

# W A T E R

## Technologies for Better Quality of Life

### WATER RESOURCES MANAGEMENT

During the last few decades, BARC has developed and successfully applied a number of isotope techniques for water resources management in collaboration with a number of end user organizations.

The techniques employed include the use of naturally occurring environmental stable isotopes of water (Deuterium and Oxygen-18), cosmic ray produced radioisotopes in the environment (Tritium and Carbon-14) and reactor produced radioisotopes (Bromine-82, Gold-198, tritium etc.).



*Mass spectrometer for measurement of stable isotopes of water*

Isotope techniques have been applied in the following investigations

- Groundwater salinisation and pollution
- Groundwater recharge in arid / semi arid areas
- Interconnection between water bodies
- Seepage in dams, reservoirs, tunnels etc.
- Flow measurements in mountainous rivers
- Dispersion of effluents in marine environment

#### **Salinisation of groundwater in coastal/inland aquifers**

Isotope techniques are useful for identification of the source of salinity and investigation of salt water- fresh water dynamics. For example, in coastal Orissa, isotopes provided the following unique information.

a) Salinity of groundwater is not due to present day seawater. It is mainly due to ancient transgressions of sea and subsequent entrapment of the seawater in the deltaic sediments.

b) A fresh water aquifer at a depth of ~ 100m receives modern recharge and could be a source of fresh water for exploitation.



*Groundwater monitoring in coastal Orissa*

The investigation was carried out in collaboration with State Groundwater Department, Orissa.

### **Arsenic Pollution of groundwater in some parts of West Bengal**

Isotope investigations were carried out in Murshidabad and 24 Parganas districts of West Bengal in collaboration with Central Groundwater Board, Kolkatta, to understand groundwater dynamics and arsenic release from sediment to the groundwater. The investigations showed that deep groundwater (> 80m) are generally arsenic free and old. They could be exploited for drinking purpose.

### **Groundwater recharge investigations in arid Western Rajasthan**

Isotope techniques have been applied in Jalore, Barmer, Bikaner and Jaisalmer in collaboration with Groundwater department Jodhpur, to understand recharge process to the aquifer. The studies showed that most of deep groundwater (> 200m) in these areas are not replenished in modern times. Excessive exploitation of these resources could lead to depletion of the water table.



*Groundwater sampling for Carbon-14 in Western Rajasthan*

### **Interconnection between surface water and groundwater – Jamarkotra Phosphate mine, Udaipur**

As the mining in the open cast rock phosphate mine at Jamarkotra reached the groundwater table, it needed to be dewatered. Intense dewatering resulted only in marginal fall in the groundwater level showing possibility of water ingress from reservoirs located within 9 km from the mine.

Isotope investigations carried out in collaboration with Rajasthan Mines and Minerals Ltd., Udaipur showed that a) the reservoir water was not connected to the mine water and b) the pumped water appeared to be recycled to the groundwater due to poor drainage. This helped the mine authorities to take necessary remedial measures.

## **Aquifer - aquifer interconnection - Cauvery delta, Tamil Nadu**

In the Cauvery delta in Tamil Nadu vagaries of monsoon and consequent problems of inter-state river water transfer often pose problems of water availability. Artificial recharge of local groundwater was considered a possibility to overcome the problem to some extent. To ensure feasibility of artificial recharge interconnection between the shallow and deep aquifer needed to be confirmed. Isotope investigations clearly showed that the 2 zones were generally not interconnected due to presence of clay lenses. The investigations were carried out in collaboration with Public Works Department, Tamil Nadu.

## **Flow measurements**

Flow measurements of fast flowing mountainous rivers are difficult by conventional methods due to high turbulence and complex cross-section of the river. In such situations isotope techniques are useful to determine the flows in these rivers. Some of the discharge measurements carried out using isotope techniques include – Tons river in Uttar Pradesh, Beas river in Himachal Pradesh, and Teesta river in Sikkim. The discharge measurements helped in planning / designing of hydel power projects and/or associated drinking water schemes.



*Tracer injection in the Teesta river, Sikkim*

## **Dispersion of effluents disposed into sea**

Information on dilution and dispersion of sewage disposed into sea is required to verify the choice of a site for a proposed new outfall or to investigate the dispersion pattern around an existing one. Isotope tracer techniques could be used to obtain the information. Isotope investigations were carried out in existing outfalls in Colaba, Worli, Malad, etc. in collaboration with National Environmental Engineering Research Institute, Mumbai. The tracer experiments helped to verify model studies carried out by the collaborators.



↑ Worli (Mumbai) outfall and Tracer monitoring →



### TRAINING AND COLLABORATIONS

The following National Institutes/Organisations have been collaborating with BARC for application of these techniques in different areas:

In addition to hosting training programmes to suit individual scientists/engineers from hydrological organizations from India and abroad, IAD, BARC has facilities for group training covering all aspects of isotope hydrology



*Participants of Department of Science and Technology sponsored school on Isotope tracer techniques for water resources development and management*

- Central Groundwater Board (CGWB), Kolkatta
- Central Water Commission (CWC), Sikkim
- Groundwater Department, Jodhpur, Rajasthan
- National Environmental Engineering Research Institute (NEERI), Mumbai
- Public works Department, Tamil Nadu
- Rajasthan Mines and Minerals Ltd., Udaipur
- Salal Hydroelectric Project, Jammu
- State Groundwater Department, Orissa

**Contact:** Head, Technology Transfer & Collaboration Division  
Bhabha Atomic Research Centre, Trombay

Phone : 022-25505337 Fax : 022-25505151