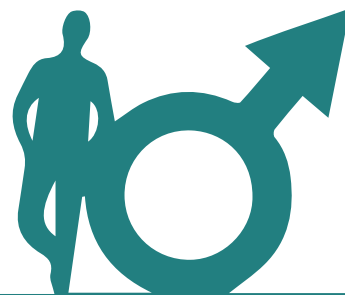


ANNUAL REPORT 2021



An initiative of IIT Madras



Contact Details



+91 44 4212 5680
+91 44 4305 1312



info@iccwindia.org



www.iccw.world

INTERNATIONAL CENTRE FOR CLEAN WATER



PREFACE

The year 2021 will go down in history as the year humans faced the harsh reality that if we do not behave in a manner befitting the most evolved species on the planet, Nature will take us to task. The coronavirus and its mutations have wreaked havoc on humans and humans alone.

Climate change and inequality are the two main fallouts of the style of development pursued so far. Clearly a change of course is needed with the realization that none of us can succeed unless all of us succeed. And the “all” is not restricted to only human beings, but every part of creation on our planet.

The ancient civilizations settled around rivers and our ancestors, even a few centuries ago, had developed elaborate systems – eris, step wells, talabs etc to capture rainwater and preserve it for future use. But the nature of human development has put paid to these systems and today we face floods during the monsoons and droughts after.

The UN World Water Development Report 2020 ‘Water and Climate Change’ states that 2.2 billion people currently do not have access to safely managed drinking water, and 4.2 billion, or 55% of the world’s population, are without safely managed sanitation. Increased urbanization is putting further stress on ageing water distribution systems and water resources. Impermeable roads and footpaths, lack of vegetation has forced rainwater – the only water source – run off to lakes, rivers, or the sea, which are themselves getting more and more polluted. The result is that while the amount of water on this planet has remained constant through millennia, it is becoming less and less available at its place of use.

The Jal Shakti Ministry of India, through its Jal Jeevan Mission programme is rapidly working to provide functional household tap connections (FHTCs) for easy water access to every household. Additionally, they have proposed a challenge for real time monitoring of water quantity and quality supplied through these taps. Several startups have strongly responded to this challenge including EyeNetAqua – incubated at ICCW this year. Pilot implementation and testing of these solutions is well underway in about 100 villages across India and real time data is available at a click on the JJM website.

However, the bigger challenge in the coming years is to ensure adequate quantity of appropriate quality water flowing through these taps. For this, rainwater harvesting and recharging need to be done on a scientific basis to enhance the availability and quality of groundwater. Surface water bodies – ponds, lakes and rivers need to be nurtured by appropriate restoration methods and prevention of recontamination by polluted water.

Water is naturally renewable and despite our callous attitude, Mother Nature does a wonderful job of recycling it through evapotranspiration and rain. It becomes our bounden duty to collectively work towards returning the water we use, back to nature, in the same or better condition than that we received.



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FOREWORD

Greetings! May I Wish You a Healthy, Peaceful, Productive and Rewarding New Year 2022!



Prof. T. Pradeep

ICCW has made steady progress on all its verticals in its third year of existence. The pandemic notwithstanding, the Implementation team has completed over 100 community drinking water projects from Gurudaspur in North Punjab to Tuticorin in South Tamil Nadu through IITM incubated companies, and the Research team has developed low-cost sensors and incubated a startup – EyeNetAqua Solutions, one of five startups shortlisted by MeitY-JJM for implementing IOT-based real-time water quality and flow monitoring.

Hydroinformatics is a discipline that has the potential to transform water management through creation of Digital Twins and visualisation that can build consensus among stakeholders on what problems are to be focused on. Digital Twins are also useful to simulate solutions before investing in pilot trials. Water+data can generate tremendous value to the society and provide lucrative career options to the youth. ICCW has made a foray into this space by engaging college students and interns for data collection and analytics.

The grave situation faced globally on water availability and quality calls for disruptive technologies. It is heartening to see that corporates and governments are encouraging startup ideas in water and supporting them through mentoring and financial support. We have been privileged to be part of Accelerator programmes and Global Water Challenges that have given us a “ring side view” of the startups and their synergetic potential to make social impact.

ICCW has sustained its efforts to create awareness among public through monthly WaterTalks and IEC activities in communities. The hallmark has been the launch of a music video entitled Rivers of India that crossed 2 lakh views in the first few months and a video entitled Drops of life recognising the stalwarts who pioneered rainwater harvesting in Chennai.

We are grateful for the support received from everyone - governments, international and national corporates, IITM alumni and individuals. ICCW is established as a place where anyone can come with an idea or a problem and go back with a product or a solution. It needs your continued participation to deliver on its mission.

I hope that you will enjoy browsing through our activities. Do visit us at [iccw.world](https://www.iccw.world) and give us your critical comments, suggestions and participate in every possible form. I look forward to your continued support.

T Pradeep
Professor in Charge (ICCW)

HIGHLIGHTS



Technology Development

- Low-cost fluoride sensor developed for online monitoring.
- Real-time monitoring with IOT connectivity developed and implemented
- Digitalization of Field Test Kit with smartphone link to the cloud

Scaling up Startups

- InnoDI Technologies - 24 units of Capacitive Desalination (CDI) implemented with support from IOCL, NSEF
- Hydromaterials - 90 units of Arsenic and Iron Removal Plants implemented for Government of Punjab
- Vayujal – 9 units of Air-Water Generators installed from 35 LPD to 2000 LPD
- Solinas Integrity -Robotic inspection of sewer lines at Mahindra World City

Community Engagement

- IEC and behaviour change activity in villages of Tuticorin and Chittoor for adoption of new technology
- Adoption of villages in Erode and Chittoor districts for comprehensive water management

Partnerships

- Grundfos supports Solar powered Membrane Distillation
- Xylem Inc joins as Gold Member. Kicks off Air Water Generator trials
- Naandi Foundation expands partnership to include cover O&M and Quality of Kiosks
- Andhra Pradesh Education & Welfare Infrastructure Development Corporation collaborates for safe drinking water to all government schools
- Saraya Japan joins hands for arsenic remediation in Asia and Africa
- Stella Maris College signs up for student involvement and certificate courses
- Alt Tech Foundation and Global Water Works engage to bring global technologies to the grassroots

Ecosystem Creation

- Akamai Technologies continues to support social impact startups through their 2nd and 3rd cohorts.
- Music video Rivers of India involving celebrity singers released on Earth Day
- Drops of Life, a documentary on Chennai's rainwater harvesting released on Independence Day
- Five WaterTalks engaging with practicing experts
- Revamped website for easy access to all resources

GOVERNING BOARD



Bhaskar Ramamurthi

Chairman ICCW

Professor Bhaskar Ramamurthi is the Ex-Director, Indian Institute of Technology Madras, Chennai, India, since 2011.



T Pradeep

Professor-Incharge

Professor T Pradeep is an Institute Professor at the Indian Institute of Technology Madras, Chennai, India.



Ashok Jhunjunwala

Member

Professor Ashok Jhunjunwala is an Institute Professor at the Indian Institute of Technology Madras, Chennai, India.



Ligy Philip

Member

Professor Ligy Philip is a Professor at the Environmental and Water Resources Division, Dept of Civil Engineering, at Indian Institute of Technology Madras.



Ravindra Gettu

Member

Professor Ravindra Gettu is the Dean for Industrial Consultancy and Sponsored Research, and V.S. Raju Chair Professor, Department of Civil Engineering, Indian Institute of Technology Madras.



Tiju Thomas

Member

Dr. Tiju Thomas is an Assistant Professor, Head of "Applied Nanostructure Engineering and Nanochemistry" lab at the Department of Metallurgical and Materials Engineering, at Indian Institute of Technology Madras.



Rajnish Kumar

Member

Dr Rajnish Kumar is an Associate Professor at the Department of Chemical Engineering, IITM.

OUR PEOPLE



E Nandakumar
CEO



Cowlagi Sripati
Expert Engineer



Kamalesh Chaudhari
Principal Scientist



Ganapati Natarajan
Principal Scientist



Dr Abirami Devdas
Senior Scientist



**Nagarjuna
Tirumalasetty**
Assistant Project Manager



Vidhya Subramanian
Scientist



Dr Ashesh Mahto
Scientist



Rekha Ganesh
Office Administrator



Priya
Coordinator (IITM)



Vishnu V
Analyst



P.Mareeswaran
Lab Technician



Mr G Ramaswamy
Data Analyst



Mr Rajesh Kumar
Junior Scientist



Khadambari Bhaskaran
Junior Scientist



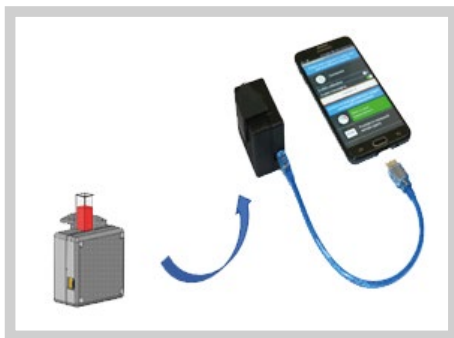
Mr Satish Kumar
Analyst

RESEARCH & DEVELOPMENT

Strategic Intent

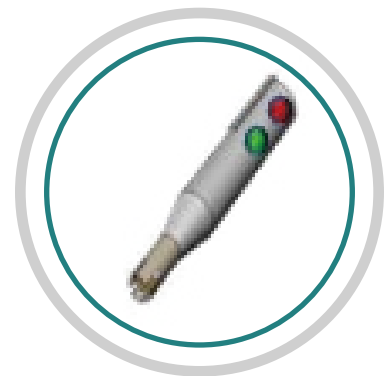
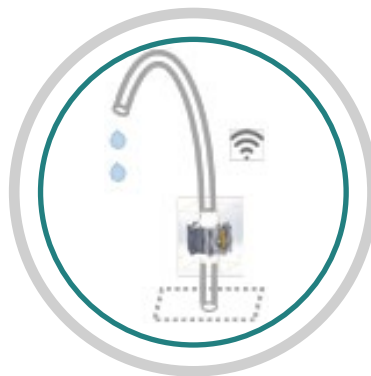
- Development of low-cost, sensors with IoT integration for real-time monitoring of water quality
- Development of sustainable treatment technologies that reduce water and carbon footprints
- Study of new age contaminants, wastewater-based epidemiology to warn and support public health, governance and policy making
- Create a Centre of Excellence for Innovation in clean water

Towards Affordable, Rapid and Accurate Quality Measurement



ICCW has developed a device that simplifies the use of Field Test Kits (FTKs). Existing FTKs employ colour charts and require complex set of steps leading to high variation and errors. The new device requires just two steps and gives a digital readout that can be instantly geo-tagged and uploaded onto the cloud through a smartphone app. It is thus possible to quickly collect large volumes of spatio-temporal data for analytics and predictions.

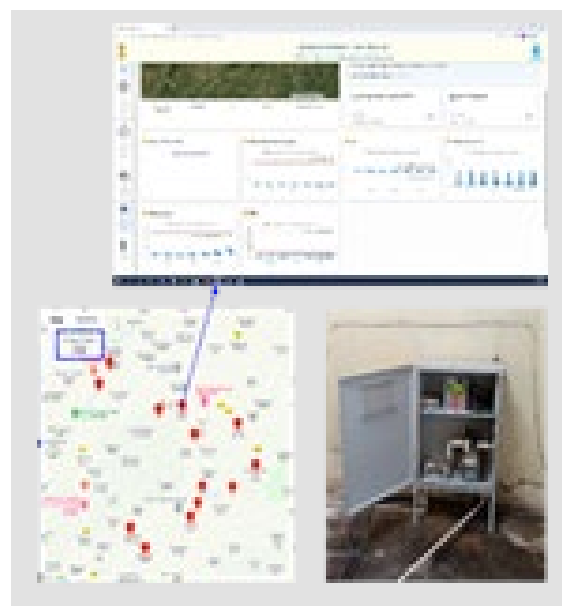
Other devices under development include a portable water test lab, a water pen and a faucet mountable device for any household.



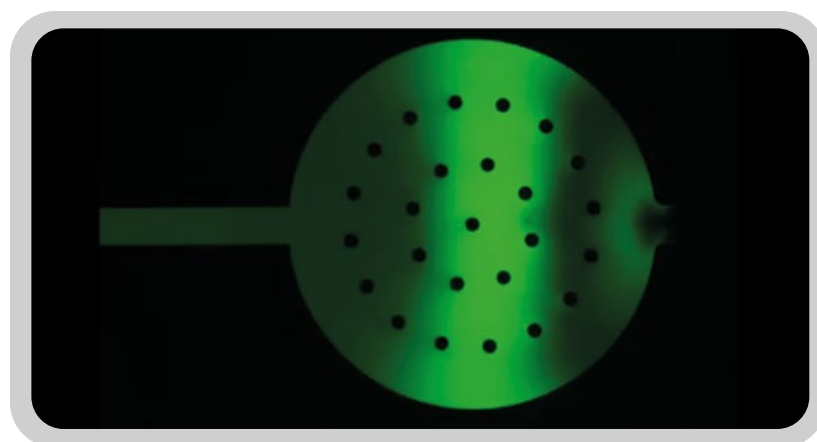
The focus is a rapid and affordable measurement of pH, TDS and free residual chlorine, nitrate, fluoride, arsenic, alkalinity, and hardness.

Real-Time Monitoring Implemented

This product development resulted in the creation of a startup - EyeNetAqua Solutions Pvt, Ltd, who completed the development in partnership with Ilonnati Innovations Pvt. Ltd. Hyderabad. These IoT based inline sensing units have been deployed at 13 villages in Ambala district of Haryana. A continuous water flow and quality data from these units is available at Ejalshakti portal.



Simultaneous Multiparameter Sensing

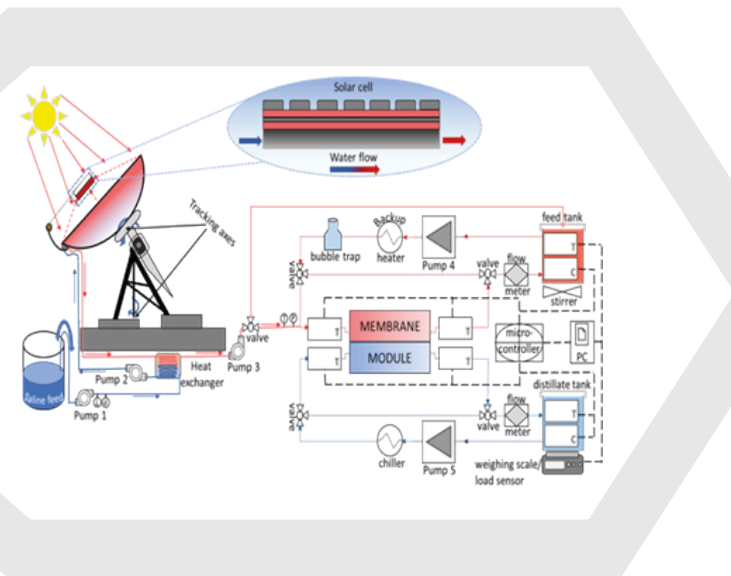


Movement of Ions Through Microchannel

ICCW in partnership with EES (Energy Environment and Sustainability) laboratory of Seoul National university, South Korea is developing microfluidic electrochemical sensors. The objective is to integrate various heavy metal ion sensors into the same device. The principle is to concentrate the metal ions for enhanced sensitivity by several folds. Targeted ions are As^{3+} , Mn^{2+} , Fe^{3+} , Cd^{2+} , Pb^{2+}

The project is funded by the Department of Science and Technology, Government of India (DST) and Ministry of Science and ICT, Republic of Korea (NRF).

Addressing Domestic Water Needs Differently



Acute shortage of potable water and widespread contamination of our natural reservoirs have deepened the global water crisis. Desalination (removing salts from saline water) has the potential to alleviate this situation; however, a sustainable and energy-efficient technology needs to be employed. Currently, RO (reverse osmosis) is the de facto desalination technology albeit with severe limitations such as, high power and maintenance costs and large reject water volumes. Membrane distillation (MD), a thermally driven process, can desalinate seawater, hypersaline brine, as well as industrial wastewater using low-grade heat.

MD is an attractive alternative that is currently developed as a 100 LPD prototype, integrated with solar thermal collectors for domestic applications at ICCW. Thanks to Grundfos India for their collaboration in developing this unique technology.

The next step in this journey is the elimination of the wetting phenomenon in MD membranes by developing self-heating membranes based on the principle of the Joule-heater. These membranes heat up when an electrical potential is applied across them and have the potential to surpass the best MD membranes in terms of water flux, anti-fouling, and anti-wetting properties. Research in this direction is currently under study at ICCW.



Infrastructure Additions

3D Printer

A Flashforge Creator 3D printer has been added to print a wide range of functional materials like PLA, ABS, PC, and WPS with a hot end that goes up to 300°C. A distinguishing feature is the independent dual extruder (IDEX) that can perform mirror printing and duplicate printing.



ANALYSIS & VALIDATION

Strategic Intent

- Leverage measurement technologies to solve problems related to clean water and wastewater management
- Develop new test methods for new-age contaminants and assist in the research of their remediation
- Validate emerging technologies for effectiveness and sustainability and provide support in joint development of new technologies
- Train youth in water quality measurement and help create a more informed population for future water security
- Create a Centre of Excellence for Water Quality

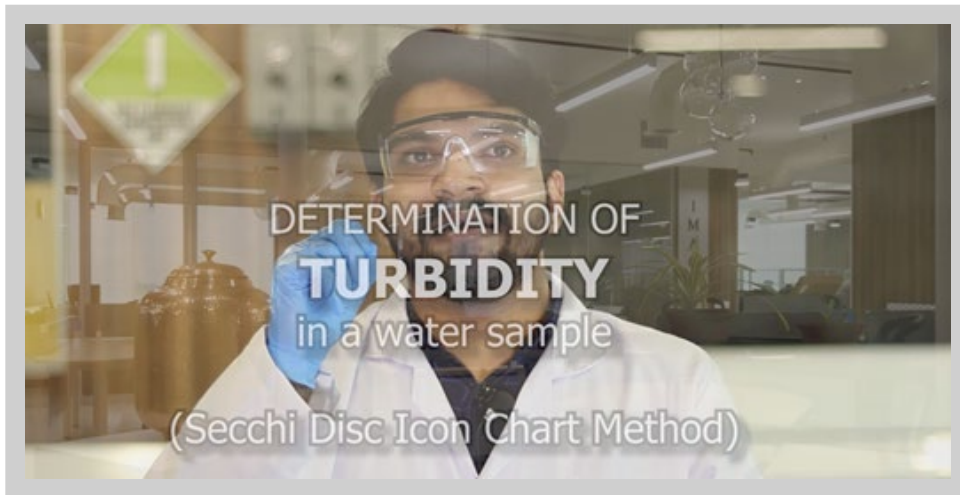
Empowering the Youth

A Certificate programme in water quality measurement was conducted for 37 undergraduate students of Stella Maris College from Chemistry, Physics and Biology streams. The students were given a theoretical overview of sophisticated test equipment at ICCW followed by demonstrations. Each student brought 5-6 water samples from their neighborhood which they analysed using Field Test Kits as well as spectrally using ICCW's FTK Reader.



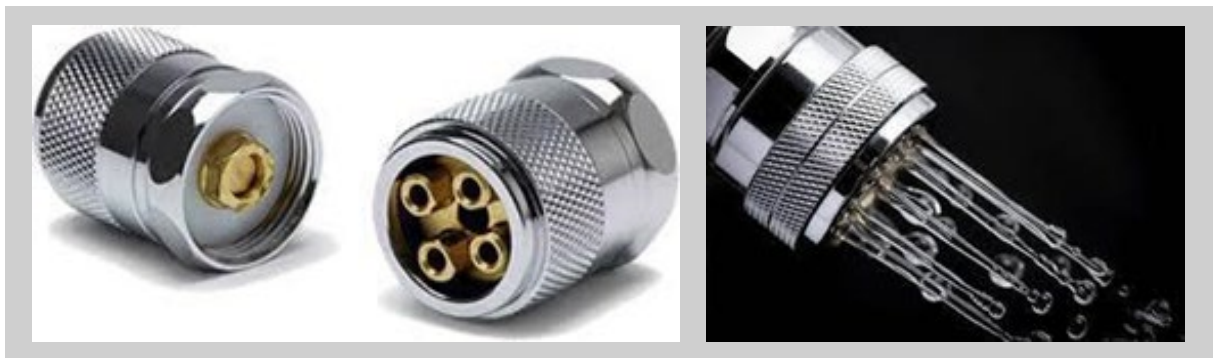
The data collected is being used for the development of a spectroscopic device that can instantly analyse and report multiple parameters and can be mounted onto household faucets

Video-Based Training Support to Govt of Punjab



Field test kit training videos for testing 14 parameters were created for use by Government of Punjab. The videos were made in English and also dubbed in Punjabi for wider dissemination

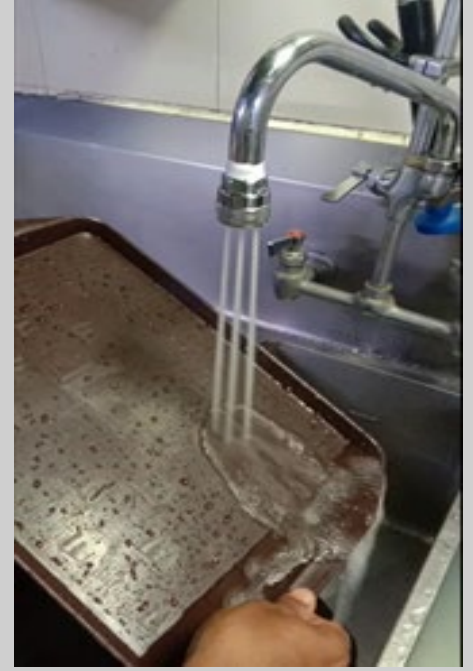
Saving Water with Improved Cleaning



In partnership with DG Takano, Japan, a water saving device - Bubble90 – was validated for the Indian market. Bubble90, as its name suggests can save 90% of water without compromising on the cleaning efficiency. This is done through a jet of air that accompanies the water coming out of the tap. The company claims that the air jet provides an additional 5% extra cleaning efficiency.

Ozone 90 is another product of DG Takano that releases Ozone at the point of dispensing. This product will eliminate the use of disinfectants for washing and render the used water easy for recycling, thereby promoting savings in costs and water usage. This product is currently under validation.

Different models with stainless steel and plastic construction were tested and validated at hotels, restaurants and hostels. Results show significant water savings can be achieved where running water is used to clean vessels



Smart water meter installed, tap for vessel / plate washing without bubble90 and with BS6 (Metal) bubble90 at Mc Donalds

Water Quality Analyses Performed

1. Scanning Electron Microscopy and fluorescence microscopy for the characterisation of test strips for Healthcare Technology Innovation Centre at IITM Research Park
2. Atomic Absorption Spectroscopy (AAS) and volumetric methods for groundwater testing of communities for selection of right technology for drinking water kiosks
3. AAS, FTIR, pXRD, TGA, BET and NMR analysis for Aquaworks
4. SEM with elemental mapping for material characterization for Slayback Pharmaceuticals
5. Validation of Sequential Progressive Bio Reactors (SEPROB) technology of M/s Horizon Plasto Tech.
6. Validation of a bio-active resin cement by assessing its release of calcium, phosphate and fluoride ions in buffer for Savitha Dental College and Hospitals.

Water touches almost all aspects of our lives, and the future of water security depends on multiple agencies coming together. The different stakeholders of water – agriculture, industry, domestic users and subsegments within them - have evolved independently and this creates conflicts during policy implementation.

ICCW has taken the initiative to connect with villages in two districts – Erode and Chittoor to understand the issues in water management and governance. The Analysis team has analysed water samples before the irrigation season to gauge the impact of fertilizers and pesticides on groundwater. These will be correlated with health and other socio-economic indicators as part of Hydroinformatics.

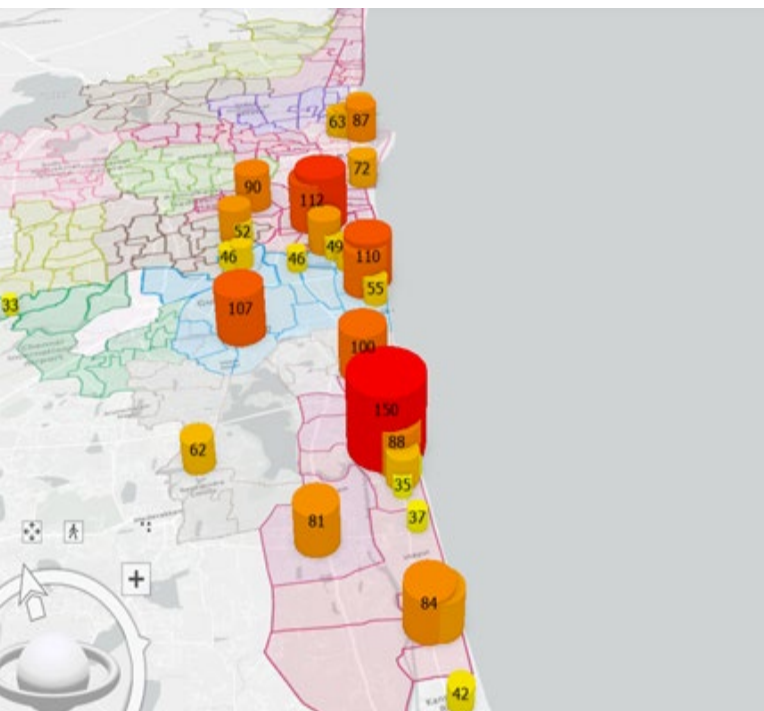
COMPUTER MODELLING & SIMULATION

Strategic Intent

- Support research by simulating and optimizing relevant parameters on the computer for rapid and least cost prototype development
- Support solution implementation by creating digital twins of equipment, plants, buildings, factories or communities and simulate possible solutions for low-cost validation before pilots
- Apply data sciences on the water quality data and triangulate with satellite and secondary data for smart water management

Groundwater Quality Mapping of India

In collaboration with Tamil Nadu State data centre and students from Stella Maris college, Chennai, ICCW initiated a rapid assessment of groundwater quality. The picture below shows the visualization of the data and the values of a composite Water Quality Index (WQI), that is derived based on the measured values. This is an illustration (not to scale).



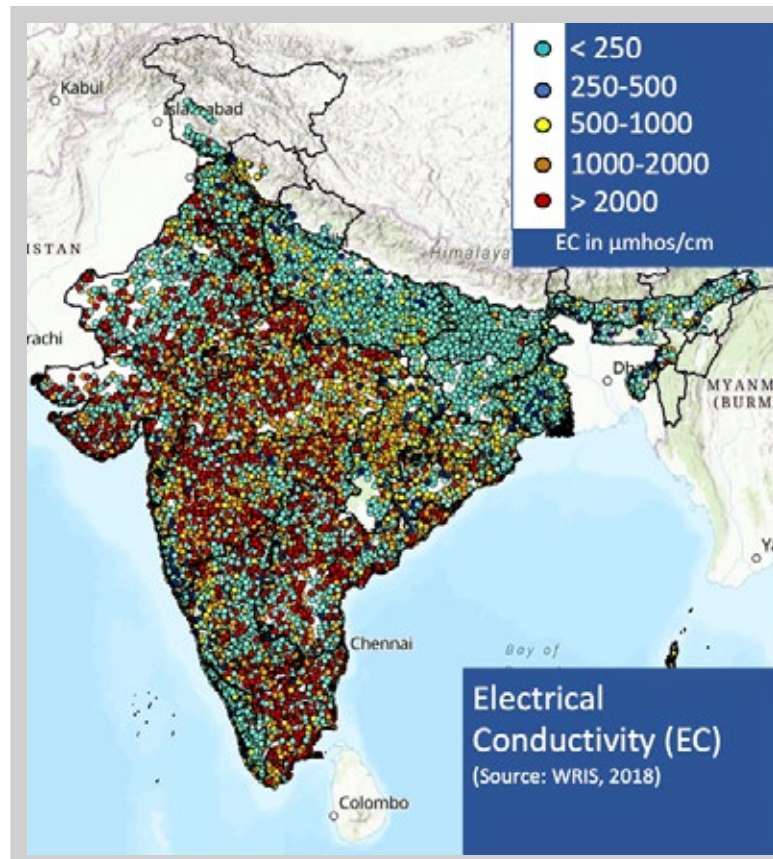
Regular monitoring of water quality with online data upload is required throughout the country. Because the water quality is a dynamic phenomenon impacted by seasonal variations, pollution, floods, etc. consistent upload and monitoring is essential. A sample study was conducted using field test kits in Chennai 2021. Water quality index (WQI) was calculated from 12 parameters measured using ICCW's test kits between February-March, and October-November 2021. The data collection was initially made at 39 sites and extended to 250 wells later in the year. The study revealed that while many places in Chennai have good water quality, several places have issues, which may be attributed to urban / industrial pollution and /or salinity intrusion.

AI-Based Predictive Platform for Groundwater Quality in India

Groundwater quality is measured by the concentration of various chemical and biological parameters, all of which need to be below their acceptable limits. ICCW is evolving a system that will accurately predict when and where any water quality parameter may exceed its acceptable limit.

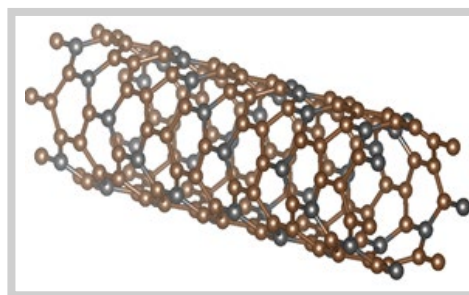
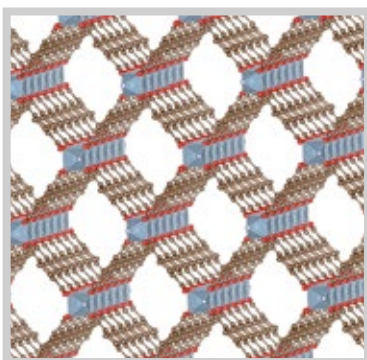
Visualizations of available data is a first step followed by analytics and algorithms connecting different influencing factors.

Modelling and machine-learning can then help progressively enhance the accuracy of predictions. Accuracy and timely capture of data with spatio-temporal coordinates is vital for actionable predictions. The entire approach provides rich opportunities for youth to build their careers around water through sensors/IOT hardware, software development, data sciences and social sciences. Such an integrated approach, when applied to a particular village/taluk or mandal over a period of time can generate sufficient evidence for policy inputs.



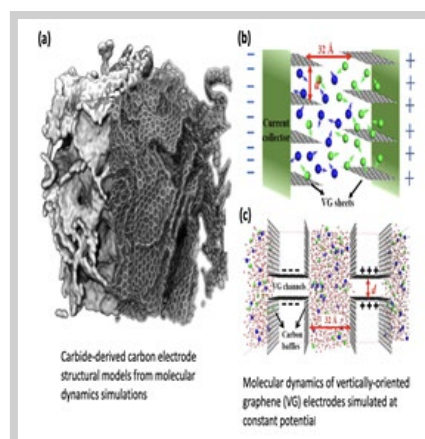
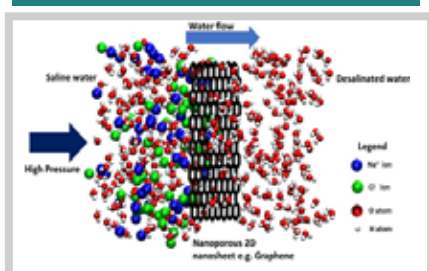
Research Projects Using Computational Modelling

Atmospheric water-harvesting materials



Nanomaterials for water quality sensors

Nanomembranes



CDI electrodes

Hydroinformatics

Hydroinformatics is an interdisciplinary application of information and communication technologies for sustainable and equitable water management. ICCW is striving to create a strong presence in this space by a combination of research and development, implementation, and training in hydroinformatics spanning across all its verticals.



Key Technologies of Hydroinformatics:

- Physical modelling & simulations
- Artificial intelligence (AI) & Machine learning/Data Science
- Blockchain
- Databases
- Cloud and Edge computing
- IoT/Cyberphysical systems
- Digital twins
- Virtual/augmented reality

Leading to Smart water management, or Water 4.0

Training in Hydroinformatics

ICCW offers internships in Hydroinformatics to students from universities and institutes across India. During the year, eight interns were engaged on different projects and are currently working on projects involving spatio-temporal water quality mapping and materials modelling in water. Online internships are available. Interested students may apply for internship.

List of Interns in Implementation and Hydroinformatics 2021

Mr Abdul Wahid

M. Sc. student in Irrigation Water Management,
Anna University.

Dec - Mar 2021

Curriculum development for students at Anna University on rainwater harvesting. Groundwater quality mapping in Chennai using field sample collection with State Water Data Centre, Tamil Nadu, and Stella Maris College

Mr G. Ramaswamy

B.E. Automobile Engineering graduate,
Madras Institute of Technology.

Apr - Aug 2021

Groundwater quality monitoring study in Chennai with the Stella Maris College and the State Water Data Centre, Tamil Nadu. Data extraction, geospatial analysis, baseline report and dashboard creation of water quality and security in various locations throughout India, including, Chennai, Tamil Nadu and Karnataka, and groundwater contamination in Punjab 2017-2020.

Mr Addanki Srikara Raghavendra

B. Tech degree student in Chemical Engineering,
NIT Calicut.

May - Sep 2021 and Dec 2022 Present

Spatial and statistical analysis of groundwater contamination in Punjab for the year 2019-20. Literature study on groundwater arsenic contamination and the water-energy-food nexus in Punjab. Modelling of nanomaterials for water quality sensors.

Ms Amol Jaggi

B. Tech degree student in Mechanical Engineering,
IIT Jammu.

May - Sep 2021

Spatial distribution of groundwater contamination in Punjab for the year 2019-20 and correlation with industrial effluents. Literature study of pollution in Punjab.

Mr Gurtej Singh Talwar

B. Tech student in Computer Science Engineering,
Chandigarh University.

May - Nov 2021

Groundwater quality data extraction, analysis and dashboard creation for Punjab for the years 2019-20 and 2017-18. Digital twin platform development and data mining from water quality research papers.

Mr Saurabh Kumar Singh

M. Tech. Industrial Mathematics student,
IIT Madras.

Sep 2021 Present

Groundwater quality prediction using machine learning techniques.

Mr Lokendra Kumar Singh

M. Tech. Industrial Mathematics student,
IIT Madras.

Sep 2021 Present

Hybrid-machine learning models for leakage detection in water networks.

Mr Ashish Yadava

M. Tech. Industrial Mathematics student,
IIT Madras.

Dec 2021 Present

Groundwater level prediction using machine learning.

Ms. Ragashree Srinivas

B. Tech, Civil Engineering,
Vellore Institute of Technology.

Nov 2021 present

Data science of effluent water in India and effluent remediation and recovery technologies.

[Click Here To Apply](#)

IMPLEMENTATION

Strategic Intent

- Conduct water management studies and build human capacity in water management
- Handhold implementation of the interventions proposed by the water management study reports
- Translate incubated and emerging technologies in the field through projects identified to benefit society
- Join hands with NGOs and conduct behaviour change initiatives in communities for adoption, ownership and sustenance of the emerging technologies

End Line Survey on Impacts of Water Resources Security Mapping Study



A rapid assessment of Water Resources Security Mapping was done in Aug-Sep 2019 for Hand-in-Hand Foundation (HiHF) and NSE Foundation. The report recommended interventions to improve water security by involving the local community. HiHF has implemented roof-top rainwater harvesting structures, decentralized sustainable safe drinking water plants, rainwater recharge structures, kitchen wastewater reuse, solid waste segregation and management and conducted awareness programmes with villagers to sustain these initiatives.

Community Drinking Water Kiosks



Salinity of groundwater is increasing day by day and the need of the hour is a technology that will remove salts with minimum reject water. It is also important that certain essential salts containing calcium and magnesium are retained. Capacitive Deionization developed by InnoDi Technologies, an IIT Madras incubated company fits this requirement.

ICCW is grateful to Indian Oil Corporation Limited (IOCL) for pioneering CDI technology in the southern districts of Ramanathapuram, Tuticorin, Madurai and Chittoor. Ramanathapuram is listed as an aspirational district by the Government of India.

CDI Installations During the Year

- Kiosks in nine villages Ramanathapuram, Tuticorin, Madurai, and Chittoor districts
- Two dispensers in government residential schools in Telangana.
- Dispensers in Life Insurance Corporation office building in Chennai and KREA University, Tada.

IOCL, SRPL Tuticorin



Awareness activities on water conservation at Vedapatti, Veppalodai and Vaagaikulam villages of Tuticorin, Ramanathapuram districts

Arsenic and Iron Removal Plants



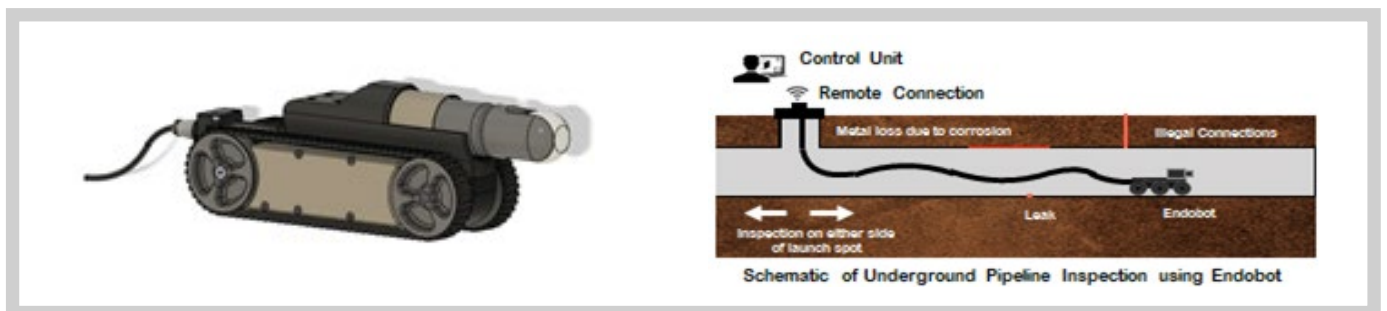
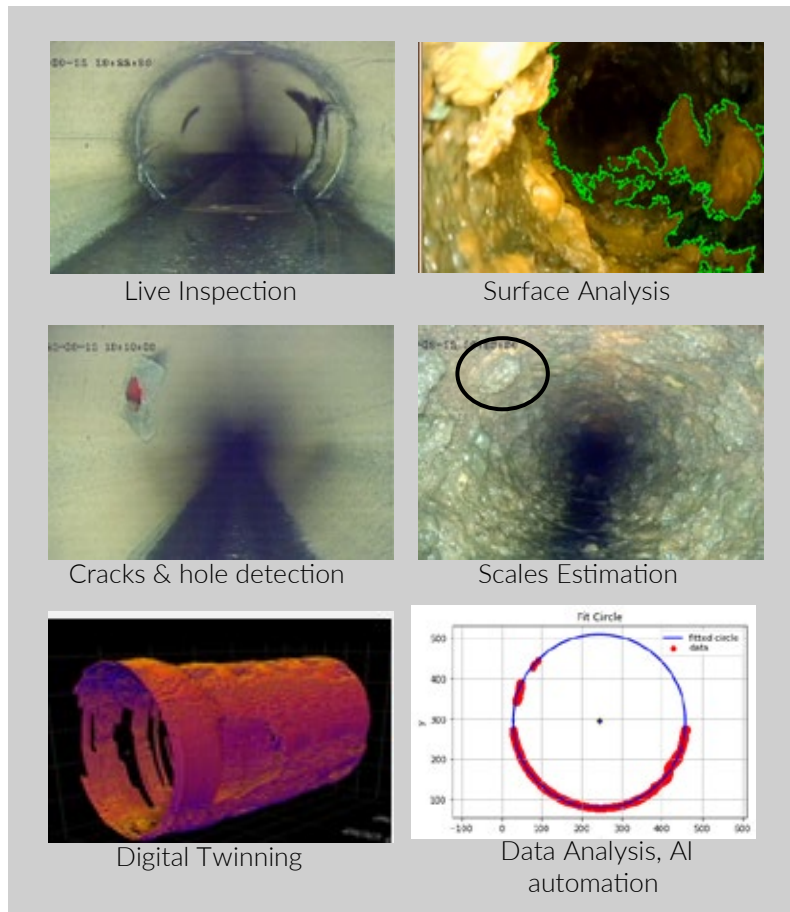
Nanotechnology based arsenic and iron removal plants were implemented in about 90 locations and Household arsenic filters in about 12,000 homes in Punjab through Hydromaterials Pvt Ltd – an IIT Madras incubated company. All plants are fitted with IOT connectivity for real time monitoring of basic quality parameters and the volume of water dispensed.

Export of Arsenic and Iron Removal Technology (AMRIT)

In collaboration with Saraya Japan, ICCW is working to provide arsenic free water to citizens of Cambodia. As a first step, ICCW facilitated an MOU between Saraya and Rural Water Supply and Sanitation (RWST) - an NGO based in Cambodia. Through RWST, five Household units are undergoing trial for efficacy of arsenic removal. Additionally, a pilot community project is being planned in conjunction with the Ministry of Rural Development and international organisations.

Leak Detection Study in Wastewater Lines

In partnership with Solinas Integrity, who have developed robots for underground pipe inspection, a pilot study of sewer line conditions was done at Mahindra World City. The study revealed several hidden factors such as debris, roots of trees and cracks in pipelines that can disrupt the sewage flow. The cracks in the sewer lines also allowed stormwater during the monsoons thereby overloading the Sewage Treatment Plant.



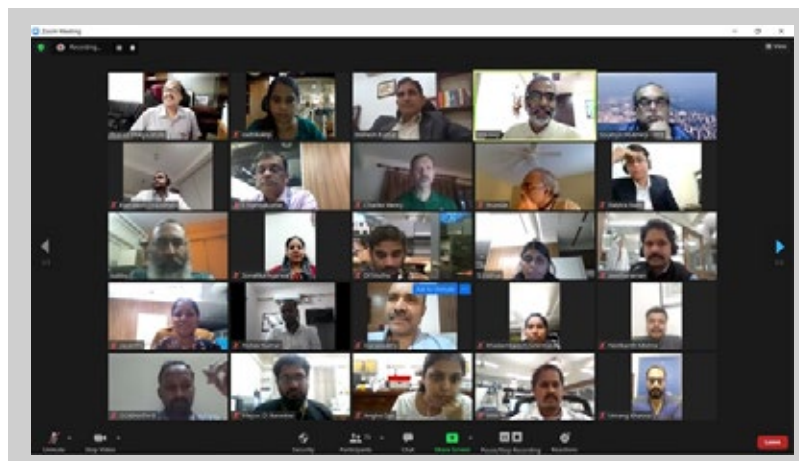
OUTREACH

Strategic Intent

- Create awareness among public of the need for water conservation and prevention of pollution
- Highlight the projects and benefits of projects executed by ICCW to the world and explore potential for replication
- Provide inputs to ICCW team on the external situation and provide connect to secure support and finances for project
- Interface with governments, corporates, philanthropic organization to enhance the reach and benefits of ICCW's activities



ICCW and IUSSTF Joint Virtual Centre Conducted the Indo-US Virtual Workshop on Smart Sensors and Analytics for Clean Water on Feb 26, 2021.



WaterTalks

WaterTalks are informal discussions that bring together different stakeholders – practicing water professionals, students, academicians, industrialists, government officials and common citizens onto a common platform. A practicing expert shares his experience and interacts with others and these interactions make people aware of what is possible and motivates them to collaborate and tackle challenges they are facing.

Speaker - 2021



Prof S Janakarajan is the President of South Asia Consortium for Interdisciplinary Water Resources Studies and a Steering Committee Member of Forum for Policy Dialogue on Conflict Resolution on Water in India



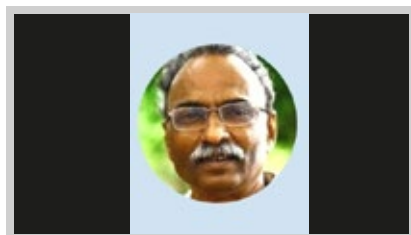
Shri Arumugam Kalimuthu is the Program Director at Water, Sanitation and Hygiene Institute, with over three decades of experience in the development sector with a strong focus on Water supply, Sanitation and Hygiene



Shri V Ramprasad, the co-founder and convener of Friends of Lakes, is also regarded as a solid waste management expert and is a member of Resources Recovery Research and Management Institute



Dr. Shekhar Raghavan (Rain man of Chennai) has been an exponent of the Rainwater Harvesting System for more than 2 decades



Dr. Hariharan Chandrashekar is an Indian ecological economist, founding and presiding over urban people-led movements for urban sustainability on water and energy,

Connecting with Music

Water is precious to us and is the very source of life, yet we manage it poorly leading to water crises. This probably points to a lack of emotional connect with water.

What better than music to bring out the emotions? Thanks to Distinguished Alumnus Dr Kanniks Kannikeswaran –an accomplished music composer, two music videos were initiated



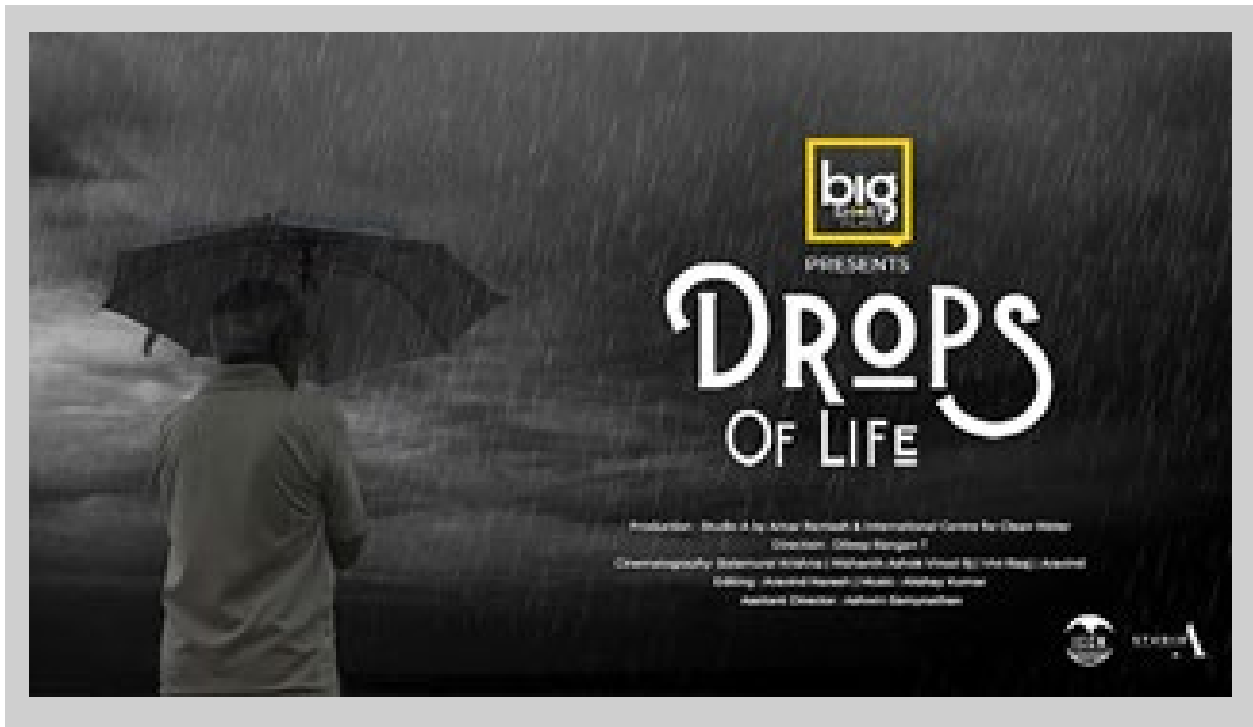
1. **R**ivers of India – a musical tribute where the lyrics are the names of our rivers rendered melodiously by celebrity singers – Smt Bombay Jayashri, Shri Amrith Ramnath, Smt Kaushiki Chakraborty and Master Rishith Desikan. With music scoring and recording by renowned Sai Shravanam, the video was launched on Earth Day 22-Apr-2021 and crossed one lakh views in the first month. [Click on the Picture](#) to access the video.



2. **M**onsoons – a call to celebrate rain and harvest rainwater rendered by Pandit Ajoy Chakraborty and celebrated singers Ranjani – Gayatri. The video that draws from Tamil treatise Thirukkural, is set to a dance rhythm and features a special performance by Kalakshetra troupe. It is scheduled for launch in early 2022.

[Click the Picture](#) for a teaser of the video.

Promoting Rainwater Harvesting



[Click on the Picture](#) to access the video

Rain is the only source of water in India, unless one were living in the Himalayas. Despite our negligence towards conserving water, Nature gives back bountifully through regular rains.

Though rainwater harvesting has been repeatedly exhorted by experts, it is yet to be widely practiced.

A video Drops of Life was released on Independence Day, where stalwarts who pioneered rainwater harvesting in Chennai in the early 2000's give their views.

A course curriculum on rainwater harvesting has been prepared and submitted to Anna University for inclusion in their Graduate programme

Ecosystem Creation

ICCW is Privileged to be Part of -

- The Jury for the CII Water Excellence Awards
- The Expert Panel for Atal Innovation Mission – Innovation Centre of Denmark Challenge 1.0 and 2.0
- WOW Action Forum initiated by Alt-Tech Foundation for citizens' involvement in water conservation.
- The Global Water Works Consortia

STARTUP SUPPORT

Strategic Intent

- Encourage new ideas through prototyping, validation to enterprise building to create positive disruption in sustainable water management
- Encourage scientists within and outside ICCW to develop their ideas into products/services
- Create an ecosystem where startups can be incubated, funded and provided mentorship
- Build a network of startups that could synergistically work in bringing up quantum improvements in water sustainability

Accelerator Programme



In partnership with Akamai Technologies, ICCW has mentored four water-based startups over two cohorts. The objective of the programme is to invest CSR funds to create social impact through startups that can make a difference in the water security of our country.

With three teams shortlisted for the third cohort to be in January 2022, a consortium is emerging whereby the startups complement one another to make a bigger impact.



Low-Cost, Smartphone Enabled Water test kits for Anybody to use



A mobile app Connecting all Stakeholders for Seamless Water-Body Restoration



Saving ponds, Improving Farmer Livelihoods with Sensors and AI-ML Based Advisory Support



Hardware-free, AI-ML Based Leakage and Metering Loss Detection in Pipelines for Utilities to Save on NRW



Robotic Condition Monitoring of Underground Water and Sewage Lines for Leak Detection and Prevention

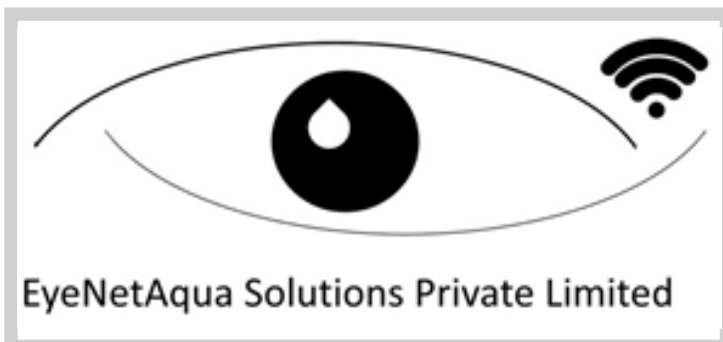


Transforming Water Assets for Compliance, Resilience and Sustainability



A one-stop Sustainable Solution to Recycle Your Wastewaters,

Incubation Hub



EyeNetAqua, a company focused on low-cost IOT enabled sensors has been incubated.

EyeNetAqua, an ICCW incubated company has qualified the first round of Information Communication Technology (ICT) Grand Challenge organized by National Jal Jeevan Mission in partnership

with Ministry of Electronics & Information Technology (MeitY). EyeNetAqua, an ICCW incubated company has qualified the first round of Information Communication Technology (ICT) Grand Challenge organized by National Jal Jeevan Mission in partnership with Ministry of Electronics & Information Technology (MeitY). EyeNetAqua works with IIT Madras' consortium on sensors to integrate as well as develop new technologies for water quality monitoring. In the second round of ICT Grand Challenge, EyeNetAqua has developed a product as per JJM specifications for the inline measurements of pH, TDS, Residual chlorine, Nitrate, Fluoride, pressure and water volume of flow.

PARTNERSHIPS

Project Partners

ICCW expresses its gratitude to the following partners for their continued support to the Centre and help in implementation of social impact projects

| | |
|---|--|
| Indian Oil Corporation | – Community Drinking Water Systems in 12 Locations |
| IITM Foundation | – Development of Online Fluoride Sensors with Enhanced CDI Performance |
| National Stock Exchange Foundation | – Community Drinking Water Systems in 11 Locations |
| Naandi Foundation | – Community Drinking Water Systems in 2 Locations Plus O&M Support |
| TSWREIS | – Drinking Water Systems for 25 Government Schools |
| Akamai Trust | – Accelerator Programmes for 5 Startups to Create Social and Environmental Impact |
| Saraya, Japan | – Extending the Benefit of Arsenic and Iron Remediation to Cambodia and Kenya |
| Hand in Hand Foundation | – Conducting Water Resource Security Mapping of Rameswaram Island and Implementing Relevant Interventions |
| DG Takano, Japan | – Joint Validation of Bubble90 and Ozone90 – Fitments that can Save Over 90% Water with Enhanced Cleaning and Disinfection |
| Grundfos | – Development of Solar Powered Sustainable Desalination using Membrane Distillation |
| APEWIDC | – Developing Specifications for Providing Drinking Water to all Government Schools in Andhra Pradesh |
| AltTech Foundation | – On Wealth of Water Action Forum (WOW-AF) - A Citizen-led Water Collective Drive to Save 2700 Crore (27 Billion) Litres in 2022 |
| Global Water Works | – To Synergize Global Efforts and Technologies in Water Conservation and Reuse |
| Business Sweden | – To Bring Sustainable Water Technologies to India |

Gold Consortia Members

ICCW is grateful to the following organisations for joining the Gold Consortia and their support in building the water ecosystem.



Marmon Group, USA

–Support for new product development, webinars on emerging technologies



Buckman, USA –improving sustainability in industrial water management



Xylem Inc, USA–technologies to address the needs of Bottom of the Pyramid population

The Pradeep Research Group

The Pradeep Research Group (PRG), IIT Madras led by Prof. T Pradeep, and a precursor to ICCW, in developing and incubating innovative sustainable technologies, has been making excellent progress.

With a strength of 7 Post Doctorates, 29 PhD students, and 2 M Sc students, during the year 2021, PRG had 29 Journal Publications, 12 Indian Patents (Granted), 4 Indian Patents (Applied) and 2 PCT Patents (Applied).



Prof. T. Pradeep receiving **Padma Shri** award from the President of India, November 8, 2021

More information on the Group can be found [here](#)
PRG's Annual Report for 2021 can be found [here](#)

FINANCIALS

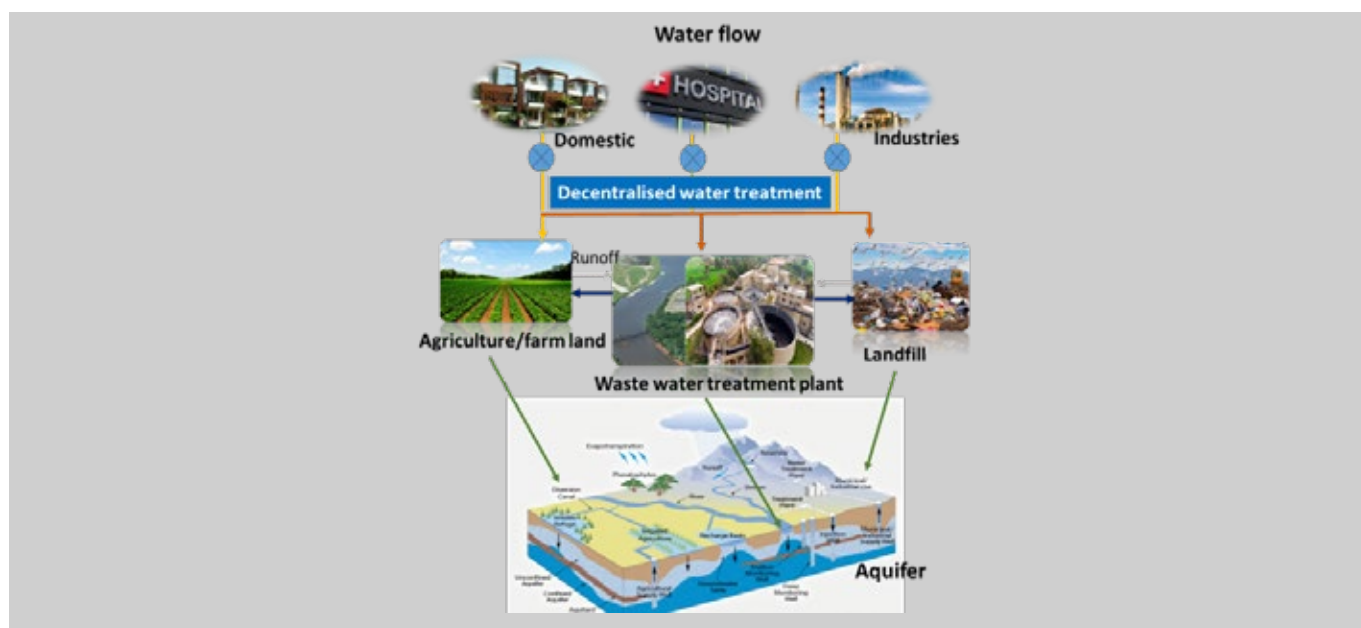
| Particulars | Year (in Lakhs) |
|---|---------------------|
| Income | 2021 |
| Project Revenue | 19,57,89,784 |
| Grants Received | 63,29,077 |
| Interest Income | 13,41,385 |
| Other Income | 1,10,93,910 |
| | 21,45,54,155 |
| Expenditure | |
| Project Expenditure (including provisions) | 22,12,69,736 |
| Employee Costs | 97,14,429 |
| Operating Expenses | |
| Rent of Premises and Other Admin | 1,51,40,758 |
| | 24,66,78,817 |

BLOG

DECENTRALIZED FIT-FOR-PURPOSE TREATMENT (DFPT) MODEL FOR EMERGING CONTAMINANTS IN WATER

A Blog by Dr Abirami Devadas Senior Scientist, ICCW

Water is an environmental treasure that comes from and returns to nature. This valuable resource should be conserved. Climate change, global population growth, rapid urbanization and fast developing infrastructure threaten this life-sustaining water resource. The aquifers are recharged by the water from the river and ground in which the contaminants are discharged. The mobility and load of the contaminants may diverge before it accumulates in the aquifer.



Studies on prevalence of emerging contaminants (EC) in water like pesticides, pharmaceuticals, surfactants, personal care products, detergents, food additives, endocrine disrupting chemicals, disinfectant by-products, etc., have been reported. They are structurally designed or used to maximize the biological activity or prolonged actions which have adverse effects on ecology and human health. They were persistent in discharged water when released and their pollution was detected in river networks in Tamil Nadu as well as in water treatment plants at Chennai.

EC's may produce more toxic or bio-accumulative compounds than the parent compounds. This includes the risks and detrimental impacts with inadvertent presence in the ecosystem. EC's are not well monitored or abstracted by conventional treatment technologies during water treatment. It worsens, when they are getting compounded through various sources and sequentially exist in the public water system. It threatens human and aquatic life, health and livelihoods. Besides, it also impacts the economic, political and security developments for the country. The advancement in analytical techniques helps in multi-residue analysis of EC's with sensitivity and accuracy (ppb level) of detection in various environmental matrices.

| Emerging Contaminants | Threats to human health | Analytical detection methods in water | Treatment techniques or process |
|--------------------------|--|--|---|
| Pesticides | Cancer, damage to nervous system, water borne diseases | Microextraction coupled to Gas chromatography or mass spectrometry, High performance liquid chromatography | Ozonation, Microfiltration, Chloramination, Advanced oxidation process, Adsorption, Electrochemical treatment |
| Pharmaceuticals | Disrupt internal biological process, genetic disorders | Isotope dilution method using liquid chromatography coupled to tandem triple quadrupole mass spectrometry, Gas or liquid chromatography with mass spectrometry | Ozonation, Activated sludge, Biofiltration, Reverse osmosis, membrane, Electrochemical, Advanced oxidation process |
| Personal care products | Induce physiological effects | Combustion catalytic oxidation and chemiluminescence detector for dissolved nitrogen and organic carbon | Microbial mediated reactions, Photodegradation, Abiotic transformations, Ozonation, Alum based dissolved air floatation, Biological filtration, Chlorination, Electrochemical oxidation, Chloramination |
| Artificial sweeteners | DNA damage at higher concentrations | Solid-phase extraction followed by liquid chromatography - tandem mass spectrometry, Colorimetric sensor array | Activated sludge, Advanced oxidation process |
| Perfluorinated compounds | Cancer, oxidative stress to cells | Liquid chromatography/ tandem mass spectrometry | Biological treatment, Electrochemical degradation, Continuous oxidation process, Activated carbon adsorption |

| | | | |
|--------------------------------|--|--|---|
| Endocrine disrupting chemicals | Affects kidney as well as reproduction system, block the action of natural hormone | Ultra-performance liquid chromatography-tandem mass spectrometry | Granular activated carbon membrane, Advanced oxidation process, Electrochemical treatment |
|--------------------------------|--|--|---|

Table shows few categories of emerging contaminants, their impact on human health, detection and treatment process. The information listed here is limited, but documented to highlight the need to create awareness and address the issue forthwith.

Water experts are looking for a new, flexible water treatment strategy that can adapt to this broad and uncertain environment. The decentralized fit-for-purpose treatment (DFPT) model can be designed to treat EC's for the regional needs in a small module in the water cycle. To enhance the assessment of risks at the point of departure, it is important to embrace the integrated treatment methodologies, imparting regulatory standards, toxicity endpoints for various types of EC's and updating the water guidelines to current scenarios. A mini toolkit can be developed for a home or small company to measure the water-consumption level and tips to reduce water wastage. Consequently, reuse, recycle and retreat the EC'S in water at macro level will recharge the groundwater for safe usage. Overall, consumers can serve as environmental warriors by proper use of water and disposal of wastes to overcome the water crisis.

VISITORS

- Dr. Amit Bali, Sr. Commamdo, Chennai Port Trust Visited ICCW on 8th Jananary 2021
- Mr. V Seshagiri, Perkin Elmer, Visited ICCW on 19th January, 2021.
- British Consulate team , visited ICCW, on 22nd January 2021.
- Dr.S. Rajasekaran, MAM College of engg & Tech Trichy, visited ICCW on 22nd January 2021.
- Mr. Moorthi Chokkanathan & Mr. Immanuel, Hexaware Technologies visited ICCW on 26th March 2021.
- Mr. V S Vilvaraj a customer for Vayujal, visited ICCW on 23rd April 2021.
- Mr. Jayakumar & Mr. Madhavanivas, Kochi visited ICCW on 26th June 2021.
- Mr. Pallava Bagla, Visited ICCW on 24th August 2021.
- Kailash Kanth, DGM (HR&CSR), TNSO Chennai, Visited ICCW on 22nd October, 2021.
- Mr. Murthygar, Executive Vice Chairman, Navatatnalu AP, Visiited our centre on 22nd Ocotber 2021.
- Mr. Lalitmohan Singh, Mr. A Shammugam Pasappai, Mr. Rajakumaran EHS Leader visited our centre on 25th November 2021.
- Mr. S S Sawant, ED,SRPL, IOCL Chennai visited ICCW, on 3rd December 2021 and signed the MoU too.
- Swami Lakshmidharanande, Ramakrishna Math, Mylapore, Visited our centre on 8th December 2021.
- Kavitha Viziakumar, Woman Program, Director Anbagam visited ICCW on 15th December 2021.
- Mr. V Seshagiri, Perkin Elmer , Chennai visited 2nd time to out centre on 16th Decem-ber, 2021.
- Dr. Asit Barma, Director , Bharathidasan Institute of Mgt, Trichy - Visited our centre on 17th December 2021.

ICCW IN NEWS

NEW REGULATIONS FOR WATER PURIFICATION SYSTEMS

Water Purifiers Must Mention Wastage, Efficiency Rating

Water supply agency to declare quality, TDS details

Aneshkoti, Vishal
@aneshkoti

New Delhi: Manufacturers of reverse osmosis-based water purifiers will now have to rate their appliances on efficiency and water wastage, while water supply agencies will have to declare the total dissolved solids (TDS) in the water being supplied, according to officials.

The environment ministry has notified regulations for water purification systems which will come into effect in 18 months from now. The move is aimed at allowing consumers to make informed decisions on the kind of water purifier needed. If all the officials cited earlier hold it.

The regulations follow the National Green Tribunal's order to the environment ministry on May 30, 2019 that it should come out with regulations on appropriate use of RO-based water purification systems.

Accordingly, the regulations have tasked all agencies and organisations engaged in water supply to inform consumers on the quality of water being supplied, including the TDS level. These are to be widely disseminated through advertisements and awareness campaigns, besides being mentioned in the utility bills.

The new Regulation on Use of Water Purification System (WPS) mandates that each water purifier will now come with a 'conformance label' declaring its efficiency level as well as water rejection wastage levels.

The Bureau of Indian Standards is meant to have developed IS standard (IS 16166: 2019) for drinking water purification systems which will be technology specific and also detail the acceptable quality of the purified water, besides the recovery efficiency of the machine. At present, purification machines have around 20% water recovery efficiency as they are estimated to reject/waste near 70-80% of the water taken in for purification.

The environment ministry, in consultation of green resources, has been pitching for bringing in a more water efficient system in a phased manner, starting with 40-45% efficiency level for domestic wastage.

The RO manufacturer will now have to obtain standard mark/certification under a licence from the BIS on the water purification system.

The regulations also say that the Central Pollution Control Board will soon announce guidelines for storage, reuse, storage, utilisation and disposal of reject water generated from drinking water purification systems.

2 FRIDAY REVIEW

The river song

Rainwater harvesting has always been a part of life in India. But in the past few decades, it has almost disappeared. The film 'The River Song' is a beautiful ode to this ancient practice. It tells the story of a small town in Karnataka where the people have started to lose touch with their natural water sources. The film is a beautiful blend of nature and human life. It is a must-watch for anyone who loves nature and wants to learn more about rainwater harvesting.

The film is a beautiful blend of nature and human life. It is a must-watch for anyone who loves nature and wants to learn more about rainwater harvesting.

புறி

ககாதரமன் குழிர் வசதி

இந்தியன் ஆயில் நிறுவனம் ஈர்ப்பில்

ககாதரமன் குழிர் வசதி

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இந்தியன் ஆயில் காப்புறவுகள் மற்றும் வசதிகள்

கத்திரிக்கப்பட்ட குழிர் வசதியை மகிழ்ச்சியுடன் தனிவாரி பிழைத்துச் சென்ற கிராம மக்கள்

ஊர்க்குடி, 14-26-2019

இந்தியன் ஆயில் நிறுவனம் ஈர்ப்பில் ககாதரமன் குழிர் வசதி செய்து கொடுத்தது மகிழ்ச்சியை ஏற்படுத்தியது. ககாதரமன் குழிர் வசதி செய்து கொடுத்தது மகிழ்ச்சியை ஏற்படுத்தியது.

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DOCUMENTING EVERY DROP THAT COUNTS

VAISHALI VIJAYARAM

When it comes to handling and managing water, it's always been a challenge. One year, we were all wading through knee-deep water. A few years later, we were banking on tankers for clean water for every purpose. Are we even treating the resource right?" asks Dileep Rangan T. That's precisely what his latest film *Arise of Life - Story of Rainwater Harvesting* throws light on.

Produced by Big Short Films, the 10-minute documentary breaks down the basics of rainwater harvesting and encourages viewers to embrace the age-old technique. "We launched the film on Independence Day, hoping that would give simple time for people to prepare themselves for the monsoon. But, the recent instances of water logging shows us that we still have a long way to go," says Dileep.

Decades of dedication

Besides offering us a reality check, the film features the stories of veterans like 'Rain Man' Sekhar Raghavan and Santha Sreedhar, former IAS officer, who've been instrumental in pioneering rainwater harvesting movements across the city. "Around June 2001, I was appointed as the water supply secretary under the late CM J. Jayalitha. This was the first time a political party had embraced the idea of rainwater harvesting. One of the first problems that worried me was the insufficiency of water and the food that followed within three-four months. There was a lot of water wastage. The city receives 1,000 mm annually and that's not a minimal amount. We fought for legislation to make rainwater harvesting mandatory and it became a people's movement," recalls Nair.

Now, many homes, organisations and institutions have access to clean water. But aggressive expansion and instant modernisation have led to floods, droughts, and practice of unsustainable methods for procuring clean water. Sekhar, director of Akash Ganga Trust Rain Centre, reiterates their slogan - Catch rain, it's free. "Remember, the city has to survive on the 84 days of rainfall for the rest of the year. If we don't harvest it, then the droughts in the coming years will be severe. I've been spreading awareness on this technique since 1995 and still many have not understood. The idea is simple - every time it rains, the water falls either on the terrace/rooftop or within the building premises. Collect the water instead of letting it into the drains," he suggests.

The documentary also brings interesting heroes under the spotlight. One such couple is Prabhakar and Harsha Koda, founders of Beign Over Water. They've been actively involved in helping set up rainwater harvesting facilities in gated communities. "A drizzle can give 20,000 litres of rainwater, one-spoon of heavy rain can give 80,000 litres and a storm can give a lakh litres (every hour). It's a workable and long-lasting model to invest in. We need to tap on this potential," Harsha points out.

It's raining solutions

To encourage the youth to participate in building a sustainable ecosystem, organisations like International Centre for Clean Water have been playing a crucial role. Nandakumar R, CEO, shares, "Anybody who has a workable idea of how water works can build a company or model with our help. We are also introducing elective courses for B.Tech programmes in Anna University."

Explaining how the students would be benefiting from the elective course, Anishan, head of the Centre for Water Resources, Anna University, notes, "Students will learn about the design structures of rainwater harvesting in urban and rural environments. It will give them a holistic perspective on the model and its functions."

Besides packing a message, the film also reminds us of a solution that's been in practice for many years. Perhaps, it's never too late to give it a shot. After all, like Prasad T, an IIT Madras professor says in the film, "Water is the basis of everything. The only way we can live is by circulating, and that's called the hydrological cycle. That cycle is complete only with rain."

Credits

Big short films
Producer: Anish Ramesh
Director: Dileep Rangan T
Music: Ashish Kumar
Cinematographer: Anish R, T, Ravi, Anand Nishith, Nishith, Ramesh Krishna
Editing: Anish Ramesh

THE ROAD AHEAD FOR 2022

Water touches every aspect of our lives and hence everybody is a stakeholder with interdependencies, which naturally lead to conflicts. On the other hand, digitalisation is also impacting every aspect of our lives. At ICCW, we are working to combine the two, i.e Water + Data to create a powerful tool for better management and equitable distribution of clean water.

Digital Twins would be a natural offshoot to capture, visualise and present problems in a manner that builds consensus around the issues and help validate possible solutions virtually before expensive pilots.

A concomitant challenge of digitalisation is availability of reliable and timely data. The cost of sensors is falling rapidly and IOT enabled systems are becoming omnipresent. ICCW's research scientists have already developed low-cost smartphone/IOT enabled sensors to enable real-time capture of critical water quality parameters.

By the end of 2022, we hope to create a few Hydroinformatic Platforms that are validated for industrial and community settings. The platform will provide dashboards for improved water management towards Water Positivity.

We see a number of youth - students and entrepreneurs - innovating around water security. Grand Challenges will bring out the best in them to address the complex issues that are involved. We have already seen excellent traction in the AIM-ICDK challenge 1.0 and the Akamai Accelerator programme, we have been privileged to be part of. These startups are like pieces of a jigsaw puzzle that together can address the big picture of water governance and future security.

We are also witnessing increased community engagement in urban and rural populations. Our IEC and behaviour change interventions have been well received by even remote communities in aspirational districts. We look forward to greater engagement with NGO's, philanthropists, corporates and local administrations to build human capacity and self reliance among citizens in ensuring clean and sustainable water for themselves at a fair price.