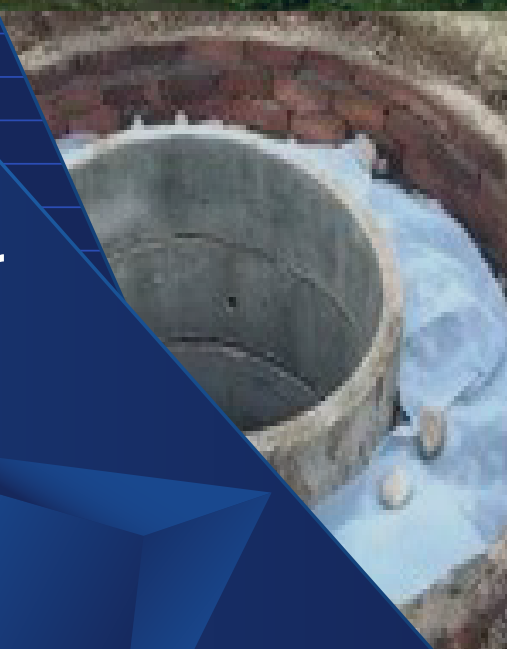


ANNUAL REPORT 2023

International Centre for Clean Water

CONTENTS

HIGHLIGHTS OF THE YEAR

The year 2023 was an eventful year for ICCW. There were many positives, but we also lost our most valuable employee Mr C Sripati. Sripati was versatile in his knowledge and commitment to the cause of water. With his affable nature he managed technicalities and behavioural challenges in water management with ease and left a void that we are finding difficult to fill. May he rest in peace.

The world of water is becoming more challenging by the day with climate change effects, new age contaminants, floods and droughts, legacy problems, developmental push and disappearing water bodies. Fortunately, technology for monitoring and remediation has been keeping pace and solutions are at hand if only all stakeholders could work synergistically.

Award

Prof T Pradeep received the prestigious Eni Award 2023 from Sergio Mattarella, President of the Republic of Italy for his groundbreaking work in providing affordable and sustainable clean water using advanced nanoscale materials.

Prof. T. Pradeep receiving the prestigious Eni Award 2023 from Sergio Mattarella, President of the Republic of Italy at the Quirinal Palace, Rome, on October 16, 2023. Eni Award has come to India for the second time.

Research & Development

Our Research & Development team has progressed in the development of low-cost multiparameter sensors for online and distributed measurement with IOT. It is now possible to accurately analyze up to 13 parameters of water quality in the field in real-time and build a water quality map of a region on the cloud. The need of the hour is to standardize the format of data storage for common use and analytics.

Industrial R&D

We have launched Industrial R&D as a sub-vertical and have taken up vexing problems of effluent treatment for industries. A solution for electroplating industry has been developed and substantial success achieved for colour removal for the textile industry..

Analysis & Validation

Continuing our solution-based approach, we have strengthened our relationship with our partners in providing value-added testing services with consultancy support. Helping our Consortia member Xylem to setup an Ozonator lab is a key highlight this year. A leaching study was undertaken to validate arsenic remediation technology AMRIT as part of the plan to globalize the technology.

Hydroinformatics

Water + data will be a game changer and the volume of water data generated at ICCW gave us a platform to build models, web/mobile apps, initiate digital twins. POC's have been developed in these areas that offer the potential for better water management in industry, communities, and agriculture.

Implementation

A detailed habitation-level water security study was done for Ramanathapuram district, which has a long history of being water stressed. A GIS map of the local water sources has been created that can be leveraged through a web/mobile app for managing daily water supply shortages from the central supply schemes.

Sustainable technologies were deployed in villages using CDI and in institutions through atmospheric water generators. Water reduction programs were continued for industry and institutions to help them achieve Net Zero Water.

A unique agreement was forged between consortia of companies from India and Taiwan to introduce green technologies for energy, water conservation, recyclable packaging, employment of marginalized women and indigenous herbs to produce disinfectants and washing liquids for school kids

ICCW signed an MOU with Feng Shia University of Taiwan for a unique project to produce WASH consumer products with 100% green energy, zero liquid discharge, women employment, ecofriendly packaging using local herbal ingredients to be distributed to government school children.

Outreach

WaterTalks by experts and Action Forums that connected citizens continued to be the key outreach activities.

Our industry connect was strengthened with online capacity building programs for water auditing, cooling water chemistry and industrial water conservation. Being a Sustainability Taskforce member of CII and jury member of competitions gave us an opportunity to see the great work done in water reduction by industries.

ICCW was the India Challenge Owner in the AIM-ICDK Challenge 3.0 and mentored four teams – one Mexican, one South African and two Indian to the global finals held in Copenhagen.

Startups

A Waterpreneur Studio was created as a continuum from ideas to scaled up business in the water sector. Challenge → Incubation → Acceleration → Networking. We have received positive responses from startups and students and are excited about the possibilities that will unfold in the years to come.

We hope to create the perfect ecosystem for water-based startups where they get all their requirements met in one place.

New Centers

Over 22 partnerships were signed during the year with different organizations, chief among them is a Letter of Intent for the Indo-Israel Centre for Water Technology signed between the Ministry of Housing and Urban Affairs (MoHUA), Government of Israel and IIT Madras.

A letter of Intent was signed for India-Israel Center of water technology at IIT Madras by Mr. Manoj Joshi, Secretary, MoHUA, Govt. of India, in presence of Shri. S. Jaishankar and Mr. Naor Gilon, Hon'ble Ministers of External Affairs of India and Israel, respectively and the Director, IITM, on May 9,2023.

GOVERNING BOARD

Prof. V. Kamakoti
Chairman

Prof. T. Pradeep
Professor in change

Prof. Ligy Philip
Member

Prof. Manu Santhanam
Member

Prof. Saritkumar Das
Member

Prof. Rajnish Kumar
Member

Dr. Tiju Thomas
Member

OUR COLLABORATORS

Prof. R. Graham Cooks
Purdue University,
West Lafayette

Prof. Marc Anderson
University of Wisconsin,
Madison

Prof. P. M. Ajayan
Rice University,
Houston

Prof. Seeram Ramakrishna
National University of
Singapore

Prof. A. K. Ghosh
Bhabha Atomic Research Centre
Mumbai

Prof. Thomas Tundat
University of Alberta,
Edmonton

Prof. Alok Dhawan
Indian Institute of
Toxicology Research

Prof. Andrea Iris Schaeffer
Karisruhe Institute of
Technology, Germany

Prof. Haiwon Lee
Hanyang University
Korea

Prof. Tony Cass
Imperial College,
London

Jane Catherine Ngila
Masinde Muliro University of
Science and Technology, Kenya

ADVISORY BOARD

Murali Sastry
CEO, IITB-Monash Research Academy

Dr. Murali Sastry is the CEO at IITB-Monash Research Academy, an Indian-Australian research partnership

K. E. Seetha Ram
Senior Consulting Specialist, Asian Development Bank Institute

Professor Seetha Ram is Visiting professor at the Center for Spatial Information Science, University of Tokyo

Kana Sureshan
IISER, Thiruvananthapuram

Dr. Kana Sureshan is a Professor at Indian Institute of Science Education and Research, Thiruvananthapuram

Yoram Oren

Dr Yoram Oren is the Emeritus Professor at Ben-Gurion University of the Negev, Israel, Zuckerberg Institute for Water Research

Amit Gross

Dr. Amit Gross is a Professor at Ben Gurion University of the Negev, Israel and Director of Zuckerberg Institute for Water Research

Ashok Natarajan

Mr. Ashok Natarajan retired as the CEO of Tamil Nadu water investment company. He is a Special Invitee and mentor for Central Public

K. K. RAMAN
IIT Madras, IIM Calcutta

We welcome Mr K. K. RAMAN to our Advisory Board
He is a Mentor to startups and offers Advisory Services for canalising funds into large infrastructure projects that have potential to create impact.

RESEARCH & DEVELOPMENT

Multiparameter water quality monitoring unit

Sensor Cabinet

A setup for the functionalization of microelectrodes

The fluoride sensor developed with funding from Ms Nalini and Mr Ramakrishnan (IITM -1974) is ready for field validation. Fluoride concentration readings in the operating range have shown high correlation with laboratory test results. The Unit, which is IOT enabled will be deployed on a Water ATM in a fluoride affected area for monitoring both the raw water and treated water fluoride concentrations.

The principle used is calorimetry, which is versatile and affordable. The Unit can be adapted to add other parameters such as Iron, Phosphate, Nitrate etc, making it a truly multiparameter quality monitoring unit.

Post field validation, the Unit will be marketed through Eyenetaqua Solutions, a startup founded by the developer Dr Kamalesh Chaudhari and incubated at ICCW.

Microfluidic sensors for sensing heavy metal ions

A pluggable microfluidic module for heavy metal ion sensing

ICCW has been working with EES (Energy Environment and Sustainability) laboratory from Seoul National university, South Korea on the development of microfluidic electrochemical sensors. Major target of this project is towards integration of various heavy metal ion sensors on the same device. The device will facilitate concentration of metal ions to enhance the sensitivity of electrochemical sensors by several folds.

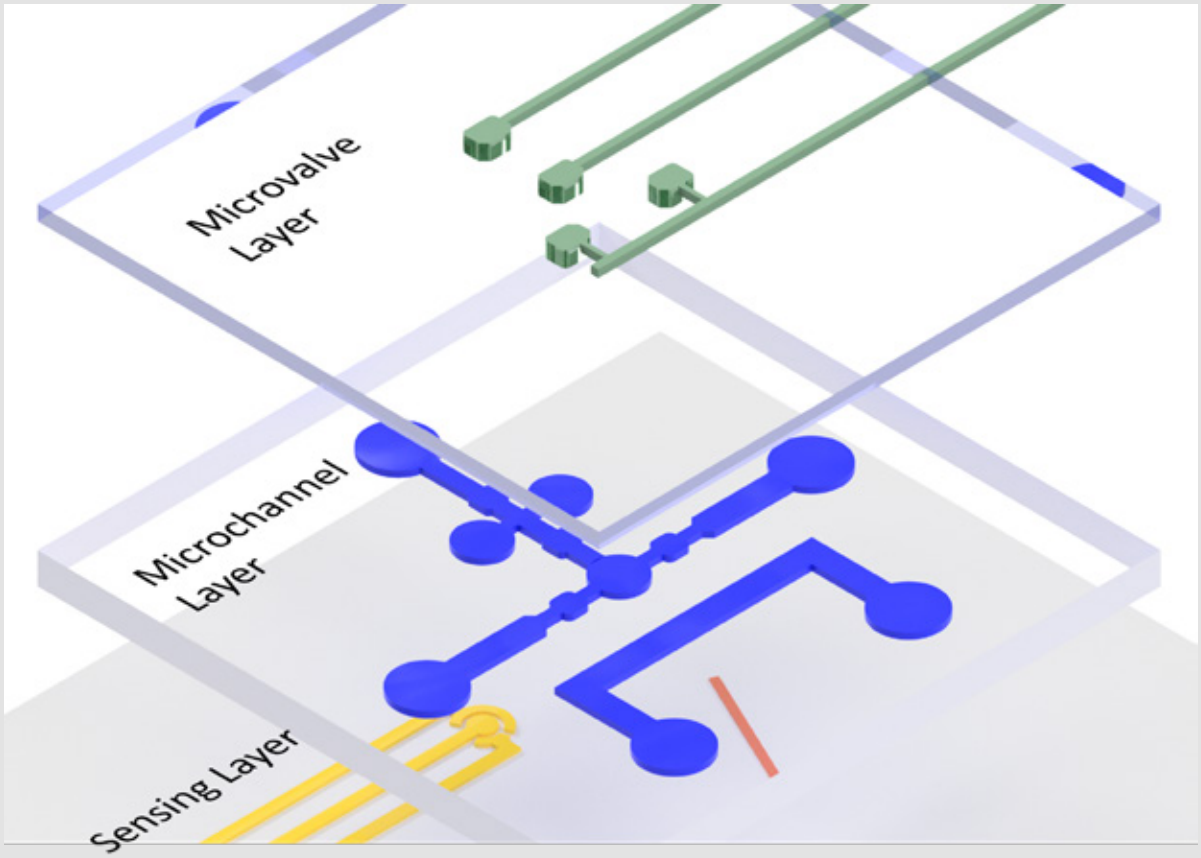
Electrochemical sensing elements with suitable functionalities towards a targeted set of toxic ions such as As3+, Mn2+, Fe3+, Cd2+, Pb2+ are being developed as a part of this project. The microfluidic technology for the concentration of ions is a complementary skill set supported by the team researchers at EES lab. Considering the complexity involved in integration of various processes and their coordination with each other, rigorous optimization studies are under progress. This project is funded by Department of Science and Technology, Government of India (DST) and Ministry of Science and ICT, Republic of Korea (NRF).

A visit by Mr. Seongho Baek (Seoul National University, South Korea) to International Centre for Clean Water

Collaborative project teams:

ICCW – Dr. Vidhya Subramanium and Dr. Kamalesh Chaudhari
SNU – Mr. Seongho Baek, Dr. Wonseok Kim and Prof. Sung Jae Kim

Lab on a chip sensor for heavy metal ion detection



This project is focused on the design and development of electrodes integrated with microfluidic concentrators for the detection of lead and arsenic. Ion concentration polarisation is utilized for concentrating the metal ions to enhance the sensitivity of the device. A valve layer has been added to the device for the localization of the concentrated ions at the desired location and a control mechanism is utilized to keep the same concentrated when electrochemical sensing is performed.

Project funded by **Aquaworks** - Marmon Water Research Center.

INDUSTRIAL R&D

In response to the many industrial enquiries and problem statements received, ICCW has setup an Industrial R&D lab. A dedicated team of scientists will work closely with industry partners to understand their needs and issues to jointly develop sustainable solutions. The ecosystem around ICCW provides a fertile bed for brainstorming and innovation.

A passionate interdisciplinary team comprising scientists, engineers, researchers and experts in water domain encourages diverse perspectives and collaboration. We strive to establish partnerships with research institutions, industries and other R&D labs to leverage external expertise, share resources and attract funding in tune with market demands. We develop products, technology with commercial viability, fostering a culture of learning, creativity and innovation within the lab.

We facilitate smooth transfer of successful technologies or innovations from the lab to the production or commercialization phase. We have flexible policies with regard to the Intellectual Property (IP) ownership for the technologies developed and implemented.

Projects

1. Extraction of specific fatty acids from treated sewage.

Fats, oils and grease (FOG) in used water pose a significant challenge in the treatment due to their insoluble nature and ability to float on water. Untreated FOG can cause environmental issues, block sewer pipes, cause unpleasant odours, lead to overflows, land contamination, and public health risks.

The above reasons voice for an alternative method to be developed for the removal of fatty acids from wastewater treatment plants. Leveraging the cutting edge resources at ICCW, the team developed an efficient method to extract specified fatty acids from STP water for an industrial requirement.

Project sponsor - Aqua Lead systems

2. Standalone membrane distillation unit for potable water production

Membrane distillation (MD), an emerging technology capable of treating high-saline feeds at an optimum temperature not possible by conventional technologies, was demonstrated at ICCW. We developed the MD module, a thermal separation process in which only the water vapor molecules pass through a microporous hydrophobic membrane and condensed into clean water. To handle 40,000 ppm of water with various constituents of ions, a multi-membrane module (MM MD) was constructed from lab to pilot scale including the design of material modification, housing and membrane connectors with a continuous flow of data. The successful development of the in-house MM MD module could produce 100 liters per day with an energy consumption of 0.3 kWh/L (excluding the inlet water heating, which could be done using solar power).

Project Sponsor – Grundfos

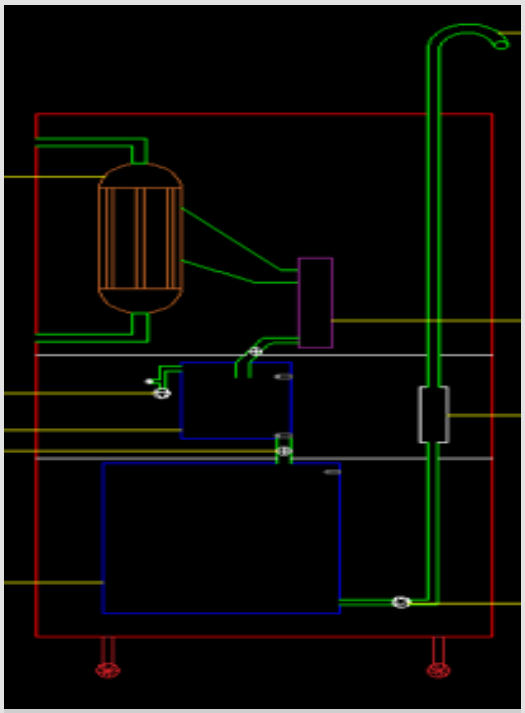
Team:

ICCW

Dr. Abirami Devadas - Principal Investigator, Head of Industrial R&D
Mr. Nandakumar.E, Chief Executive Officer
Mr. Siva Thiyagarajan – Project Engineer
Mr. Mareeswaran - Engineer

Grundfos

Mr. Flemming Hedegaard - Head of Technical Innovation
Mr. Dinesh Ramalingam - Product Manager, Safe Water
Ms. Usha Subramaniam - Country President of India
Ms. Divya Sundaramoorthi - CI, Associate Specialist
Mr. Joakim Bach Kaas - Water Treatment Engineer
Mr. Loreen Ople Villacorte - Senior Supervisor, Water Filtration



Compact design of MD

In-house MM MD for 100 LPD

3. Material development for portable water purifier and assessment of heavy metal removal from water

With a multidisciplinary approach with integrating material sciences, engineering and water treatment, the material for portable water purification had been developed for a start-up that effectively remove heavy metals and pathogens in water.

The developmental activities involved material modification, rigorous testing of materials under various conditions to assess their performance as well as the variations in water quality before and after passed through the developed material in complying with water quality standards and regulations. The water flow rate and heavy metal contaminant removal efficiency were studied to understand the adaptability to different water sources. The scalability of the material for the feasibility of large-scale manufacturing, durability and cost-effectiveness were also considered.

Project sponsor - Technomorph **(Startup)**

4. Process design for treating greywater for its reuse and safe disposal

Reuse of industrial floor cleaning water

Research and development (R&D) ....regulations. A customized solution was developed for recycling floor cleaning water for an industrial unit. Water used for floor cleaning was collected from soak pits and analyzed for their constituents.

A step-by-step method was adopted for removing/neutralizing the constituents that will enable the treated water to be reused for floor cleaning. A pilot trial is planned to validate the treatment methodology. Its success will reduce the ETP load for the unit, while reducing the freshwater intake for process.

We can take up such projects for industry that can decentralize process water recycling, reducing the ETP load and water withdrawals helping their units towards Net Zero Water.

Project sponsor - TVS - Hosur

5. Technical viability of electrocoagulation process as well as the development of electrode materials to treat textile effluent

The R&D is focussed on the development of electrode materials for the reduction of COD, turbidity and color from textile effluent. Our preliminary investigation shows promising results on color and turbidity reduction. The critical operating parameters for electrocoagulation will be established. Assessing the efficiency in the contaminant reduction as well as the shelf-life of the developed material through input and output water quality will be tested. A lab-scale demonstration of the developed technology will be the outcome.

Project Sponsor – WATSAN Envirotech

Team:

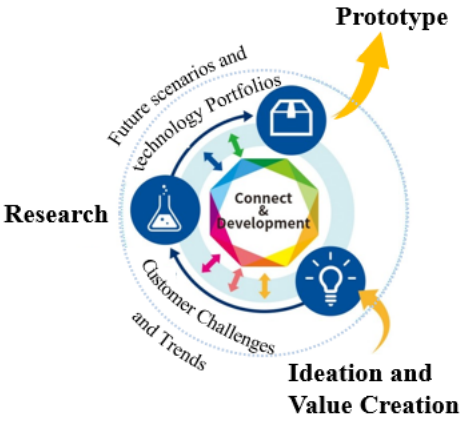
Industrial R&D Team :

Dr. Abirami Devadas - Principal Investigator, Head of Industrial R&D
Dr. Rabiul Islam – Scientist
Dr. Antony Lopis - Scientist
Ms. Gowri Manohari - Analyst

ANALYSIS & VALIDATION

ICCW, along with its parent institution IIT Madras has the facility to analyse almost any water parameter from conventional physico-chemical quality to new age contaminants, heavy metals, trace elements.

Our focus in this area is not just to analyse and report water quality, but to take it up as a project and contribute to interpretation of the results in furtherance of our customer's objectives. Hence we strive to utilise the most optimum test method to optimize costs, accuracy and reliability.



The following projects will give an idea of the kind of services offered:

1. Sample analysis and data interpretation for our clients.

Through sample analysis and characterisation, we support researchers or analysts to understand the underlying relationships and reliable data for making informed decisions.

We worked with Ather Energy in their scientific research by analysis and its data interpretation which is the key to extract meaningful insights, deriving conclusions and contributing to the overall body of knowledge.

2. Serving as analytical arm for research organisations

Ohmium Operations and Solidaridad have benefited from our association by optimizing their resources to focus on their core research and leaving the analytical aspects to us.

3. Establishment of xylem centre for ozonation @ ICCW

For Xylem Water Solutions – a Gold Consortia Member – we have established a dedicated lab for their Ozonator. Ozone is a powerful oxidizing agent used in water treatment to remove colour, odour and oxidize contaminants. It is particularly effective in breaking down organic and inorganic pollutants, disinfecting water, and improving overall water quality.

Trials of effluent water on the Ozonator and their corresponding chemical analyses give relevant and accurate information for Xylem to develop an optimum large scale solution. Comprehensive quality, safety, environmental and data privacy protocols have been put in place to simulate the customer experience of ozonation of their effluent water.

ICCW is proud to collaborate with Xylem to stay abreast of the advancements in ozone based water treatment for Industries. We see exciting possibilities of offering such services to the water industry.

Training and certification on water quality parameters

ICCW conducted an 2-credit internship program for B Sc students of Stella Maris College, Chennai on water quality testing. We were overwhelmed by the students' response and participation levels. They brought water samples from their neighbourhood for testing and got "hands on" exposure on the contaminants and their test procedure.

We are partnering IIT Madras and Tele Aviv University in introducing an online water quality testing program with practical exposure through advanced field test kits in different locations.

Students from Stella Maris College

Maharishi Vidhya Mandir students – Training on water quality parameters

Internship for Graduates

VALIDATION SERVICES

We offer technology validation services to startups and established companies as required. The validation can be carried out against a claim made by the manufacturer or against any standard protocol such as EPA guidelines. Some of the validation projects taken up during the year are:

1. TCLP studies on AMRIT for Xylem

Toxicity Characteristic Leaching Procedure (TCLP) studies provide insights into the potential environmental impact of disposing of specific waste materials by assessing their leaching potential. We conducted TCLP studies on AMRIT (Arsenic and Metal Removal by Indian Technology) spent adsorbent media to assess compliance with regulatory thresholds for hazardous waste, particularly in the context of disposal and management. The waste material is mixed with an acidic solution that simulates the conditions of a landfill. The mixture is agitated over a specified period to simulate leaching. Our studies indicate the saturation level of arsenic adsorption well below the maximum concentration of contaminants for the toxicity characteristic, as determined by the TCLP ("D" list).

2. ELICO's Portable Multi-Parameter Water Quality Analyzer (e-Jal)

The technical assessment of ELICO's Portable Multi-Parameter Water Quality Analyzer (e-Jal), was conducted and verified for 23 parameters in compliance with APHA standard protocols.

3. Evaluation on the chemical composition of Edelweiss Dentistry products (CAD/CAM composite blocks)

A technical assessment of the inorganic and organic constituents present was done by extraction and analysis followed by characterization techniques. Certification of the chemical composition was provided after validating the CAD CAM composite against ISO-10993-18 for leachability.

A&V Team:

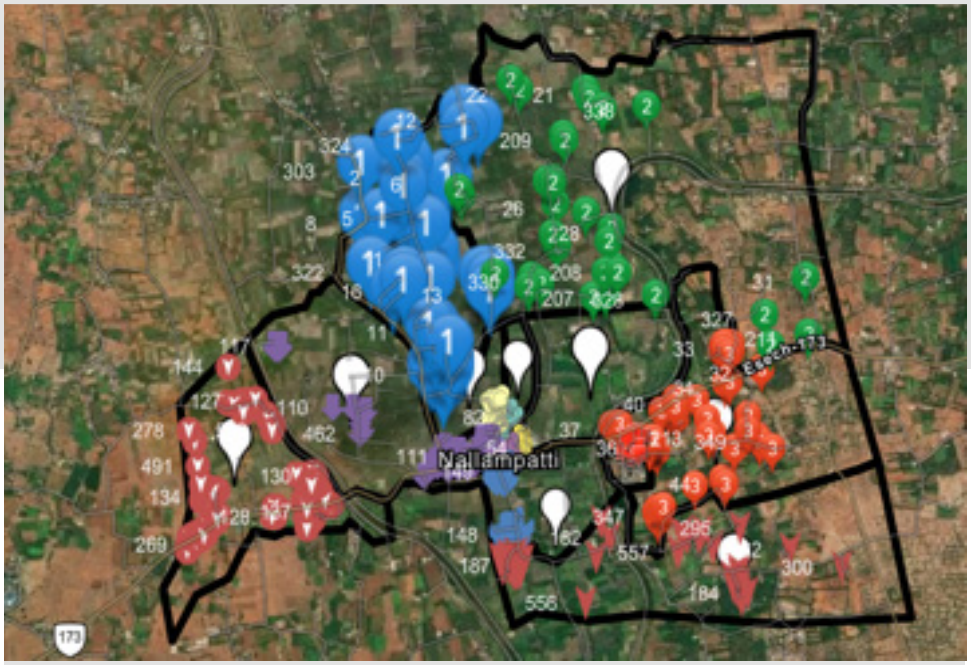
Dr. Abirami Devadas - Principal Investigator, Head of Industrial R&D
Dr. Rabiul Islam - Scientist
Ms. Chithra – Senior Analyst
Ms. Priyadharshini – Analyst
Ms. Priyadharshini – Analyst
Ms. Rose Mary - Analyst
Mr. Satish – Analyst
Mr. Mukesh - Analyst
Ms. Bhuvana - Analyst
Ms. Uroosha – Analyst
Mr. Ranjit Kumar – Data Analyst

HYDROINFORMATICS

Hydroinformatics recognises the inherently social nature of the problems of water management and of decision-making processes, and strives to understand the social processes by which technologies are brought into use.

ICCW has taken initial steps in this domain through the following projects:

1. Building a hydroinformatics tool to correlate the health of a community with water & soil quality data and in turn correlate the latter with agricultural and irrigation practices.



Water quality map showing clusters of different contaminants.

Studies in a town in Southern India, where a high incidence of diabetes and CVDs were discovered, showed some correlation of contaminants between the amounts of fertilizer an pesticide used and the concentration of contaminants in soil and water. More study and modelling is needed to establish a precise relationship.

Correlations between water & soil parameters during monsoons, dry seasons and flood irrigation are being studied to assess the impact of industrial effluents from a neighboring town on soil/water contamination and the health of the population.

2. A digital tool for specific water reduction for industries.

Water management is gaining importance and even becoming critical in industrial establishments. There is a paucity of professionals trained in water audit. The high cost of a basic water audit and the long time taken from start to finish deters many organisations from conducting such audits.

ICCW is developing a tool to enable utility and facility managers to conduct their own water audits easily. Besides being very affordable, the tools will link to a platform for tracking water usage, compare industry benchmarks, set goals and monitor effectiveness of water reduction programs

3. A Web/Mobile App for daily water management for communities.

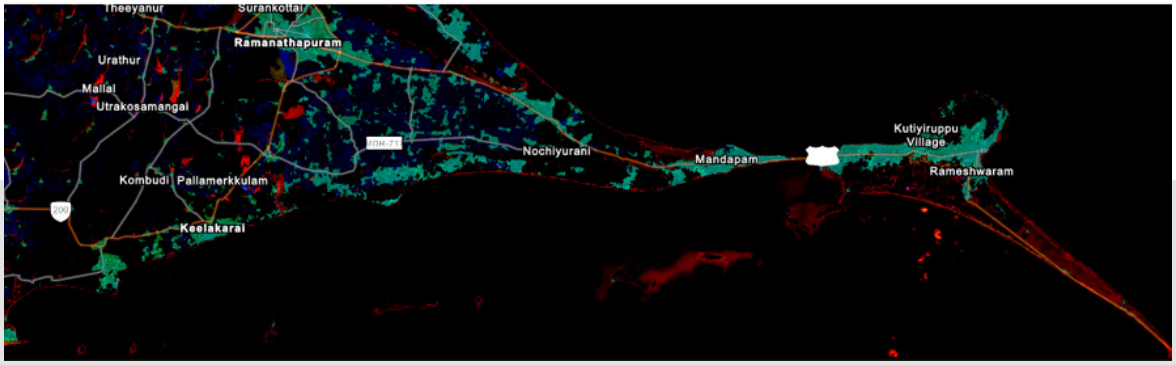
Several districts in India are water stressed. Centralised water supply schemes exist, but the amount of water supplied and its quality is inadequate. Several habitations have seen migration of people simply because there is no water even for domestic purposes.

While there is knowledge of local water sources, treatment technologies, recycling & recharging techniques and water body restoration, there is no coordinated effort to synchronize the technologies to provide last mile comfort to communities.

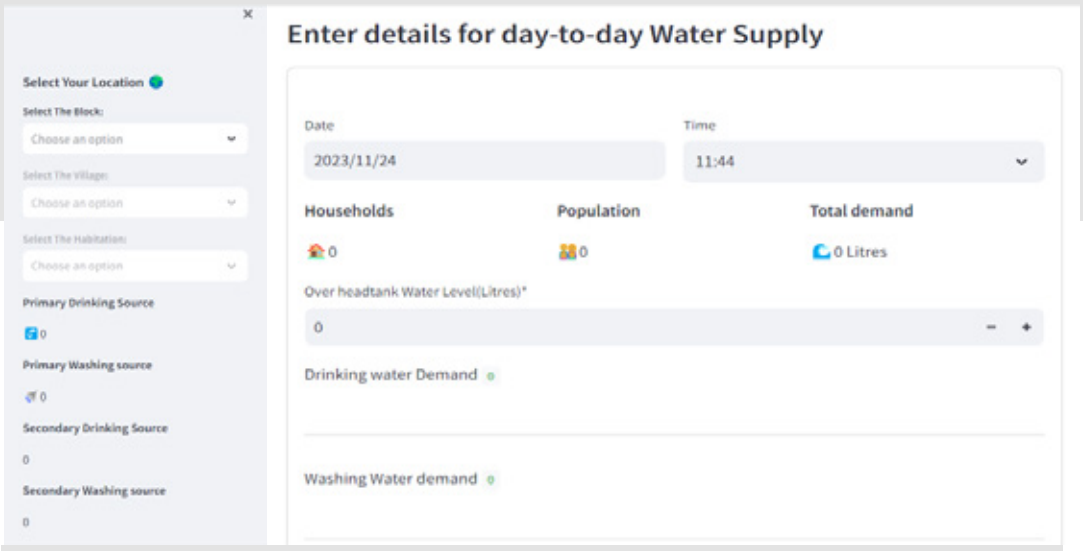
The Web/Mobile App attempts to do just that. It is not unlike a Food Delivery App, except that instead of delivering food to a household, it delivers water to a habitation.

A prototype of the App is ready for testing in Ramanathapuram district where ICCW conducted a detailed water security study at habitation level.

Develop the decision support system to address the day-to-day water supply and demand with GIS mapping.



Develop a web application to suggest Alternate water sources for drinking and washing.



App for daily water management

Team:

Mr Nagarjuna – Project Manager
Dr Wakeel Ahmed Dar – Scientist
Mr P Mareeswaran – Engineer

IMPLEMENTATION

Community Projects

1. Study of domestic water security in ramanathapuram.

At the behest of Collector, Ramanathapuram district (TN), a comprehensive study of the domestic water supply was conducted across all 11 Blocks that contain 429 villages, 2306 habitations.

Ramanathapuram is a coastal district and has been water stressed for decades. Donestic water supply is provided from Cauvery river situated hundreds of kilometres away by the Tamil Nadu Water and Sewerage Board (TWAD).

TWAD was implementing a retrofit of the existing Ramnad Central Water Supply Scheme (RCWSS) and a New Multi Village Scheme (NMVS) that was designed to meet the shortfall of domestic water for the next thirty years.

The objective of the study was to

I. Assess the current ground reality of water delivery and reconcile with the proposed RCWSS and NMVS.

II. Evaluate the readiness of the district authorities to distribute the additional water equitably to households now and in the future.

III. Map the local sources in each village in terms of their suitability for drinking and other domestic purposes, as a backup.

IV. Capture all information on a GIS Map for ease of understanding, communication and actions.

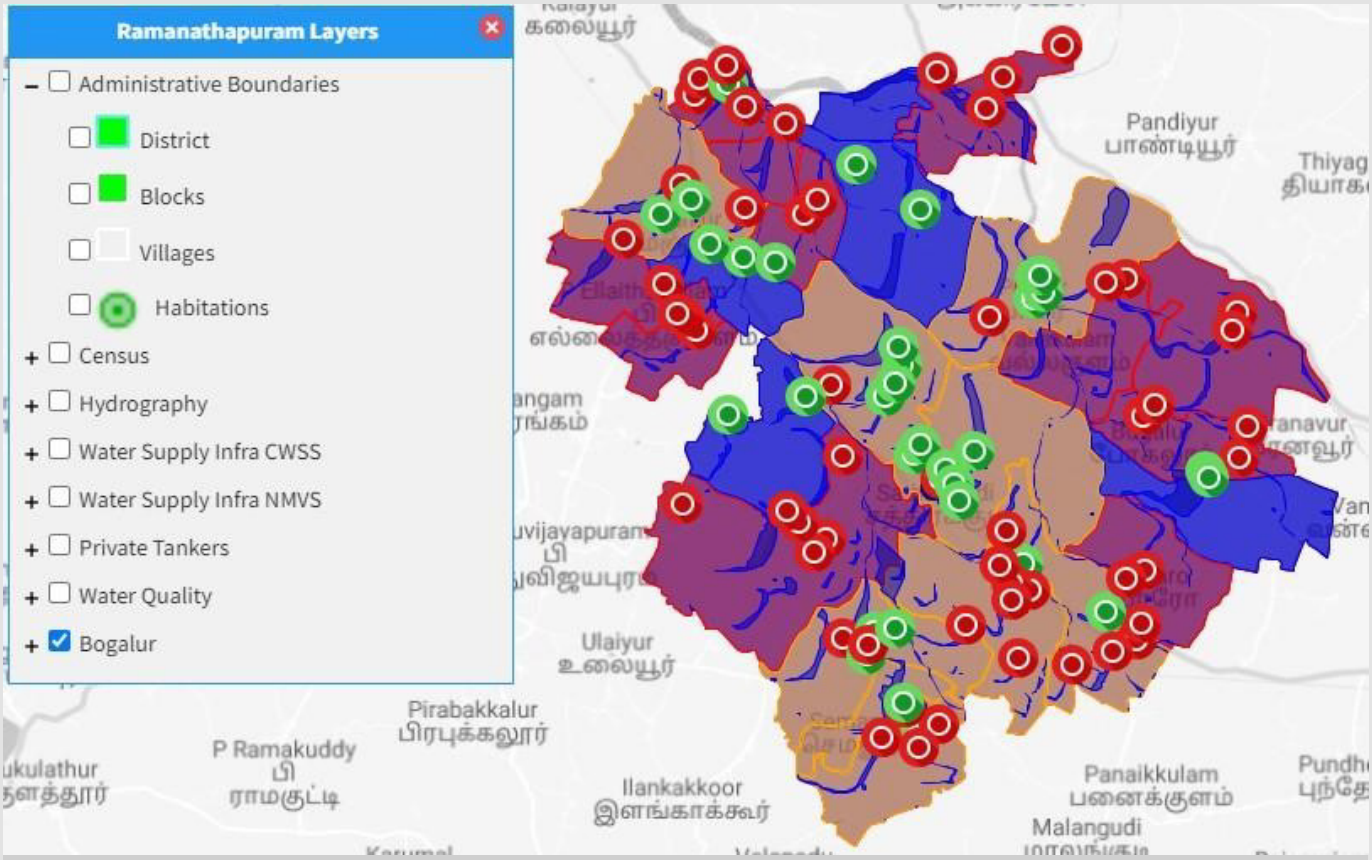
V. Develop a mechanism for grievance handling and measuring customer satisfaction.

The entire study was conducted by involving the people. Outreach programmes were held at each Block, where questionnaires were explained and distributed to the village administrators. The data collected was captured on to a GIS Map.

Because of the diversity of issues within the district, 11 habitations were specially identified and studied as archetypes of different challenges faced. Solutions for these villages would be replicable across similar habitations.

Outreach at Block level to explain data collection.

Survey of one of the 11 locations.



Intervention study with GIS Mapping and projected spatial layers

The data collected provided actionable insights enabling the development of web and mobile apps for managing daily water distribution efficiently and equitably.

The project methodology and outcomes are translatable to any district that is facing water stress.

Project team members:

(Late) Mr. Cowlagi Sripati – Project Director
Dr. Jothilingam – Co-Director
Mr. P Vijayasagar – GIS Expert
Mr. J Saravanan - Hydrogeologist
Mr. R Ilango – Field Co-ordinator
Mr. M Gurudev – Data Manager.
Mr Mahaathithyan – Field Assistant
Mr Murukesan – Field Assistant

2. Sustainable desalination based drinking water kiosks

Reverse Osmosis, the de facto desalination technology, suffers from high reject water, high energy consumption, low pH and TDS of treated water, and soil contamination from used membranes.

Capacitive Deionization (CDI) is an emerging technology that removes ions selectively retaining essential minerals such as calcium and magnesium. The reject water stream is ~20%, with low energy consumption, and there are no membranes to dispose of. The system can run with solar power.

With CSR support from Indian Oil Corporation Southern Regional Pipelines Division, CDI technology was deployed in communities of Madurai, Sivaganga and Kolar districts.

Awareness programs were conducted to educate the people and train them to use the system. Operations & Maintenance support is provided for 3 years.

This initiative positively impacted a population of around 5500, providing access to safe drinking water.

Awareness and Behavior Change programmes

Information, Education & Communication (IEC) activities during commissioning.

Industry Projects

1. Water Reduction Programs

Industrial units in the country are increasingly facing challenges in water management. On the one hand there are stringent norms for discharge, and on the other, industrial units are being asked to buy water and not withdraw from borewells. Water Neutrality is a goal set by NITI Aayog to be achieved by 2030.

ICCW is assisting organisations – factories and buildings - in their quest to be Water Neutral or Water Positive.

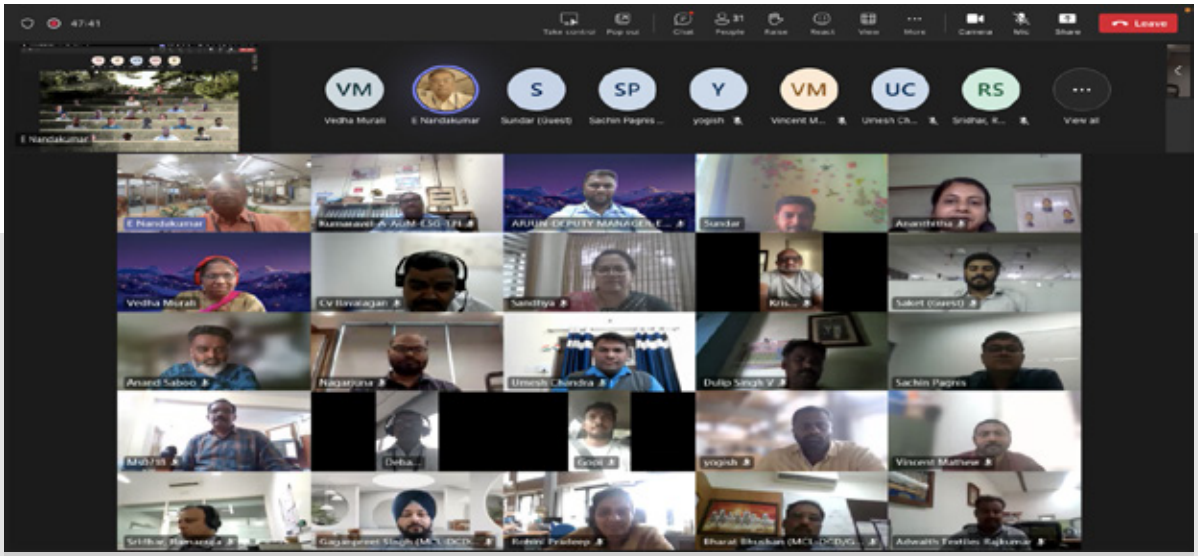
We start with a basic Water Audit and follow it up with interventions that systematically reduce water usage and increase recycling. During the year, we have worked with automobile, hospitality and pharma industry.

In partnership with Confederation of Indian Industries – Southern Region (CII-SR), ICCW has

- Supported Kaizen competitions as a jury member
- Produced a compendium of best practices in water management.
- Conducted an online Certification Program in Water Audit.

In partnership with Buckman, a course on cooling water chemistry was conducted with site visits to St Gobain and Grundfos as benchmark companies.

In partnership with the Indian Chemical Council, a Webinar on industrial water conservation and management was conducted.



Online Certification program for Water Auditing in partnership with CII.

Government Projects

1. TechnoCommercial assessment of TRL6 and above technologies developed in india in Academia, Research Labs, and Industry

For the Department of Scientific and Industrial Research (DSIR), we have taken up a project on technology assessment of drinking water technologies that are TRL-6 and above. The objective of this study is to learn from the technology developers and implementors, the challenges faced in commercialising new technologies.

The study covers both successful and unsuccessful ventures developed by laboratories, institutions and corporations.

Experts in the field were empanelled to provide the framework for Technology Readiness Assessment (TRA), which hitherto did not exist for water technologies. The outcome of this study will guide scientists and developers of future technologies to succeed in faster commercialisation.

We have shortlisted 52 water purification technologies developed by Indian scientists, tackling a variety of contaminants. On this transformative journey to advance technology and promote sustainable solutions, we conducted a comprehensive Techno-Commercial Assessment of Indian-developed technologies at TRL6 and above. Guided by the recommendations of the Department of Scientific and Industrial Research (DSIR), we followed a rigorous evaluation process and, to gain first-hand experience, visited CSIR labs in Odisha, New Delhi, and Lucknow (UP).

Our aim was to comprehensively understand water purification technologies in India. Our exploration extended beyond success stories. We delved into narratives of attempted innovations that faced hurdles in transitioning from potential breakthroughs to successful commercialization. Open discussions unveiled the bottlenecks and reasons behind these failures, providing valuable insights into the dynamic landscape of technological evolution.

Water technology developed by institutions we visited:

1. CSIR IMMT, Odisha

- Domestic Defluoridation Filter Unit
- Turbid & Iron Filter DomesticTerafil
- Development of Biobased Lowcost Material

2. CSIR NPL, New Delhi

- Process for preparing zinc peroxide nanoparticles,
- A process for improving water quality contaminated by pesticides
- An Antimicrobial agent and process for the preparation thereof

3. CSIR IITR, Lucknow

- Disinfection of drinking water

This journey is more than just about technology. It's a story of human creativity, determination, and a strong desire to solve the worldwide problem of clean water. As we explore both successes and challenges, we're not just evaluating technologies; we're discovering stories that connect with our shared dream of a better, sustainable future.

Water technology developers at CSIR IMMT, Bhubneshwar, Odisha

Implementers of Turbid & Iron Filter DomesticTerafil technology, CSIR IMMT

Manufacturing team of domestic filters at Central Institute of Petrochemicals Engineering & Technology (CIPET), Bhubaneswar, Odisha who have developed

OUTREACH

Expert interactions

Water talks: Informal discussions convene a diverse array of stakeholders, including water professionals, students, academics, industrialists, government officials, and ordinary citizens, on a shared platform. Through these gatherings, experienced professionals engage in dialogue, sharing their insights and engaging with others. These interactions serve to raise awareness about potential solutions and inspire collaboration among participants, empowering them to address the challenges they encounter.

Since its inception, this initiative has conducted and concluded 27 talks that garnered substantial participation from professionals, researchers, engineers, and students alike, marking a successful engagement within the community.

List of Speakers - 2023

#20 Speaker:	Dr. Vijay Sagar, Managing Director at EGIS Solutions Pvt. Ltd, **Topic: "GIS - An essential tool for water supply planning"**
#21 Speaker:	Mr. J Saravanan, Director at Thrust Geoconsultants Pvt. Ltd, **Topic: "Importance of Hydrogeology in water Management"**
#22 Speaker:	Mr. Gary Wyeth, CEO Wyeth Water Consultants, **Topic: "Non-revenue water reduction in water supply networks"**
#23 Speaker:	Mr. S R Ramanujam, expert on Infrastructure policy & finance, Director at Samatva Infrastructure Advisors, **Topic: "Water Utilities of the future"**
#24 Speaker:	Dr. D Thirumalaivasan, Professor and Director, Institute of Remote Sensing, Anna University, **Topic: "Space based Water Resources Management and Water Quality Assessment"**
#25 Speaker:	Mr. Jayant Bhagwan, Executive Manager of the key strategic area of water use & waste management, South African Water Research, **Topic: "Sanitation Technology Disruption through Creativity & Innovation"**
#26 Speaker:	Dr. Balaji Deviraju, Assistant Professor, Department of Civil Engineering, IIT Kanpur, **Topic: "Measuring water by measuring Earth's size, shape, and gravity field"**
#27 Speaker:	Dr. Rahul Kumar, Center of Excellence Fellow, Indian Institute of Technology, Madras, **Topic: "Wastewater Based Epidemiology"**

World Of Water Action Forum (WoW AF)

WoW AF is an initiative of Alttech Foundation to draw and inspire ordinary citizens to contribute to water conservation. ICCW has joined Alttech along with Global Water Works in Wisconsin, the Indian Plumbing Association, and other leading groups who see the dire need for change in the World of Water.

WoW AF is active in Bengaluru, Hyderabad, Chennai and is gaining traction in other cities too. ICCW conducted four session in 2023.

WOW Action Forum

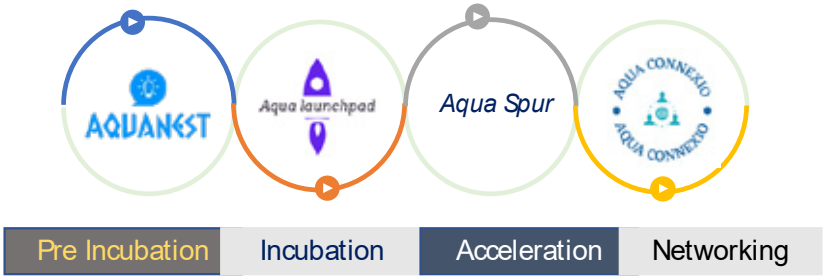
#24 WOW Chennai Speaker:	Mr. C. Sripati, Executive Engineer ICCW, Chennai, **Topic: "Looking Behind, Looking Ahead, Inviting Reflections for 2023 "**
#25 WOW Chennai Speaker:	Dr. G. Sekaran, Chief Scientist CSIR-Central Leather Research Institute, Chennai, **Topic: "Net Zero Water Options for Tanneries, Textiles"**
#26 WOW Chennai Speaker:	Mr G. Balachandar, Serial Entrepreneur, Innovator and Founder & Director, Bookwater **Topic: "IOT for Safe Water"** **Video Link:** https://youtu.be/P15aPGK1Z70 Thanks for being a Mission Director of WOW Chennai and focussed with a target to conserve 1000 Cr litres of water, by creating awareness.
#27 WOW Chennai Speaker:	Mr G. Balachandar, Serial Entrepreneur, Innovator and Founder & Director, Bookwater **Topic: "IOT for Safe Water"**

World Water Week March 17th to 22nd

The World Water Day activities hosted at IITM Research Park aimed to advocate for water conservation, featuring a pledge to save water and an awareness program tailored specifically for the working professionals within the research park. These initiatives sought to highlight the importance of water conservation and empower professionals to take actionable steps towards preserving this invaluable resource.

WATERPRENEUR STUDIO

ICCW is creating a Waterpreneur Studio to create a seamless pipeline from idea to scalable enterprise. The Studio is intended to bring synergy among start-ups for a greater value proposition and a larger social impact.



In March 2023, a Water Hackathon was launched, which was later christened as Aquathon. Among several entries including from school kids, two winners were shortlisted for Aquanest

Aqua launchpad was launched in October. 22 applications were received of which 8 have been shortlisted. The incubatees will be onboarded in early 2024 and taken through a bootcamp.

Akamai Incubation Cohort - 1

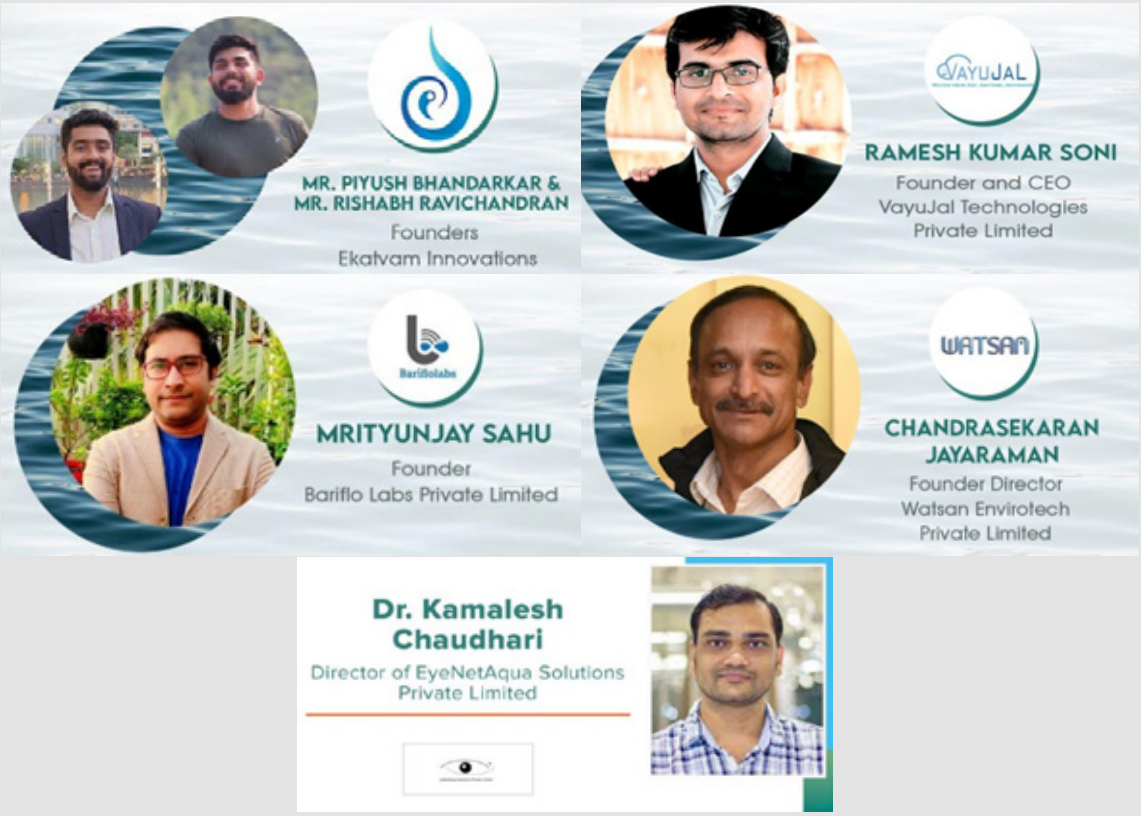
The Water Incubation Program represents a flagship initiative and corporate social responsibility project of Akamai Technologies India, supported by ICCW, an IIT Madras Initiative, and knowledge expertise from Sattva Consulting. The call for applications opened from Oct 1st to 31st. 7 startups has been shortlisted for the final screening

The ICCW's first acceleration program was initiated with the support of Akamai CSR trust, India in 2020. So far, 7 startups have graduated through 3 acceleration cohorts.

Akamai Acceleration Cohort - 4

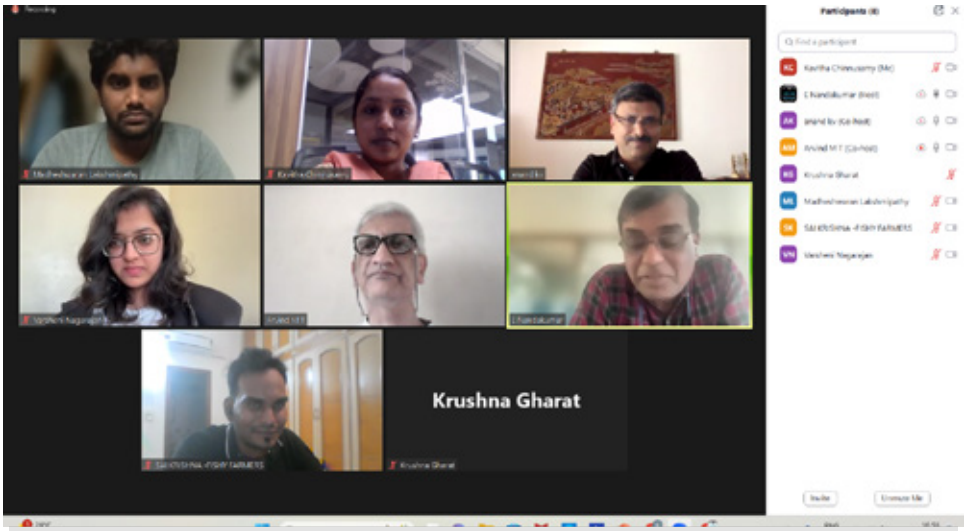
The Akamai Acceleration Program Cohort 4 was launched in January 2023. Five startups have been awarded a grant of 1.6 Cr. The boot camp was conducted by Mr. K V Anand, Trimtab Consulting LLP to refine their business models and validate their assumptions.Now, the cohort is undergoing mentoring sessions to build a sustainable business model and social impact.

Accelerator Program



Cohort-5 of Accelerator was also launched this year with three teams

1. Fishy Farmers – innovative bead filter for aquaculture water reclamation
2. Amvyraad – Robotic hyacinth removal from waterbodies
3. Agromorph – algae-based sewage and effluent treatment systems for a circular economy



Bootcamp of Cohort-5 held in virtual mode.

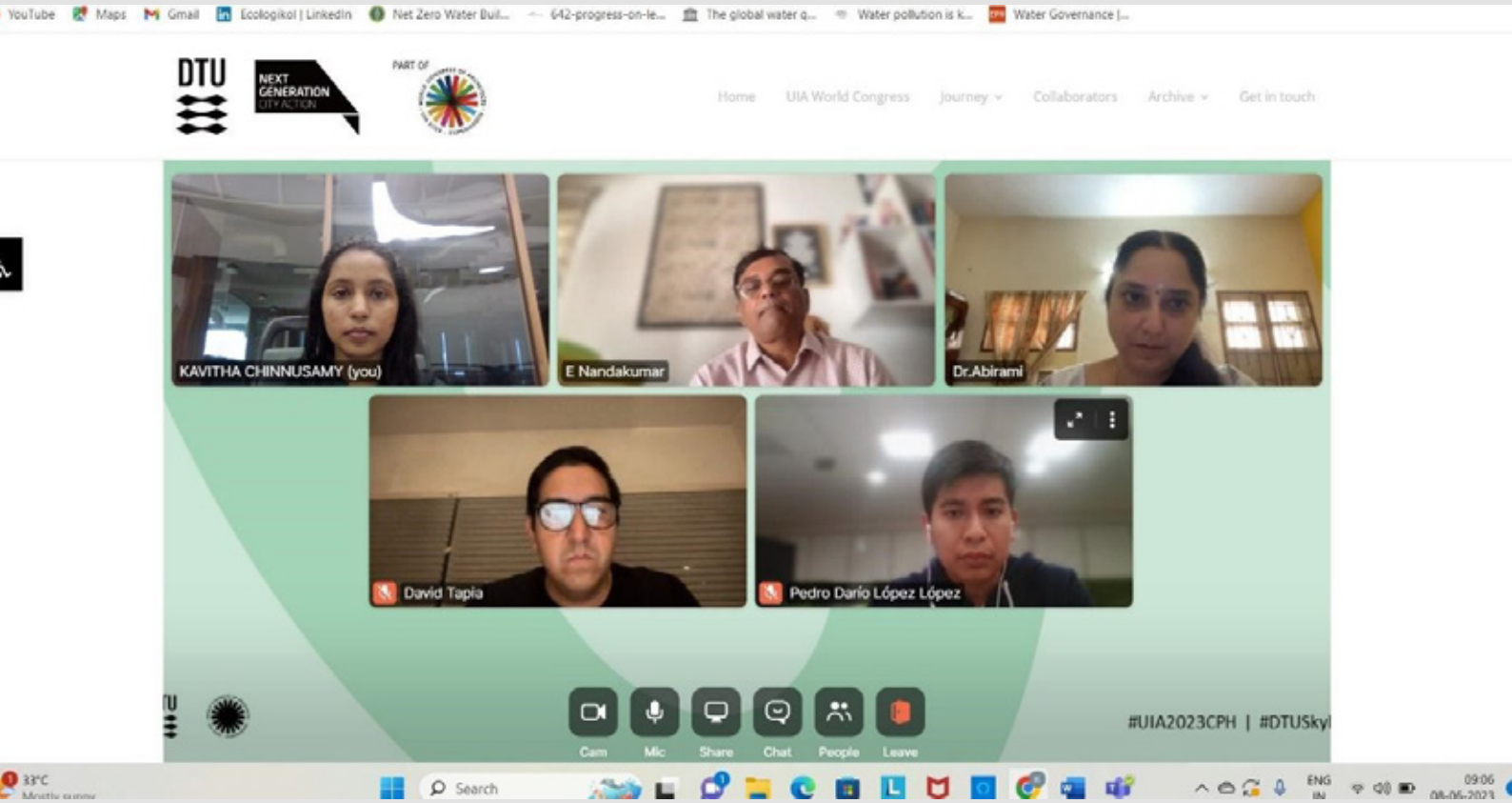
To continue engagement with the accelerated startups, **Aqua Connexio** was launched in June 2023. Through this program, startups and MSMEs in the water sector can continue to engage with ICCW for networking, financial support, R&D support, mentoring, market connects, manufacturing connects and contribute to creating a sustainable planet.

Three startups have joined our Aqua Connexio programme

1. Agromorph
2. Earth Fokus
3. Bariflo labs

Other entrepreneurship initiatives by ICCW:

Next Generation City Action: ICCW team mentored the shortlisted startups in the Next Generation action of the Atal Innovation Mission – Innovation Centre Denmark (AIM-ICDK) Challenge.



ICCW was the Challenge Owner and E. Nandakumar (CEO) was the one of the jury panelist for the Next Generation City Action, where he evaluated the ideas of 13 teams consisting of individuals from diverse backgrounds. These teams were dedicated to addressing sustainability challenges related to water.

120 students and early-stage entrepreneurs embarked on the last leg of their hashtag#NextGenerationCityAction journey at DTU Skylab. Seventeen participants from India, including mentor, Mr. Nandakumar E. touched down in Copenhagen to participate in the UIA World Congress of Architects CPH 2023.

E. Nandakumar (CEO) as a panel member in the discussion on 'Robotics & Digitization for Asset Management,' held as part of the event Digitizing & Managing Sewer Infrastructure.

ICCW's journey to Bariflo Labs Private Limited in Puri, Bhubaneswar, was truly enlightening! We dove deep into the intricate challenges of temple pond management and engaged with the dedicated team. Our profound insights revealed the remarkable transformations following Bariflo's unit deployment. The impact extends far beyond the temple ponds, touching the spiritual and environmental ecosystems in profound ways.

The ICCW team, along with the incubated startups, participated in the SRW India Water Expo 2023, which saw some innovative displays of domestic and industrial water solutions, paving the way for transformation in the water industry.

PARTNERSHIPS

S.No	Organisation	Nature of Partnership
1	Impactree	Online Dashboard for Social Impact Tracking
2	K Pack	Research Collaboration for enhanced water treatment and real time monitorig
3	Xylem Water Solutions, India	Setting up of an Ozonation Lab for developing customised treatment solutions to industry
4	Akamai CSR Trust	Cohorts 4 & 5 of the Startup Accelerator and Water Incubator
5	ITC Social business	Quality and flow monitoring of drinking water supply to villages
6	CWDRM	Collaborative Research in Water technologies
7	Xylem Latin America	Arsenic remediation for drinking water in Chile
8	Feng Shia Institure Taiwan	Implementation of sustainable green factories for WASH products for BPL school children
9	Virgina Tech Institute	Collaborative Research in Water technologies
10	Uchappati Village Panchayat	Implementaiton of sustainable drinking water kiosk
11	Karisalpatti Village Panchayat	Implementaiton of sustainable drinking water kiosk
12	Social Responsibility Asia	Collaboration in Water Research and Implementation

S.No	Organisation	Nature of Partnership
13	A2Z	Joint projects for Pharmaceutical industires
14	Cleanedge	Salt removal from paper industry effluents to reduce discharge
15	Ecoaeon, Israel	Advanced water management technologies for agriculture
16	Indus Water Institute	Extention of collaboration for capacity building and implementation of treatment technologies
17	Plaksha Institute	Collaborative Research in Water Tecjhnologies
18	State Bank of India Startup Branch	Financial support for startups
19	Agromorph Technologies	Aqua Connexio Networking program for startups
20	Earthfokus	Aqua Connexio Networking program for startups
21	Bariflo labs	Aqua Connexio Networking program for startups

FINANCIALS

Income

INR - 2022-2023

Direct Revenue	–	5,92,34,279
Grants Received	–	1,87,09,938
Interest Income	–	2,41,842
Other Income	–	11,87,276
Total	–	**7,93,73,335**

INR - 2021-2022

Direct Revenue	–	20,61,74,995
Grants Received	–	97,55,768
Interest Income	–	4,60,556
Other Income	–	3,503
Total	–	**21,63,87,816**

INR - 2020-2021

Direct Revenue	–	12,97,11,927
Grants Received	–	1,64,53,893
Interest Income	–	13,84,720
Other Income	–	4,55,387
Total	–	**14,80,05,927**

INR - 2019-2020

Direct Revenue	–	1,02,88,428
Grants Received	–	-
Interest Income	–	239
Other Income	–	30,48,582
Total	–	**1,33,37,249**

Expenditure

INR - 2022-2023

Direct Expenditure	–	4,13,36,693
Employee Costs	–	1,34,23,161
Operating Expenses	–	4,80,182
Administrative Expenses	–	2,70,52,985
Total	–	**8,22,93,021**

INR - 2021-2022

Direct Expenditure	–	18,50,07,952
Employee Costs	–	1,32,87,807
Operating Expenses	–	7,37,756
Administrative Expenses	–	1,98,03,419
Total	–	**21,88,36,934**

INR - 2020-2021

Direct Expenditure	–	13,51,31,064
Employee Costs	–	1,30,64,113
Operating Expenses	–	5,38,479
Administrative Expenses	–	2,11,11,097
Work-in-progress	–	6,68,296
Total	–	**16,91,76,458**

INR - 2019-2020

Direct Expenditure	–	31,25,400
Employee Costs	–	85,63,609
Operating Expenses	–	4,45,283
Administrative Expenses	–	2,21,06,213
Total	–	**3,42,40,505**

ACKNOWLEDGEMENTS

Visitors to the Centre

Date: 09-01-2023
Visitor: Prof. Anik Bhaduri, Associate Professor Griffith University in Australia.

Date: 18-01-2023
Visitor: Mr. Ramkumar (IITM) and Mrs. Ramkumar

Date: 24-01-2023
Visitor: Professor Rajeev Thottappillil and colleagues from KTH Royal Institute of technology Sweden

Date: 30-01-2023
Visitor: UMI Universal Materials Incubator Co.,Ltd., Japan visit to ICCW

Date: 13-02-2023
Visitor: Mr. K. V. Anand & Mr. M. T. Arvind (Faculty-Trimtab Consultants), Ms. R. Rajashree (Mentor) along with participants of Akamai Cohort-4 Bootcamp

Date: 17-02-2023
Visitor: Virginia Tech Delegation Visit from US
Dr. Cyril Clarke - Executive Vice President and Provost
Dr. Azim Eskandrian and Rebecca Des Champs -Chair/Professor, & Department Head, Mechanical Engineering
Dr. Guru Ghosh - Vice President for Outreach and International Affairs
Dr.Dan Sui - Senior Vice-President, Chief Research and Innovation officer
Dr.Aimee Suprenant - Dean, Virginia Tech Graduation School
Dr. Vishwanath Venkatesh - Eminent Scholar and Verizon Chair of Business Information Technology, Director-Executive PhD in Business
Dr. M.K Padmanabhan - Director VT India
Ms. Rangapriya Goutham - Dy. Director
Mr.Sreekanth Nambiar - Manager (Ops & Mkt
Dr. Gayathri - Program Manager

Date: 21-02-2023
Visitor: Dr. Liu Lili, Technology Manager Buckman Singapore

Date: 21-02-2023
Visitor: SSN Incubation Foundation

Date: 23-02-2023
Visitor: Mr. Rajesh Jain, Digital Paani

Date: 08-03-2023
Visitor: Mr. Vinod Aachi Cleanedge Water, Singapore

Date: 20-03-2023
Visitor: Team MKS Global
Palanivel Subramaniyan, Chief Operating Office
Andrew Krause – Chief Technology Officer
Dinesh Manoharan - AVP

Date: 20-03-2023
Visitor: Dr. D. Rautaray and Mr. M. K. Bhaduri – DCM Shriram

Date: 20-03-2023
Visitor: H. E. Freddy Svane Ambassador
Remarks: Royal Danish Embassy and team

Date: 05-04-2023
Visitor: Dr. B. K. Sethuram and Mr. M. Subramaniam (IIT M 1984)

Date: 06-04-2023
Visitor: Dr. M. Kumaraguru (IIT M 1984)

Date: 09-05-2023
Visitor: Mr. V.Mukundan - Buckman and
Mr. T Arunkumar MRF Limited Visit

Date: 10-05-2023
Visitor: Mr. Satish Visit From MURATA Electronics

Date: 20-05-2023
Visitor: Mr. Amol Sawhey & Ms. Mona Singh – India Accelerator
Mr. Mohandas Menon – Greenfern
Mr. Pradeep Jain

Date: 24-07-2023
Visitor: Mr. Muthu Singaram (CEO-HTIC),
Dr. Myoor Padhmanabanan (VTI)

Date: 31-07-2023
Visitor: Amvyraad team

Date: 04-08-2023
Visitor: Mr. B.K. Venkatesh, Mr. Michael Jenno
ICICI

Date: 11-08-2023
Visitor: Mr. Narain Madhavan & Dr. Simon Duke from Xylem

Date: 26-09-2023
Visitor: Dr. Pawan Labhasetwar form NEERI

Date: 10-10-2023
Visitor: Agromorph team

Date: 10-10-2023
Visitor: Dr. Akanksha Agarwal, Mr. Abilish Agarwal, Agromorph

Date: 10-10-2023
Visitor: Ms. Nirmala, Ms. Madhuri, Ms. Khushbu from Paani.earth

Date: 18-10-2023
Visitor: Dr. Ajit Paranje (IITM 1984) and his father. Capt. Balakrishnan and Ms. Vibha Jain

Date: 31-10-2023
Visitor: Mr. V. Venugopal, Dr. K. Gayathri (ITC - PCPB)

Date: 13-11-2023
Visitor: Prof. Bryan Brooks (Baylor University, USA, Editor in Chief: ES&T Letters)
Dr. Maggie Mills (Managing Editor, ACS Publications)
Dr. Ashesh Mahto
Development Editor, ACS Publications, ACS International India
Dr. Ajay Jha

Date: 18-11-2023
Visitor: Dr. Sriram (IITM-84)

Date: 22-11-2023
Visitor: Mr. Reju Cherian, Mr. Arunkumar, from MRF, Mr. Mukundan Buckman

Date: 08-12-2023
Visitor: Mr. Yu-Yen Huang From EVER-CLEAR ENVIRONMENTAL ENG.CORP

Date: 12-12-2023
Visitor: **Team from Yokohama National University**
Prof. Yoshitake Hideaki
Prof. Matsuda Hiroyuki
Rerd. Prof. Tochigi Katsumi
Prof. Takaba Hiromitsu
Prof. Tsuji Tomoy
Ms. Mori Mariko
Associate Professor Nakamura Kazuho

Homage to a Green Warrior – A Tribute to C. Sripati

Mr Cowlagi Sripati was a Chemical Engineer from Manipal Institute of Technology. He started his career in 1996 as a Service Engineer with Chemical Specialities India P Ltd, where he worked on water chemistry and corrosion resistance of boilers.

He then proceeded to do an M.TECH in Energy Engineering from NIT Trichy, 1998-2000, and joined as a Technical Lead with Osten Enzyme India Private Limited. After two years of selling fuel oil additives, for boilers, furnaces and DG sets to improve their combustion efficiency, he entered the water business as an entrepreneur.

In 2002, he started a company, along with his mother, called Hari Guru Kripa Aqua Systems P. Ltd. He learnt the ropes of RO treatment, testing, analysis, bottling and sales. Also what BIS certification was all about, the nuances of retail and wholesale trade of bottled water. It was here that he came face-to-face with management of labour, finances, licensing and regulations.

Starting an enterprise in the early 2000's in drinking water, at a time when buying water was a novel phenomenon in India, required tremendous courage and commitment. In what must have been very challenging circumstances, he hung on to his enterprise for five and a half years, which speaks volumes for his commitment and courage as well as his devotion to his mother. It was also a testing time for his family as he got married and had to raise a child.

In 2008, in what must have been a painful act, he discontinued the business and joined as Senior Counsellor at the CII Godrej Green Business Centre, Hyderabad . He excelled in this role and worked to establish the water management services at CII through the Centres of Excellence and CII Triveni Water Institute,

He developed businesses for industrial water audits and project management with multilateral funding agencies. He enjoyed event management and conducting skill development programs for operators, technicians and helpers. He identified wastewater treatment in CETPs as a neglected area and focused on the skill development of CETP employees.

The itch to get "hands on" with water management got the better of him in 2016 and he left CII to join GIZ Gmbh as Technical Advisor. He worked to reduce water pollution in river Yamuna through effective stakeholder participation. He honed his skills in managing stakeholders in Delhi particularly the Government Central and State, MSME units in the 6 industrial areas of Delhi, Delhi State Industrial infrastructure development corporation (DSIIDC).

In 2019, as ICCW was getting formed, we were fortunate that Sripati was looking to move to Chennai as his son was growing up and he wanted to return to his hometown to be with his in-laws. On the very day he joined, he got involved in a water audit for an automotive company in Chennai and never looked back in his contribution to making India water secure.

As an Expert Engineer, he leveraged his vast experience and network to implement sustainable drinking water technologies, conducting capacity building programs for government officials, industry professionals, school and college students and general public too. He wasted no time in connecting with district administrations to conduct water security studies, initiate intervention programs by integrating technical solutions.

When the pandemic struck, he was quick to leverage the virtual medium and conducted webinars, arranged WaterTalks, anchored citizens Action Forums and was always in the forefront of activities that involved people and water management.

Sripati was the epitome of sincerity and compassion, ever ready to mentor youngsters. One who rarely lost his cool but was always straightforward, even blunt, to make a point. ICCW is richer by his contribution and the legacy he leaves behind. The young employees miss his wisdom and his comforting presence. Teaching was his passion. The last event he executed for ICCW was on World Water Day (22-March-2023)

On the personal side, he was deeply spiritual, an excellent listener, one rooted in family values and traditions. An ardent lover of music, especially Carnatic music, skilled in the Mridangam player. He is survived by his wife Sudha and son Krishna who is completing his B.Tech in SRM Institute, Chennai.

Interns

Jainam Shah

Project
Assessing the market potential for a new textile effluent treatment system

P. Vasanth

Project
Developing a sustainability value proposition for atmospheric water generators

Sudharshan Shekle

Project
Developing a framework for advisory services on water availability for farmers and corporates

Viraj Sharma

Project
Developing a digital tool to help industries achieve Water Neutrality

Shivang Chauhan

Project
Development of GIS enabled dashboards for village to support decision making in water management

Gopika Shree

Project
Data cleaning and developing user interfaces for applicatoins

Welcome Aboard

Ms Girija Ramesh
Outreach Manager

Ms Kavitha Chinuswamy
Incubation Manager

Dr. Antony Lopis
Scientist

Ms J Chithra
Senior Analyst

Ms Rose Mary
Analyst

Ms I Priyadarshini
Analyst

Mr Mukesh Sharma
Analyst

Dr. Wakeel A. Dar
Scientist

Mr Ranjit Kumar
Data Analyst

Mr Gurudev Asura
Data Analyst

Mr Arohan Paul
Senior Data Analyst

Alumni

We bid adieu to several alumni of ICCW this year who played a significant role in the objectives achieved so far. They have moved on to various other employment prospects and a shout out to all those who contributed to the success of our organization. Our best wishes.

Dr Ganapati Natarajan
Prinicpal Scientist

Ms ShivaPriya
Analyst

Dr Rabiul Islam
Scientist

Ms Gowri Manohar
Analyst

Dr Gowri Mohandass
Scientist

Ms Pooja Shenvi
Outreach Manager

Ms Bhuvana
Analyst

Ms Uroosha
Analyst

Thank You From

1. E. Nandakumar – CEO
2. Dr Kamalesh Chaudhari – Principal Scientist
3. Dr D Abirami – Principal Scientist
4. Mr Arohan Paul – Senior Data Analyst
5. Mr Nagarjuna – Project Manager
6. Ms Girija Ramesh – Outreach Manager
7. Ms Kavitha Chinuswamy – Incubation manager
8. Dr Vidhya Subramaniam – Scientist
9. Dr Antony Lopis – Scientist
10. Ms J Chithra – Senior Analyst
11. Ms Priyadharshini – Analyst
12. Ms Rose Mary – Analyst
13. Mr A Sathish – Analyst
14. Mr Mukesh Sharma – Analyst
15. Mr M Gurudev – Data Analyst
16. Mr Ranjit Kumar – Data Analyst
17. Mr P Mareeswaran – Engineer
18. Mr T Siva – Engineer
19. Ms Bharini – Administrator
20. Dr Wakeel Ahmed Dar – Scientist
21. Technical Consultant_ Dr TNVV Rao
22. Financial Consultant – SPR & Co
23. Human Resource Consultant – Maximus Business Services