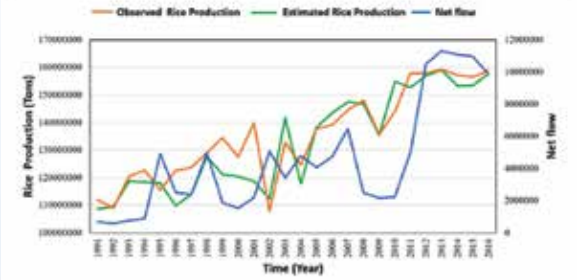
1.2.4 Information Sciences

Reliable prediction of crop requirement and production in advance plays an important role to ensure food security in a country.

CSIR-4PI estimated rice production of India by using neighbouring Asian countries' rice production and local rainfall data using deep

learning technique. A detailed sensitivity analysis has been conducted to fine tune the input data. The proposed model is validated with net flow (export-import data) on rice production of India and neighbouring countries which. The figure indicated that net flow is following the trend of estimated and observed rice production from 1991 to 1993 and 2005 to 2015. It is also observed that during 1993 to 2004 trend of net flow and crop production is contrasting to each other due to some other influencing factors.

Figure. Relationship between rice production (observed, estimated) and net flow (Export - Import)



Measurement and Analysis of Green House Gases

Measurements of greenhouse gases at Hanle station and Hoskote station from Apr 2021 to Oct 2021 are shown in Figure after data filtering. As Hanle site is very clean, the within-hour variability of CO2 concentration is less. So all the data can be taken for processing. The average of CO2 from April 2021 to October 2021 is recorded around 414 ppm in Hanle. This has a difference of around 2.3 ppm compared to April-October 2020. The highest amount of CO2 can be seen in April & May and lowest amount can be seen in August and September [Fig. (a)]. Contrarily, CH4 concentration is higher in August and September due to paddy cultivation and wetlands [Fig. (b)]. CH4 has increased 20 ppb during April-October 2021 compared to April-October 2020.

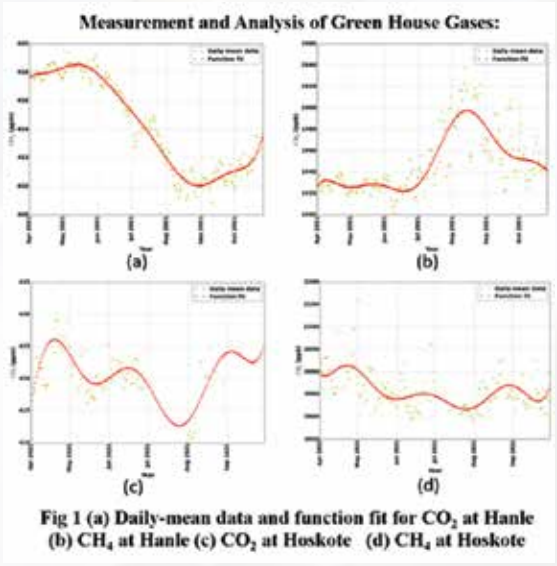
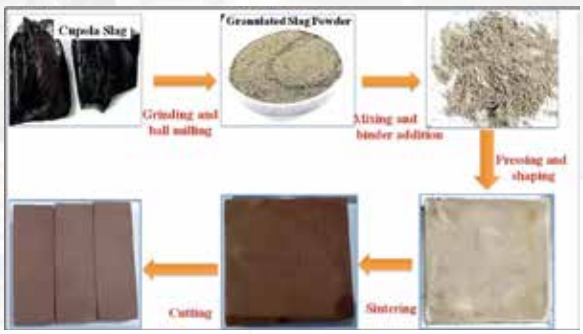


Fig 1 (a) Daily-mean data and function fit for CO_2 at Hanle (b) CH_4 at Hanle (c) CO_2 at Hoskote (d) CH_4 at Hoskote

1.2.5 Physical Sciences

Cast iron slag for value added products

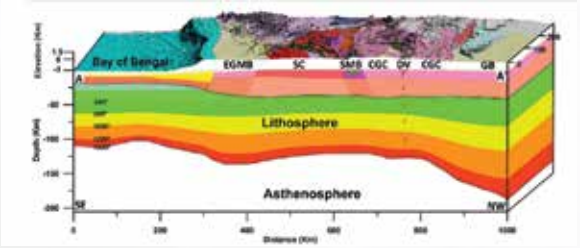
Cast iron slag after crushing, and grinding can be used for making tiles, paver blocks and partial (up to 50%) replacement of portlland cement for construction purposes. CSIR-AMPRI discussed with cast iron foundry industries in EEPC Kolkata and are looking forward for demonstration for commercialisation process for making tiles from cast iron slag



Geopotential evidence of a missing lithospheric root beneath the eastern Indian shield - An integrated approach:

Moderate crustal density difference in various crustal domains, as well as an almost smooth crust-mantle boundary at 37-40 km

depth, suggests the effect of substantial mafic-ultramafic crustal intrusion and together with the thin (135-140 km) lithosphere reinforces the evidence of thermo-chemical processes that controlled the lithospheric modification in the eastern Indian shield.



Schematic cross-section showing interpretation of the lithospheric structure of the eastern Indian shield from geopotential and geological studies. The upper panel shows geology and the lower panel represents the interpreted lithospheric density model. The extent of BoB: Bay of Bengal, CGC: Chhotanagpur Gneissic Complex, EGMB: Eastern Ghats Mobile Belt, GB: Ganga basin, SC: Singhbhum Craton, SMB: Singhbhum Mobile Belt, DV: Damodar valley are given on the x-axis of the graphic.

Coral Reef Monitoring Robot (C-Bot)

The coral reef monitoring robot (C-Bot) is an underwater robot, which replaces the human divers. It works as a free swimming robot with the help of two propellers for forward motion and two propellers for diving. In combination with propellers and smart algorithms running onboard a single board computer, CSIR-NIO developed C-Bot can perform various tasks like line transects, lawn mowing over reef areas and hovering like a helicopter for a prolonged period of time. Its free swimming capability, low cost and the smart algorithms provides C-Bot an edge over the other remotely operable vehicles which are connected through a cable, a possible hazard for the corals. C-Bot in the present form has an endurance of 6 hours and can dive upto 200 meters.

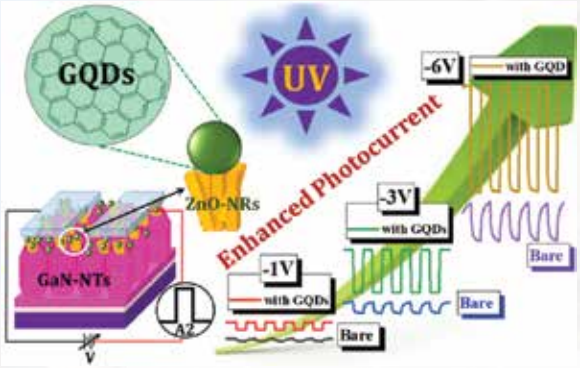
Development of Metal Oxide based Gas Sensors for air pollutants by PVD process

CSIR-NPL is engaged in developing gas and optical sensors based on semiconducting materials. SnO2 and ZnO thin films are developed by sputtering and vacuum evaporation processes. In sputtering process, it is found that SnO2 film deposited under unbalanced magnetron (UBM) configuration consist of Sn4+ oxidation state, while those deposited under UBM configuration have Sn4+ and Sn2+ oxygen states. SnO2 based CO gas sensors have been developed by post oxidation of vacuum evaporated Sn films. The post-oxidation was performed by two different methods such as step-oxidation (SO-1) and direct-oxidation (DO-1) at a maximum temperature of 850 ◦C. The SnO2 films produced by both oxidation methods possess a rutile crystal structure and porous, granular surface morphology with an optical bandgap of 3.36–3.59 eV. But, the sensitivity towards 915 ppm of CO gas is significantly higher with 71 % for the direct-oxidized 100 nm thick SnO2 with a fast response time of 21 s and a limit-of-detection of 10 ppm.

Graphene Quantum Dots Sensitized ZnO-Nanorods/GaN-Nanotowers Heterostructure based High Performance UV Photodetector

The fabrication of superior performance UV photodetector utilizing graphene quantum

dots (GQDs) as sensitization agent on ZnO NR/GaN-NT heterostructure has been realized at CSIR-NPL. GQD sensitization displays substantial impact on the electrical as well as the optical performance of heterojunction UV photodetector. The GQDs sensitization stimulates charge carriers in both ZnO & GaN and allows energy band alignment which is realised by spontaneous time-correlated transient response. The fabricated device demonstrates an excellent enhancement (~265%) of R (3.2x103 A/W) at -6V as compare to its bare counterpart. In addition, photodetector also exhibits very high EQE of 1.2×106 %, better switching speed and signal detection capability as low as ~50fW.



Schematic of fabrication UV photodetector utilizing graphene quantum dots as sensitization agent on ZnO NR/GaN-NT

Realization of ITS-90 Radiance Temperature Scale from 961.78 °C to 3000 °C at CSIR-NPL

CSIR-NPL has developed Metal-Carbon eutectic fixed point blackbodies with in-house R&D efforts and by using Ag and Cu blackbodies we have realized the radiance temperature scale upto 3000 °C. With this CSIR-NPL is providing the traceability to R&D, Strategic and Calibration Laboratories.

2.0 CONSULTANCY DEVELOPMENT CENTRE

2.1 INTRODUCTION

The Consultancy Development Centre (CDC) was set up in January 1986 in the form of a registered society supported by the Department of Scientific and Industrial Research (DSIR) as its Administrative Ministry, to promote, develop and strengthen consultancy capabilities in the country. CDC was approved as an Autonomous Institution of DSIR by the Government of India in 2004. The Centre is managed by a Governing Council consisting of members drawn *inter alia* from Government Departments, Research organizations, Academic institutions and Consultancy companies. CDC has been getting an annual plan support from DSIR for carrying out schemes, projects and activities aimed largely at competency enhancement and capacity building of consultants in the country. Some of the major activities undertaken (including ongoing projects) during the year included:

- Study on "Need based interventions for better marketability of Handicraft Clusters in Uttar Pradesh (Wooden crafts in Nagina and Zari / Zardozi crafts in Varanasi)".
- Training and Consultancy Services for Implementation of ISO 9001: 2015 Quality Management System (QMS) at CSIR-IHBT Institute of Himalayan Bio-resource Technology, Palampur.
- Selection of System Integrator for Design, Development, Implementation, Support for OFAMOS project and CCTV solution for Dept. of Health and Family Welfare, Govt. of Punjab

- Study on "DC-MSME schemes for MSME Sector –with focus on North Eastern Region including Sikkim O/o DC-MSME, New Delhi.
- Consultancy Services for ISO 9001:2015 Certification to CBRI-Roorkee and for NABL accreditation to their Fire Research Laboratory (FRL).
- Annual Survillance Audit of NRDC for ISO 9001:2015

2.2 HIGHLIGHTS OF PERFORMANCE

During the year, CDC undertook various activities keeping in view its mandate of promotion and development of consultancy covering capacity building, creation of trained human resources in the consulting domain and facilitation of client organizations in the selection of right consultants for their projects.

I. Study on "Need based interventions for better marketability of Handicraft Clusters in Uttar Pradesh (Wooden crafts in Nagina and Zari / Zardozi crafts in Varanasi)". Report submitted.

II. Study on "DC-MSME schemes for MSME Sector –with focus on North Eastern Region including Sikkim O/o DC-MSME, New Delhi. Report submitted.

2.3 FINANCIAL DETAILS

During the financial year 2020-21, expenditure of Rs. 307.40 lakhs was incurred compared to Rs. 345.93 lakhs in the FY 2019-20 and total revenue generation from various programmes and activities during the year was Rs. 133.72 lakhs compared to Rs. 141.95 lakhs in the FY 2019-20.

2.4 CDC EMPLOYEE DETAILS

In the FY 2021-22 there were 16 employees in CDC comprising of 15 regular employees and one contract/tenure based employee. In the regular employees 14 were from General category and one was from SC category. In December 2021 there are 13 regular employees out of which one is from SC category and remaining from General category.

CHAPTER 10 : ASSISTANCE TO PUBLIC SECTOR ENTERPRISES

ASSISTANCE TO PUBLIC SECTOR ENTERPRISES

1.0 NATIONAL RESEARCH DEVELOPMENT CORPORATION

INTRODUCTION

National Research Development Corporation (NRDC) is a Government of India enterprise, under the Administrative control of Department of Scientific & Industrial Research (DSIR), established in 1953 under section 25, now section 8, of the Companies Act 2013 The main objective is to promote, develop and commercialize technologies/ know how/ inventions/ patents/ processes emanating from various national R&D institutions. The Corporation offers its services through-out the country in improving the Nation's manufacturing base with innovative technologies especially suitable for our entrepreneurs and conditions. It acts as an effective Interface for translating R&D results into marketable products. Over the last more than six decades of its existence, the Corporation has forged strong links with various R&D organizations both within the country and abroad and pursued bringing inventions and innovations to commercial fruition. The Corporation is recognized as a repository of a wide range of technologies and has licensed technologies to over 5000 entrepreneurs spread over almost all areas of industry and has provided assistance for filing of more than 2000 IP's.

PROFIT

The highlights of the performance and the financial result for the financial year ended on 31st March 2021 as per revised accounting policy are given below:

Performance Parameters	2019-20 *(Rs. in Lakhs)*	2020-21 *(Rs. in Lakhs)*
Gross Income	991.35	816.52
Revenue from operations Other Income	931.17 60.18	777.46 39.06
Surplus Before Tax and extraordinary expenses	41.95	33.01
Extraordinary expenses	45.54	1.69
Profit / Loss Before Tax	(3.59)	31.32
Paid up Share Capital	441.81	441.81
Reserves & Surplus	485.11	503.22
Net Worth	926.92	945.03

**The 75% Royalty share of DSIR i.e. Rs. 11,30,04,255/- has not been shown in Revenue as per Accounting Standards.*

1.0 PROCESSES ASSIGNED AND LICENCE AGREEMENTS CONCLUDED

The Corporation continued to lay emphasis on broadening and strengthening the technology resource base by nurturing long-term relationships with R&D institutions as well as Universities, technical organizations, industries and also individual inventors. This endeavor is reflected in the Corporation's signing of 17 MOUs/MOAs/Agreements with Institutions/Organizations for intellectual property protection, technology commercialization, technology consultation and other value-added services. Some of the major institutions are as under:

a) Birla Institute of Technology, Mesra

b) Punjab Agricultural University, Ludhiana

c) National Institute of Technology, Tamil Nadu

d) Assam Agriculture University, Assam

e) Biocyte Institute of Research & Development, Sangli Maharashtra

f) Andhra Pradesh State Council of Higher Education, Guntur

(I) Process Assigned

During the financial year 63 new processes/ technologies were received (assigned) to the Corporation for licensing.. Some of the commercially important processes assigned to the Corporation from various research institutes, universities were:

a) **Innovation Cell of Institute of Naval Medicine, Indian Navy**
Nav Rakshak PPE suit

b) A.L. Vedavyasa, Hyderabad
Bi-facial solar panel Technology

c) Biocyte Institute of Research and Development
Novel carbon nano-tube based hand sanitiser and hand wash

d) Central Manufacturing Technology Institute (CMTI)
High Precision Optical Standard Glass Scales
Ultra-Precision Air Bearing Spindle-Nanospin AIM 80
Air Bearing Rotary Stage
Spindle Error Scope
Thread Measurement System – TMS-030

e) Central Sericultural Research & Training Institute
Process for extraction of Alpha-Linolenic Acid from Silkworm, *Bombyx mori* Pupae Oil

f) Crest King
Space Sanitizer

Assignment of Nav Rakshak PPE suits to NRDC for Licensing

(II) Major Technologies Licensed

As a result of Value addition, the Corporation managed to sign 24 license agreements with industry to undertake manufacturing during the year compared to 19 license agreements executed in the previous year. Some of the major processes/technologies licensed by the Corporation in the financial year were:

1. Annamalai University
Seaweed Extract Fertilizers

2. CCRAS
Ayush-64
Ayush-CCT

3. Central Manufacturing Technology Institute (CMTI)
High Precision Optical Glass Scale

4. S.N. Bose National Centre For Basic Sciences ("Snbncbs"), Kolkata
Breath Analyzer
Detection of neonatal hyper-bilirubinemia

An Active Respirator with Attached Exhalation Valve and Suspended Particulate Matter Filter for Comfortable and Hygienic Breathing

Long-Lasting Nano-sanitiser with a Dispensing Antimicrobial Layer

(III) Lump sum Premia and Royalty

Corporation's consolidated Lump sum Premia & Royalty income is Rs. 618.38 lakhs as compared to Rs. 691.58 lakhs in the previous year. The Royalty received was from both the NRDC licensees and PATSER projects.

(IV) MoU EVALUATION

Corporation's performance has been evaluated on the basis of audited data by the concerned Syndicate Group of the Task Force constituted by the Department of Public Enterprises (DPE). We report that the rating awarded by the DPE as per the Memorandum of Agreement (MoA) signed with the Government of India during the year 2019-20 after annual evaluation was 'POOR'.

2.0 PROMOTIONAL ACTIVITIES/ OPERATIONS.

NRDC has been undertaking two promotional programmes of DSIR i.e (i) Programme for Inspiring Inventors and Innovators (PIII) and (ii) Programme for Development of Technologies for Commercialization (PDTC).

2.1 PROGRAMME FOR INSPIRING INVENTORS AND INNOVATORS (PIII)

The programme is planned to encourage the innovators/inventors in developing new innovative technologies and products and tap these technologies for Corporation's business activities. To achieve this, Corporation carries out various activities like awarding meritorious inventions, protection of IPs, evaluation of technologies, knowledge management and providing techno-commercial support to the new innovations/ technologies etc. The activities carried out under this programme are summarized below.

2.1.1 NRDC National Meritorious Invention Awards of the Year 2020

The Corporation under its Programme for Inspiring Inventors and Innovators (PIII), with the support of DSIR, gives tax free cash awards, annually, to the Indian citizens in scientific and industrial fields for the development of meritorious inventions with an objective to encourage inventive talent in the Country. The awards are decided by the Prize Award Committee during their meetings.

Applications for the year 2020 were invited under three different award categories i.e. National Innovation Award, National Societal Innovation Award and National Budding Innovators Award. A total of ten awards have been selected by the Prize Award Committee, two under National Innovation Award Category, three under National Societal Innovation Award Category and five under Budding Innovators Award Category.

The cash awards amounting to Rs. 24.0 Lakh alongwith the certificates and citations has been distributed to the 38 awardees of the year 2020 mainly in the field of environmental friendly manufacturing processes, waste to wealth generation, quality jute fibre extraction method, flexible and light weight ballistic resistant material, effective Juice preservation methods, low-cost drop-on-demand printing technique and hand rehabilitation robotics.

The details of Meritorious Inventions Awards of the Year 2020 are as follows:

INNOVATION AWARD OF THE YEAR 2020

Innovation Award 1: Zero Formaldehyde High Performance Melamine-Chromium Synthetic Tanning Agent for Greener Leather Manufacture: Laboratory to Leather Industry

Dr. J. Raghava Rao, Dr. K. J. Sreeram, Dr. G. C. Jayakumar, Dr. M. Sathish, Dr. R. Aravindhan, Dr. Balachandran Unni Nair and Dr. S. Sangeetha of CSIR-Central Leather Research Institute, Adyar, Chennai, Tamil Nadu have been jointly awarded Rs. 5.0 Lakh (Rupees Five Lakh only) for the development of, "Zero Formaldehyde High Performance Melamine-Chromium Synthetic Tanning Agent for Greener Leather Manufacture: Laboratory to Leather Industry".

National Innovation Award 2: Premium Grade Iron Oxide Pigment from Waste Chloride Pickle Liquor of Steel Industries

Dr. K. K. Sahu, Dr. D. Mishra, Dr. Archana Agrawal, Shri S. Shekhar, Shri S. Sinha, Dr. S. Agarwal, Shri R. Choudhari and Shri D. Mahto of CSIR-National Metallurgical Laboratory, Jamshedpur (Jharkhand) have been jointly awarded Rs. 5.0 Lakh (Rupees Five Lakh only) for the innovation, " Premium Grade Iron Oxide Pigment from Waste Chloride Pickle Liquor of Steel Industries ".

SOCIETAL INNOVATION AWARD OF THE YEAR 2020

National Societal Innovation Award 1: Innovation in Jute Retting Technology through Microbial Consortium 'CRIJAF SONA' for High Quality Fibre

Dr. Bijan Majumdar, Dr. Amit Ranjan Saha, Ms. Suparna Das, Dr. Subhojit Datta, Dr. Dipnarayan Saha, Ms. Lipi Chattopadhyay, Dr. Suniti Kumar Jha and Dr. Gouranga Kar of ICAR - Central Research Institute for Jute & Allied Fibres, Barrackpore, Kolkata, West Bengal have been jointly awarded Rs. 3.0 Lakh (Rupees Three Lakh only) for the development of, " Innovation in Jute Retting Technology through Microbial Consortium 'CRIJAF SONA' for High Quality Fibre ".

National Societal Innovation Award 2: Lead Free X-ray Shielding Red Mud Tiles

Dr. Shabi Thankaraj Salammal, Dr. Sunil Kumar Sanghi, Dr. Deepti Mishra, Dr. Rini Paulose, Ms. Varsha Agrawal, Shri Rahul Arya, Shri Akshay Singh Tomar, Dr. Sanjai

Kumar Singh Rathore and Dr. Avanish Kumar Srivastava of CSIR-Advanced Materials and Processes Research Institute, Hoshangabad Road, Bhopal, M.P. have been jointly awarded Rs. 3.0 Lakh (Rupees Three Lakh only) for the innovation, " Lead Free X-ray Shielding Red Mud Tiles ".

National Societal Innovation Award 3: Peripheral Blood Smear Instrument (Stainer)

Shri Sandeep Khuba Zope of Supreme Bioscientific Pvt Ltd., 4, Salasar Community Centre, Fatak Road, Bhayandar (East), Thane has been jointly awarded Rs. 3.0 Lakh (Rupees Three Lakh only) for the innovation, "Peripheral Blood Smear Instrument (Stainer)".

NATIONAL BUDDING INNOVATORS AWARD OF THE YEAR 2020

National Budding Innovators Award 1: Development of Process Technology for Manufacture of Shelf Stable Sugarcane Juice

Ms. Chirasmita Panigrahi, Student of Institute of Technology Kharagpur, Kharagpur, West Medinipur, West Bengal has been awarded Rs 1.0 Lakh (Rupees One Lakh only) for the innovation, " Development of Process

Technology for Manufacture of Shelf Stable Sugarcane Juice".

National Budding Innovators Award 2: Drop Impact Printing

Shri Chandantaru Dey Modak, Student of Centre for Nanoscience and Engineering, Indian Institute of Science, Bangalore, Karnataka has been awarded Rs. 1.0 Lakh (Rupees One Lakh only) for the innovation, " Drop Impact Printing".

National Budding Innovators Award 3: Development of Indigenous Technology of Light Weight Soft Body Armour Using Shear Thickening Fluid

Shri Mukesh Bajya, Student of Institute of Technology Delhi, Hauz Khas, New Delhi has been awarded Rs. 1.0 Lakh (Rupees One Lakh only) for the innovation, " Development of Indigenous Technology of Light Weight Soft Body Armour Using Shear Thickening Fluid ".

National Budding Innovators Award 4: Wearable Tattoo Sensor for Respiration Rate and Pulse Monitoring

Shri Vaishakh Kedambaimoole, Student of Indian Institute of Science, CV Raman Road, Bengaluru, Karnataka has been awarded Rs. 1.0 Lakh (Rupees One Lakh only) for the innovation, " Wearable Tattoo Sensor for Respiration Rate and Pulse Monitoring ".

National Budding Innovators Award 5: A Plug and Train Robotic Kit for Hand Rehabilitation

Shri Aravind N., Student registered for a Doctoral Degree Programme at Indian Institute of Technology Madras, Chennai, Tamil Nadu has been awarded Rs. 1.0 Lakh (Rupees One Lakh only) for the innovation, " A Plug and Train Robotic Kit for Hand Rehabilitation ".

2.1.2 INTELLECTUAL PROPERTY PROMOTION & FACILITATION

2.1.2.1 NRDC – Innovation Facilitation Centres (NRDC-IFCs)

The Corporation with the support of Department of Scientific & Industrial Research, Ministry of Science & Technology, Government of India under its Programme for Inspiring Inventors and Innovators (PIII) has set-up fifteen Innovation Facilitation Centres in the premises of the Universities and Institutions engaged in innovative research & development in different regions of the country till financial year 2020-21.

The fifteen NRDC-IFCs are set-up in the following Universities and Institutions, AIIMS, New Delhi; Amity University Uttar Pradesh, Noida; NIT Silchar, IIEST, Shibpur, GTU, Ahmadabad, IIT Kanpur, NIPER, Mohali; University of Hyderabad, Hyderabad & IIT BHU, Varanasi, Anna University, Chennai; Kavayitri Bahinabai Chaudhari North Maharashtra University, Umavi Nagar, Jalgaon and Tezpur University, Napaam, Sonitpur; Punjab Agricultural University, Ludhiana, NIT Tiruchirappalli and Assam Agriculture University, Jorhat and signed MOUs with them. These Centres are implementing the programme effectively.

The Corporation is promoting innovation related activities in the Universities, Autonomous Institutions & Academic Institutions across the country through these NRDC–Innovation Facilitation Centres (NRDC-IFCs).

2.1.2.2 MoMSME-NRDC Intellectual Property Facilitation Centre (IPFC), and WIPO Technology Innovation Support Centre (TICS) Vishakhapatnam

NRDC-MoMSME-IPFC Visakhapatnam office was established in Visakhapatnam,

Andhra Pradesh on January 28, 2017. In due course of time, the 3rd Technology and Innovation Support Centre (TISC) by World Intellectual property Organization (WIPO) and DPIIT, Govt. of India was established in NRDC-IPFC at Visakhapatnam on February 25, 2018.

The objective of NRDC-MoMSME-Intellectual Property Facilitation Centre (IPFC)& WIPO-Technology Innovation Support Centre (TISC)is to promote technological innovation, IP promotion, IP management and technology transfer in the region in view of growing industrialization and start-up ecosystem. The centre has developed wide network with scientific and industrial community in southern India in short span of time.

The Centre is working effectively towards its roles and objectives through activities including technologies licensing, IP facilitation and capacity building and awareness programs. NRDC-IPFC&TISC, Visakhapatnam is focused to make the centre self-sustainable.

During the year, the centre has provided IPR and technology transfer services to various PSU's/start-ups/entrepreneurs and MSME's including IPR consultancy services to ordnance factories. The activities carried out by NRDC-MoMSME-IPFC & TISC, Visakhapatnam during the year 2020-21 are mentioned below.

Sl #	Services Provided	FY 2020-21
1	Patent Services facilitated with due diligence	83 (42 filed)
2	Technology Transfer	01
3	Technologies Assigned	5
4	Trademark services facilitated & filed	23
5	Copy right services facilitated & filed	5
6	Industrial Design services facilitated & filed	11
7	Geographical Indication of Goods Initiated & Services Facilitated	2
8	MoU/MoA Signed	4
9	IP Workshops/ Webinars Conducted	55
10	Techno Enterprenurship Programme attended	1

"DHANUSH Towed Gun System

Some of the notable achievements of the centre are detailed below:

a) Facilitated filing of patent and trademark of "DHANUSH 155/45 Calibre Towed Gun system", Ordnance Factory Board, Ministry of Defence, Govt of India of the Indian Ordnance Factories. Dhanush is India's First Indigenously designed and developed gun system by Indian Ordnance Factory.

b) Managing IP assets of Rashtria Ispat Nigam Limited (RINL)

c) Facilitated in getting assignment of five indigenous potential technologies for commercialization namely:

Sl. No	Name of Know-How
1	Bifacial Solar PV Technology
2	Technology for bioremediation of hydrocarbon by marine hydrocarbonoclastic bacteria
3	Recombinant glutaminase-free L-asparaginase from marine actinobacteria for cancer therapy
4	Recombinant ectoine deep sea bacteria for skin care and cosmetic applications
5	Production of C-phycocyanin from marine spirulina for nutracetical applications.

d) Transferred technologies sourced from public funded laboratories related to indigenous drifting buoys that are widely deployed to measure near surface ocean currents and temperature.

e) Conducted 20 workshops on IP reach out to all stakeholders and also attended more than 90 IP promotional events

f) Organized international webinar on "Strategic Benefits of the WIPO Match Platform for the Indian Intellectual Property and Innovation Stakeholders" on August 11, 2020

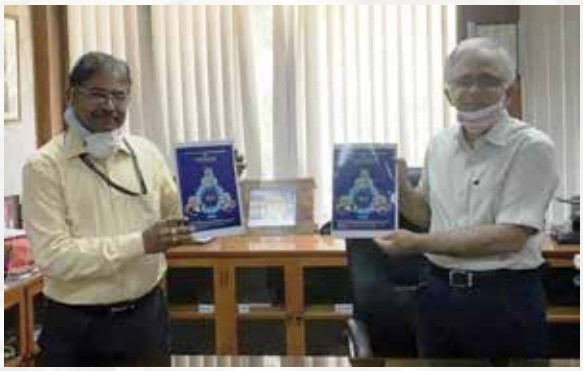
g) Facilitated in bringing out a Compendium of Indian Technologies for Combating COVID-19 - Tracing, Testing and Treating.

2.1.2.3 IPR Activities of the Corporation

The main objective of our National IPR Policy is to encourage creativity and innovation which helps in generation of Intellectual Properties and also protect the same by securing Intellectual Property Rights. Instruments of IP Rights are considered to achieve economic, social and technological advancement for a country. India has to emerge as a Global Intellectual Hub. The Indian Scientific Community/ R&D professionals are very brilliant and have an enormous intellectual strength and this valuable intellectual strength is being harnessed by the Corporation for generating and securing Intellectual Property Rights in India for the growth and prosperity of our country.

The Corporation continued to provide financial technical and legal support to protect inventions developed by various universities, R&D institutes, etc by filing patent applications in India and abroad in the year 2020-21

The various services provided and activities undertaken under the National Patent Protection Scheme are:



Launch of Compendium on Covid-19 technologies

(i) IP Protection

During the year 2020-21, the Corporation in its pursuit of protection of inventions and technologies developed by scientists, researchers, etc has provided financial/ technical assistance for filing of 67 patent applications received from various universities, R&D institutes, etc. The corporation also provided technical and financial support for filing of 22 Trademark Applications, 9 Design Applications and 2 Copy Right Applications. The Corporation has been prosecuting a number of patent applications filed in India and abroad. The

efforts of the Corporation have resulted in the grant of 8 Patents in diverse fields like chemical. Mechanical, sericulture, dairy, food, drugs, etc.

(ii) **Patent Search Facility**

The Corporation has been catering to the requests received from various Universities, R&D Institutes and individual inventors etc for conducting the state of the art searches, the results of which are utilized for submitting research projects at university level so that the invention related to the R&D project should be novel and not a mere repetition of the R&D work already done. During the year 2020-21, 111 Prior Art Searches have been conducted by the Corporation.

(iii) **Patent Awareness**

During the year 2020-21, NRDC-MoMSME-IPFC&TISC has organized and acted as resource persons for more than 52 webinars for promoting and creating awareness about Innovation, Technologies, Role of IPR and Management in national and international platforms.

2.1.3 PROMOTION OF FLAGSHIP PROGRAMMES

2.1.3.1 Promotion of Innovation in North-East & Rural Area

During financial year 2020-21 twenty EDP programs were conducted in North East and Rural Areas (EDP-NERA) under Grant–in-Aid Scheme PIII of DSIR with an objective to create employment opportunities and capacity building of development agencies for skill up-gradation through the application of innovative technologies in North East and Rural Areas. Following are some of the major EDP programme/ activities carried out during the year.

1. EDP on "Ringal Craft" conducted at Village, Halna & Bharangaon, Uttarkashi, Uttarakhand in association with Sanjeevani Foundation for Health Education and Environment Research Action (SFHEERA), New Delhi and about 37 participants benefited during this programme.

2. EDP on "Ecopreneurship Skill Development of Rural Woman on Low Cost Biodegradable Sanitary Napkin" organised in association with Rashtriya Yuva Swyamrojgar Vikas Sanstha (RYSVS), Ratnagiri at Ratnagiri, Maharashtra and about 200 participants benefited during this programme.

3. EDP on "Training on enrichment of indigenous bio-mass and traditional crop residues for production of low cost, balanced animal feed by farmers, unemployed youth of tribal and weaker sections in Odisha for income generation" organised at Nellore Rural in association with Innovate Orissa Initiative (IOI), and about 200 beneficiaries benefited during this programme.

4. EDP on "Brass bell metal artisans though Modern Technology- Energy Efficient Melting Furnace " organised at Balasore, Orissa in association with

Technical Training Institute (TTI), Balasore, Orissa and about 30 artisans benefited during this programme.

5. EDP on Mahua and Tamarind candy making technique in Bhandara, Maharashtra in association with Jagruti Gramin Vikas Sanstha (JGVS), Bhandara and 30 participants both men and women benefited during this programme.

EDP Programmes In Progress

2.2 PROGRAMME FOR DEVELOPMENT OF TECHNOLOGIES FOR COMMERCIALISATION (PDTC)

The programme aims to add value to the lab-scale technologies developed by the universities/research institutes/ organizations, dissemination of the information and promotion of entrepreneurship development and appropriate innovative technologies in rural and north-east regions. Under this scheme the Corporation carried out various activities like Development of Innovation Portal, Value addition through preparation of Basic Engineering Design Package (BEDP), Market Surveys, and dissemination of information through exhibitions/ seminars/workshops etc., promotion of indigenous technologies abroad through showcasing of indigenous technologies. The various programmes undertaken in this scheme are:

2.2.1 TECHNOLOGY VALUE ADDITION

Technology upgradation for taking the Technology from Lab to Land provided to 60 technologies by conducting Market Surveys (MS), Basic Engineering Design Package (BEDP), Feasibility Reports (FR), Socio Economic Impact Assessment (SEIA), Techno-Commercial Support (TCS) and Priority Projects (PS) so as to take the technology from lab to industry.

2.2.1.1 Basic Engineering Design Package (BEDP)

The preparation of Basic Engineering Design Package carried out by the Corporation is a very important value addition activity for laboratory scale technologies. The package provides information on the plant and equipment, raw material and the product, etc. which helps the entrepreneurs in decision making as well as implementation of the project. It requires a detailed study for working out the final process scheme, which can be obtained through series of simulation of the laboratory scale process and then incorporating required engineering input so that the process is workable. Once the BEDP is prepared based on the data the feasibility study and Detailed Project Report (DPR) can be prepared. With these reports it becomes easy for the entrepreneur to carry out detailed engineering for setting up the commercial plant. The reports also help the Corporation in planning for marketing of its technologies.

During the year, BEDP on the following

technologies were conducted through professional empanelled consultants:

Sr. No	Name of Technology
1.	Steel Carbon Nano Tube Metal Matrix Composites
2.	High precision optical Standard Glass scale
3.	Novel Carbon tube based hand sanitizer and hand wash gel
4.	Fibre Bragg Gratings for Industrial and strategic applications
5.	Abrasive Flow Finishing Machine (AFFM-150D)
6.	Treatment of wastewater discharged from Covid-19 hospital and other screening centres by using electrochemical based "Elcogen Technology"
7.	Sukshm 3D Microfabrication System

2.2.1.2 Feasibility Reports

The preparation of Feasibility Report carried out by the Corporation is an important value addition activity for laboratory scale technologies. The report provides information on the investment to be made on plant and equipment, raw material and the product, etc. which helps the entrepreneurs in decision making as well as implementation of the project according to their investment capacity. It also helps the entrepreneurs to get loans from financial institutions by submitting the Feasibility Reports. Based on the data of Basic Engineering Design Package (BEDP), the Feasibility Report is prepared. With these reports it becomes easy for the entrepreneurs to carry out detailed engineering for setting up the commercial plant and planning for investment strategy. The reports also help the Corporation in planning for marketing of its technologies.

During the year (2020-21), Feasibility Reports on the following technologies were conducted through professional empanelled consultants:

Sr. No	Name of Technology
1.	Multi layer Plastic technology
2.	Steel Carbon Nano Tube Metal Matrix Composites
3.	Nav Rakshak PPE
4.	Sukshm3D Microfabrication System
5.	Activated bamboo carbon filters for enhanced safety in personal protection masks

2.2.1.3 Market Surveys

Market surveys are of considerable significance to the process of technology transfer. It makes the technology package more attractive to entrepreneur. During the year 2020-21, market survey reports on the following technologies were conducted through professional empanelled consultants: -

Sr. No.	Name of Technology
1.	Development and Characterization of silk and silk blended melange yarn.
2.	Ultra Precision Turning Machine
3.	An Active respirator with attached exhalation valve and suspended particulate matter filter for comfortable and hygienic breathing
4.	Multi layer Plastic technology
5.	Battery Powered Disinfectant Sprayer
6.	Geopolymer Blocks Technology
7.	Technology for bioremediation of hydrocarbon by marine hydrocarbonoclastic bacteria
8.	Recombinant ectoine from deep sea bacteria for skin care and cosmetic applications
9.	Production of C-phycocyanin from marine spirulina for nutraceutical applications

Sr. No.	Name of Technology
10.	Smart self healing coatings
11.	Steel Carbon Nano Tube Metal Matrix Composites
12.	Poshan- A Multi-nutrient Formulation for Correcting the Nutrient Deficiencies in Mulberry
13.	Sukshm3D Microfabrication System
14.	Abrasive Flow Finishing Machine (AFFM-150D)
15.	Centerless Bar Turning Machine (TBC-36)
16.	Centerless Grinding Machine (GN-3050)
17.	Facing and Taper Boring Machine (FTB-320)
18.	Line Boring Machine
19.	Universal Cylindrical Grinding Machine (UGC-260)
20.	Finish Turning Machine (TGPR-CNC)
21.	Finish and Boring Machine (FB-50)
22.	CNC Keystone Piston Ring Grinding Machine (GKPR-CNC)
23.	Steel on Aluminium Bronze Bimetallic Parts
24.	Bronze on Steel Bimetallic Parts
25.	Remanufacturing of Parts through Additive Manufacturing
26.	Swirl Flame LPG Canteen Burner
27.	Raksha Kawach

2.2.1.4 Socio Economic Impact Assessment (SEIA) of Technologies Licensed by NRDC

NRDC since its inception has commercialized technologies to more than 5000 entrepreneurs It was felt that the socio economic impact of the technologies/products licensed by NRDC on common man/ masses should be carried out for major technologies. The report is prepared based on the information of Licensee, production data and interaction with the end users of the product, their feedback, etc. The reports will help the Corporation in planning for marketing of its technologies in specific sector as per the feedback and demand of the end-user.

Socio Economic Impact Assessment (SEIA) reports on the following technologies were conducted through professional empaneled consultants: -

Sr. No	Name of Technology
1.	Nav Rakshak PPE
2.	Navinya- A Plant based Formulation for control of Mulberry root rot disease- CSRTI, Mysore.
3.	Neem soap and Pongamina Soap- IIHR, Bengaluru
4.	Phyto Ecdysone- CSRTI, Mysuru
5.	Test kit for Microbiological Quality of Drinking water- DRDE- Gwalior
6.	Chauki Leaf Chopper- CSRTI, Mysuru
7.	Nata-de-coco Production from Microbial fermentation of coconut water through enrichment techniques- UAS Bengaluru
8.	Soil Moisture Indicator- Sugarcane Breeding Institute ICAR- Bengaluru

2.2.1.5 Techno-Commercial Support to Scientists, Innovators and Students for Process Trial and Validation of Technologies

The activity provides necessary support to the scientist for overcoming minor issues like testing of the product, authentication and obtaining necessary approvals from statutory bodies, development of prototypes, preparation of Know-how document, demonstration of technology, etc.

The Techno-commercial support is being provided for the following purposes –

a) Improvements in prototype to make it commercially acceptable

b) Carrying out field trials / testing / analysis, further studies etc.

c) Preparation of a pre-feasibility report

d) Preparation of video about working of the invention.

e) Preparation of comprehensive know-how document.

f) Demonstration of the technology

During the year techno-commercial support was provided for the following 8 technologies:-

Techno-commercial support for 8 Technologies:

S. No	Name of the Technology	Value (Rupees)
1	Corona Protective Gloves/ PPE.	2,00,000/-
2	High capacity disinfectant spraying machine with auto-retractable hose reel for use in large public spaces	2,00,000/-
3	Activated bamboo carbon filters for enhanced saftey in personal protection masks	2,00,000/-
4	Foot Operated Mobile, Wash and Sanitizing station	2,00,000/-
5	Space Sanitizer	2,00,000/-
6	Preparation of protoype of washable & reuseable PPE Kit for corona warriors for commercial scale	2,00,000/-
7	Treatment of wastewater discharged from Covid-19 hospital and other screening centres by using electrochemical based "Elcogen Technology"	2,00,000/-
8	Novel Carbontube based hand sanitizer and hand wash gel	2,00,000/-

2.2.1.6 Technology Development Programme for Priority Projects and Techno Commercial Support

The core mandate of the Corporation is commercialization of technologies developed in the Indian R&D sector and over the years the Corporation has been acquiring several technologies from R&D institutions and individual innovator for commercialization. Most of the technologies acquired by the Corporation are under laboratory / bench scale with proven concepts and with IP protection. For taking the technologies to higher scale of operations and for attracting the industry for obtaining the license for its commercial exploitation, there is need to scale up the technologies to a higher level of readiness. To facilitate value addition of the technologies, the Corporation has been inviting proposals from the Research Institutes/Individual Inventors, Universities, etc. for providing financial support through the program on "Development Projects and Value Addition for Priority Projects" (DPVAPP) upto Rs. 10.00 Lakhs and Techno Commercial Support (TCS) upto Rs. 2.00 Lakhs which is a component of the PDTC Promotion Program funded by the Govt. of India.

Considering the COVID-19 pandemic during the year proposals were invited from Innovators for upscaling the COIVID-19 related technologies. The list of the shortlisted proposals for Priority Projects and Techno Commercial Supports is as under:-

Priority Projects:

S. No	Name of the Technology	Value (Rupees)
1	New Protoype Development for NavRakshak PPE, Institute of Naval Medicine, Indian Navy, GOI	5,00,000/-
2	Al-enabled Covid virtual test kit : A cloud based healthcare technology VBRI Innovation Pvt. Ltd., New Delhi	10,00,000/-
3	Plasma Activated Ozone Sanitizer, Institute of Design of Electrical Measuring Instruments, Mumbai	10,00,000/-
4	Rapid and reliable diagnostic biosensors for covid-19, The M.S. University of Baroda	9,90,000/-
5	Development of scalable, safe and cost-effective process for API of Unifenovir (arbido) a promising repurposed drug for Covid-19 from National Institute of Pharamceutical Education and Research (NIPER), Hyderabad	10,00,000/-

2.2.2 DISSEMINATION OF INFORMATION ON SCIENCE AND TECHNOLOGY

2.2.2.1 Exhibitions and Publicity

Participation in exhibitions, seminars, workshops and entrepreneurship development programs are of vital importance for the creation of awareness about the activities of the Corporation and the role of the Corporation in technology transfer and technologies available with the Corporation for transfer. With this objective in view, the Corporation participated in 04 exhibitions and 03 Webinars in India organized by various agencies.

2.2.2.2 Publication of Magazines in NRDC for dissemination of information on Science and Technology for the Financial Year 2020-2021

NRDC continues to bring out its regular publications — Awishkar (Monthly Hindi S&T magazine) and *Invention Intelligence* (Bi-Monthly English S&T magazine). The main objectives of the magazines are to disseminate information and create awareness about new technologies, inventions, innovations, IPR issues, etc. amongst the masses and foster the spirit of inventiveness, innovativeness and entrepreneurship in the country.

During the year some of the important articles covered in Awishkar are: COVID-19: An Overall View; History of pandemics; Evolution of Coronaviruses; Viruses and their invisible world: some glimpses; Combating COVID-19: Biotechnological researches in India; DRDO technologies to combat COVID-19; DST strengthen India's hands in fight against COVID-19; DSIR combating the pandemic, providing solutions; NRDC aligning with Indian R&D labs to combat COVID-19; A glimpse of the technological solutions to combat COVID-19 from leading Indian Academic Institutions; ICMR leads fight against COVID-19; Science of vaccine; Useful technologies of CSIR-NEERI, etc. An exclusive interview of Prof. Chandrima Shaha, President INSA, also featured in the November 2020 issue of Awishkar.

During the year some of the important articles/topics covered in *Invention Intelligence* are: ICMR leads fight against COVID-19; History of Pandemics; Evolution of Coronaviruses; Epidemiology, Basic Reproduction Number, and Herd Immunity of SARS-CoV-2; The World after COVID-19 Crisis; CSIR's Five-Pronged Strategy to Fight COVID-19; After COVID-19, What?; CSIR fighting unitedly against SARS-CoV-2;

Global Patent Landscape of COVID-19 Technologies; NRDC: Aligning with Indian R&D Labs to combat COVID-19; Startups vs COVID-19; CSIR Combating the Pandemic, Providing Solutions; DST strengthens India's Hands in Fight Against COVID-19. Combating COVID-19: Biotechnological Research in India; DRDO Technologies to Combat COVID-19; Innovation-The Driving Force of Human Civilisation; CSIR — Giving a Push to Rural Technologies; Rural Inventions and Entrepreneurship; NRDC Catalysing Development in Rural India; Innovation in Rural Settings; Grassroots Innovations — A Neglected Yet Highly Significant Sector; Bright Minds Usher Rural Dawn; Transforming Lives: ISRO Paves the way to Apply Space Technology for Rural Development; NRDC-Awarded Innovations that are useful for Rural Areas; 2020 — The Year in Science; Inventions and Innovations from MoES Touching Everyday Lives of Indians. An exclusive interview of secretary, DSIR and DG CSIR Dr. Shekhar C. Mande also featured in the March-June 2020 issue (Combined Special Issue on COVID-19) of Invention Intelligence.

2.2.3 START-UP INDIA: SEED FUNDING OF MANUFACTURING START-UPS IN INCUBATION CENTRES.

Through this scheme, the Corporation selects the start ups & early stage companies and provides a part of the capital required, as Seed funding against equity to innovators, who prima facie have the potential to develop significant technical and commercial entities.

During the year, the Corporation completed the investment activity in one start-up M/s Aquafront Infrastructure Pvt. Ltd. and invested Rs 25.0 Lakhs against equity. Also the meeting of Investment and Disinvestment Committee for shortlisting of proposals received for Seed Funding for F.Y 2019-20 and F.Y 2020-21 was held on 4th August 2020. The committee had finalised that Rs 25.0 Lakhs would be invested in one of the three parties recommended in order of merit for FY 2019-20 and Rs 25.0 Lakhs each would be invested in 4 recommended proposals/ parties for FY 2020-21. The letter was intent was issued to all the selected parties. One Party, M/s Sonant Technologies gave the consent and the due-diligence process has been initiated.

3.0 START-UP INDIA INITIATIVE

3.1 ASSESSMENT OF START-UP-INDIA APPLICATIONS FOR TAX-EXEMPTION

"Start-up-India" is an initiative of Department for Promotion of Industry and Internal Trade (DPIIT), Government of India, designed for fostering innovations, create jobs and facilitate investments. Start-up India receives applications from all over India for getting recognition (as Start-ups) for further availing proposed benefits under this scheme including the three year tax benefits.

DPIIT has nominated NRDC for technically assessing these applications for recognizing start-ups and recommending the eligible start-ups for tax exemption and other benefits. As notified, for further availing tax benefits, the eligible applications are further reviewed by an Inter-Ministerial Board (IMB) chaired by JS, DPIIT. NRDC evaluates the applications on the basis of norms given by Start-Up India initiative and submit the reports regarding the same to Inter Ministerial Board (IMB) for final decision. NRDC has submitted report for 1127 cases in the financial year 2020-21 i.e. from 44th to 51st IMB meetings. Based on the recommendation of assessment by NRDC the IMB has approved 98 startups for availing tax benefits in the financial year 2020-21.

3.2 FILING OF PATENT, TRADEMARK AND DESIGN APPLICATION UNDER SIPP SCHEME

Indian Patent office, Government of India recognized NRDC as a facilitator for filing patents, design and trademarks of start-ups under the Start-up Intellectual Property Protection (SIPP) scheme (CG/Misc./ Facilitator/2016/506 dated 27.052016).

In the year 2020-21, 5 trademark applications and 1 patent applications were filed under the PIII (startup) along with the filing of the complete specifications of the previously filed patents, trademarks and design.

The list of newly filed SIPP applications is as follows:

S. No.	Name of The Start-Up	Type of Application (Patent/ Trademark/ Design)	Status of The Application
1.	Casa De Flora Private Limited	Trademark (Class 31)	Filed
2.	Pratyaksha Agrotech Private Limited	Trademark (Class 31)	Filed
3.	Navshali Innovations Private Limited	Keraio Logo (class 10, 11 and 21) Trademark	Published in journal
4.	Navshali Innovations Private Limited	Pyotam Logo under class 11 and 40	Published in journal
5.	Krishna Arya Tech Corp LLP	Trademark	Under Process
6.	Bable Technology Pvt Ltd.	Patent	Provisional specification filed

4.0 CONSULTANCY

4.1 INDIAN OIL START-UP SCHEME: MENTORING & MONITORING START-UPS

Indian Oil Corporation, India's flagship National oil major, has launched a Start-up Scheme with a funding of Rs. 30.00 Crores to promote promising start-ups and nurture an eco-system conducive for innovations in the domestic hydrocarbons and allied sectors. Driven by Indian Oils Research & Development Centre based at Faridabad, the scheme is supporting projects that aim to establish innovative technology and business process re-engineering ideas with significant business potential, social relevance and focused on environment protection. It will help them pursue their promising ideas right up to validated Proof of Concept (POC) by funding the incubation ecosystem and through intellectual mentoring. Indian Oil may further aid in the commercialization of selected validated PoCs through equity participation.

Based on our experience in working with Start-up eco system, IOCL entered into an agreement with NRDC for short listing and fixing of milestone from the proposals received from the start-ups for funding. During the year corporation provided mentoring and monitoring services to 25 start-ups funded by IOCL to promote the start-up culture in the country. Now IOCL has invited proposals for third round up to 30th June 2021 and signed MOA in this regard on 10th March 2021. The role of NRDC as per the MOA shall be to mentor, incubate, monitor, evaluate and review the Start-up project selected under the scheme and to provide inputs and assistance to validate the idea/project till the POC stage and to recommend the release of funds based on milestones agreed. For the services rendered to IOCL by NRDC under this MOA, for a maximum no. of 15 projects to be monitored/ mentored over period of 18 months for Business Process Re-engineering (BPRE) and 36 months for Technology Process Re-engineering (TPRE) Projects, a

remuneration of Rs. 1.86 & Rs. 2.10 Crores plus taxes respectively has been earned.

4.2 ENGAGEMENT OF NRDC AS AN IPR CONSULTANT:

MoA was signed between following institutions and NRDC to provide support for filing of IPR applications and for organising capacity building training programmes/ workshops for creating awareness in IPR:-

S. No.	Institution	No. of Patent Application Filed for the financial year 2020-21
1.	National Institute of Food Technology Entrepreneurship and Management (NIFTEM), Sonepat	Filed 3 patent applications (including one PCT application)
2.	Mishra Dhatu Nigam Limited (MIDHANI), Hyderabad	Filed 2 patent applications
3.	Bharat Dynamics Limited (BDL), Hyderabad	Filed more than 35 IPR applications (patents and copyrights)

4.3 ESTABLISHING INTELLECTUAL PROPERTY FACILITATION CELL (IPFC) FOR DIRECTOR GENERAL OF QUALITY ASSURANCE, DEPARTMENT OF DEFENCE PRODUCTION, MINISTRY OF DEFENCE FOR CAPACITY BUILDING OF IPFC UNDER IPR CONSULTANCY SCHEME OF NRDC

To spur creativity and stimulate innovation in defence sector, Ministry of Defence launched 'Mission Raksha Gyan Shakti' (MRGS). This mission aims to institute an enabling framework for creation and management of Intellectual Property (IP) in Indian defence sector. Therefore, an Intellectual Property Facilitation Cell (IPFC) has been set up under the aegis of Director General Quality Assurance (DGQA) to steer all efforts in this direction. NRDC signed an MoU with IPFC of DGQA, Department of Defence Production, Ministry of Defence on 9th July 2019. As per the MoA, NRDC shall provide support to DGQA for capacity building of their Intellectual Property Facilitation Cell (IPFC) for a period of two year. The major roles and responsibilities have been to provide a suitable organizational structure of IPFC, formulate IP management policies for DPSUs/ OFBs, formulate requisite Standard Operating Procedures (SOPs), Process Sheets, Forms and Reports, provide structured and hands on training to personnel of IPFC, provide services for filing of IP applications through NRDC empanelled attorneys, provide professional guidance and assistance for empanelment of IP Attorneys, provide professional guidance for procurement of suitable hardware, software and databases, conduct basic and advanced training on IP Management for personnel from DPSUs, OFs, Army / Navy / Air Force and Private Sector and to provide professional guidance and assistance on any other issue pertaining to IPR / IP Management

NRDC has carried out the following activities for the IPF Cell:

1. Assisted in formulating the policy for Creation and Management of Intellectual Property (IP) by Defence Public Sector Units & Ordnance Factories.
2. Placed two full time Consultants at IPFC cell for providing support and professional guidance to the IPF Cell.
3. Assisted in preparation and publication of three editions of e-magazines

'MRGS Samvaad' for dissemination of information on IPR.

4. Assisted in filing of 35+ IP applications including patent, copyright and trademark of Indian Army, Navy, AFMC etc. through NRDC empanelled attorneys.

5. Participated in progress review of MRGS.

6. Indian Navy and NRDC partnered in protecting the IP developed by Innovation Cell of Institute of Naval Medicine and commercialization of NavRakshak PPE Kit. The Manufacturing Know-How of NavRakshak™ has been licensed to six Indian MSME manufacture.

7. Providing Professional guidance for any other issue pertaining to IP Management.

4.4 ASEAN-INDIA INNOVATION PLATFORM (AIIP)

Technology Database:

During the period the ASEAN Portal was designed, developed, tested and launched. The portal was equipped with details of 400 National Technologies and 58 International Technologies developed at various ASEAN Member State. During the COVID pandemic, the portal was also utilised for exchanging the information with technical heads of ASEAN countries on the initiatives taken by Government of India and Technologies available to fight with this pandemic.

IPR Workshop:

On the basis of the feedback and suggestions provided by the delegates who attended the 1st workshop on IPR and Tech Transfer that was held in April 2019, it was observed that the delegates from the ASEAN countries like Malaysia and Myanmar were interested in co-hosting the workshop in their country with NRDC and DST-India, Government of India. After the 1st workshop ended, delegates of Malaysia (Dr. Rahmah Mohamed, Universiti Teknologi MARA (UiTM, Malaysia and Dr. Mohd. Shahrul Nizam Mohd. Danuri, Kolej Universiti Islam Antarabangsa Selangor (KUIS), Malaysia) showed interest in co-hosting the 2nd workshop at their place and requested NRDC to nominate them as representatives for negotiating with other stakeholders at Malaysia.

With respect to the above, NRDC initiated discussions and sent a letter to nominate them for helping NRDC to collaborate with Intellectual Property Corporation of Malaysia (MyIPO) and other universities like Universiti Teknologi MARA and Kolej Universiti Islam Antarabangsa, Selangor for conducting the 2nd workshop on "IPR and Tech Transfer".

NRDC was supposed to organize the 2nd workshop in April, 2020. But because of the pandemic situation due to Covid-19, NRDC could not conduct the workshop on time. Based on the situation worldwide, NRDC intends to organise the 2nd workshop by the end of FY 2021-22 at Delhi.

5.0 e-office DEPLOYMENT

e-office is predesigned web based application, Designed and Developed by National Informatics Center NIC, Ministry of Electronics & Information Technology, Government of India. Contributing towards the Digital India campaign, Corporation has also deployed E-Office at Corporation. In order to achieve this, a local data centre was established within Corporation and the E-Office was formally launched on 01st September 2020 and module on electronic

File Management system was made online. Now all the files are created in a digital mode, which has reduced the physical file movement to zero. The module on Leave Management System has also been deployed, which has automated the entire leave management. This process has removed the physical movement of leave applications. Presently we are in the process of automation of our tour management using ETour module.

6.0 MANPOWER (HUMAN-RESOURCE)

The real asset of any company is its human resource. The total regular manpower of the Corporation as on 31st March, 2021 was 62 viz. (Group A-31, Group B-07, Group C-21 and Group D-3) and 7 contractual engagements (viz 4 technical + 3 Non-technical). The representation of reserved category of regular employees as on 31.3.2021 stood at SCs (25.81 % - (16 employees) ST (Nil % - No employee) OBC (6.45% - 4 employees), PwD (1.61 % - 1 employee), ESM NIL (No employees) and women representation (20.97 % - 13 employees) and Minority Community (4.84% - 3 employees) respectively. The Corporation is following all the instructions and Govt. directives relating to reservation of the above categories issued from time to time. In some areas, their representation could not be brought to the prescribed levels due to non-filling of vacant posts due to MoF instructions and the continuing rationalization of existing manpower. The employee-management relationship was cordial throughout the year. In order to improve the average age mix and skill level of the employees as well as to achieve optimum manpower utilization in the Corporation.

6.1 HUMAN RESOURCE DEVELOPMENT

Training and development of all levels of employees was given due priority by the Corporation to increase effectiveness. Special emphasis was given to organisation building and shaping right attitudes, team building and work culture besides preparing employees to understand the trends in fast changing technology/switching over to latest technology for achieving higher results in productivity and profitability. Due to financial constraints and pandemic, during the year none of the officials of the Corporation were deputed to training programmes on Right to Information Act. The thrust for better utilisation of Human Resources and improvement in work practice continued during the year.

6.2 INFORMATION STATUS OF COMPLAINT MECHANISM FOR WOMEN

NRDC has a 'Women's Cell' consisting of the following members to look after the well-being and welfare of the female employees:

1. Ms. Mayuree Sengupta
   Chairperson
2. Ms. Sharda
   Membee (Rep. Officers Association)
3. Ms. Asha Devi
   Member (Rep. Staff Union)
4. Ms. Smita Parashar
   Convenor

The Women Cell is provided with requisite facilities. The Cell also shares awareness for all female employees on sexual harassment at workplace. The Cell also display posters to show the type of harassment act at work places. All the circulars pertaining to welfare/ protection of women's rights received from the Government Departments are brought to the notice of female employees for awareness. A meeting of the Committee was held on

8th March, 2021. The Corporation did not receive any complaints during the financial year 2020-21.

The Women Cell members looks into the grievances of female employees and complaints of sexual harassment received, if any. There is a cordial atmosphere for male and female employees of the Corporation.

7.0 RIGHT TO INFORMATION

Under the provisions of section 4 of the Right to Information Act, 2005, every Public Authority is required to display necessary information to citizens to secure access to information under the control of public authority in order to promote transparency and accountability in its working and functioning.

NRDC, being a responsible Central Public Sector Enterprise, has displayed essential information on its website under the head RTI. The management has notified APIO, PIO, Transparency Officer and the First Appellate Authority (FAA) in compliance with the requirements of the RTI Act. Between April 1st, 2020 to March 31st, 2021, a total of 17 applications were received by the Company and all of them were disposed off by providing requisite information as per rules. Apart from RTI applications, the Company also received 03 appeals against the information provided, which too were duly attended to and appropriately disposed off by the First Appellate Authority. It is pertinent to note that Central Information Commission has not passed any adverse order against the PIO/FAA.

8.0 TECHNOLOGY ABSORPTION, ADAPTATION INNOVATION & CONSERVATION OF ENERGY

Being a Section 8 company under Companies Act 2013, while a major objective of the Corporation is the promotion, development and commercialization of indigenous technologies, the Corporation itself does not carry out any R&D. However, it promotes and provides limited finances assistance for R&D on a meritorious & need basis to both laboratories and industries. As the Company's operations do not involve any manufacturing or processing activities, the particulars required under Section 134(3)(m) of the Companies Act, 2013 read with Rule 8(3) of the Companies (Accounts) Rules, 2014 regarding conservation of energy and technology and absorption are not applicable.

9.0 CORPORATE GOVERNANCE

Corporate governance is the system of rules, practices and processes by which a company is directed and controlled. Corporate Governance refers to the way in which companies are governed and to what purpose. It is, in essence, a toolkit that enables management and the board to deal more effectively with the challenges of running a company.

NRDC is fully committed towards good Corporate Governance in letter and spirit. NRDC makes all efforts to achieve the highest level of corporate governance as per the applicable guidelines in this regard.

The Department of Public Enterprises (DPE), for the year 2019-20 awarded "Very Good" ranking to NRDC on compliance with Guidelines on Corporate Governance.

10.0 IMPLEMENTATION OF OFFICIAL LANGUAGE (2020-21)

The Corporation continued to make efforts to fulfil the targets prescribed by Govt. of India in the Official Language Act and Rules framed there in with regard to increase the

use of Hindi Rajbhasha in office during the year 2020-21. Employees were motivated to use their working knowledge of Hindi in day to day official work. All the Standard Forms, Files etc. are bilingual. Significant progress has been made in the field of correspondence, noting and drafting in Hindi. All Hindi letters are being replied in Hindi only. The Annual Report of the Corporation is being published in digital form in both Hindi & English since 1986-87. The Corporation also publishes a popular Science & Technology monthly magazine in Hindi, entitled 'Awishkar'. To popularize the use of Hindi, the Corporation organized a "Rajbhasha Pakhwara" (14 - 30 September 2020). During the Pakhwara Hindi Essay writing competition was organized & cash awards were given to the winner Cash Awards were also given to employees under "Rajbhasha Incentive Scheme". In order to popularize Hindi and as suggested by the Parliamentary Committee on Official Language, a Rajbhasha Sammelan was also jointly organized by NRDC with four other PSUs on 15/01/2021 in gracious presence of Secretary, Department of Official Language, Government of India. To enrich Hindi vocabulary of the employees of the Corporation as well as visitors, an English word with its Hindi meaning is written daily on a writing board as 'Today's word' at the reception of the Corporation.

2.0 CENTRAL ELECTRONICS LIMITED

2.1 INTRODUCTION

Central Electronics Limited is a Public Sector Enterprise under Department of Scientific & Industrial Research (DSIR), Ministry of Science & Technology, Govt. of India. It was established in 1974 with an objective to commercially exploit the indigenous technologies developed by National Laboratories and R&D Institutions in the country. The company has commercialized number of products developed in collaboration with CSIR, DRDO and other institutions. The renewed mandate of CEL includes development and harnessing technology for (i) Solar Energy Systems and Solutions (ii) Strategic Electronic Components and Systems required for defense and other science and technology missions (iii) Signaling and safety in public transport systems and (iv) Security and surveillance in strategic establishments.

CEL has pioneered in Defense components and materials like Phase Control Modules (PCM) and CZT substrates, Solar Photovoltaic, Railway Safety & Signaling Equipment, and different types of PZT elements in the country. The company is a leading manufacturer of RDSO approved railway safety and signaling systems with a market share of 60%. These signaling systems are important equipment for public safety during the operation of trains.

CEL is involved in commercialization of critical products for strategic applications for defense like, Ceramic Radome for Missile radar for Air force, laser fencing systems for border security, Drishti Transmissometer for visibility measurement in Airports, circulators & Isolators for ISRO, body armours, K-33 materials for ISRO, Piezo ceramic array for Sonars, CEL is also working on failsafe new generation railway signaling and safety systems.

CEL has established partnerships and linkages with various stake holders and business associates in the areas of railways, power generation and distribution companies, service providers in the energy sector, public funded institutions and even rural communities through the state governments. CEL's programs and operations for production, business operations, distribution and marketing as well as support services are aligned with the programs being implemented by the central government of India.

2.2 MAJOR DEVELOPMENTAL ACTIVITIES DURING 2021-22

(i) New Multi Section Digital Axle Counter (newMSDAC)

MSDAC is a multi-section digital axle counter system used for detection of railway tract occupancy primarily in a station.

The current version of MSDAC being manufactured by CEL is a fail-safe, train detection system and caters to maximum of 40 Detection points suitable for larger installations. The new generation MSDAC is planned to come up with smaller configuration system for meeting railways requirement, to be price competitive, to tackle the component obsolescence in the existing system in compliance to RDSO EMI/EMC specifications.

The sub-modules and engineering model of the system have been developed by the company and the system is under evaluation. The sub-modules such as axle detector and field Unit are designed in such a way that they could be used for other axle counter versions too. This will help in achieving

common inventory in railways as well as ease of manufacturing in CEL. The Reset Panel is used for normalizing the system in case any soft failure occurs. Visual display feature was incorporated in Reset Panel to meet the future requirement of Railways.

Sub Modules of New MSDAC

Central Evaluator

Field Unit

Axle Detector

Station Master Panel

(ii) Solid State Block Proving Axle Counter (SSBPAC)

Solid State Block Proving by Digital Axle Counter (SSBPAC) is a solid state system used for controlling the coordinated movement of the train between two points in the block section. SSBPAC has been designed as per RDSO/SPN/175/2014. The system reduces the number of relays in the conventional BPAC system. The sub modules such as central evaluator, station master panel (SM) have been developed and functional prototype has been manufactured.

Sub Modules of SSBPAC

Central Evaluator

Station Master Panel

Technology Absorption, Adaptation, Innovation:

(iii) Drishti Transmissometer

CEL has recently manufactured and demonstrated a prototype of Drishti Transmissometer which is mandatory equipment required for safe landing and take-off operations at the airport. The know-how of the system has been provided by CSIR-National Aerospace Laboratories

(NAL). The system measures visibility as low as 4m and as high as 10km and meets standards of International Civil Aviation Organization (ICAO) and World Meteorological Organization (WMO) and suitable for all categories of airports viz CAT I, CAT II, CAT III A & B.

Drishti Prototype installed in CEL

(iv) Ceramic Radomes

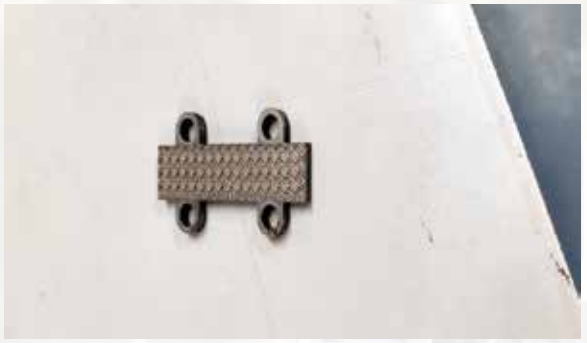
Radome is a thermo-structural member used in tactical missiles and houses the avionic systems like seeker. It is subjected to severe thermal as well as structural loads during the flight. It is one of the most critical components for the seeker missile having complex manufacturing process. High temperature ceramic materials which are transparent to electromagnetic radiation are chosen as radome materials. The know-how of the ceramic radome technology was provided by Defence Metallurgical Research Laboratory (DMRL), DRDO and the company has set up the manufacturing and inspection facilities for sintered radome and successfully commercialized the product. The company has also received orders of worth Rs. 6.5 Cr from defence organizations for supply of ceramic radomes for various missile systems like Astra, Akash-NG, QRSAM and Rudram.

(v) SONAR

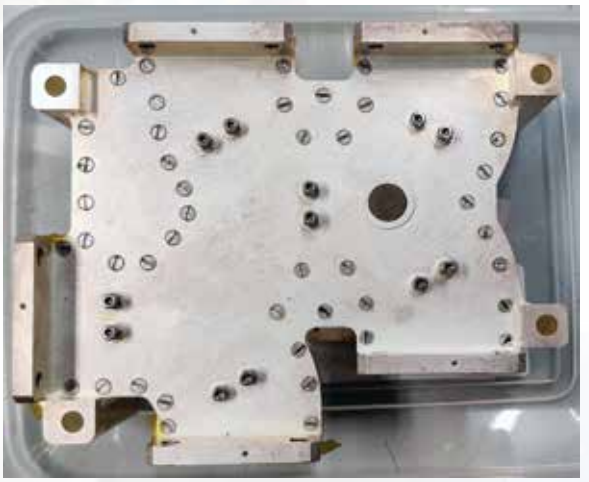
CEL manufactured RADOMES

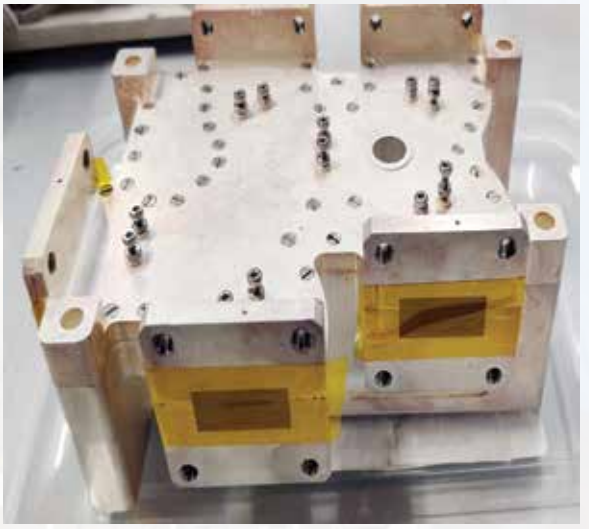
SONAR is a transducer used for underwater object and location detection. CEL is currently working to develop a 200 Khz SONAR based on piezo array based technology for defense applications. This is useful for detection of threats such as unidentified submarines in naval warfare. The protoype of SONAR is manufactured as per the design of BEL, Bangalore. CEL has received a development order of the same from BEL,Bangalore.

SONAR housing components



Circulator





(vi) CIRCULATOR

Circulators are microwave devices used for transfer of power between two or three RF ports. CEL has manufactured a prototype of X band Circulator Switch Assembly as per the design of SAC,ISRO. The device operates on 9600 ± 300MHz and are frequently used microwave remote sensing payloads of ISRO (Satellite Application). Design is based on ferrite based blocks used for maneuvering signals inside the housing. The testing of the product is underway after which shall be supplied to ISRO. CEL has received a development order of worth Rs.1.4 Cr for supply of circulator to SAC, ISRO.

Memorandum of Understanding (MoU) s Signed

- Memorandum of Understanding (MoU) signed with Indian Institute of Kanpur (IIT-K) to work on common areas of interest for the development of technology and various indigenous products.
- Technology transfer agreement has been signed with Naval Materials Research Laboratory (NMRL DRDO) for production of special grade ferrite based radar absorption material for stealth application.

Financial Achievements

- A continuous profit making organization since FY2013-14.
- Highest ever net worth of Rs.105.82 Cr. as on 31.3.2021 with positive reserves.
- Debt equity Ratio less than 5% as on 30.09.2021.
- Over Rs.100 Lakhs spent under Corporate Social responsibility (CSR) in last 4 years.
- Highest ever single year profit before tax (PBT) of Rs.34.20 Cr in FY 2020-21.

Information on PwDs:

The percentage of PwDs (Persons with disabilities) employed in the company is 4% as on 01/11/2021.

Financial details in comparison with previous years supported with Table/figure:

Year	2020-2021	2019-2020
Production	287.21	249.09
Sales	296.37	245.99
Gross Margin	41.40	14.01
Gross Profit	36.58	9.06
Profit Before tax (PBT)	34.21	6.36
Net Profit after Tax (PAT)	23.26	3.13

CSR activity details with financials

(a) Rs. 15.74 Lakhs was spent towards infrastructure improvement of primary school located at Karheda, Ghaziabad.

(b) Manner in which amount spent during the financial year is detailed below:

1	2	3	4	5	6	7	8
Sl No.	CSR project or activity identified	Sector in which the project covered Relevant Section of Schedule VII in which the project is covered (Note)	Project or programs Local Area or others Specify the State and District where the projects or programs was undertaken	Amount out lay (budget) project or programs wise	Amount spent on the project or programs Sub Head: 1. Direct Expenditure on project or programs. Overheads	Cumulative Expenditure upto the reporting period	Amount Spent: Direct or through implementing Agency
1	Education	II	Contribution of CSR fund spend on renovation and others works of primary government school located in Karheda	Rs. 15.74 Lakhs	Rs. 15.74 Lakhs	Rs. 41.61 Lakhs	CEL CSR Trust

Manpower details with OBC/SC/ST/PWDs details

The particulars of SC / ST and other categories of employees as on 31 March 2021are as under

Categories of Employee	As on 31.03.2020	
	Executives	Non Executives
SC	16	44
ST	NIL	NIL
OBC	14	19
PH	5	7
General	113	98

Implementation of official language

The Financial Year, 2020-21 had been a year of achievements for your company in the area of official language. During the year, Inspection of CEL Head Office was carried out by second sub committee of Parliamentary Committee on Official Language.

The Meeting of official Language Implementation committee were organised in each quarter to review and improve implementation of official language policy. Hindi website of company was updated regularly .02 Hindi workshop/training programmes were organised whereas 20 Executives and 30 Non- Executives were trained. Employees were imparted training in usage at Hindi computer applications.

Annual Report of the company was published in Diglotform.

A 'Kavya Path Pratiyogita' was organised by CEL under the aegis of TOLIC (UPKRAM), Ghaziabad. One of our employees won the fourth Protsahan Prize.

To create a Hindi oriented environment, the company celebrate Hindi day on 14.09.2020 and Hindi fortnight was organised during 14.09.2020 to 28.09.2020.

Various competitions, like Hindi Samanya Gyan Pratiyogita for Non-Hindi and all employees, Poetry and Hindi speech completions were also held. Employees are encouraged to use Hindi in official correspondence.

The company continues to implement the official Language Policies of the Government through motivation and encouragement.

All these efforts were motivational tools in creating possibilities of better and progressive use of Hindi in the office.

Technology absorption, adaptation, innovation and conservation of energy

The particulars relating to conservation of energy, technology absorption, foreign exchange earnings and outgo, as required to be disclosed under the Act are as under:

1) Power Factor Improvement

Power factor is an expression of energy efficiency. Poor Power factor means that we are using power inefficiently. This matters to the company because it can result in:

- Heat damage to insulation and other circuit and other circuit components.
- Reduction in amount of available useful power.
- A required increase in conductor and equipment sizes.
- Power factor increases the overall cost of a power distribution system because the lower power factor requires a higher current to supply the loads.

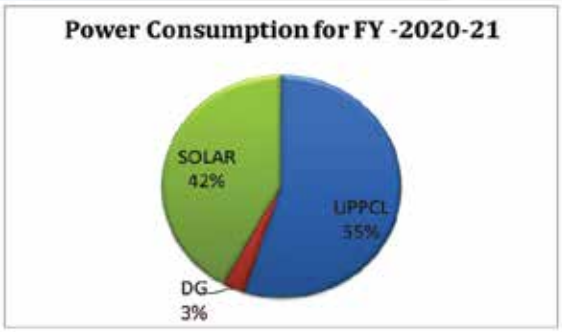
In our company, Power factor improved significantly by installing detuned reactors in APFC Panels and Harmonic Active Filter at HT & LT lines which has resulted in saving & conservation of electricity.

Presently our company achieving PF ≥ 0.99

2) Utilization of Solar Energy

Presently, we have installed & operating multiple in-house solar PV plants having capacity around 1.2-MWp. We have also net metering system in our company campus in which we are utilizing the solar power directly by load in working days and by exporting solar power to grid in non-working days. This also helps to reduce the load on grid.

Solar proportion in our total electricity consumption was 42 % in FY 2020-21.



3) Procurement of Gas generator in place of Diesel generator for power back-up.

The commission for Air Quality Management in National Capital Region and Adjoining areas has given clear instruction that the use of Diesel generators is strictly banned in Delhi NCR during winter to prevent air pollution.

In view of this Engineering Division has installed PNG Meter and pipeline at DG Set area from M/s Indraprastha Gas limited. The file for the procurement of gas genset has also been initiated and parallelly a tender for procurement of new gas genset has already been floated.

Implementation of RTI Act

Government of India has enacted the Right to Information Act (RTI) 2005 with a view to bring-in transparency and accountability in the working of Public Authorities. The company has evolved necessary structure to facilitate implementation of the RTI Act in the Company.

Information Officer has been appointed and an Appellate Authority has been designated for smooth implementation of various provisions of the RTI Act. Necessary information has also been posted on the website of the Company www.celindia.co.in.

Human Resource Development

1. Welfare of the reserved categories

All Government directives relating to the reserved category such as SC, ST, Physically Handicapped, Ex-servicemen, etc. were continuously implemented during the year.

2. Industrial Relations and Human Resources Development

Industrial Relations continued to be harmonious during the year. The Company has imparted training to the workmen and executives at various levels through in – house programs as well as participating in external programs in relevant areas, which has been helpful in the development and growth of employees. A system of regular shop level and plant level meetings has been put in place for improving workers participation in Management. Online APARs have also been implemented for all levels of executives.

Process of regular recruitments at various levels in keeping with the Company's growth & technology needs has been put in place to induct new blood into the Company.

3. Status of Sexual Harassment of Women at Workplace

The Company has in place a Policy on Prevention, Prohibition and Redressal of Sexual Harassment of Women at Workplace. As per the provisions of the Sexual Harassment of Women at Workplace Prevention, Prohibition and Redressal Act 2013, an internal complaints committee has been set up, where any aggrieved female employee can lodge complaint.

All concerned persons, as per the Act, are covered under the policy. The following is a summary of Sexual Harassment complaints received and disposed off during the year 2020-21:

No. of complaints received: Nil

No. of complaints disposed off: Nil

e-Office Guidelines of Central Electronics Limited

Introduction

The e-office aims to supports correspondences by using effective & transparent intra-Cel processes. The vison of e-office is to achieve simplified, responsive, effective and transparent working of all divisions / sections. It will improve productivity & bring transparency in decision making & reduce paper consumption.

1. Objective

The objective of these guidelines is to ensure secure access and usage of CEL e-Office services by its users. Users have the responsibility to use this resource in an efficient, effective, lawful, and ethical manner. Use of the CEL e-Office service amounts to the user's agreement to be governed by this guidelines.

This e-Office guidelines:

- Lays down the guidelines with respect to use of e-Office services.
- Reduces the security and business risks faced by CEL.
- Let's users know how they are permitted to use company e-mail service.
- Ensures users follow good e-Office etiquette.
- Helps the company satisfy its legal obligations regarding e-Office.

Any other policies, guidelines or instructions on e-office previously issued shall be superseded by these guidelines. The Implementing Division/Department for the CEL (hereinafter also referred to as company) e-Office service shall be SSG & IT department.

2. Applicability

These guidelines applies to all "users" which includes employees (regular/contractual/ Outsourced/Daily wagers) of CEL or persons working on third party contract and have been given an official e-Office account by CEL to use the CEL's e-Office system.

It is applicable irrespective of the place: on company premises, while travelling for business or while working from home etc.

3. Usability

i All approval notes/proposals should be routed through e-office. Now, with the advent of e-office in CEL other services cannot be used for approvals like e-mails, WhatsApp, Physical.

ii All roles & rights like downloading of approved files, notes, proposals, draft can only be given to HOD of concerned division/section only.

iii HRD needs to provide transfer / promotion order of employees transfer so that e-office account details can

be updated by e-office team. e-office account of employee cannot be modified without availability of office order account transfer order with reporting details from HR.

iv No dues certificate should be provisioned separately for e-office & DSC is the no dues certificate of superannuation, resignation case.

v Employee shall be responsible for any kind of file transaction related fault. Run time issues should be sent to e-office admin through proper channel via concerned department head.

vi New users account can be created after getting approval from concerned department head.

4. Signing the files

Digital signature certificate (DSC) is required for digital signing the note sheets and drafts for approvals (DFA) in file Management system (e-file). At present, Class – 3 SCs with signing certificate are recommended for e-office instance at CEL. Yellow notes need not to be signed as they are used for intra-division correspondence. User are advised not to delete DSC certificate & not to forget pin for DSC.

Certificate once deleted will invite new procurement & employee will have to bear the cost of the same. In case of loss/damage, cost of fresh DSC will be charged within the span of three (3) years from the date of issue. DSC is issued for the sole purpose of eOffice & users will not use for other means. DSC is not transferable & it must be surrendered on leaving the services of the company.

5. Files making

All file movements should be through proper channel only. If any officer is on leave then file may be sent to next immediate reporting officer making the primary reporting officer "on leave "or "on line "& "on duty. in the note sheet itself.

6. Noting

All final noting's should be done in green notes only. Yellow notes should be used only for drafting and intra division correspondences only.

7. Pulling files back

All users are advised not to use "pull back" options frequently as the same will be in record and reflect in MIS reports of the employees.

8. Supports

SSG & IT division have trained "master trainers "of each division & sections. All users first line of support shall be "master trainers" of that particular division. System Admin of eOffice shall be contacted in extreme urgency of work or serious issues pertaining to eOffice instance. All issues should be routed through proper channel only.

9. Implementation

During the year, eoffice was implemented in Central Electronics Ltd.

Corporate Governance

The Company believes that Corporate Governance provides principled process and structure necessary for attaining the Objectives of the Company. The Directors ensure that Govt. Guidelines/Directives are followed in full. Management Discussion Analysis and Corporate Governance report form part of the Directors Report.

The DPE guidelines on Corporate Governance for CPSEs provide that the CPSEs would

be graded on the basis of their compliance with the guidelines. During 2020-2021 all the four quarterly self evaluation reports have been "Excellent" and the Company expects to receive the EXCELLENT grading from Department of Public Enterprises for the year 2020-2021.

MoU evaluation/performance

As per the letter dated 29th June, 2021 issued by Director (MOU), Department of Public Enterprises, Central Electronics Limited was rated Poor in its MOU evaluation for the year 2020-2021.

CHAPTER 11 ADMINISTRATION & FINANCE

ADMINISTRATION & FINANCE

1.0 ADMINISTRATION

The Department of Scientific & Industrial Research (DSIR) was created in January, 1985. The Administrative Division of the Department, comprising Establishment Section, General Section and Vigilance Unit, looks after activities related to personnel, implementation of the Flexible Complementary Scheme (FCS) promotion mechanism meant for the Scientists (Group 'A'), foreign deputations of officers, vigilance matters, administrative reforms mechanism, work relating to CGHS facilities, staff welfare, coordination etc. Since both Department of Science & Technology and DSIR are situated in the same premises, all the events such as Hindi Pakhwada, Vigilance Awareness Week, Yoga Day, etc. are celebrated jointly with active cooperation of both Departments.

During the year, Department actively participated in the Special Campaign for disposal of pendency. Some of the achievements of the Department during the Campaign are listed as under:-

a) **Record Management:-** Management of record is a major challenge for the Department due to paucity of space in the offices, Most of the files were placed in corridors, Sections/Divisions and floors of the record room. There was urgent requirement for recording, reviewing, digitization and weeding out of files in the Department. During the Special Campaign on disposal of pendency from 2nd Oct 2021 to 31st Oct 2021, a total of 11,211 files were reviewed, out of which 4950 files were identified for weeding out. Most of the files have been digitized in the Department for keeping a soft/ digitized copy for future reference .

b) **Cleanliness Drive:-** Department and its organizations actively participated in the cleanliness drives organized during the period. There was very positive response from all organizations and Divisions of the Department in making the campaign successful. A total of four Special cleanliness drives were launched in the Department (proper) and Public Sector Enterprises as well as Autonomous Bodies under its administrative control which helped to improve hygiene and work environment in the office premises.

c) **Scrapping of waste:-** The obsolete items lying in the Department for many years were identified and disposed off through a Departmental Committee for the purpose, resulting in considerable amount of space being freed.

d) **Disposal of Public Grievances:-** During the Special Campaign, 216 grievances were disposed out of a total of 256. Some of the grievances pertaining to the Council of Scientific and Industrial Research (an Autonomous Body under control of DSIR), pending since a considerable time, were disposed off by concerted and continuous efforts under the leadership of senior officers of the Department.

1.1 STAFF STRENGTH

The staff in position against the regular posts under different groups in the Department, other than Autonomous Bodies viz. Council of Scientific and Industrial Research (CSIR) and Consultancy Development Centre (CDC) and Public Sector Undertakings viz. National Research Development Corporation (NRDC) and Central Electronics Limited (CEL), as on

30/11/2021 is given below and in **Annexure 13**

	General	SC	ST	OBC	Total
Group 'A' (Gazetted)	26*	05	02	04	37*
Group 'B' (Gazetted)	05	02	00	01	08
Group 'B' (Non-Gazetted)	07	00	02	03	12
Group 'C'	03	07	01	04	15
Total	41*	14	05	12	72*

*** Excluding one post of Joint Secretary (Administration) which is on notional basis.**

2.0 FINANCE

The financial summary giving the BE 2021-22, RE 2021-22, AE 2021-22 (upto 31.12.2021) and BE 2022-23 (proposed) for DSIR is given in Table 1.

3.0 RAJBHASHA SECTION

To ensure compliance with the constitutional and legal provisions regarding the official language of the Union and to promote the use of Hindi for official purposes of the Union, the Department of Scientific and Industrial Research under the Ministry of Science and Technology has established the Rajbhasha Section. The Rajbhasha Section has been continuously striving to expedite the use of Hindi in the official work of the Union. During the period under report, the Rajbhasha Section has taken the following steps to ensure progressive use of Hindi in the Department and its autonomous bodies and public sector undertakings under its administrative control-

- In compliance with Section 3(3) of the Official Languages Act, 1963, the provisions of this Act were fully complied with and all documents, reports, monthly summaries etc. were issued bilingually.
- 04 quarterly progress reports and annual Hindi evaluation reports related to progressive use of Hindi were made available to the Department of Official Language in time.
- Under the control of the Department – Inspection of CDC and NRDC office related to the use of Hindi in official work was done on 16.08.2021 and 18.08.2021 respectively.
- Inspection related to the use of Hindi of Indian Institute of Chemical Biology, Kolkata and Central Glass and Ceramic Research Institute, Kolkata office under CSIR, an autonomous body under the control of the DSIR, was done on 08.09.2021 and 09.09.2021 respectively.
- Inspection by the second sub-committee of Parliamentary Official Language Committee was done on 17.07.2021 at Indian Institute of Integrated Medicine, Jammu, on 24.08.2021 at National Institute of Oceanography, Goa and on 13.01.2022 at Institute of Genomics and Integrative Biology, New Delhi.

Hindi Pakhwada was celebrated by the Department of Scientific and Industrial Research jointly with the Department of Science and Technology from September 13th to 24th, 2021, in which several competitions were organized and cash prizes along with citations were given to the winning participants.

4.0 EXTRACTS OF AUDIT OBSERVATIONS

Audit paras pertaining to DSIR that appeared in the CAG report of 2021 are placed at **Annexrec 14.**

TABLE 1: FINANCIAL SUMMARY (Rs. in Crore)															
Scheme	**Actual Expenditure 2020-21**			**Budget Estimates 2021-22**			**Revised Estimates 2021-22**			**Actual Expenditure upto 31.12.2021**			**Budget Estimates 2022-23**		
	Revenue	**Capital**	**Total**	**Revenue**	**Capital**	**Total**	**Revenue**	**Capital**	**Total**	**Revenue**	**Capital**	**Total**	**Revenue**	**Capital**	**Total**
DSIR - Secretariat	11.73	0.00	11.73	17.00	0.00	17.00	14.00	0.00	14.00	10.49	0.00	10.49	17.70	0.00	17.70
DSIR Building	0.00	3.50	3.50	0.00	20.00	20.00	0.00	10.00	10.00	00.00	10.00	10.00	0.00	10.00	10.00
Central Sector Schemes/Projects															
Industrial Research & Development (IR&D)															
PRISM	2.05	0.00	2.05	2.50	0.00	2.50	2.50	0.00	2.50	1.98	0.00	1.98	3.50	0.00	3.50
PACE (Grants)	1.07	0.00	1.07	0.85	0.00	0.85	1.55	0.00	1.55	0.52	0.00	0.52	1.00	0.00	1.00
PACE (Loan)	0.00	0.00	0.00	0.00	1.65	1.65	0.00	1.65	1.65	0.00	0.60	0.60	0.00	2.00	2.00
BIRD(CRTDH)	8.06	0.00	8.06	11.00	0.00	11.00	11.41	0.00	11.41	9.66	0.00	9.66	17.50	0.00	17.50
A2K+	1.36	0.00	1.36	5.00	0.00	5.00	3.89	0.00	3.89	2.20	0.00	2.20	5.00	0.00	5.00
Assistant to PSEs for other Scientific Research															
CEL(Grants)	2.29	0.00	2.29	4.00	0.00	4.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
CEL(Equity)	0.00	1.80	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRDC	5.29	0.00	5.29	10.00	0.00	10.00	10.00	0.00	10.00	9.00	0.00	9.00	10.00	0.00	10.00
Total Central Sector Schemes/Projects	20.12	1.80	21.92	33.35	1.65	35.00	30.35	1.65	32.00	23.36	0.60	23.96	37.00	2.00	39.00
Other Central Sector Expenditure (Autonomous Bodies)															
Council of Scientific and Industrial Research(CSIR)															
National Laboratories-CSIR	3808.40	0.00	3808.40	4669.27	0.00	4669.27	4758.72	0.00	4758.72	3955.94	0.00	3955.94	5102.7	0.00	5102.7
Research Schemes Scholarships & Fellowship-CSIR	400.00	0.00	400.00	475.00	0.00	475.00	475.00	0.00	475.00	397.17	0.00	397.17	460.06	0.00	460.06
Total CSIR	4208.40	0.00	4208.40	5144.27	0.00	5144.27	5233.72	0.00	5233.72	4353.11	0.00	4353.11	5562.76	0.00	5562.76
CDC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
APCT (Contributions) UN Body	5.58	0.00	5.58	7.50	0.00	7.50	7.50	0.00	7.50	5.63	0.00	5.63	6.50	0.00	6.50
APCTT (Building) UN Body	0.00	0.50	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50
Grand Total DSIR inclusive CSIR	**4245.83**	**5.80**	**4251.63**	**5202.12**	**22.15**	**5224.27**	**5285.57**	**12.15**	**5297.72**	**4392.59**	**10.60**	**4403.19**	**5623.96**	**12.50**	**5636.46**
Note: Actuals are as per elekha statement as on 31.12.2021.															

SWACHHTA ACTION PLAN

The Government of India launched Swachh Bharat Mission on 2nd October, 2014 with target to make the country clean by 2nd October, 2019. DSIR Swachhta Action Plan was prepared with a budget head of Rs 9.00 lakh for FY 2021-22. DSIR- Swachhta Action plan is being updated on dedicated Swachhta portal (www. Swachhtaactionplan.com) created by Ministry of Drinking Water and Sanitation (MoDWS).

DSIR organized various activities within the office premises with active participation of officers and staff under DSIR- Swachhta Action plan:

Pursuant to the Hon'ble Prime Minister's call on "Swachh Bharat" campaign and directive from the Ministry of Drinking Water and Sanitation, Swachhta Pakhwada was observed from 1-15th Nov 2021. The program was inaugurated with Swachhta pledge' by all employees and stress upon owing up the drive and spread the awareness among others not in office alone but also among their family members, neighborhood and at their social circles. As per the directive of Government of India following activities were undertaken:

(i) All officials of DSIR participated in Shramdan and an intensive cleanliness work was undertaken to weed out unwanted files and records, cleaning of work stations and office premises.

(ii) Essay, Posters and slogans competition in which employees of DSIR participated.

(iii) Cleaning of DSIR workspace and disposal of obsolete/unserviceable and beyond economic repair items.

(iv) A lecture on "Swachhta" was organized on 10th Nov. 2021 at DSIR, Technology Bhawan, Delhi. The purpose of workshop was to update DSIR officers and staff towards innovative technology and its implementation towards greener environment.

(v) Plantation of Saplings behind new building at Technology Bhawan Campus. Secretary, Joint Secretary and senior official of DSIR participated in it.

(vi) Hygiene Drive at workplace and Distribution of COVID prevention Kit.

DSIR observed Cleanliness Campaign from 2nd October 2021 to 31st Oct. 2021 under the special Campaign for Disposal of Pendency.

Figure 1 Seminar on Swachhta at DSIR

Figure 2 Swachhta Pledge at DSIR

Figure 3 Weeding of old records

ANNEXURE-1

STATEMENT OF RECOGNITION OF IN-HOUSE R&D UNITS (FRESH APPLICATIONS)

Month	Receipt	Cumulative Receipt	Disposal	Cumulative Disposal	No. Companies Recognized	Endorsement of total recognized companies	New Companies recognized	Total R&D Units recognized
December	16	16	0	0	12	0	12	12
January	16	32	34	34	8	0	8	8
February	39	71	0	34	12	5	7	12
March	36	107	51	85	11	1	10	11
April	4	111	0	85	11	0	11	11
May	0	111	14	99	14	1	13	14
June	33	144	0	99	2	1	1	3
July	28	172	40	139	12	2	10	13
August	21	193	0	139	14	3	11	15
September	21	214	81	220	7	1	6	7
October	14	228	23	243	13	4	9	14
November	13	241	0	243	9	2	7	10
December	24	265	20	263	11	1	10	11
Total	252	265	263	263	136	21	115	141

ANNEXURE-2

STATEMENT ON RENEWAL OF RECOGNITION OF IN-HOUSE R&D UNITS WITH VALIDITY OF RECOGNITION UPTO 31.03.2021

Month	Year	Receipts	Cumulative Receipts	Disposal	Cumulative Disposal
January	2021	31	31	38	38
February	2021	85	116	30	68
March	2021	149	265	65	133
April	2021	108	373	22	155
May	2021	00	373	00	155
June	2021	67	440	21	176
July	2021	26	466	66	242
August	2021	08	474	65	307
September	2021	20	494	105	412
October	2021	11	505	89	501
November	2021	05	510	42	543
December	2021	35	545	33	576

Note: A total of 56 applications are being processed currently in the department.

ANNEXURE - 3

LIST OF IN-HOUSE R&D UNITS IN INDUSTRY REPORTING ANNUAL EXPENDITURE MORE THAN Rs. 5000.00 LAKHS

Sl. No.	Name of the Company	R&D Expenditure Reported (Rs. In Lakhs)
1.	Tata Motors Ltd.	129860
2.	Cipla Ltd.	93117
3.	Hindustan Aeronautics Ltd.	87370
4.	Cadila Healthcare Ltd.	61886
5.	Sun Pharma Advanced Research Company Ltd	51813
6.	Oil and Natural Gas Corporation Ltd.	46371
7.	Reliance Industries Ltd.	46032
8.	Indian Oil Corporation Ltd.	42408
9.	HCL Technologies Ltd.	38100
10.	Bharat Heavy Electricals Ltd.	34238
11.	Watson Pharma Pvt. Ltd.	17806
12.	Biocon Ltd.	17476
13.	Biocon Biologics Ltd. (Formerly M/s. Biocon Biologics India Ltd.)	14965
14.	AVL Technical Centre Pvt. Ltd.	13727
15.	Eicher Motors Ltd.	11361
16.	BEML Ltd.	10354
17.	Bharat Petroleum Corporation Ltd.	10222
18.	Mankind Pharma Ltd.	10129
19.	BASF Chemicals India Pvt. Ltd.	9575
20.	Secure Meters Ltd.	9528
21.	Brakes India Ltd.	9475
22.	Steel Authority of India Ltd.	9027
23.	Tractors & Farm Equipment Ltd.	8688
24.	MRF Ltd.	8635
25.	JK Tyre & Industries Ltd.	8153
26.	Hetero Labs Ltd.	7309
27.	Lohia Corp Ltd.	6850
28.	Tata Chemicals Ltd.	6818
29.	IFB Industries Ltd.	6072
30.	Divi's Laboratories Ltd.	5944
31.	Abbott Healthcare Pvt. Ltd.	5859
32.	Oil India Ltd.	5494
33.	Solara Active Pharma Sciences Ltd.	5065
34.	Aragen Life Sciences Pvt. Ltd.	5043

ANNEXURE – 4

LIST OF IN-HOUSE R&D UNITS IN INDUSTRY REPORTING ANNUAL EXPENDITURE IN THE RANGE OF Rs. 500.00 LAKHS TO Rs. 5000.00 LAKHS

S. No.	Name of the Firm	R&D Expenditure Reported (Rs. In Lakhs)
1.	Electronics Corporation of India Ltd.	4700
2.	Rallis India Ltd.	4658
3.	Suven Life Sciences Ltd.	4650
4.	Sentiss Pharma Pvt. Ltd.	4554
5.	Reckitt Benckiser (India) Pvt Ltd.	4439
6.	Mahyco Pvt. Ltd.	4432
7.	Endurance Technologies Pvt. Ltd.	4381
8.	Pidilite Industries Ltd.	4152
9.	ElgiEquipments Ltd.	4048
10.	Central Mine Planning & Design Inst. Ltd.	3928
11.	Aarti Industries Ltd.	3790
12.	Virchow Biotech Pvt. Ltd.	3788
13.	Norwich Clinical Services Pvt. Ltd.	3773
14.	Amneal Pharmaceuticals Pvt. Ltd.	3589
15.	Simpson & Co. Ltd.	3549
16.	Shree Cement Ltd.	3539
17.	Perrigo Laboratories India Pvt. Ltd.	3370
18.	Mann and Hummel Filter Pvt. Ltd.	3165
19.	Indofil Industries Ltd.	3082
20.	Unison Pharmaceuticals Pvt. Ltd.	2965
21.	Hamilton Housewares Pvt. Ltd.	2678
22.	Exicom Tele-System Ltd.	2615
23.	Seed Works International Pvt. Ltd.	2592
24.	Porus Laboratories Pvt. Ltd.	2521
25.	Laxai Life Sciences, Pvt. Ltd.	2477
26.	Dabur India Ltd.	2414
27.	Ankur Seeds Pvt. Ltd.	2312
28.	Steel Strips Wheels Ltd.	2275
29.	MSN Laboratories Pvt. Ltd.	2133
30.	Steril-Gene Life Sciences Pvt. Ltd.	1954
31.	Ultraviolette Automotive Pvt. Ltd.	1944
32.	Zydus Healthcare Ltd.	1894
33.	Berger Paints India Ltd.	1892
34.	Naari Pharma Pvt. Ltd.	1875
35.	Rico Auto Industries Ltd.	1868
36.	Coromandel International Ltd.	1824
37.	JodasExpoim Pvt. Ltd.	1806

S. No.	Name of the Firm	R&D Expenditure Reported (Rs. In Lakhs)
38.	Jubilant Life Sciences Ltd.	1703
39.	VNR Seeds Pvt. Ltd.	1692
40.	Sami SabinsaGroup Ltd.	1686
41.	Namdhari Seeds Pvt. Ltd.	1606
42.	Troikaa Pharmaceuticals Ltd.	1590
43.	Optimus Drugs Pvt. Ltd.	1574
44.	Indian Immunologicals Ltd.	1573
45.	EPL Ltd.	1559
46.	Apicore Pharmaceuticals Pvt. Ltd.	1551
47.	Garden Reach Shipbuilders & Engineers Ltd.	1536
48.	SymbiotecPharmalab Pvt. Ltd.	1533
49.	Raptim Research Ltd.	1494
50.	National Engineering Industries Ltd.	1479
51.	Malladi Drugs & Pharmaceuticals Ltd.	1446
52.	Medley Pharmaceuticals Ltd.	1442
53.	Gulf Oil Lubricants India Ltd.	1437
54.	National Aluminium Company Ltd.	1355
55.	Flowmore Ltd.	1350
56.	Inventys Search Company Pvt. Ltd.	1310
57.	Rane Madras Ltd.	1304
58.	Huntsman International (India) Pvt. Ltd.	1272
59.	Synzeal Research Pvt. Ltd.	1270
60.	Ecocat India Pvt. Ltd.	1262
61.	Charoen Pokphand Seeds (India) Pvt. Ltd.	1231
62.	Havells India Ltd.	1228
63.	KabraExtrusiontechnik Ltd.	1215
64.	Sundaram Brake Linings Ltd.	1214
65.	Kennametal India Ltd.	1180
66.	Poly Medicure Ltd.	1155
67.	Elcom Innovations Pvt. Ltd.	1118
68.	Selec Controls Pvt. Ltd.	1092
69.	FTF Pharma Pvt. Ltd.	1079
70.	NeubergSupratech Reference Laboratories Pvt. Ltd.	1030
71.	Transasia Bio-Medicals Ltd.	1010
72.	Bayer Vapi Pvt. Ltd.	934
73.	India Nippon Electricals Ltd.	916
74.	Embio Ltd.	890
75.	Prathista industries Ltd.	887
76.	CEAT Ltd.	880
77.	Savannah Seeds Pvt. Ltd.	853
78.	HPL Electric & Power Ltd.	839

S. No.	Name of the Firm	R&D Expenditure Reported (Rs. In Lakhs)
79.	AYM Syntex Ltd.	837
80.	Fermenta Biotech Ltd.	834
81.	Singalchip Innovations Pvt. Ltd.	830
82.	Nucleome Informatics Pvt. Ltd.	828
83.	Jindal Steel & Power Ltd.	826
84.	Gujarat Alkalies& Chemicals Ltd.	825
85.	Innova Rubbers Pvt. Ltd.	775
86.	Stanadyne India Pvt. Ltd.	769
87.	Anthem Biosciences Pvt. Ltd.	767
88.	Natesan Synchrocones Pvt. Ltd.	731
89.	Goa Shipyard Ltd.	725
90.	Mayur Uniquoters Ltd.	718
91.	Doehler India Pvt. Ltd.	714
92.	JK Lakshmi Cement Ltd.	707
93.	Arjuna Natural Pvt. Ltd.	704
94.	BDR Lifesciences Pvt. Ltd.	698
95.	Sai Life Sciences Ltd.	679
96.	Aten PorusLifesciences Pvt. Ltd.	673
97.	Elin Electronics Ltd.	657
98.	Fourrts (India) Laboratories Pvt. Ltd.	652
99.	Skipperseil Ltd.	650
100.	Thinq Pharma CRO Ltd.	646
101.	Saurav Chemicals Ltd.	633
102.	CTR Manufacturing Industries Ltd.	623
103.	Naga Ltd.	609
104.	Clearsynth Labs Ltd.	608
105.	Alivira Animal Health Ltd.	607
106.	Tierra Agrotech Pvt. Ltd.	607
107.	Propel Industries Pvt. Ltd.	604
108.	LG Balakrishnan & Brothers Ltd.	600
109.	Flash Electronics (India) Pvt. Ltd.	596
110.	Pranav Vikas (I) Ltd.	587
111.	Oriental Aromatics Ltd.	585
112.	Sandhar Technologies Ltd.	584
113.	Log 9 Materials & Scientific Pvt. Ltd.	579
114.	Eveready Industries India Ltd.	566
115.	MKU Ltd.	561
116.	Ganga Kaveri Seeds Pvt. Ltd.	542
117.	Anand NVH Products Pvt. Ltd.	539
118.	Poddar Pigments Ltd.	538
119.	J Mitra & Co. Pvt. Ltd.	532

S. No.	Name of the Firm	R&D Expenditure Reported (Rs. In Lakhs)
120.	Kimia Biosciences Ltd.	529
121.	Metalman Auto Pvt. Ltd.	518
122.	Themis Medicare Ltd.	511
123.	Srini Pharmaceuticals Pvt. Ltd.	505
124.	Ghaziabad Precision Products Pvt. Ltd.	504
125.	Parason Machiney India Pvt. Ltd.	502

ANNEXURE – 5

LIST OF IN-HOUSE R&D UNITS IN INDUSTRY REPORTING ANNUAL EXPENDITURE IN THE RANGE OF Rs. 200.00 LAKHS TO Rs. 500.00 LAKHS

S. No.	Name of the Firm	R&D Expenditure Reported (Rs. In Lakhs)
1.	Avon Meters Pvt. Ltd.	498
2.	Knorr-Bremse Systems for Commercial Vehicles India Pvt. Ltd.	491
3.	Hi-Media Laboratories Pvt. Ltd.	476
4.	Yansefu Inks And Coatings Pvt. Ltd.	472
5.	Kusum Healthcare Pvt. Ltd.	467
6.	Advanced Microdevices Pvt. Ltd.	460
7.	Hindustan Shipyard Ltd.	460
8.	JNS Instruments Ltd.	458
9.	Sundaram Industries Pvt. Ltd.	458
10.	Hytech Seed India Pvt. Ltd.	453
11.	HIL Ltd.	443
12.	Avra Laboratories Pvt. Ltd.	441
13.	Achira Labs Pvt. Ltd.	440
14.	Imperial Auto Industries Ltd.	438
15.	Jaipur Rugs Company Pvt. Ltd.	437
16.	Gracure Pharmaceutical Ltd.	437
17.	Vulcan Industrial Engineering Company Pvt. Ltd.	437
18.	R L Fine Chem Pvt. Ltd.	428
19.	Century Textiles & Industries Ltd.	413
20.	Romsons Group Pvt. Ltd.	410
21.	Trimurti Plant Sciences Pvt. Ltd.	406
22.	Astrome Technologies Pvt. Ltd.	397
23.	RohaDyechem Pvt. Ltd.	397
24.	JK Paper Ltd.	396
25.	Venky's (India) Ltd.	396
26.	Metal Power Analytical Pvt. Ltd.	392
27.	A Raymond Fasteners India Pvt. Ltd.	391
28.	IPL Biologicals Ltd.	388
29.	Nongwoo Seed India Pvt. Ltd.	388
30.	Rakon India Pvt. Ltd.	380
31.	Sahajanand Technologies Pvt. Ltd.	373
32.	Accuprec Research Labs Pvt. Ltd.	370
33.	Maharashtra Fastners Pvt. Ltd.	366
34.	Smruthi Organics Ltd.	364

S. No.	Name of the Firm	R&D Expenditure Reported (Rs. In Lakhs)
35.	Sakata INX (India) Ltd.	362
36.	Gandhar Oil Refinery India Ltd.	356
37.	Welcome Crop Science Pvt. Ltd.	355
38.	TTK Prestige Ltd.	350
39.	HLL Lifecare Ltd.	345
40	Modi Mundipharma Pvt. Ltd.	337
41.	Sakar Healthcare Ltd.	336
42.	Emmbi Industries Ltd.	325
43.	Thirumalai Chemicals Ltd.	325
44.	Cholayil Pvt. Ltd.	324
45.	I&B Seeds Pvt. Ltd.	320
46.	Anuh Pharma Ltd.	315
47.	The Dharamsi Morarji Chemical Co. Ltd.	307
48.	Sonarome Pvt. Ltd.	303
49.	Rajasthan Electronics & Instruments Ltd.	303
50.	Indfrag Biosciences Pvt. Ltd.	299
51.	Amtech Electronics (India) Ltd.	298
52.	Jesons Industries Ltd.	297
53.	GSP Crop Science Pvt. Ltd.	293
54.	EnzaZaden India Pvt. Ltd.	288
55.	Ravenbhel Healthcare Pvt. Ltd.	287
56.	Pluss Advanced Technologies Pvt. Ltd.	286
57.	Devtech M2M Ltd.	282
58.	GR Intrachem Ltd.	280
59.	Lotus Wireless Technologies India Pvt. Ltd.	277
60.	Vehant Technologies Pvt. Ltd.	276
61.	Sahajanand Laser Technology Ltd.	275
62.	Wires And Fabriks (S.A.) Ltd.	271
63.	HLE Glascoat Ltd.	271
64.	Nu Genes Pvt. Ltd.	267
65.	Colorjet India Ltd.	265
66.	Catalysts Bio-Technologies Pvt. Ltd.	265
67.	Trans ACNR Solutions Pvt. Ltd.	263
68.	BG-LI-IN Electricals Ltd.	262
69.	Sankar Sealing Systems Pvt Ltd.	255
70.	Spack Automatives Pvt. Ltd.	255
71.	Viswaat Chemicals Ltd.	250
72.	Elofic Industries Ltd.	250
73.	ArcelorMittal Nippon Steel (AMNS) India Ltd.	249
74.	Elico Ltd.	248

S. No.	Name of the Firm	R&D Expenditure Reported (Rs. In Lakhs)
75.	Tatva Chintan Pharma Chem Pvt. Ltd.	247
76.	Avon Cycles Ltd.	242
77.	Kalyani Forge Ltd.	240
78.	San Engg& Locomotive Co. Ltd.	240
79.	Unique Biotech Ltd.	238
80.	Pan Seeds Pvt. Ltd.	231
81.	Flamingo Pharmaceuticals Ltd.	230
82.	Holostik India Ltd.	228
83.	Manali Petrochemicals Ltd.	227
84.	Motherson Sumi Systems Ltd.	226
85.	Gujarat Narmada Valley Fertilizers & Chemicals Ltd.	226
86.	AIMIL Ltd.	224
87.	Shantani Proteome Analytics Pvt. Ltd.	222
88.	Ultra International Ltd.	219
89.	Durovalves India Pvt. Ltd.	216
90.	The Motwane Manufacturing Co. Pvt. Ltd.	216
91.	ISSAR Pharmaceuticals Pvt. Ltd.	213
92.	Strand Life Sciences Pvt. Ltd.	213
93.	Savio India Pvt. Ltd.	213
94.	Steelcast Ltd.	212
95.	Everest Blowers Pvt. Ltd.	211
96.	Karad Projects and Motors Ltd.	208
97.	Frontier Lifeline Pvt. Ltd.	207
98.	United Rubber Industries (I) Pvt Ltd.	205
99.	Nirmal Seeds Pvt. Ltd.	205
100.	Isgec Heavy Engineering Ltd.	201
101.	Lakshmi Ring Travellers (Coimbatore) Pvt. Ltd.	201
102.	Voith Paper Fabrics India Ltd.	201

ANNEXURE -6

LIST OF SCIENTIFIC & INDUSTRIAL RESEARCH ORGANIZATIONS (SIROS) RECOGNIZED BY DSIR DURING THE PERIOD DECEMBER 2020 TO NOVEMBER 2021

S.No.	Name of the Organization	Recognition granted upto
Natural and Applied Sciences		
1.	Maruthi Educational Society, Hyderabad (Telangana)	31.03.2023
2.	SPBM Foundation Trust, Bhubaneswar (Odisha)	31.03.2023
3.	Bangalore Bioinnovation Centre, Bengaluru (Karnataka)	31.03.2023
4.	M.S. Ramaiah Institute of Technology of Gokula Education Foundation, Bangalore (Karnataka)	31.03.2023
5.	Rajagir College of Social Science, Kochi, (Kerala)	31.03.2023
6.	NMICPS Technology Innovation Hub on Autonomous Navigation Foundation, Hyderabad, (Telangana)	31.03.2023
7.	Mahindra University, Hyderabad, (Telangana)	31.03.2023
8.	Advanced Manufacturing Technology Development Centre, Chennai, (Tamil Nadu)	31.03.2024
9.	Atal Incubation Centre-Centre for Cellular & Molecular Biology (AIC-CCMB), Hyderabad, (Telangana)	31.03.2024
10.	Institute of Integrated Resource Management, Sonitpur, (Assam)	31.03.2024
11.	I-Hub for Robotics and Autonomous Systems Innovate Foundation ("ArtPark"), Bengaluru, (Karnataka)	31.03.2023
12.	Aishwarya Vignan Educational Society, Nellore, (Andhra Pradesh)	31.03.2024
13.	Graphic Era (Deemed to be University), Dehradun, (Uttarakhand)	31.03.2024
14.	The University of Trans-Disciplinary Health Sciences and Technology, Bengaluru, (Karnataka)	31.03.2024
15.	Ambe Durga Education Society, Nagpur, (Maharashtra)	31.03.2024
16.	Pimpri Chinchwad Education Trust, Pune, (Maharashtra)	31.03.2024
17.	IITM Pravartak Technologies Foundation, Chennai, (Tamil Nadu)	31.03.2023
18.	I-Hub Foundation for Cobotics (IHFC), Hauz Khas, (New Delhi)	31.03.2023
19.	iHub Drishti Foundation, IITJodhpur, Jodhpur, (Rajasthan)	31.03.2023
20.	The LNM Institute of Information Technology, Jaipur, (Rajasthan)	31.03.2024
21.	Center for Excellence in Energy and Telecommunication (CEET), Chennai, (Tamil Nadu)	31.03.2024
22.	IIT Bhilai Inovation and Technology, Raipur, (Chhattisgarh)	31.03.2023
23.	IIT Mandi iHub and HCI Foundation, Mandi, (Himachal Pradesh)	31.03.2023
Agricultural Sciences		
24.	Agricultural Development Trust, Baramati, Pune (Maharashtra)	31.03.2023
25.	National Agro Foundation, Chennai (Tamil Nadu)	31.03.2023
26.	Manthan Gramin Evam Samaj Sewa Samiti, Bhopal, (Madhya Pradesh)	31.03.2024
27.	South Asia Biotechnology Centre (SABC), Jodhpur, (Rajasthan)	31.03.2024
28.	Institute of Rural & Social Development, 24 Parganas, (West Bengal)	31.03.2024

S.No.	Name of the Organization	Recognition granted upto
Social Sciences		
29.	Sri Sharada Institute of Indian Management-Research Foundation Trust, Vasant Kunj, (New Delhi)	31.03.2023
30.	IIHMR University, Jaipur, (Rajasthan)	31.03.2024
31.	Manbhum Ananda Ashram Nityananda Trust (MANT), Kolkata, (West Bengal)	31.03.2024
Medical Sciences		
32.	Kovai Medical Center Research and Educational Trust, Coimbatore, (Tamil Nadu)	31.03.2023
33.	Mohan (Multi Organ Harvesting Aid Network) Foundation, Chennai (Tamil Nadu)	31.03.2023
34.	Rama University, Kanpur (Uttar Pradesh)	31.03.2023
35.	Datta Meghe Institute of Medical Sciences (Deemed to be University), Sawangi Meghe, Wardha (Maharashtra)	31.03.2023
36.	MAA Research Foundation, Hyderabad (Telangana)	31.03.2023
37.	Indian Red Cross Society Gujarat State Branch, Ahmedabad (Gujarat)	31.03.2023
38.	Swasti, Bangalore (Karnataka)	31.03.2023
39.	Indrashil KaKa Ba & Kala Budh Public Charitable Trust, Mehsana (Gujarat)	31.03.2023
40.	Hindustan Educational and Charitable Trust, Coimbatore, (Tamil Nandu)	31.03.2024
41.	Chandramma Educational Society, Secunderabad (Telangana)	31.03.2024
42.	Muni Sewa Ashram, Vadodara, (Gujarat)	31.03.2024
43.	Tata Memorial Centre, Mumbai, (Maharashtra)	31.03.2024
44.	Sri Sathya Sai Sanjeevani Research Foundation, Bangalore, (Karnataka)	31.03.2024
45.	Srishyla Educational Trust, Davanagere, (Karnataka)	31.03.2024
46.	Shri Shamjibhai Harjibhai Talavia Charitable (SHTC) Trust (RK University), Rajkot, (Gujarat)	31.03.2024
47.	Karpagam Charity Trust, Coimbatore, (Tamil Nadu)	31.03.2024
48.	Niramay Charitable Trust, Gandhinagar, (Gujarat)	31.03.2023
49.	Dayananda Sagar University, Bangalore, Karnataka	31.03.2024
50.	The Neotia University, Kolkata, (West Bengal)	31.03.2024
51.	All India Institute of Medical Sciences, Hyderabad, (Telangana)	31.03.2024
52.	All India Institute of Medical Sciences, Bhopal, (Madhya Pradesh)	31.03.2024
53.	King Institute of Preventive Medicine and Research, Chennai, (Tamil Nadu)	31.03.2024
54.	IQ City Foundation, Kolkata, (West Bengal)	31.03.2024

ANNEXURE –7

LIST OF COMPANIES APPROVED (Valid upto 31.03.2020) UNDER SECTION 35(2AB) OF INCOME TAX ACT, 1961

Sl. No.	Company Name
1.	M/s. Atul Auto Ltd.,
2.	M/s. LPS Bossard Pvt Ltd.,
3.	M/s. Henkel Anand India Pvt Ltd.,
4.	M/s. Alan Electronics Systems Pvt Ltd.,
5.	M/s. Dinker Seeds Pvt Ltd.,
6.	M/s. Jasmin Infotech Pvt. Ltd.,
7.	M/s. Biogenetic Drugs Pvt. Ltd.,
8.	M/s. AVN Ayurveda Formulations Pvt. Ltd.,
9.	M/s. Surya Remedies Pvt. Ltd.,
10.	M/s. Vins Bioproducts Ltd.,
11.	M/s. Entod Pharmaceuticals Ltd.,
12.	M/s. ALCON Constructions (Goa) Pvt. Ltd.,
13.	M/s. India Kawasaki Motors Pvt. Ltd.,
14.	M/s. Techno Waxchem Pvt. Ltd.,
15.	M/s. Amalgamations Valeo Clutch Pvt. Ltd.,
16.	M/s. Spack Automotives Pvt. Ltd.,

ANNEXURE- 8

DETAILS OF PROJECTS SUPPORTED UNDER PROMOTING INNOVATIONS IN INDIVIDUALS, START-UPS AND MSMEs (PRISM)

(During the Period from 01.12.2020 - 31.12.2021)

New Projects supported

1. Disinfectant against SARS-CoV-2 and other pathogenic bacteria applied on Surfaces, Mask and use as Fumigation liquid with USP Safety
2. Early detection of Estrous and Foot-and-Mouth Disease (FMD) in Indian cattle using intelligent wearable: prototype development and deployment
3. A Fuzzy Based Solar Egg-Incubator: A Low Cost New Technology
4. Designing of Self Retaining Vascular Forceps
5. Elimination of viruses such as SARS-CoV-2 in condition recirculated air using electrostatics
6. Power Appliance for Toilet Cleaning
7. Redesigning, testing and implementation of blowpipe (baklas) to protect the goldsmiths from exposure to smoke/fume during melting of gold beads/jewellery
8. "AMBU (Aqua Management Binary Unit)"
9. Compact Wearable 12 Led ECG System
10. Development of Enhanced Potato Yield using Tubronic Acid based novel approach
11. Development of Bio-Gender Electromagnetic Machine
12. Iron & Vit-C Chocolate formulation
13. An Automated Panipuri Vending Machine
14. Sustainable Photovoltaic Thermal (PVT) Rickshaw for Rural Transportation
15. Infusion Flow Monitoring Device
16. Building Zinc Gel Battery for e-Rickshaw (electric three wheelers)

Ongoing projects supported

1. A paper based microfluidic chip to detect HR-HPV during cervical cancer screening.
2. Casil-O-Scope- The affordable & portable eye examining device

ANNEXURE- 9

DETAILS OF COMPLETED PROJECTS SUPPORTED UNDER PROMOTING INNOVATIONS IN INDIVIDUALS, START-UPS AND MSMEs (PRISM)

(During the Period from 01.12.2020-31.12.2021)

Completed Projects supported

1. Design and Fabrication of cost-effective improved biomass cook stove for domestic utility
2. GAIT Analysis based patient specific prosthetic polycentric knee joint and socket for transfemoral amputees to improve their walking pattern
3. Eco friendly Health Pro Reliable Water Purifier
4. HyperXs - a Thumb wearable device with distributed gesture recognition architecture
5. Novel Silicon Nipple to prevent early childhood caries (dental decay)
6. Modeling and fabrication of security gadget for Tirumala Pilgrims
7. Development of pucca Housing Topography using Bamboo fiber Ferro cement concrete being
8. Validation of single device for detection of three most prevalent mosquito borne disease
9. Automated Wheel Chair for physically challenged
10. Homemade Bending machine

ANNEXURE-10

DETAILS OF THE NEW PROJECTS SUPPORTED UNDER TECHNOLOGY DEVELOPMENT AND UTILIZATION PROGRAMME FOR WOMEN (TDUPW) DURING THE YEAR 2021-2022

S.No	Title of Project	Name of Organization
1	"Enhancing the livelihoods of tribal and rural women through technological intervention of trainings on postharvest handling and value addition of custard apple and Ber Fruits" Division of Food Science & Postharvest Technology	ICAR- Indian Agricultural Research Institute, New Delhi
2	Socio-Economic Development of Women Weavers' Community in Dakshina Kannada and Udupi districts of Karnataka"	Sahyadri College of Engineering & Management, Sahyadri Campus, Adyar, Mangaluru
3	Empowering women through Appropriate technology intervention in weaving sector for Productivity enhancement and drudgery reduction of artisans	Indian Institute of Technology (IIT), Guwahati
4	Promoting opportunities for Women Empowerment Rejoicing Through Traditional Arts/Crafts for Women in Varanasi District	Sai Institute of Rural Development, Basani, Varanasi, Uttar Pradesh
5	Mechanized system or making Hawaijar- a traditional fermented food of North-East India.	Central Institute of Post-Harvest Engineering and technology, Ludhiana, Punjab.
6	Women empowerment through silkworm Culture in tribal dominated Mayurbhanj District of Odisha	Mayurbhanj Biological Research Bhanjpur, Baripada, Mayurbhanj, Odisha
7	Skill Development Program on Processing, Preservation and Value Addition of Food & Agro based products for commercial use in eight Aspirational Districts of Uttar Pradesh with special emphasis on Development of Women entrepreneurs	CSIR - CFTRI, Resource Centre, Chinhat Deva Road, Lucknow – 226019
8	Training of Progressive Technologies and Capacity Building for Himalayan Community	Himalayan Environmental Studies and Conservation Organization (HESCO), Village- Shuklapur, P.O.- Ambiwala, via Premnagar, Dehradun, Uttarakhand
9	Development of Women Entrepreneurship for low cost Sanitary Napkins production	JSS Academy of Technical education, C-2011, Sector 62, Noida, GB Nagar.
Skill Satellite Centre(s)		
1	Creating sustainable livelihood opportunities to the tribal women of Kuchai block, Saraikel district by establishing a Skill Development Centre	Deepak Foundation, Nijanand Premises, Adjoining L&T Knowledge City, on NH-8, Vadodara, Gujarat
2	Dehydrated Flowers and Foliages for Women Empowerment	CSIR – National Botanical Research Institute, Lucknow

ANNEXURE 11

LIST OF APCTT'S PARTNER ORGANIZATION/ INSTITUTIONS

S. No.	Organization/ Institution
1	All India Institute of Medical Sciences, New Delhi, India
2	Anand and Anand Intellectual Property Law Firm, India
3	Asia-Europe Institute, University of Malaya, Malaysia
4	Asian Development Bank
5	Association of Southeast Asian Nations Centre for Energy
6	Asia-Pacific Regional Innovation Knowledge Network for 4th Industrial Revolution Technologies
7	Azman Hashim International Business School, Universiti Teknologi, Malaysia
8	Bangladesh Council of Scientific and Industrial Research Laboratories, Bangladesh
9	Centre for Analysis and Coordination of the 4th Industrial Revolution, Ministry of Economy, Republic of Azerbaijan
10	Centre for the Fourth Industrial Revolution India, World Economic Forum, India
11	Centre for Rural Development and Technology, Indian Institute of Technology Delhi, India
12	Chinese Academy of Sciences Innovation Cooperation Center, Bangkok, Thailand
13	Council of Scientific and Industrial Research, Government of India
14	Council of Scientific and Industrial Research – Central Glass and Ceramic Research Institute, India
15	Council of Scientific and Industrial Research – Institute of Genomics and Integrative Biology, New Delhi, India
16	Council of Scientific and Industrial Research – National Environmental Engineering Research Institute, India
17	Council of Scientific and Industrial Research – National Institute of Science Communication and Policy Research, New Delhi, India
18	Deloitte & Touche, South Africa
19	Department of Economic Affairs, Ministry of Finance, Government of India
20	Department of Industry, Ministry of Industry Commerce & Supplies, Government of Nepal
21	Department of International Cooperation, Ministry of Science and Technology, People's Republic of China
22	Department of International Cooperation, Ministry of Science and Technology, Viet Nam
23	Economic Research Institute for ASEAN and East Asia, Indonesia
24	Faculty of Technology, Eastern University, Sri Lanka
25	Guangzhou Institute of Energy, Chinese Academy of Sciences, People's Republic of China
26	Guangzhou University, People's Republic of China
27	Indian Institute of Science, Bangalore, India
28	Indonesian Institute of Sciences, Indonesia
29	Indian Institute of Technology Bombay, Mumbai, India
30	Indian Institute of Technology Delhi, New Delhi, India
31	Inha University, Tashkent, Republic of Uzbekistan
32	International Solar Alliance, India
33	Iranian Research Organization for Science and Technology. Islamic Republic of Iran
34	Kunming Institute of Botany, Chinese Academy of Sciences, China

S. No.	Organization/ Institution
35	Korea Institute of Public Administration, Seoul, Republic of Korea
36	Korea Policy Center for the Fourth Industrial Revolution, Korea Advanced Institute of Science and Technology, Republic of Korea
37	Nano Malaysia Berhad, Malaysia
38	National Engineering Research & Development Centre, Government of Sri Lanka
39	National Institute of Technology, Arunachal Pradesh, India
40	National Office for the Implementation of Innovations and Transfer of Technology, Ministry of Innovative Development, Republic of Uzbekistan National Research Foundation, Singapore
41	Philippine Council for Health Research and Development, Department of Science and Technology, Government of Philippines
42	Regain Paradise, Singapore
43	Research and Information System for Developing Countries, New Delhi, India
44	School of communication Arts, Sukhothai Thammathirat Open University, Thailand
45	School of Engineering, Macquarie University, Australia
46	Smart Cities Network, Singapore
47	South Centre, Geneva, Switzerland
48	Sri Lanka Sustainable Energy Authority, Sri Lanka
49	Technology Application and Promotion Institute, Department of Science and Technology, Philippines
50	Thailand Institute of Scientific and Technological Research, Thailand
51	University of Tehran, Islamic Republic of Iran
52	Yunnan Academy of Scientific and Technical Information, People's Republic of China

ANNEXURE 12

APCTT - LIST OF PUBLICATIONS

Publication title	Focus area	Periodicity	Target audience
Asia-Pacific Tech Monitor	Sustainable energy development – Innovative business models and best practices (Oct-Dec 2020)	Quarterly	Science technology and innovation policymakers, small and medium enterprises, research and development institutions, academia, technology transfer intermediaries
	Science technology and innovation for Sustainable and resilient recovery from COVID-19 crisis (Jan-Mar 2021) in support to the theme of the 77th ESCAP Commission Session held in May 2021	Quarterly	
	Fourth industrial revolution technologies for inclusive and sustainable development (Apr- Jun 2021)	Quarterly	
	Technologies for adaptation to climate change in Asia-Pacific – Enabling mechanisms and best practices (Jul-Sep 2021)	Quarterly	
Publication on Intellectual Property Management and Technology Licensing	Intellectual Property Management and Technology Licensing - Guide for Policymakers and Managers of Research and Development Institutes (In press)	One time publication	Policymakers, managers of technology licensing and transfer offices of research and development institutes, and the private sector enterprises
Three theme papers on innovation, transfer and diffusion of fourth industrial revolution technologies for sustainable development, healthcare, and climate change mitigation	Fourth industrial revolution technologies for sustainable development, healthcare, and climate change mitigation	One-time reports	Policy makers and Government officials, technology promotion agencies, public, private as well as non-governmental organizations, research and development institutions and academia

ANNEXURE 13

REPRESENTATION OF SCs, STs AND OBCs AS ON 30/11/2021

Groups	Number of Employees					Number of appointments made during the Calendar year										
	(As on 30/11/2021)					By Direct Recruitment				By Promotion			By other Methods			
	Gen.	SCs	STs	OBCs	Total	SCs	STs	OBCs	Total	SCs	STs	Total	SCs	STs	OBCs	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Group A	26*	5	2	4	37*	-	-	-	-	-	-	-	-	-	-	-
Group B	12	2	2	4	20	-	-	-	-	-	-	-	-	-	-	-
Group C	3	7	1	4	15	-	-	-	-	-	-	-	-	-	-	-
Total	41*	14	5	12	72*	-	-	-	-	-	-	-	-	-	-	-

Note: 1. DSIR recruits only Scientific and Technical posts.

2. *Excluding one post of Joint Secretary (Administration) which is on notional basis.

REPRESENTATIONS OF THE PERSONS WITH DISABILITIES AS ON 30/11/2021

Group	**Number of Employees**				**Direct Recruitment**							**Promotion**						
					No. of Vacancies reserved				**No. of Appointments Made**			**No. of Vacancies reserved**			**No. of Appointments Made**			
	Total	**VH**	**HH**	**OH**	**VH**	**HH**	**OH**	**Total**	**VH**	**HH**	**OH**	**VH**	**HH**	**OH**	**Total**	**VH**	**HH**	**OH**
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Group A	37*	-	-	1	-	-	-	-	-	-		-	-		-	-	-	-
Group B	20	-	-	-	-	-	-		-	-		-	-		-	-	-	-
Group C	15	-	-	-	-	-	-		-	-		-	-		-	-	-	-
Total	72*	-	-	1	-	-	-		-	-		-	-		-	-	-	-

***Excluding one post of Joint Secretary (Administration) which is on notional basis.**

ANNEXURE 14

EXTRACTS OF AUDIT OBSERVATIONS BY CAG

Audit paras pertaining to DSIR that appeared in the CAG report of 2021

Audit Observations on DSIR :

-Nil-

Audit Observations on Autonomous Bodies under DSIR – Council of Scientific and Industrial Research (CSIR) :

Report No.2 of 2021

Para 11.1 : Functionality of IT application system `OneCSIR'

The IT Application System 'OneCSIR' developed by the Council of Scientific and Industrial Research could not be utilized to its full potential due to non availability of some of the modules leading to non implementation of several processes in the system and lack of input controls & validation checks that rendered the database incomplete and unreliable.

Pendency position of ATNs in respect of Audit observations

Sl.No.	Year	No.of Paras/PA reports on which ATNs have been submitted to PAC after vetting by Audit	Details of the Paras/PA reports on which ATNs are pending		
			No. of ATNs not sent by the Ministry even for the first time	No. of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	No. of ATNs which have been finally vetted by Audit but have not been submitted by the Ministry to PAC
1.	2020	2	0	0	0
2.	2021	0	1	0	0

CSIR Establishments

BIOLOGICAL SCIENCES

CSIR-CCMB	Centre for Cellular and Molecular Biology, Hyderabad
CSIR-CDRI	Central Drug Research Institute, Lucknow
CSIR-CFTRI	Central Food Technological Research Institute, Mysore
CSIR-CIMAP	Central Institute of Medicinal & Aromatic Plants, Lucknow
CSIR-IGIB	Institute of Genomics & Integrative Biology, Delhi
CSIR-IHBT	Institute of Himalayan Bio resource Technology, Palampur
CSIR-IICB	Indian Institute of Chemical Biology, Kolkata
CSIR-IIIM	Indian Institute of Integrative Medicine, Jammu
CSIR-IMTECH	Institute of Microbial Technology, Chandigarh
CSIR-IITR	Indian Institute of Toxicology Research, Lucknow
CSIR-NBRI	National Botanical Research Institute, Lucknow

CHEMICAL SCIENCES

CSIR-CLRI	Central Leather Research Institute, Chennai
CSIR-CECRI	Central Electrochemical Research Institute, Karaikudi
CSIR-CSMCRI	Central Salt & Marine Chemicals Research Institute, Bhavnagar
CSIR-CIMFR	Central Institute of Mining & Fuel Research, Dhanbad
CSIR-IICT	Indian Institute of Chemical Technology, Hyderabad
CSIR-IIP	Indian Institute of Petroleum, Dehradun
CSIR-NCL	National Chemical Laboratory, Pune
CSIR-NEIST	North-East Institute of Science and Technology, Jorhat
CSIR-NIIST	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram

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, Bhubaneswar
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

INFORMATION SCIENCES

CSIR-NIScPR	National Institute of Science Communication and Policy Research, New Delhi (Merger of CSIR-NISCAIR & CSIR-NISTADS)
CSIR-4-PI	Fourth Paradigm Institute, Bengaluru

PHYSICAL SCIENCES

CSIR-CEERI	Central Electronics Engineering Research Institute, Pilani
CSIR-CSIO	Central Scientific Instruments Organisation, Chandigarh
CSIR-NGRI	National Geophysical Research Institute, Hyderabad
CSIR-NIO	National Institute of Oceanography, Goa
CSIR-NPL	National Physical Laboratory, New Delhi

UNITS

CSIR-HRDC	Human Resource Development Centre, Ghaziabad
CSIR-TKDL	Traditional Knowledge Digital Library, Ghaziabad
CSIR-URDIP	Unit for Research and Development of Information Products, Pune
CSIR-OSDD	Open Source Drug Delivery, New Delhi
CSIR-TRISUTRA	Translational Research and Innovative Science through Ayurgenomics, New Delhi

ABBREVIATIONS / ACRONYMS

AMPRI	Advanced Material and Processes Research Institute
APCTT	Asian and Pacific Centre for Transfer of Technology
CBDT	Central Board of Direct Taxes
CBRI	Central Building Research Institute
CCMB	Centre for Cellular and Molecular Biology
CDC	Consultancy Development Centre
CDRI	Central Drug Research Institute
CDS/ISIS	Computerized Data Services/Integrated Set of Information Systems
CECRI	Central Electrochemical Research Institute
CEERI	Central Electronics Engineering Research Institute
CFTRI	Central Food Technological Research Institute
CGCRI	Central Glass and Ceramic Research Institute
CII	Confederation of Indian Industry
CIMAP	Central Institute of Medicinal & Aromatic Plants
CIMFR	Central Institute of Mining and Fuel Research
CITT	Centre for International Trade in Technology
CLRI	Central Leather Research Institute
CMERI	Central Mechanical Engineering Research Institute
CRRI	Central Road Research Institute
CSIO	Central Scientific Instruments Organisation
CSIR	Council of Scientific & Industrial Research
CSMCRI	Central Salt & Marine Chemicals Research Institute
DBT	Department of Bio-Technology
DCPC	Department of Chemicals & Petrochemicals
DCSSI	Development Commissioner, Small Scale Industries
DRDO	Defence Research and Development Organization
DSIR	Department of Scientific & Industrial Research
ESCAP	Economic and Social Commission for Asia and the Pacific
EXIM	Export-Import
FC	Foreign Collaborations
FICCI	Federation of Indian Chambers of Commerce and Industry
ICAR	Indian Council of Agricultural Research
ICAS	Indian Council of Ayurveda & Siddha
ICMR	Indian Council of Medical Research
ICSSR	Indian Council of Social Sciences Research
ICSTI	International Centre for Science & Technology Information
IDAMS	Internationally Developed Data Management System
IGIB	Institute of Genomics & Integrative Biology
IGNOU	Indira Gandhi National Open University
IHBT	Institute of Himalayan Bioresource Technology
IICB	Indian Institute of Chemical Biology

IICT	Indian Institute of Chemical Technology
IIFT	Indian Institute of Foreign Trade
IIIM	Indian Institute of Integrative Medicine
IIP	Indian Institute of Petroleum
IISc	Indian Institute of Science
IIT	Indian Institute of Technology
IITR	Indian Institute of Toxicology Research
IMMT	Institute of Minerals and Materials Technology
IMT	Institute of Microbial Technology
INFLIBNET	Information Library Network
INSA	Indian National Science Academy
IPR	Intellectual Property Rights
ISRO	Indian Space Research Organization
ITPO	India Trade Promotion Organization
LAN	Local Area Network
LCA	Light Combat Aircraft
MDR	Multi Drug Resistance
MIT	Ministry of Information Technology
MoU	Memorandum of Understanding
NACIDS	National Access Centres to International Database Services
NAFEN	National Foundation of Indian Engineers
NAL	National Aerospace Laboratories
NBRI	National Botanical Research Institute
NCAER	National Council of Applied Economic Research
NCL	National Chemical Laboratory
NCSI	National Centre for Science Information
NEERI	National Environmental Engineering Research Institute
NEIST	North-East Institute of Science & Technology
NGRI	National Geophysical Research Institute
NICMAR	National Institute of Construction Management and Research
NID	National Institute of Design
NIDC	National Industrial Development Corporation
NIFT	National Institute of Fashion Technology
NIIST	National Institute for Inter-disciplinary Science and Technology
NIO	National Institute of Oceanography
NISCAIR	National Institute of Science Communication and Information Resources
NISTADS	National Institute of Science Technology and Development Studies
NMCC	National Manufacturing Competitiveness Council
NML	National Metallurgical Laboratory
NPL	National Physical Laboratory
NRDC	National Research Development Corporation
NRFC	National Register of Foreign Collaborations
NSTMIS	National Science and Technology Management Information System

PSE	Public Sector Enterprise
SERC	Structural Engineering Research Centre
SIRO	Scientific and Industrial Research Organization
SME	Small and Medium Enterprise.
TCO	Technical Consultancy Organization
TDB	Technology Development Board
TEDO	Technology Export Development Organization
TePP	Technopreneur Promotion Programme
TIFAC	Technology Information Forecasting and Assessment Council
TM	Technology Management
TQM	Total Quality Management
UGC	University Grants Commission
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
WIPO	World Intellectual Property Organization

Council of Scientific & Industrial Research (CSIR)
Anusandhan Bhawan, 2 Rafi Marg, New Delhi-110001
www.csir.res.in

Consultanncy Development Centre (CDC)
2nd Floor, Core IV-B, India Habitat Centre, Lodhi Road,
New Delhi-110003
www.cdc.org.in

National Research Development Corporation (NRDC)
20-22, Zamroodpur Community Centre,
Kailash Colony Extention, New Delhi-110048
www.nrdcindia.com

Cenral Electronics Limited (CEL)
4 Industrial Area, Sahibabad, Uttar Pradesh - 201010
www.celindia.co.in

www.dsir.gov.in