3.6 WATER RESOURCES MANAGEMENT WITH RADIOTRACERS

Radiotracers play a vital role in the management of water resources in India. They also help in identifying leakages in large reserves.

Investigation of the recharge zone of springs in the mountainous Himalayan region, Gaucher Area, Uttaranchal

In the mountainous region of Uttaranchal, springs are the only available source of water for domestic and agricultural use. Insufficient spring water due to low discharge causes a lot of hardship to the people in summer. At the request of Himalayan Environmental Studies and Conservation Organisation (HESCO), Uttaranchal, environmental isotope investigation was carried out, along with hydrogeology and hydrochemistry, to identify the recharge zone of the springs in the mountainous Himalayan region.

Stable isotope ($^2$H & $^{18}$O) data of springs collected from 3 different valleys indicated that the springs located in valleys 1 and 2 were getting recharged from the same area while the springs located in the valley 3 was getting recharged from a different area. Local precipitation is the main source of recharge. Hydro-chemical results indicated that the quality of spring waters was fresh and contained Mg-Ca-HCO$_3$.

The investigation for identification of the recharge zone of the drying springs in Gaucher Area, Uttaranchal has been completed. Based on these studies artificial recharge structures are being planned by HESCO.

Evaluation of artificial recharge measures in the augmentation of the coastal sedimentary aquifers of Tiruvadanai, Tamil Nadu

For sustainability of the coastal aquifers of Tiruvadanai in Ramanathapuram district of Tamil Nadu, in terms of both quality and quantity, Tamil Nadu Water Supply and Drainage Board (TWAD) has planned a number of artificial recharge methods for replenishing groundwater resources of Tiruvadanai. At the request of TWAD authorities, environmental isotopes ($^2$H, $^{18}$O, $^3$H & $^{14}$C) investigation was carried out, in conjunction with hydro-geology and in-situ physico-chemical parameters, to evaluate the effectiveness of artificial recharge measures being adopted on a pilot scale by TWAD at the recharge area of aquifer.

From the investigation it was concluded that the modern recharge to the aquifer, through natural, incidental and artificial means, appears to be very low or slow and a suitable river for planning (large-scale) artificial recharge measures could be the one lying on the north-east boundary of the aquifer, the Manimutharu River, rather than the south-west bounded river Sarugani.
Environmental isotope studies on the largest freshwater lake in Kerala

Hydrological investigation on Sasthamkotta lake and its catchment was carried out in collaboration with the Center for Water Resources Development and Management, Kozhikode using environmental isotopes (D, 18O, 2H, 137Cs).

From the isotope study, it appears that the recent sedimentation rate in the lake ranges from ~0.18 to 1.81 cm/year, with higher values very close to an existing earthen bund, constructed at the southeast side of the lake and the predicted future life of the lake is estimated to be about ~1400 years (assuming the lake’s average depth as ~7 m). The δD - 18O data and groundwater contours suggest that the lake-groundwater system is a flow-through type. The south-east located and west flowing perennial river, Kallada is not in hydraulic communication with the lake.

Therefore, there is a need for effective management of the lake environment for sustenance of some of the dug wells located in the N and NE part of the lake.

Hydrodynamics of fresh water-saline water interface in coastal aquifers of southern parts of Chennai metropolitan area, Tamil Nadu: An isotope hydrological investigation was carried out in collaboration with the Central Ground Water Board and Dr. M. S. Swaminathan Research Foundation, Chennai to assess the ground water quality, source of recharge, interconnection between aquifers in the multi-aquifer system and ground water salinity in Tiruvanmayur aquifer.

From the investigation, it was concluded that the precipitation is the main source of recharge to the aquifer and the water quality is mostly fresh, except at Mettukuppam, Nilangarai and Shilanagar.

Stable isotopes (D & 18O) data indicated that the salinity and brackishness of ground water is not due to present day seawater intrusion but it is due to dissolution of evaporites of marine origin at Mettukuppam. The brackishness found in Nilangarai, Taramani and Shilanagar deep zones could be due to leaching of salts (non-marine) from formation as indicated by D, 18O and 14C data. [The saline and brackish groundwaters measured a 14C age of ~7000 and ~11, 000 a B.P, respectively].
Also from the investigation, it was found that the aquifer system in the study area could be considered as two-aquifer system, viz., top sandy aquifer and weathered, fractured aquifer (basement). The groundwater occurs under unconfined condition in top sandy aquifer and under semi-confined condition in the underlying basement. Interconnection has been ascertained at Mettukuppam, Ekkatur, Sholinganallur and Uthandi. The investigation would help the end user to effectively manage the groundwater resources in this coastal area.

- **Investigation of source of salinity in coastal aquifers of Sirkhazhi area, Nagapattinam district, Tamil Nadu**

To investigate the source of groundwater salinity, dating of saline groundwater and possibility of seawater-fresh water interface in the coastal aquifer of Nagapattinam district, Tamil Nadu, an isotope hydrological investigation was initiated in March 2004. A number of water samples were collected from existing hand pumps and tube wells in and around the study area for the analysis of environmental isotopes ($^2$H, $^{18}$O, $^3$H, $^{14}$C & $^{34}$S), hydrochemistry (major minor ions) and in-situ physical parameters (pH, T, EC etc). The results of the $^{14}$C analysis of post monsoon samples indicated that the saline ground waters are old waters (8000 - 10000 a B.P.

- **Investigating environment and water resources in Tatapani Geothermal area, Surguja, Chhattisgarh**

This study is being carried out in collaboration with the Geological Survey of India (GSI) (Central Region), Nagpur. 31 water samples from various water bodies in and around the geothermal area have been collected for chemical and isotopic analyses. Chemical analysis of the water samples will be carried out at GSI, Nagpur. The $^{18}$O analyses of the samples are completed. D analyses will be taken up shortly. $^3$H values of the samples indicate that the hot thermal waters (~1 TU) are older as compared to cold thermal waters of the area.

- **Leakage Problem of Nagewadi Dam, Maharashtra**

At the request of dam authorities, isotope hydrological investigation on leakage problem of the minor irrigation dam, Maharashtra was carried out using environmental isotopes ($D$ & $^{18}$O) and dye tracer (Rhodamine-WT) to know the source of tail channel leakage and identify entry levels for d/s face leakages. From the investigation, it was concluded that the source of tail channel leakage was from the reservoir and not from the local groundwater and the entry levels for d/s face leakages did not lie near the head regulator. Thus it was suggested to the dam authorities that the earlier planned remedial measures near the head regulator were not essential.

- **Confirmation on the location of a hydraulic piezometer of Ranjit Sagar Dam Project in Punjab**

Environmental isotopes ($^{18}$O, D & $^3$H) investigation was carried out to confirm the location of hydraulic piezometer (no. 13 indicated in the figure) embedded in the foundation gallery of the multi-purpose and inter-state project. It was concluded that the piezometer as per the design records was not located at the d/s of core of the main dam instead it was wrongly placed at the u/s of core of main dam. This finding corroborated the dye tracer experiments carried out by the resident geologist of dam project. Thus it was suggested to the dam authorities that higher pore potential readings of the piezometer, which was of deep concern from the safety point of the dam, might be either ignored or taken as the u/s pores potential readings.

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Schematic layout of Ranjit Sagar Dam with interpreted geology (Comprising of alternate sandstone and clay stone bands)