



CSIR-CSMCRI

YEAR REPORT - 2023

Explore, harness, and transform marine
resources for the good of the people of India

Mission of CSIR-CSMCRI – R&D Verticals



Marine Products & Processes

- Salt
- Water
- Marine Chemicals
 - - Inorganic
 - - Organic
 - - Natural Products
- Marine Elements



Marine Biology

- Marine Aquaculture
 - - Seaweeds
 - - Microalgae
- Halophytes
- Salt Tolerant Plants
- Marine Biotechnology
- Marine Microbes
- Marine Bio-actives
- Processing & Products (including food and nutrition)



Marine Environment

- Marine Pollution
 - - Abatement Processes
 - - Microplastics
- Marine Ecology
- Monitoring & Impact Assessment

Technology Portfolio of CSIR-CSMCRI

Salt & Marine Chemicals	Inorganic & Organic Chemicals; Polymers & Membranes	Waste to Wealth (for CPIs)	Marine Biology
<ul style="list-style-type: none"> • High purity salt • Low sodium salt • Double fortified salt • IP grade salt • Potash and magnesia from bittern • Hydrotalcite • LB and HB $MgCO_3$ • Dry sea mix 	<ul style="list-style-type: none"> • Zeolite-A • $CaCO_3$ (rubber and paper grade) • Precipitated silica (diff. grades) • Green brominating agent • Bromo compounds • Bio-diesel (oil-seeds and algae) • 2-Phenylethanol • Membranes/Polymers (TFC RO/HF for water desalination/purification) • Interpolymer cation and anion exchange membrane for ED/EDI/energy applications • Solvent-resistant membrane • Polymeric ion-exchangers • Bio-based chemicals (γ-valerolactone, polymers, etc.) • Membrane-based tool kits (curd strip, pathogen, etc.) 	<ul style="list-style-type: none"> • ZLD process for distilleries (with recovery of potash and organics as cattle feed); 100% water soluble FCO grade SOP from distillery ash • Separation/Recovery of salts (inorganic) from different chemical processes/ effluents (salt washery, textile, leather, paper & pulp, etc.) • Valorization of Kimberlite waste tailings • Recovery of precious metals (like Pd, Li) from spent catalysts/e-waste/ effluent streams • Recovery of lac from effluent and recovery of aleuritic acid from seedlac • Activated carbon from rice husk ash waste 	<ul style="list-style-type: none"> • Cultivation technology for Kappaphycus, Gracilaria, Gelidiella species and their processing to bio-stimulant/animal/poultry feed and phycocolloids (carrageenan, agar, agarose, and alginates) • Liquid Seaweed Plant Bio-stimulant (LSPB) from brown algae – Sargassum • Microalgae cultivation and processing to crude oil and Pigments • Cultivation of Salicornia, a salt-tolerant plant, processing to value-added products • Bio-degradable thin films, capsules from carrageenan • Microbial synthesis - PHA

❖ IP Protected

❖ Licensed & Commercialized

❖ TRL Level 6 & above

❖ Industry supported

Dear well-wishers of CSIR-CSMCRI Bhavnagar,

Greetings of the year!! Your belief in CSIR-CSMCRI has been invaluable, and I am delighted to look back 2023, a year that is marked by significant achievements, growth, and your association with us that we deeply appreciate.

In order to showcase our capabilities, the technological breakthroughs & innovations and their relevance to society, we organized 'One Week One Lab' Programme at CSIR-CSMCRI, during April 10-14, 2023, which was graced by the august presence of Dr. (Smt.) Bhartiben Shiyal, Hon'ble MP, Bhavnagar. We also illustrated our R&D capabilities in "82nd CSIR Foundation Day-CSIR Decadal Achievements Exhibition (2014-2023)" at Bharat Mandapam in New Delhi on September 26, 2023. Self-powered portable desalination cum water-purification van capable of providing clean drinking water to communities at the times of calamities like floods, earthquakes, cyclones was displayed during this event and was greatly appreciated by Prof. Ajay Kumar Sood, Principal Scientific Advisor to the Government of India, who urged it to be used at Pan-India level.



The technological prowess was also demonstrated to public at Vibrant Gujarat "Bhartiya Vigyan Sammelan – 2023" at Science City, Ahmedabad, from December 21- 24, 2023, where Hon'ble Chief Minister of Gujarat, Shri Bhupendra Rajnikant Patel witnessed the products and processes developed by us. We also showcased our R&D facilities and capabilities in various other programmes such as 108th Indian Science Congress – 2023 (ISC-2023) at Nagpur, Ujjawal Rajasthan Exhibition at Udaipur. The National Technology Week-2023 was organized during May 11-14, 2023 in New Delhi with the theme "School to Startup— Igniting Young Minds to Innovate", in which CSIR-CSMCRI demonstrated its technologies to school students and also delivered a Ted-talk. Dr. Jitendra Singh, Hon'ble Union Minister of State for S&T and Vice President, CSIR also appreciated the technologies developed by CSIR-CSMCRI and urged the students to adopt entrepreneurship mindset.



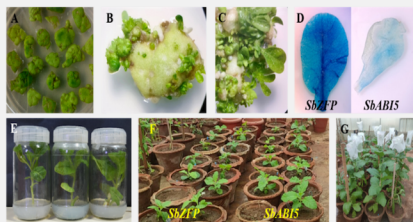
Research Frontier Highlights

At the forefront of scientific innovation, CSIR-CSMCRI is dedicated to serving society and supporting industry.



100% Soluble Fertilizer-Grade Potash (SOP) Production (Atma Nirbhar Bharat, Make in India initiative)

- Pioneering production using distillery spent wash (DCM Shriram & ChemProcess).
- Technology demonstrated in a plant in Uttar Pradesh.
- First commercial plant utilizing distillery spent wash for fertilizer, to be commissioned next year.



Double Fortified Salt with iron- and iodine

- Animal testing studies for FSSAI certification of fortified salt are completed and the results are promising. Next year, we shall submit to FSSAI for certification and in turn for commercial licensing.

Industrial Waste Utilization

- Development of alkali-activated sustainable concrete saltpan bed from soda ash and chlor-alkali industry waste.
- Reduce in brine losses through seepage and strengthen mechanized loading processes.



Catalytic Conversion Advances

- Chemicals from algae



Jal Jeevan Mission

- Development of IoT-based water deployment and sensors for inline water quality monitoring.

Mixed Salt Production

- Factors influencing the production of Kainite and Carnallite from sea/subsoil bitterbrines.
- Positive results in recovery of MOP and SOP.



Halophytes

- Genome sequencing of *Salicornia brachiata* and *Aeluropus lagopoides* completed.
- Soil reclamation for salinity and heavy metals.

Seaweed Farming Pre-Feasibility Study

- The survey was conducted across 248 locations in India.
- 78 sites were identified as suitable; 44 sites were completed, and 34 were ongoing.
- 24 sites found suitable for commercial seaweed farming.



Studies on seaweed biostimulants

- Mechanistic studies on Sargassum, Gracilaria, and Kappaphycus-based liquid biostimulants on crops.
- Found safe for use according to new FCO guidelines.
- Supporting government to frame FCO guidelines.
- Validation of Sargassum based biostimulant on different crops in varied agro-climatic regions of India,



Carbon Capture Utilization and Storage Mission

- Collaboration with Adani Thermal Power Plant for CO₂ sequestration via large-scale microalgae cultivation in seawater.
- Efforts in downstream processing for biofuels, nutraceuticals, and bio-actives.



Membrane Technologies

- Low-fouling thin film composite membrane for seawater desalination (50 m² scale per batch).
- Polymeric hollow fiber membrane for arsenic remediation.
- Nanofiltration membranes @ 50 m² per batch and spiral 4040 module that exhibited rejection of 95–97% dye, 98% MgSO₄, and 99% Na₂SO₄ – promising for wastewater treatment and water softening.
- Design, installation, and commissioning of BWRO desalination plant (20 m³/h) @ Tata Steel, Haldia, with >80% water recovery and >95% salt rejection from the feed water (2000–5000 ppm) and is currently operational.



Other Innovations/Interventions

- Direct extraction of agarose from Gracilaria dura.
- Synthesis of functionalized nanomaterials for Uranium Extraction from Seawater (UES).
- EIA studies to validate and recommend CPCB for deep sea discharge guidelines.
- Long-term environmental health monitoring of Alang (Ship breaking yard) as per the directive of NGT.
- Successful preparation of nanotricomposite material for extraction of different types of microplastics from potable and seawater.
- Process for precipitated silica is developed from Rice Husk Ash (RHA) derived sodium silicate for various applications is developed.

Academic Excellence and Honors



- CSIR-CSMCRI provides Ph.D. in Sciences and Engineering under the Academy of Scientific and Innovation Research (AcSIR). In 2023, 22 scholars enrolled for Ph.D. CSIR-CSMCRI also provides an internship program for master's and undergraduate students. In 2023, 160 students from various Universities completed their internship in the institute.
- The year 2023 was promising with 219 publications with an average impact factor of 5.38. We also filed 22 patents (Indian-20; Foreign -2) and received 35 granted patents (Indian-29; Foreign -6).
- CSIR-CSMCRI ranked 2nd among all the CSIR labs in contributing to the R&D ecosystem in three major domain areas viz., Publications, Ph.D.'s., and IPRs based on the study conducted by the Office of the Principal Scientific Adviser (O/o PSA) to the Government of India along with the Confederation of Indian Industry (CII) and Centre for Technology, Innovation, and Economic Research (CTIER).
- A Stanford University study indicated 13 of our institute Scientists are among the Top 2% Most Influential Scientists of 2023 in different domains .
- Our scientist Dr. Anshul Yadav received the “Best Thesis Award of AcSIR (Engineering Sciences)” for his excellent work in the field of membrane distillation for high saline and wastewater treatment.
- Our student Dr. Pulak Sarkar received the “Best Thesis Award under the faculty of Chemical Sciences” of AcSIR for the year 2022 in recognition of his outstanding work on "Ultrathin Polymer Nanofilms for Ionic and Molecular Separations".
- Dr. Arvind K. Singh Chandel, our alumni, has been selected for the prestigious “Marie Skłodowska-Curie Fellowship 2022” for pursuing his post-doctoral study.
- Our Scientist Dr. Arup Ghosh was awarded Fellow of the Crop and Weed Science Society (CWSS), West Bengal in October 2023.
- Many of our students have bagged best poster & oral presentation awards and medals in many national and international conferences and seminars.



Footfalls at CSIR-CSMCRI

Shri. Jagdishbhai Vishwakarma, Hon'ble State Minister of Co-operation, Salt industries, Printing and Stationery, Protocol (all Independent Charge), Micro, Small and Medium Industries, Cottage, Khadi and Rural Industries, Civil Aviation, Government of Gujarat visited our facility, & interacted with scientists on various projects, prospects, and applications of research at CSIR-CSMCRI for society.



In line with our dedication to promoting gender equality and empowering women, we celebrated International Women's Day with a weeklong series of events from March 1, 2023. Rajkumari of Bhavnagar & Founder, Bhavnagar Heritage Preservation Society & Vice President Princes Auction House & Gallery, Smt. Brijeshwari Kumari Gohil, graced the event as the Chief Guest.

As part of our commitment to developing sustainable practices through our R&D, we celebrated World Environment Day 2023 on June 8, 2023. We were honored to have Prof. (Dr.) Shyam R. Asolekar as the Chief Guest who delivered a lecture at the event. Prelude to India International Science Festival was organized on December 22, 2023, in which around 350 school students and 15 teachers visited our institute to participate in an exhibition and lectures on the expertise of the institute.





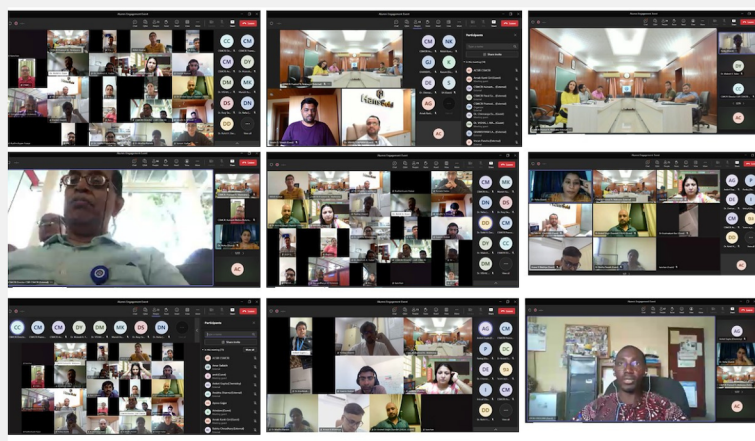
Conferences/ Events Organized

The fourth India International Seaweed Expo and Summit 2023 was organized and convened jointly by CSIR-CSMCRI and Indian Chambers of Commerce during January 17-18, 2023 in Ahmedabad. The event was attended by more than 300 participants who were entrepreneurs, senior government officials including from NITI Aayog, scientists, international experts and deliberated upon multifarious issues related to seaweeds. Hon'ble Minister of Fisheries, Animal Husbandry and Dairying, GoI, Hon'ble Shri Parshottam Rupala addressed the participants and appreciated the efforts done by CSIR-CSMCRI.



CSIR-CSMCRI along with the Indian Membrane Society (IMS) has organized an International Conference “Membrane based Separations: Past, Present & Future” on October 16-18, 2023 to celebrate the 100th Birth Anniversary of Prof. S. Sourirajan. Eminent Scientists, scholars and entrepreneurs across the country and from outside the country have attended the conference.

To develop an active alumni network and to build renewed relationship with our passed-out students an online “Alumni Engagement Meet” was held on 13th September 2023. During this meeting alumni shared their journey at CSIR-CSMCRI, and various other topics such as how to increase the visibility of the institute and to improve the network among active research scholars and alumni of the institute were discussed.





Research Scholars of CSIR-CSMCRI have organized two days “Gujarat Research Scholar’s Connect 2023” during December 07-08, 2023 with the intention to create a scientific platform to display their scientific achievements and also to create network among research scholars across the state of Gujarat.



CSIR-CSMCRI, Bhavnagar along with the Regional Science Centre, Bhavnagar, and the Royal Society of Chemistry organized a Teachers’ Training Workshop on September 25-26, 2023 under the CSIR-Jigyasa program. Around 40 teachers from different schools across Gujarat have attended the workshop.

We organized a training on “Intellectual Property Rights for Academics & Research” for scientists and students of the institute on July 20-21, 2023 under the umbrella programme of the “National Intellectual Property Festival” that was celebrated across the country during July 01-31, 2023 to celebrate Azadi ka Amrit Mahotsav.



Industry Interactions

We address research challenges by working closely with our partners by undertaking dedicated projects. In 2023, CSIR-CSMCRI garnered projects worth INR 95 million, which includes 21 government and 20 industry projects.



We have associated with various entrepreneurs, startups, and industries. Some of them including L'oreal India Pvt Limited, TATA Chemicals Limited, Hindustan Salts Limited, National Aluminium Company Limited, Cirkla Technologies Pvt Ltd, ENPRO Enviro Tech and Engineers Pvt. Ltd.



Technology Transfers

CSIR-CSMCRI successfully transferred eight (08) different technologies accruing about INR 18 million, encompassing areas such as seaweed processing, artificial seawater preparation, cultivation and value addition of halophyte, microalgae cultivation and solvent-resistant membranes.



MoUs and Agreements for Collaborations



We signed 63 agreements of various types with different organizations like TATA Chemicals Ltd, Central Pollution Control Board, ONGC, Pidilite Industries, Public Health Engineering Directorate – West Bengal, Bhavnagar Municipal Corporation, Adani Power Limited, Shree Somnath University, Marwadi University, ENPRO Enviro Tech and Engineers Pvt. Ltd., Gujarat Technological University.



Societal Activites



Through joint efforts of NECTAR, solar dryer facility developed by CSMCRI installed in NECTAR Center, Guwahati. This technology will help enhance nearby farmers income by creating value added products through drying.

CSIR-CSCMRI has organized a societal mission program for the upliftment of salt farmers in the Halvad region, Gujarat. Under this program, we have conducted mindset training for project beneficiaries on improving the quality and yield of salt produced by the marginal agarias of Kutch and also on improving their income through value addition of bitterns, halophyte plantation and potable water recovery.

Jigyasa (Science Outreach) & Skill development

Following the philosophy of learning by doing, we believe in imparting skills at a very young age. To implement this, over 14,852 school students and 636 teachers from various parts of Gujarat have been sensitized by CSIR-CSCMRI staff under the JIGYASA initiative. Similarly, through our CSIR-Integrated skill development program, approximately 576 individuals have been trained, empowering them to venture into business in areas related to seaweeds, soil testing, biotechnology, microalgae, salt production activities, etc.





Other Important Activities/ Achievements

- Our institute has bagged the “National Official Language Kirti Award” which was conferred at the 3rd All India Official Language Conference, Pune.
- We have prepared and published “Technology compendium” in Hindi. This book contains the basket of technologies developed by CSIR-CSMCRI, all the details such as various applications of technologies developed, Technology Readiness Level, business scope, and opportunities. Various other publications regarding the technologies have been published in vernacular languages such as Gujarati and Tamil.
- To strengthen the institute's human resources, a recruitment drive was conducted. 14 new people in various cadres including Technician (1), Technical Assistants, Junior Secretariat Assistants have joined.
- CSIR-CSMCRI have been accredited by NABET as Master Environmental Consultant in four sectors – 1. Distilleries, 2. All ship breaking yards including ship breaking units, 3. Ports, harbours, breaking waters, and dredging and 4. CETPs.



Shanti Swarup Bhatnagar Memorial Tournament

We hosted 51st Shanti Swarup Bhatnagar Memorial Tournament (SSBMT -2023), 1st Zonal Indoor Games from October 17-19, 2023 in coordination with CSIR Sports Promotion Board. Around 149 players representing 08 different labs of CSIR from various parts of India participated in the zonal games.



Reflecting on the progress made in 2023 fills me with optimism in our ability to innovate through collective efforts and shape the future of our country. I am sure that our concerted efforts would catapult CSIR-CSMCRI to even greater heights in the days to come.

May the future bring you great promise and fulfillment!

Kannan Srinivasan
Director, CSIR-CSMCRI



Thank You Stakeholders...



