An Investigation of Aquifer Recharge Sites Identification Using Spatial Technologies

Debasish Das, Department of Environmental Science, University of Kalyani, PIN 741235, India

ABSTRACT

To ensure sustainable supply of ground water it is essential to take practical measure for ground water storage augmentation through recharge of aquifer by constructing suitable structure. Proper site selection for a recharge structure is no less important than the other aspects of the entire recharge program. This is again more realistic where the country rock is hard and fractured. Upper catchment area of Kangsabati river basin, Purulia, eastern India bounded by latitude $23^0$05′ to $23^0$30′N and longitude 86^0 to 86^0 20′ E, the present study area belongs to peninsular India and comprises of hard crystalline gneissic rock. The terrain has low porosity (less than 5 percent) and very low permeability (10^{-1} to 10^{-5} Darcys). This area is agriculturally drought prone, having an average annual rainfall of 1200 mm. The regional slope is moderate and this prevailing situation promotes high surface run-off and low infiltration.

In a drainage basin, the land surface within the limits of the basin perimeter constitutes a system boundary through which precipitation is imported. In general low drainage density is an indicator of highly permeable subsoil material with good vegetative cover. High drainage density is favoured in regions of impermeable subsoil material with sparse vegetation and moderate to high relief. On the basis of above concept, the entire area has been studied for identification of artificial recharge sites. The area has been divided into two categories (low and high) of drainage density values with respect to 3^{rd} order sub-basin. Low drainage density values range from 1.55 to 2.97 km/km^2 and high drainage density values range from 3.13 to 7.41 km/km^2. Drainage map (Scale, 1:50,000) has been developed using survey of India (SOI) topographical sheet and Indian Remote Sensing Satellite (IRS) – IB standard false color composite (FCC) data aided by field verifications. Hydrogeomorphological and land cover/ land use thematic maps have also been prepared using the same tools. Individual thematic layer has been digitized and overlay analysis is performed using GIS technique involving the individual thematic layer like drainage density, hydrogeomorphology and land use/land cover to arrive at a prognostic spatial model in the form of a composite map (scale,1:50,000) which reveals the suitable sites for locating artificial recharge structures. Water table data of pre and post monsoon seasons have also been considered for proper accomplishment of the work.

It has been observed that the values of drainage density and stream frequency indicate that a major portion of rainwater drains as surface run-off. Higher values of bifurcation ratio corroborates the presence of some elongated shaped basins with highly dipping rocks. Since the crystalline rocks of the area have low permeability, groundwater accumulation takes place within channel fill of present and older fluvial systems, which are mostly engraved in the deep-seated interconnected fractures and in the weathered pediplain. Areas having low values drainage density and characterized by alluvial and/or weathered residuum overlying fractured basement crystallines appear to be prospective sites of groundwater recharge.