short-term training courses were conducted every year under the aegis of Science and Engineering Research Board (SERB), DST, Govt. of India, blending the theory and practical/field aspects of isotope hydrology. Around 250 participants from different parts of the country representing NITs, IISc, Universities, State & Central Government Departments and R&D Centers are benefitted from 11 training courses conducted till 2014.

Workshops - In addition to the regular training courses at CWRDM, several one-day workshops have been organized at various institutions in many parts of the country to popularize this novel technique. Around 800 Professionals/Researchers/Academicians have been exposed to the potential of the isotope technique in basic and applied research.

Other Scientific Events - Apart from the regular training courses, the Division has been instrumental in organizing several National/ International events.

The Advisory Group Meeting (AGM) of the International Atomic Energy Agency (IAEA), Vienna, was conducted at CWRDM and discussed on the integration of isotope techniques in water resource investigation in the Asia Pacific Region.

National level workshops on 'Radiochemistry and Application of Radio-isotopes' was conducted in collaboration with University of Calicut and sponsored by Department of Atomic Energy, Government of India.

National workshop on 'Nuclear Hydrology' sponsored by Central Board of Irrigation and Power, (CBIP) was also conducted by the Division.

Salient Achievements

Major research projects implemented exclusively on the application of isotope techniques to solve various water related problems:

- Application of nuclear techniques to hydrological problems of Kerala
- Global Network of Isotopic Composition of Precipitation
- An investigation on isotopic composition of precipitation, surface and sub-surface water and their interrelationship
- Development of methodology to apply environmental isotope technique for leakage investigations of a few dams in Kerala
- Environmental isotope studies on the largest fresh water lake in Kerala
- Estimation of rate and pattern of sedimentation in the Chilika lake-Orissa using environmental isotope techniques
- Isotope and Hydro-chemical mapping of two River basins in Kerala and an island in Lakshadweep
- Application of isotope techniques for ground water investigations for the Kolar semi-arid regions-Karnataka State
- Migration of pesticide in soil-water-plant environment - a study using phosphorus-32 labelled potassium phosphonate compound effective against foot rot disease of black pepper
- Isotope hydro-geochemical investigations of coastal aquifers in northern Kerala to elucidate salinisation processes and discrimination of pollutant sources
- Geochemical and Isotopic Characterization of Groundwater in Multi Aquifer System along Alleppey Coast, Kerala
- Isotope Fingerprinting of Pamba River Basin



Publications – Based on the research findings 32 research papers have been published in various National and International Journals and Conference Proceedings. Other than this, over 15 technical / research reports have also been published under various projects.

Guidance- Scientists of IHD are recognized as guides from Calicut and Kannur Universities. Many students who are pursuing M.Sc. or M.Tech. degrees are guided by the scientists for their dissertation work. Six research scholars are pursuing for their Ph D degree, under the guidance of IHD scientists.

Major Funding Agencies

Recognizing the capabilities of IHD, many International, National and State level funding agencies are supporting various projects/programmes. Some of the major funding agencies are :

- International Atomic Energy Agency (IAEA-Vienna)
- Department of Atomic Energy (DAE-BRNS, GoI)
- Department of Science and Technology (DST, GoI)
- Kerala State Council for Science, Technology & Environment (KSCSTE)
- Chilika Development Authority (CDA, Govt. of Odissa)
- Kerala State Electricity Board (KSEB)
- Kerala Water Authority (KWA)
- Fertilizer and Chemicals Travancore Ltd (FACT)

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ISOTOPE HYDROLOGY DIVISION

CENTRE FOR WATER RESOURCES DEVELOPMENT AND MANAGEMENT (CWRDM)

(An Institution of Kerala State Council for Science, Technology and Environment Govt. of Kerala)

Kunnamangalam, Kozhikode, Kerala – 673 571

CWRDM – An Overview

Centre for Water Resources Development and Management (CWRDM) is one among the chain of autonomous research institutions established by the Government of Kerala under its progressive Science and Technology policy in 1978. The Centre was amalgamated with the Kerala State Council for Science Technology and Environment (KSCSTE) in 2003. CWRDM functions with nine scientific divisions (Surface Water, Groundwater, Environmental Studies, Water Management-Agriculture, Isotope Hydrology, Water Quality, Training Education & Extension, Geomatics and Library, Documentation & Information). There are three Sub-Centres of CWRDM located at Neyyattinkara (Thiruvananthapuram), Kottayam, and Manimalakunnu (Ernakulam), to address the special R&D needs of different agroecological regions of Kerala. The Centre presently has a multidisciplinary team of 27 scientists specialized in water resources engineering, hydrology, environmental engineering & sciences, agricultural engineering & sciences, chemical sciences, hydrogeology, biological sciences, social sciences, etc., facilitating inter-disciplinary research with the support of 33 technical staff, and 57 administrative staff.

Isotope Hydrology Division (IHD)

Isotope Hydrology Division (IHD) came into existence in the year 1994 by invigorating the erstwhile Radio Tracer Laboratory, which was functioning since 1984. IHD has the following laboratories:

I) **Environmental Isotope Laboratory**
II) **Radio Tracer Laboratory**

In the early years of its inception, studies pertaining to soil-plant-water relationship using artificial radioactive isotopes were mainly undertaken. Subsequently, application of stable and radioactive isotopes of natural origin was started for better understanding of the hydrological cycle and its vagaries in the environment. Presently, research activities of the Division embrace the frontiers of surface water hydrology, groundwater hydrology, water management, hydrometeorology, pollution and not the least, basic research. In addition to the regular research activities, IHD also undertakes consultancy programmes as per the need and demand from various user departments/agencies, within and outside Kerala State.

Vision of IHD

IHD shall be a Centre of Excellence in Isotope Hydrology for undertaking research and training in the field of water resources.



Mission of IHD

- To improve the understanding of water related issues and problems using isotope techniques for sustainable development and management of water resources
- To collaborate and interact with national and international agencies/institutions in advanced research in isotope hydrology
- To create awareness and impart training to personnel from academic, R&D institutions and user departments on the use of isotope techniques to address water related issues

Major Research Areas

The Division focuses on the following research topics pertaining to hydrological and environmental issues:

❖ Origin and transport mechanisms of precipitation ❖ Surface water – groundwater interconnection ❖ Hydrograph separation ❖ Aquifer-aquifer interaction ❖ Groundwater recharge studies ❖ Soil moisture movement ❖ Groundwater velocity and direction ❖ Salinization ❖ Pollution source discrimination ❖ Stream flow measurement ❖ Seepage in dams and canals ❖ Sedimentation in lakes and reservoirs ❖ Wetland studies

National Isotope Facility for Hydrology

A state of the art laboratory for isotope analysis, the NATIONAL ISOTOPE FACILITY was established at the Division in the year 2004-05 with the financial assistance from Department of Science and Technology (DST), Government of India under the IRHPA scheme along with a supporting grant-in-aid from KSCSTE. The Facility was created under the project - Stable Isotope Facility for Research in Basic and Applied Sciences.

Salient features of National Facility

- A state-of-the-art laboratory for stable and radio isotope analysis
- One among the six fully equipped isotope laboratories in the Country
- Analytical facility is available on payment for professionals in isotope techniques
- On-line reservation facility for analytical services and up to date information on the status of the reservations are available to the public.

The details can be viewd in the URL: **www.cwrdm.org/national facility**

Major Infrastructure Facilities

❖ Isotope Ratio Mass Spectrometer (IRMS) ❖ GasChromatograph-Mass Spectrometer (GC-MS) ❖ Ion Chromatograph (IC) ❖ Ultra Low Level Liquid Scintillation Counter (ULLLSC) ❖ Tritium Enrichment Line ❖ Multi Purpose Liquid Scintillation Counter ❖ High Purity Germanium Detector (HPGe) ❖ Alpha Spectroscopy System ❖ Gamma Ray Spectroscopy System [NaI (Tl) ❖ High Performance Liquid Chromatography System (HPLC) ❖ Mini Liquid Nitrogen Plant ❖ Deep Water Sampler ❖ Sediment Gravity Corer ❖ Freeze Dryer ❖ UV-Vis Spectrophotometer ❖ Portable Multi Parameter Water Quality Analyzer



Collaborative Research Activities

Many research institutions and universities have joined hands with the Isotope Hydrology Division in probing perplexing hydrological problems using isotope technique to achieve lucid information. The Division, through the project – Stable Isotope facility for Basic and Applied Sciences - has rendered financial and technical support to these collaborating institutions. The problems addressed through these collaborative programmes include sedimentation rate in lakes; interconnection between water bodies; pollution-source & extent; saline water intrusion; tank hydrology; etc. The study area investigated spans from coastal plains to the highlands; from the arid, semi arid to humid climates; and involves, saline to freshwater lakes, wetlands, shallow & deep aquifers, percolation tanks, reservoirs, river basins, islands, etc.

Collaborating Institutions

❖ Physical Research Laboratory, Ahmedabad, Gujarat
❖ Indian Institute of Spices Research, Kozhikode, Kerala
❖ National Institute of Technology - Warangal, Telangana
❖ National Institute of Technology - Kurukshetra, Haryana
❖ National Institute of Technology - Calicut, Kozhikode, Kerala
❖ Madras University, Chennai, Tamil Nadu
❖ Bangalore University, Karnataka
❖ Tamil Nadu Agricultural University, Tamil Nadu
❖ Jawaharlal Nehru Technological University, Hyderabad, Telangana
❖ Andhra University, Visakhapatanam, Andhra Pradesh
❖ Amity University, Noida, Delhi
❖ Annamalai University, Chidambaram, Tamil Nadu
❖ Kerala University, Thiruvavnanthapuram, Kerala
❖ MES Ponnani College (Calicut University), Malappuram, Kerala
❖ Karunya University, Coimbatore, Tamil Nadu

Outreach Programmes

Trainings - Isotope Hydrology Division is engaged in many outreach programmes in order to create awareness about the potential applications of isotope techniques in water resources development and management among the professionals and academic community. Series of weeklong