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GROUND WATER BALANCE STUDY TO DEVELOP A TECHNIQUE TO IMPROVE THE GROUNDWATER SYSTEM IN VAVUNIYA

S. S. Sivakumar

This study presents policy alternative to operate minor / medium irrigation schemes as a new technique to improve groundwater systems in the Vavuniya area for the lifting of water table for the economic pumping for agricultural and domestic water use, by optimizing the use of groundwater and surface water.

Forty one dug wells were identified as observation wells within a study area of about 185.23 km^2 in Vavuniya to represent the system. This study area was divided into forty one Thiessen polygons by connecting the perpendicular bisectors of adjoining observation wells, with three years seasonal historic water levels, together with four year seasonal and one year monthly collected water levels (Oct.1997 - May.2005).

A groundwater simulation model was formulated in electronic spreadsheet for this polygonal net work using integrated finite difference method. A complete water balance study for each polygon for each season was carried out. The model was calibrated for the period from 1997 to 2003 having twelve seasons. The recharging season of eight months was taken from 1st October to 31st May of the following year and discharging season of four months was taken from 1st June to 30th September. Since the initial value was taken as at October 1997, the time step Δt was taken as 8 months followed by 4 months. These time steps were used alternatively throughout the calibration period.

Forty one error models have been prepared for the water balance, for each polygon for all the season. Each error model is a function of Transmissibility, Storage coefficient, Recharge coefficient for Irrigation scheme, Recharge coefficient for irrigation field, Recharge coefficient for rainfall and the Withdrawal factor for agro and domestic pumping. To avoid the negative & positive errors getting cancelled, the squares of each seasonal error were added and minimized with suitable constrains. By this calibration the hydro geological stress parameters such as Transmissibility, Storage Coefficient, Recharge Coefficient for Irrigation scheme, Recharge Coefficient for irrigation field, Recharge Coefficient for rainfall and the Withdrawal factor for agro and domestic pumping were found using optimization technique. MATHCAD 2000 was used for this optimization.

Using the results obtained, validation of the model was carried out with next two seasonal water levels. The model successfully predicted the water levels with very little error (less than three percent). This integrated finite difference model in spreadsheet was used to predict the system of behavior for various operational policy of the Vavuniya groundwater system.

Water levels were predicted for boundary treatment to reduce the transmissibility in steps, change in operational policy of minor / medium irrigation schemes by forgoing

certain percentage of cultivation and combination of both. The economic feasibility was analyzed taking the energy saved in pumping of raised groundwater as return and boundary treatment cost and income loss due to change in operational policy of minor / medium irrigation schemes by forgoing certain percentage of cultivation as cost. The present worth of benefit and cost for various interest rate and implementation period were calculated and compared.

Change in operational policy of minor / medium irrigation schemes by forgoing one third of the cultivation under minor / medium irrigation schemes or keeping one fourth of the storage of minor / medium irrigation schemes at any time will recover on an average of 45% to 65% of the loss of water table in any consecutive seasons in almost 80% to 90% of the area under consideration.

Key words: ground water, irrigation scheme, domestic water use, water management, economic pumping.

Deputy Director of Irrigation, Mullaitivu, Sri Lanka.