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Environmental isotopes, Multi tracer technique and Hydrogeochemical approach to study pollutant behavior in the unsaturated zone at IARI Farm, New Delhi

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Natural resources are fast depleting due to enormous increase in population. Groundwater, an important natural resource due to its increase in demand for industry, agricultural and drinking etc. is not only depleting but is also subjected to pollution.. In IAEA/CRP on "Isotopes in the study of pollutant behavior in the unsaturated zone for groundwater protection" emphasis has been given on understanding pollutants behavior in the unsaturated zone generated from agricultural activities, in particular, due to application of fertilizer inputs (Nitrate) to the variety of crops Groundwater being an important natural resource, it is important to protect it from getting polluted. It is hence essential to have a clear understanding of the complex process (physical, chemical and biological etc.) undergoing in the unsaturated zone. Tracers (Radiotracers, chemical and stable isotopes ^{13}C, ^{18}O, ^{2}H) and hydrochemistry give good insight about the pollutant behavior in the unsaturated zone. Tritiated water and ^{60}Co (a gamma emitting tracer in the cyanide complex form) tracers were injected at 60 cm depth along with chemical tracers (Li^+ and Br^-) for pollutant transport study in the unsaturated zone at the Indian agricultural Research Institute (IARI) farm, New Delhi. Tritium and ^{60}Co tracer displacements were measured by liquid scintillation and sodium iodide scintillation method respectively. Li^+ and Br^- tracers displacement were measured by ion chromatography. These tracer studies indicate that the pollutants may reach the groundwater in about four years as saturated zone starts from 11 meters. The groundwater samples from the tube wells located in the IARI farm were collected yearly and analyzed for major ion chemistry, $\delta^{18}O$, δD, and field parameters (pH, conductivity, temperature, alkalinity etc.). Water quality was found to be Na – Ca - Mg - Cl – HCO_3 type. In the δD - $\delta^{18}O$ plot groundwater samples were clustered in to a group indicating same source and was due to existing distribution system of the water in the IARI farm. Soil cores up to 6.8 m depth were taken out from rain fed and irrigated sites for major ion chemistry and isotope analysis. In the irrigated site, nitrate moved to deeper depths as compared to the rain fed site. ^{13}C in the soil solutions, in air CO_2 and in groundwater as DIC was measured for understanding the biochemical processes taking place in the unsaturated zone.