

GOVERNMENT OF INDIA
MINISTRY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

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Industrial application of findings in the field of science and technology

2689 Smt. SANGEETA YADAV:

Will the Minister of Science and Technology be pleased to state:

- (a) The state of industrial application of different findings in the field of science and technology by the Department of Science and Technology (DST) during the last five years along with the findings in brief;
- (b) The manner in which such industrial applications, if any, are percolating to the common masses;
- (c) whether there is any finding that is useful for women folk in particular; and
- (d) if so, the details thereof?

ANSWER

**MINISTER OF STATE (INDEPENDENT CHARGE)
SCIENCE & TECHNOLOGY AND EARTH SCIENCES
(Dr. JITENDRA SINGH)**

(a) & (b) The core mandate of Department of Scientific & Industrial Research (DSIR), Ministry of Science & Technology is to promote and strengthen Research and Development of Scientific and Technological applications for the industry. It is the nodal Department for granting recognition/ registration as well as supporting to the In-house R&D centres established by industry in the country. An illustrative list of Industrial applications of different findings in the field of Science & Technology as reported by the industrial In-house R&D units recognized/supported by DSIR in the last five years is annexed at **Annexure-I**. Council of Scientific & Industrial Research (CSIR), an autonomous organization of DSIR, has developed innumerable technologies for the industry, which have direct relevance not only for the common masses but for the entire mankind. The brief details of the technologies developed in the last five years at CSIR is provided at **Annexure –II**. Central Electronics Limited, an Public Sector Enterprise of DSIR has developed technologies like the Voice over Internet Protocol (VoIP), New generation Single Section Digital Axle Counter (ngSSDAC), New Generation High Availability Single Section Digital Axle Counter (ngHASSDAC), Multi Section Digital Axle Counter (MSDAC), Radome for Missiles, Radar Absorbing Paints, etc. besides introducing Drishti systems for Indian Meteorological Department (IMD) installed at Airports.

Some of the technologies developed by CSIR and by the In-house R&D centres of Industry recognized/supported by DSIR have helped common masses facilitating inclusiveness by

means of providing cost-effective products viz: Covid vaccines and their mass dissemination through digital platform, products for improvement of health and hygiene of the people, providing food security, technologies for reduction in post-harvest losses, Water technologies, renewable energy and technologies for reduction in Carbon Emissions by launching EVs for transport sector, development of UAVs (drones) for various applications and technologies for national security etc. Details of the list of technologies developed by Council of Scientific & Industrial Research and by the DSIR recognized/supported In-house R&D centres of industry having relevance for the general masses is given at Annexure II and I respectively.

(c) & (d) There are certain technologies developed by the DSIR recognized and supported in-house R&D units of industries which are useful for women folk especially products developed for health & hygiene, personal care products, medicines for diseases of women like breast cancer treatment etc. As far as CSIR is concerned, the technologies listed at Annexure-II are not only the by-product of the translational R&D performed by CSIR this directly resulted in market viable technologies and indirectly resulted in skilled manpower, Journals, National/International Conferences, patents etc. Most of the applications are directly for industries, health care sector and government agencies, the primary targeted sector have been the above mentioned. However, the secondary and tertiary beneficiaries will ultimately span the mentioned demographics - women and societal at large. The initiatives undertaken/ technologies developed specifically, for women folk by CSIR are given at **Annexure –III**.

Technologies for Agricultural Sector

- Development of high yielding and wilt resistance hybrid variety in castor.
- Development of Process for extraction of total curcuminoids (90- 95%) from turmeric.
- Development of synthesizing solvent free sesamin complex 90% extract from sesame seed.
- Development of notified varieties of crops - Paddy, Bajra, Jowar, Sweet corn, Vegetables like Tomato, Chilli and Bhendi.
- Development of Inbred lines through double haploid technology in Cucumber, Cabbage, Cauliflower and Hot Pepper to shorten the breeding cycle.
- Development of rice and mustard Hybrids
- Development of GMS (Genetic Male Sterility) technology for Cotton hybrid production.
- Development of transgenics in Cotton , Rice, Brinjal, Okra & Cassava for traits like Insect resistance and virus resistance
- Development of full season single and double cross hybrids in yellow and white corn suitable for kharif and winter cultivation.
- Development of smart pisciculture and feed formulation for aquaculture
- Development of new varieties of poultry having traits of early maturity, good feed conversion ratio and innovative feed formulation for poultry
- Development of Sterial Bio Synthesis Inhibitor (SBI) as fungicide, insecticide and nematocide
- Development of embedded software products with IoT and AI for animal farm management to smart control and co-ordinate in the whole value chain of milk production, management like milk collection, milk transport, milk chilling and milk distribution
- Development of embedded system, “Contrak” to help remotely monitor bulk milk and rapid milk chillers that are deployed in the procurement chains (specifically in Chilling Centers) in the dairy companies
- Development of a phosphorous solubilising fungi (avatar), a biofungicide, made up of beneficial fungi and bacteria that colonize and assail plant pathogens, thereby thwarting the diseases caused
- Development of New genes for insect resistance, development of resistance for BLB, blast and BVH in rice varieties through molecular markers.
- Development of new products such as Black Tea Liquid Concentrate, Decaffeinated Green Tea Extract Sweetened Liquid, Rosemary Extract 10% Carnosic acid decolorized de-flavored antioxidant for shelf-life extension of Food, Personal Care Products –Skin tone formulations, Hair care formulations, Rice Protein Concentrate & Hydrolysate.
- Development of Pod planting system with OCP (Optimised Coconut Plantation).
- Development of coconut Tissue Culture plantlets from inflorescence explants using Micro-propagation technique.
- Organic NPK granules to provide alternative to synthetic NPK Fertilizers for sustainable agriculture.
- Formulation for organic herbicide for controlling weed population.

Technologies for Biological / Biomedical Sciences/Pharmaceuticals:

- Development of a new process for the preparation of Besifloxacin Hydrochloride, Linezolid, Dydrogesteron and Ulipristal
- Development of process for Semi Synthetic Artemisinin
- Development of Velpatasvir (Hepatitis C Virus Inhibitor), Cabezitaxel (Antineoplastic), Afatinib (Antineoplastic), Ibrutinib (Antineoplastic), Carfilzomib (Antineoplastic)
- Development of process of stable water dispersible Lutein beadlets, Betacryptoxanthin beadlets, capsimax beadlets, lutein encapsulation
- Development of Solvent free process for curcumin spray dried powder
- Development of a transparent hydrogel wound dressing containing silver nanoparticles to address infected wounds.
- Development of Disposable Insulin Administrative device
- Clinical Studies of Metadichol; Novel TMPRSS inhibitor as therapeutic target for Anti-SARS-COV-2 in collaboration with NanoRx, USA
- Preclinical development of novel Immunomodulatory Peptides as therapeutic target for Respiratory viral infections in Association with Neo7Logix LLC, USA
- Preclinical development of novel glucagon-like peptide-1 receptor agonist for Diabetes management in collaboration with Bhami Research, India
- Preclinical Development of novel anti-HIV reverse transcriptase inhibitors
- Development of camel anti-IL-6 humanized antibody and Evaluation of anti-IL-6 as a therapy for COVID-19 infections
- Development of a method for the quantitative estimation of BCR-ABL transcripts
- Development of a method for the qualitative detection of PML-RARa transcripts
- Indigenous novel process development of API-Favipiravir
- MDI Formulation development of Remdesivir
- Development of a wearable device for deaf and dumb
- Newcastle Disease Vaccine, Infectious Coryza Vaccine, Avian Infectious Bronchitis vaccine, Newcastle Disease and Fowl Cholera vaccine, Newcastle Disease and Inclusion Body Hepatitis Vaccine
- Development of Brucella abortus live vaccine, Rabies Veterinary Vaccine.
- Development of diagnostic test for Thyroid function Test (T3, T4 and TSH) on the ACIX100 platform, Development of ELISA test for detecting antibodies against COVID19.
- Development of new products such as Rabies vaccine, Quadrivalent Flu vaccine, anti-VEGF protein, anti-TNF MAb for treatment of autoimmune disorders, anti-CTLA-4 protein, recombinant Human Albumin as New Biological Entity, anti-TNF fusion protein for treatment of autoimmune disorders.
- Development of L1 protein in the form of Virus Like Particles (VLP's) against Human Papilloma Virus that causes cervical cancer in women;
- Growth, production and purification of S1 Spike protein used in preparation of vaccine against SARS-COVID-19.
- Development of Anti-Scorpion Venom Antiserum.

Technologies developed in the field of Chemical Sciences:

- Development of Process for capture and utilization of carbon dioxide
- Development of Prepolymerization technology for production of impact polymer in PP gas phase

- Development of a semi continuous process for the synthesis of a catalyst for use in manufacturing polyolefins
- Development of process to produce an agrochemical intermediate.
- Development of technology for manufacture of pharmaceutical grade sodium bicarbonate.
- Development of low oil absorb besan product, which uses up to 20% less oil when utilized for frying.
- Development of a new form of sugar-Tata Nx
- Development of Customized Fertilizer (CF) for basal application
- Development of lithium ion Battery packs for electric scooter, bike application
- Development of Biofibre enzyme cocktail (FIBERZYME for the treatment of raw bast fibres
- Development of Palm oil enzyme cocktail for enhancing Oil recovery from palm fruit (POWER)
- Full Range of ABS Plating Chemicals, Stainless Steel Polishing Chemical, Liquid Cleaner for CAL & ETL Lines of Steel Mills, Antimicrobial Chemical for Plywood Industry with Nano material, High Efficiency Acid Pickling inhibitor

Technologies for Engineering / Information Technology:

- High pressure projectile launching system valve (Drain Valve)
- Development of Missile launch detection system II
- Development of cantilever type seat mounting
- Development of Indigenous Waterjet Propulsion System
- Development of high frequency composite sonar dome.
- Development of new processes for change in technology of light source from incandescent and fluorescent to solid state
- Development of new Carbon black reactor which improves the combustion efficiencies and increases yield
- Development of electronic throttle body for diesel engines to meet BS6 emission requirements
- Development of Customer specific electronic throttle body
- Developments of Gasoline Engines to meet BS6 emission requirements
- Development of customer specific Accelerator Pedal Module (Non Contact version)
- Development of Fuel efficiency spark plug development and development of drivability spark plug for 2 wheeler
- Development of 26W BLDC ceiling fan and a Connected app controlled IoT fan with smart algorithms based on temperature and humidity sensing.
- Development of an embedded for Air Traffic Controller (ATC) to notify the location of the aircraft to the ATC for situational awareness
- BrahMos Missile Container, BrahMos Air-Borne Launcher, RFQ (Radio-Frequency Quadrapole), F3 Metallic Section, Cryo Engine
- Lead acid ultra, Development of ETX 14 battery, punched plate technology for MC battery, epoxy sealed ETZ4A battery.
- Development of Armored vehicles for main battle tank such as T-90 and T-72 and Infantry fighting vehicles such as BMP I and BMP II.
- Development of Hemo Dialysis Machine.

Details of significant technologies developed by the CSIR and to the extent they have been able to ameliorate the lives of common man in past five years

SNo.	Technology Name	Benefit of the Technology on Common Man / Society as a whole
1.	Oneer- An electronic device for the disinfection of drinking water	<ul style="list-style-type: none"> • On an average four persons/family require approximately 30-50 liters of potable drinking water/day • A single unit of Oneer will cater to approximately 100-125 families or 400-500 people of a community. This could be expanded by deploying multiple units of the Oneer • Domestic model of Oneer provides 10 Liters of safe water per batch suitable for house hold and small establishments and can also be operated on a solar powered battery. • Community model of Oneer can continuously supply 450 Liters of water/ hour for communities.
2.	Milk adulteration detection kit (Milk checker)	<ul style="list-style-type: none"> • The kit is useful for the detection of adulterants like Hydrogen peroxide, urea, Formalin, Ammonia & Ammonium compounds, Dairy salt, Starch, boric acid, Neutralizers, Cellulose, Nitrates& nitrites and detergent in adulterated milk. • It has High sensitivity, cost effective and Serves as a handy tool for consumers/ retailers
3.	Emergency Retrieval System (ERS) For Power Lines:	<ul style="list-style-type: none"> • ERS an indigenously developed technology, modular aluminum towers used to quickly restore power on damaged power transmission lines with a minimal power interruption. • These are temporary structures that can be deployed typically in 2-3 days, as against several weeks required for permanent restoration of the towers. • During Power outage due to TL tower failure, the ERS will be used to restore power in short duration of time typically 2-3 days, which minimize loss of service to the society. • This improves the quality of life in urban and rural areas with minimal interruption to the basic amenities/services like water supply, health care, waste management, communication, security, education, transport, etc.
4.	Portable lightweight foldable module for make shift hospitals	<ul style="list-style-type: none"> • Poli Tal (M) for constructing temporary shelters/structures during unforeseen situations/natural calamities in both urban and rural

	and other needs Poli Tal (M)	<p>areas.</p> <ul style="list-style-type: none"> • The design utilizes optimum material, is extremely stable, can be erected very quickly and can be used as make-shift hospitals, emergency/temporary shelters, toilet units, etc. • To support the effort of the Government in tackling the emergency condition that arisen due to the spread of COVID-19 pandemic, CSIR using the Poli-Tal technology, constructed 10-bedded portable and lightweight transit hospital structure at NDRF, Arakkonam.
5.	Anaerobic Gas lift Reactor (AGR) for the treatment of organic solid waste	<ul style="list-style-type: none"> • Treatment of organic solid waste for the generation of biogas and bio manure • Scale operation: 500 kg to 10 tons per day • Plants with the capacity of 1 ton per day and below deployed at 22 locations • Plants with the capacity of above 1 ton per day but below 10 ton per day deployed at 4 locations <p><i>Plants based on Substrates</i></p> <ul style="list-style-type: none"> • Food Waste: 15 locations • Market and vegetable waste: 7 locations • Poultry litter: 2 locations • Organic fraction of MSW and leachate:1 location • Mulberry waste: 1 location • AGR technology has been commercialized and licensed to many companies on non-exclusive basis
6.	Accelerated Anaerobic Composting (AAC) of Organic Waste	<ul style="list-style-type: none"> • Most of the lakes in India are polluted due to the discharge of untreated industrial wastewater and sewage resulting in eutrophication. Water hyacinth is a noxious weed which grows uncontrollably in these lakes due to eutrophication. • A pilot project for the conversion of water hyacinth filled in Kapra lake in Hyderabad to soil conditioner has been successfully demonstrated. • Two full scale plants are under installation at Nizam and Rajeev Gandhi Lake • About 47 composting units of 250 – 300 kg/day capacity for the conversion of market vegetable waste to soil conditioner is in progress in Telangana State
7.	Design of highly	<ul style="list-style-type: none"> • Environmentally safe process

	compact vertical modular nanofiltration system for purification of ground and surface water	<ul style="list-style-type: none"> • The NF plant is successfully commissioned at Mogallu Village in West Godavari District of Andhra Pradesh for surface water purification. A similar pilot plant was also installed at CSIR-IICT for providing drinking water to IICT staff and students and for cooking purpose at IICT canteen. • The NF plant has also been installed at annual Hyderabad Industrial Exhibition, Nampally to provide safe drinking water free of cost to the general public.
8.	Compact Membrane Unit for Fluoride Removal from groundwater	<ul style="list-style-type: none"> • Effective fluoride reject treatment procedures are being developed • The developed defluoridation membrane technology is deployed at both rural and urban areas in schools, hospitals, hostels and small hamlets. • More than 20 such compact systems have been installed successfully in several schools and fluoride worst hit villages of Telangana; on charity basis funded by CSIR-IICT for production of safe drinking water. • All the units are running successfully from past few years.
9.	High Resolution Heliborne Aquifer Mapping & Management	<ul style="list-style-type: none"> • This technique will provide very precise information on groundwater potential zones in the problematic areas and water stressed regions of the country • Through this technique high resolution 3-D image of the sub-surface will be generated based on the response of the various lithologies, structures and structural discontinuities up to a depth of 500 meters below the surface. • This technique has been successfully implemented in various parts of the country and recently CSIR-NGRI successfully completed a mega project in Rajasthan and Gujarat in collaboration with Central Ground Water Board (CGWB); Ministry of Jal Shakti, Govt, of India.
10.	Herbal Incense Cones from flowers	<ul style="list-style-type: none"> • Technology transferred to Temple Trust, Dist. Sirmour (H.P.) and Jagriti NGO, Baijnath • Employment to more than 50 people was provided through technology deployment
11.	Compost booster for cold regions	<ul style="list-style-type: none"> • Technology transferred to NGO's, Panchayat level, Army headquarters for the deployment of technology in high altitude areas • Technology deployed in two Cluster; one in Sikkim and

		<p>One in Himachal Pradesh</p> <ul style="list-style-type: none"> Improved income for families of selected 400 beneficiaries through SFURTI scheme of MoSME. Farmers can earn additional income Rs. 30,000/ year by selling enriched compost
12.	Shitake mushroom: vitamin D2 enriched	<ul style="list-style-type: none"> Technology transferred through MSME's to clusters in Sikkim for farmers livelihood promotions Technology deployed in three clusters and six entrepreneurs Improved income for families of selected 750 beneficiaries through SFURTI scheme of MSME. Farmers can earn additional income Rs. 50,000/ year by selling fresh and dry shiitake
13.	Iron and zinc enriched spirulina-based bars	<ul style="list-style-type: none"> Technology deployment through integration of products to POSHAN Abhiyaan and Integrated Child Development Services (ICDS) Technology transferred to five entrepreneurs A total of 100 malnourished children and 60 pregnant and lactating women benefitted by technology deployment through Poshan Abhiyan
14.	Multigrain high protein mix	
15.	Protein & fibre enriched cereal bars	
16.	Iron enriched fruit bars and candies	
17.	Canning technology for ready to eat (RTE) foods	<ul style="list-style-type: none"> Technology deployment through the ones affected by Cyclone Amphan in Orissa/Kolkata under the National Disaster Response Force (NDRF) supply and Making available food during Lockdown: COVID-19-related public lockdown led to the limited supply of food products wherein the migrant laborers were seriously affected Technology transferred to Three entrepreneurs 5,28,000 (220 tons) packs of RTE Tinned Food during COVID and Orissa disasters: 3,00,000 packs during Cyclone Amphan in Orissa/ Kolkata under NDRF supply; 1,00,000 packs in Odisha during Cyclone Fani; 68,000 packs supplied during COVID Pandemic in Orissa, H.P.,
18.	Damask rose (Rosa damascena): agro-and processing technology	<ul style="list-style-type: none"> Under "CSIR Aroma Mission" 2816 hectare brought under cultivation in 11 states and two UT, generating revenue of Rs. 31.27 crores. 1st time large scale cultivation of Saffron in H.P. Lauded by Hon'ble C.M., H.P. Capacity building for 189 farmers.
19.	Wild marigold (Tagetes Minuta): agro-and processing	

	technology	
20.	Lavender (<i>Lavandula officinalis</i>): agro- and processing technology	
21.	Rosemary (<i>Rosmarinus officinalis</i>): agro and processing technology	
22.	Agro-technology for mass production of saffron (<i>Crocus sativus</i> L.)	
23.	German chamomile (<i>Matricaria chamomilla</i>): agro and process technology	
24.	Improved bee hive for quality and hygienic extraction of honey	<ul style="list-style-type: none"> • Technology deployment through clusters for integration of apiculture in floriculture through "CSIR Floriculture Mission • Eleven bee keeping clusters (20 famers in 10 clusters and 10 farmers in 1 cluster) were formed in Himachal Pradesh and Uttarakhand
25.	Lilium: agrotechnology	<ul style="list-style-type: none"> • Planting material is provided to farmers, NGOs, Government schools, colleges, hospitals and other offices for technology deployment and awareness • "Under Floriculture Mission" 250-hectare area brought under cultivation of floriculture crops benefitting 1004 farmers.
26.	Calla lily: agrotechnology	
27.	Gerbera: agrotechnology	
28.	Agro-technology of carnations	
29.	Alstroemeria: agrotechnology	
30.	Cut-roses: agrotechnology	
31.	Chrysanthemum: agrotechnology	

32.	Desktop Autoclave for R&D Institutions:	<ul style="list-style-type: none"> • The desktop autoclave was developed to meet the expectations of academia and research institutions in establishing an affordable, low energy consuming, aerospace grade autoclave. • The Desktop autoclave have been supplied to IIT Madras, II-Delhi, IIT-Guwahati, MIT-Manipal, and IIT-Hyderabad and the academic intuitions in the country earlier dependent on imports of the system for carrying out research. • The indigenous technology has helped Indian students in composite research to great extent in their academic R&D
33.	Wind Solar Hybrid System:	<ul style="list-style-type: none"> • Deployed 1 kW Wind Solar Hybrid (WiSH) system at various science and technology educational institutions in Bangalore, Odisha and at CSIR laboratories like CSIR-IMMT, CSIR-SERC & CSIR-CBRI. • CSIR-NAL's renewable energy activity has resulted in the successful design and development of Wind Solar Hybrid system capable of generating power of 1 kW to 10 kW. • The developed WiSH system are suitable for powering agri pumps and off-grid remote rural applications.
34.	Airboat for Cleaning Lakes – JALDOST:	<ul style="list-style-type: none"> • JALDOST is an Aerospace technology-based spin off societal product for cleaning waterbodies • CSIR-NAL is in talks with BBMP Lakes Authority for deployment and successful commercialization through industry partner
35.	PPE & SwsathVayu BiPAP Ventilator for Covid-19	<ul style="list-style-type: none"> • CSIR-NAL has made significant contributions in the area of Health and Societal Mission for the COVID-19 mitigation in service of the nation • Both the technologies have been transferred to industries for commercial production which has resulted in quick deployment of about 1500 SwasthVayu units to hospitals of NCT- Delhi, Ramgarh & Chatra- Jharkhand, Bhopal-Madhya Pradesh, Mysore, Hyderabad and more than 2 lakhs units of PPE coverall to Hindustan Latex Limited (HLL), Jaslok Hospitals etc. during covid-19.
36.	Octa-Copter Drone for Agri	<ul style="list-style-type: none"> • 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. • <i>Agri Application:</i> NAL has developed a modular Oct-Copter UAV system that can carry a maximum

		<p>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. First field demonstration of NAL's Oct-Copter has been carried out for the farmers of Alur APMC, Bangalore.</p> <ul style="list-style-type: none"> • <i>Medical Applications @ Bengaluru:</i> CSIR-NAL has teamed with Department of Health & Family Welfare, Govt. of Karnataka for aerial delivery of covid-19 vaccine's in remote area. The Octacopter has 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. • <i>Medical Applications @ Jammu:</i> CSIR-NAL has teamed with CSIR-IIIM, Jammu and Department of Health & Family Welfare, Govt. of Jammu for aerial delivery of covid-19 vaccine's in remote border area. The Octacopter has successfully delivered 50 vials of Covid-19 vaccines along with syringes in a special container from IIIM-Jammu to Sub-District Hospital, March on 27th November 2021.
37.	System for Monitoring of Adulteration in Milk Supply Chain	<ul style="list-style-type: none"> • This technology ensures the supply of adulteration-free, healthy Milk to people. • Qboid (Licensee) has deployed 36 units till now and executing the order of 140 units to generate a royalty of ~8.80 Lakhs.
38.	Rapid Milk Analyser	<ul style="list-style-type: none"> • This technology supports the Quality assurance of Milk. • This StartUp plans to deploy on a subscription basis. Actual deployment details are awaited.
39.	Rapid Ksheer Scanner	<ul style="list-style-type: none"> • This technology ensures the supply of adulteration-free, for consumption by people. • REIL has sold 552 units till 31-03-2021 and Royalty of 28.48 Lakhs has been generated. • AgNext plans to deploy on a subscription basis. Actual deployment details are awaited.
40.	Smart Watch for Vital Health Parameter	<ul style="list-style-type: none"> • This technology supports the development of healthcare reporting and enables the self-sufficiency of Startups. • This startup has a target of deploying 10,000 units based on this Technology by FY 23-24.

41.	IoT enabled Smartphone based Colposcope for Cervical Cancer Examination	<ul style="list-style-type: none"> • This technology supports the development of healthcare diagnostics by Indian startups. • In production and executing orders of 100 pieces generation
42.	Aromatic crops	<ul style="list-style-type: none"> • Area Covered under cultivation of aroma crops: ~27,000 hectares • States covered: 29 • Tribal Clusters developed:20 • On the farm processing/distillation units:300 • Training/awareness/skill development programmers organized:1124 • Farmers benefitted: ~65,000 • Rural employment generated:12 lakh man days • Farmers income enhancement: Rs 30,000 – 70,000/- per hectare per year • Purple Revolution by catalysing Lavender Cultivation in J&K, which is a high value commodity: cultivation in 10 districts of J&K, Increase in the farmer’s income from Rs. 20,000/- to Rs. 200,000/- per acre per year. • Atmanirbharata in Lemongrass essential oil: From being one of the importers of Lemongrass essential oil a few years back, India has now become one of the largest exporters in the world with annual export of 300-400 tonnes Lemongrass essential oil worth Rs. 35-40 crore. Farmers are earning the income of Rs. 30,000/- to 70,000/- per hectare per year depending upon the water availability and environmental conditions • Golden revolution in Himachal Pradesh: Introduction of improved varieties ‘HIMGOLD’ and ‘HIM SWARNIMA’ of wild Marigold (<i>Tagetes minuta</i> L.) yielding high grade aromatic oil. Total essential oil production in the country is 6.5 tonnes, which has enhanced the farmers’ income 2.5 times over traditional crop
43.	Floriculture crops	<ul style="list-style-type: none"> • Area brought under cultivation of Floriculture crops: 750 hectares • State covered: 21 • Indigenous development of Tulip bulb production initiated in Lahaul & Spiti has helped reduce the import of quality planting material.

		<ul style="list-style-type: none"> • Apiculture integration with Floriculture in collaboration with KVIC: 49 clusters established
44.	Dry Swab Technology for the detection of SARS-CoV-2	<ul style="list-style-type: none"> • The Dry Swab Technology for the detection of SARS-CoV-2 was a huge success and was widely used in testing laboratories across our Country during the Covid19 pandemic era; considerably making affordable diagnostics available.
45.	Improved Samba Mahsuri (RP BIO 226): a bacterial blight disease resistant and low GI (diabetic friendly) rice variety	<ul style="list-style-type: none"> • Similarly, ISM Rice variety has influenced the lives of farmers across our country uniformly at all such places where bacterial blight has been a serious threat to paddy cultivation
46.	Paper-based affordable micro fluidic kit for early pregnancy detection in cattle and buffaloes	<ul style="list-style-type: none"> • The Cattle Pregnancy technology developed by us is currently being co-developed further for making it suitable for the usage at field level.
47.	Modular Ceramic Membrane based plant of capacity upto 2m ³ /hour for water purification	<ul style="list-style-type: none"> • Deployments are in the states of West Bengal and Bihar for Iron and Arsenic removal plants. Iron removal plants are deployed in West Bengal and north eastern states. • More than 115 plants are deployed. Estimated daily production capacity is 11 lakh litre which caters to the need of more than 11000 families. All these plants altogether use ceramic membranes, which has led to investment on equipment by ceramic industry for fabrication of membrane. • More than 1000 rural potters are trained under various training programs.
48.	Mobile cold Mixer cum Paver (MCMP)	<ul style="list-style-type: none"> • Technologies are useful for the common man by reducing the fuel consumption (improving fuel
49.	Development of Rejuvenator for Recycling of Asphalt Pavement material for Hot-in-Plant and Hot-in situ Recycling of Bituminous Pavement	
50.	Macro surfacing Technology: Thin	

	Surfacing for Cement Concrete Pavement	<p>efficiency), traffic congestions, pollution and improving riding quality of roads and time saving.</p>
51.	Process for construction of shallow multidirectional underpass intersection by box jacking and soil nailing without effect existing traffic	
52.	Method for instant improvement of foundation soil during box jacking operation without affecting the live rail/road traffic thereof	
53.	Herbal Gulal from Floral Temple Waste	<ul style="list-style-type: none"> • The majorly offered flowers in temples are marigold rose, jasmine, chrysanthemum, Hibiscus, etc. Such floral waste can be utilized indifferent ways to produce valuable products for economic upliftment of the weaker sections and can also help to save environment from pollution caused due to improper disposal of flower waste. • Local, villages around famous temple can be deployed for collection, sorting and primary processing. Small scale processing unit can be set up in the village or nearby town.
54.	Herbal Floor Disinfectant and Cleaner (Floor Mop)	<ul style="list-style-type: none"> • It is a good alternative to chemical-based floor cleaners which contain laurel sulphate, acetic acid and other chemical preservatives; it is skin and eco-friendly. This technology is useful in job creation and income generation for small scale Entrepreneurs.
55.	Alcohol Based Liquid Herbal Hand Sanitizer	<ul style="list-style-type: none"> • It's a scientifically validated and cost-effective product that is suitable for regular use. Useful for MSME and Pharma industries. • Small-scale processing unit can be set us in the village or nearby town which may prove as an income generation tool to provide supplementary income to the villages.
56.	Recycling of plastic waste into tiles for Structure Designing	

	for societal usage	<ul style="list-style-type: none"> • Technology has been transferred to many industries for deployment
57.	Noise Absorptive barrier for Metro/Railway/ Highway/ Airport Noise Abatement	
58.	Process for production of Biodegradable table wares and cutleries from agricultural wastes	<ul style="list-style-type: none"> • India being an agricultural country, a huge volume of agro-wastes is produced. NIIST technology for making biodegradable cutleries utilizes this agri-waste and helps farmers in enhancing their earnings through selling of plates or cutleries, which are alternatives to single-use plastics. • Ayurvedic formulation trikatu syrup, automatics hand sanitizers, Air sanitizer and the SFM face masks were developed during the times of Covid-19 pandemic and these technologies were need of the hour. • It all came out as a boon to the common man and protected them from severe infections.
59.	Trikatu syrup Preparation	
60.	Automatic Hand Sanitizer Dispenser	
61.	Air Sanitizer	
62.	Reusable Stopgap Face Mask	
63.	Novel Crow and Fuel Ball Bio-Methane Reactor	<ul style="list-style-type: none"> • The sustainable development initiative by CSIR CIMFR helps replaces burning of coal for cooking to renewable energy such as biogas from coal washery effluent with biomass blend, plantation of trees per family/per tree
64.	Developed certain varieties of crops in of Lemon grass (Cymbopogon khasianus x C. pendulus, Poaceae) [CKP-25], Kalam, Rosagrass (Cymbopogon nardus/khasianus) RRL (J)CN- 5 & IIIM (J)CK- 10, Mentha spp. (M. longifolia, M. Piplata, M. spicata, M. Arvensis), Jammu Monarda (Monarda citriodora) Var. IIIM (J) MC02, Ocimum species (Var.	<ul style="list-style-type: none"> • Several varieties of aromatic crops developed by Institute have been extended to farmers in different parts of country under Aroma Mission enhancing the income of farmers.

	Og 14 & Ob 15).	
65.	Energy Efficient Brass Melting Furnace for Artisans	<ul style="list-style-type: none"> • The energy efficient furnace has enabled the brassware artisans in some areas to improve their product efficiency, product quality. In this regard, the technology transferred to: • Moradabad Industrial Development company, Moradabad, UP in 2013 • Technical Training Institute (TTI), Balasore, Odisha, in 2014 • Khadi & Village Industries Board, MSME & T Dept. Govt. of W.B, in 2017 • Yugantar Bharati, Ranchi, Jharkhand, in the year 2016 • Moradabad Industrial Development company, UP installed CSIR-NML's energy-efficient furnace at Kutch, Gujarat in the year 2017. CSIR-NML so far Trained ~ 450 artisans- entrepreneur at NML, Demonstration given to ~ 700 artisan across the country, installed the furnaces at 7 different places. • CSIR-NML is actively involved to uplift the utensils, artifacts, and jewelry cluster by technological intervention and prepared detailed project report in five different clusters of West Bengal during the year 2018 to 2022 where a large number of common people are involved.
66.	Anti-tarnishing lacquer	<ul style="list-style-type: none"> • The lacquer has enabled the brass artisans of brass clusters of India to improve their product quality and increase the sales. For example, brass artisans of Bankura, West Bengal are using the lacquer to produce better quality "dokra" handicrafts, improving its sales and hence their earnings. • The lacquer has also enabled SMEs involved in manufacturing of brass handicrafts and hardware items to produce better quality products and compete in the market with the international products.
67.	Portable NPK soil analysis	<ul style="list-style-type: none"> • It helps farmers to improve productivity
68.	interventions for leather making through WCTT, ZLD	<ul style="list-style-type: none"> • Empowered the industry to address the environmental pollution as well as health hazards through techno-enabled economical solutions. • Interventions from CSIR-CLRI have resulted in productivity enhancement with time economy, without sacrificing the quality.

		<ul style="list-style-type: none"> • Technological options have emerged to ensure wealth from waste whereby value-added products are produced for consumer applications, such as gelatine from raw hide/skin trimmings, leather like sheet from agro- and leather industry wastes, etc, thereby invoking the concept of circular economy. • Generation of more employment has been facilitated.
69.	Improved Jaggery Making Plant:	<ul style="list-style-type: none"> • Common men have certain basic needs. To name a few, the major challenges that India faces revolve around: Poverty, Pollution, Unemployment, etc.; The technologies developed by CSIR-IIP have been able to ameliorate for the common men of India addressing some of their basic needs.
70.	Production of Liquid seaweed plant bio stimulants from Sargassum spp. IN 201811029622	<ul style="list-style-type: none"> • India being agriculture country, there is considerable demand for developing low cost bio fertilizer that can be affordable even by marginal farmers for enhancement of crop yields & quality. • The residue generated while producing liquid fertilizer can be used as a feedstock for making a commercially important products such as cellulose, carbon materials, for desired applications etc. • It is tested for enhancing the crop yield & quality. Liquid seaweed plant bio stimulants from Sargassum and its solid formulations shows excellent enhancement in crop yields from 13 to 28%.
71.	Zero Liquid Discharge Process for the production of alginic acid and its derivatives from alginophytes. IN 201711025753	<ul style="list-style-type: none"> • The fresh/dry seaweed biomass is liquefied to produce a seaweed liquid fertilizer which proven to be a promising low-cost bio fertilizer (foliar spray as well as soil applications) and residue processed for recovery of cellulosic and carbon materials which may be used for suitable applications. Raw material (brown seaweeds) used are abundant in nature and easy to harvest. • India import large quantity of seaweed fertilizer that involves high foreign exchange exchequer (tentatively estimated at ₹800-1000 crore). The technology has already been transferred to 10 industries for commercial production in India & revenue opportunity potential of licensee (in the near term) is ~₹20 crore. • Similarly, Animal feed additive Market – By 2022 is projected at USD 1.853 billion and growing CAGR@ 8.1 %, and thus offers tremendous scope. The formulations have been tested and validated by different ICAR institutes working on animals (IVRI, NDRI) and poultry (CARI) Toxicology studies of specific formulation are available.
72.	Kappaphycus alvarezii and Red Seaweed Based Formulations for Improving Productivity and Health of Dairy and Poultry Animals.	<ul style="list-style-type: none"> • The fresh/dry seaweed biomass is liquefied to produce a seaweed liquid fertilizer which proven to be a promising low-cost bio fertilizer (foliar spray as well as soil applications) and residue processed for recovery of cellulosic and carbon materials which may be used for suitable applications. Raw material (brown seaweeds) used are abundant in nature and easy to harvest. • India import large quantity of seaweed fertilizer that involves high foreign exchange exchequer (tentatively estimated at ₹800-1000 crore). The technology has already been transferred to 10 industries for commercial production in India & revenue opportunity potential of licensee (in the near term) is ~₹20 crore. • Similarly, Animal feed additive Market – By 2022 is projected at USD 1.853 billion and growing CAGR@ 8.1 %, and thus offers tremendous scope. The formulations have been tested and validated by different ICAR institutes working on animals (IVRI, NDRI) and poultry (CARI) Toxicology studies of specific formulation are available.
73.	Production of Sap from Kappaphycusalvarezii and its appliaction. (<ul style="list-style-type: none"> • The fresh/dry seaweed biomass is liquefied to produce a seaweed liquid fertilizer which proven to be a promising low-cost bio fertilizer (foliar spray as well as soil applications) and residue processed for recovery of cellulosic and carbon materials which may be used for suitable applications. Raw material (brown seaweeds) used are abundant in nature and easy to harvest. • India import large quantity of seaweed fertilizer that involves high foreign exchange exchequer (tentatively estimated at ₹800-1000 crore). The technology has already been transferred to 10 industries for commercial production in India & revenue opportunity potential of licensee (in the near term) is ~₹20 crore. • Similarly, Animal feed additive Market – By 2022 is projected at USD 1.853 billion and growing CAGR@ 8.1 %, and thus offers tremendous scope. The formulations have been tested and validated by different ICAR institutes working on animals (IVRI, NDRI) and poultry (CARI) Toxicology studies of specific formulation are available.

		<ul style="list-style-type: none"> • It has shown improved performance of poultry and cattle, better immuno-responsiveness (cellular mediated and HA titer) in poultry and cattle, gut health (microbial & structural) in poultry, higher egg production and advancement in egg laying age, higher calcium and iron content in milk, reduced methane emission and higher energy use efficiency, higher daily growth rate in cross bred calves. • Low energy requirement, raw materials indigenously available, competitive cost, idea of toxicological profile and active constituents, palatable to animals, can be offered as feed additive to animals in different forms including powder and cattle lick.
74.	Medical oxygen (MO2) plant	<ul style="list-style-type: none"> • CSIR-NCL has developed indigenous technology for the manufacturing of Lithium zeolite for oxygen concentration. The zeolite provides 93% O2 concentration, which is approved for medical usage in ICUs. CSIR-NCL also commissioned an oxygen concentration plant developed by CSIR-IIP at Aundh Government hospital • The plant was at its fullest operation during the peak Covid period and many Covid patients were benefitted due to its 24x7 operation
75.	Oxygen Enrichment Unit:	<ul style="list-style-type: none"> • The Oxygen Enrichment Unit (OEU) developed by CSIR-NCL team is efficient in providing 35-40% oxygen concentration from air with an adjustable flow rate of 0.5-15 lit/min. The technology was licensed to NCL start-up, GENrich Membranes. About 50 units were assembled and demonstrated in various forums, hospitals and primary health centres.
76.	Environmental surveillance of SARS-CoV2 in Pune:	<ul style="list-style-type: none"> • Testing waste water can serve as a cost-effective early warning system and help officials keep track of coronavirus at an early stage even among asymptomatic persons. Pune Municipal Corporation (PMC) along with scientists of CSIR-National Chemical Laboratory (CSIR-NCL) conducted a pilot project that has shown traces of the virus causing Covid 19 in the sewage.
77.	Recycling of decontaminated COVID PPE waste	<ul style="list-style-type: none"> • Standardized a protocol to decontaminate the biomedical waste and recycle them into valuable products. CSIR-NCL team has developed the know-how to recycle used efficiently/contaminated PPE - especially overalls and gowns. • Demonstrated that decontaminated, shredded, and agglomerated PPE material can be used as feed-in

		polymer melt processing operations such as injection molding.
78.	Eco-friendly Ganesh Immersion	<ul style="list-style-type: none"> • CSIR-NCL and Pune Municipal Corporation (PMC) are jointly supporting the activity of Eco-friendly Ganesh Immersion and providing free Ammonium Bicarbonate (ABC) along with technical help for safe implementation of eco-friendly process. • This method is very easy to implement at home and takes about 48 hours to dissolve the idol completely. The initiative has been widely accepted. • A Mobile van was also launched for the collection of Ganesh idols from Pune for eco-friendly immersion using the CSIR-NCL technology in association with Ujjivan Small Finance Bank.
79.	Development of hydrogen fuel cell technologies to reduce on-road pollution by diesel driven heavy vehicles	<ul style="list-style-type: none"> • India's first Hydrogen Fuel Cell (HFC) prototype car running on an indigenously developed fuel cell stack was demonstrated at CSIR-NCL, Pune in 2020. • CSIR-NCL and CSIR-CECRI partnered with KPIT for the development of an automotive grade PEM Fuel Cell technology
80.	SWASTIIK- Disinfection of Water using Cavitation Technology and Natural Oils:	<ul style="list-style-type: none"> • CSIR-National Chemical Laboratory (CSIR-NCL), Pune has combined the Modern technology and Indian traditional knowledge of Ayurveda finding out a solution to disinfect water completely and offer possible health benefits of natural oils like lemongrass oil, clove oil, eucalyptus oil, etc.
81.	Development of manufacturing technologies for bulk drugs like paracetamol	<ul style="list-style-type: none"> • CSIR-NCL has developed a superior and cheaper process for the manufacture of the widely used drug, paracetamol. • This process has been developed under CSIR Mission Mode Project "Innovative Processes and Technologies for Indian Pharmaceuticals and Agrochemical Sector Industries (INPROTICS)".

Initiatives undertaken/ Technologies developed particularly for women folk

(i) Electric Sanitary Pad Incinerator (GreenDispo)

CSIR-NEERI has developed an Electric Sanitary Pad Incinerator (GreenDispo) with improved operational efficiency, reduced power consumption meeting the incinerator emission standards. It has been scientifically designed not only to achieve technical performance but its design also offers enhanced durability and attractive look, which is also an important criteria among several rural users now a days. The specially designed heaters of the currently developed GreenDispo generates more than 800°C, which helps in complete combustion of sanitary pad wastes with minimum flue gas emissions and is suitable for unbleached pads and those with high cellulose content. In a further improved model, a secondary heating chamber is provided with temperature of 950 ± 50 °C to avoid hazardous emissions from such incinerators when burning plastics and chlorinated products and can efficiently burn pads with high moisture content and super absorbent polymers (SAP). The product has been made in collaboration with the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) and Sowbal Aerothermics (SA).

(ii) Infection preventing medicated sanitary napkins- NAARI

NAARI is a scientifically developed low cost medicated sanitary napkin with natural aroma, *Aloe vera*, natural absorbent and essential oils. It protects from bacterial infection, helps to maintain personal hygiene and gives relief from unpleasant menstrual odour. The technology has been transferred to three MSMEs for commercialization.

(iii) Utilization of offered flowers collected from places of worship for making incense sticks, fragrant cones and rose water

CSIR-CIMAP has developed a technology for judiciously utilisation of offered flower for making of value added products like incense sticks, fragrant cones, essential oils and rose water. Tonnes of floral wastes are either disposed-off recklessly in rivers, ponds, fields or left to decompose in open, especially in and around the places of worship, where devotees offer floral reverence to Gods and deities. It will also strengthen the “Swachh Bharat and Skill India Mission”. This safe and useful disposal of floral and other bio-degradable waste of religious places and to establish waste as an income generating resource for the community. This technology was popularised with more than 5000 women and shrine boards in all over India especially in major place of worships.

(iv) Valued added products developed for the benefit of women folk

CSIR is developing valued added products for the benefit of women folk. Some of the products/technologies are: oral contraceptive, minerals & vitamin enriched products, multigrain high protein mix, natural perfumes, herbal lipstick/lip balm etc.

CSIR Mission Mode Projects

CSIR is implementing Mission mode programs across the country aimed at enhancing the farmer's income including women, entrepreneurship development involving rural population

through technologies that promote cultivation and processing of economically important plants and development of value-added products.

About 27 women folks across the country have been benefitted and became entrepreneurs and farmers by adopting following CSIR technologies under CSIR Aroma Mission.

- ✓ Multiplying CSIR released high-yielding varieties and supplying them to farmers/SHGs/NGOs for expansion of aromatic crops in their region.
- ✓ Setting up of distillation units in the clusters developed and extracting natural essential oils for packaging and marketing.
- ✓ Some of them have also started manufacturing CSIR products after signing an MoU.
- ✓ Self Help Group of Women at Shri Sai Temple, Shirdi (Ahmednagar) are using CSIR technology to convert offered flowers in to incense sticks and other value-added products helping in enhancing their livelihood.
