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Potential estimation of groundwater recharge using pesticides as tracer

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Pakistan, a developing agrarian economy has achieved self sufficiency in food grains due to extensive development of the groundwater resource by farmers to supplement surface water supplies to meet crop water requirements. Pakistan has the largest contiguous gravity irrigation system of the world but it was mostly designed for cropping intensities ranging between 50 and 75%. Higher population growth rate forced the farmers to cultivate their lands more intensively to earn their livelihood. Furthermore, water logging due to seepage of surface water from the irrigation system and farmer fields, technological advancement in well technology, government incentives to the farmers for installation of wells to drain the agricultural land and drought-like conditions in the last decade of the previous century were other driving forces behind consistent development of groundwater resources for irrigation over half a century. Groundwater development for irrigation through tubewells was highest in the Punjab, the most populated of the four provinces of Pakistan. Its contribution in agricultural production is highest too. Cropping intensity in Punjab now exceeds 130% and in some areas it is around 200%. Groundwater meets the additional crop water requirement rising from this increased cropping intensity. The consequence of heavy groundwater withdrawal is found in declining groundwater tables, secondary salinization due to pumping of underlying saline water and intrusion of saline water from under developed saline water areas to over-exploited freshwater areas.

To study groundwater use and recharge, a study was conducted in the rice-wheat zone of Rechna Doab in Punjab, Pakistan, to estimate recharge. Behavior of banned and current pesticides (for example DDT) in groundwater was studied, through samples collected in the command area of Lgar Distributary of Upper Gugera Branch Canal originating from Lower Chenab Canal. Samples were collected from hand pumps, medium and deep tube wells installed in the area, hence representing three different depths. Nine farmer farms were selected: three each at head, middle and tail of the three sample watercourses of the Lagar distributary to record inflow to the area from all irrigation sources and rainfall. Outflow by evapotranspiration by rice and wheat crop grown in the sample farms was calculated. Groundwater levels were monitored from observation wells installed along five of the nine observation farms. In this paper, data collected from the nine farms will be used to estimate spatial irrigation return flow and groundwater use keeping evapotranspiration as a check, while pesticides information will be used to estimate overall annual groundwater recharge in the area.