ESTIMATION OF GROUNDWATER RECHARGE

The utilizable water resources of India are estimated to be $112*10^6$ ha m out of which $69*10^6$ ha m are surface water resources and $43*10^6$ ha m are groundwater resources. Due to uneven distribution of rainfall, both in time and space, the surface water resources are also unevenly distributed. The development and over-exploitation of groundwater resources in certain parts of the country have raised the concern and need for judicious and scientific resource assessment, management and conservation.

The Groundwater Estimation Committee (GEC, 1997) recommended that the groundwater recharge should be estimated based on groundwater level fluctuation method. This Committee proposed several improvements in the existing methodology based on groundwater level fluctuation approach.

TECHNOLOGY

The methodologies adopted for computing groundwater resources are generally based on the hydrologic budget techniques. The estimation of groundwater balance of a region requires quantification of all individual inflows to or outflows from a groundwater system and change in groundwater storage over a given time period. With water balance approach, it is possible to evaluate quantitatively individual contribution of sources of water in the system, over different time periods, and to establish the degree of variation in water regime due to changes in components of the system. Considering the various inflow and outflow components in a given study area, the groundwater balance equation can be written as:

$$R_r + R_c + R_i + R_t + S_i + I_g = E_t + T_p + S_e + O_g + \Delta S \quad \ldots (1)$$

where R_r is the recharge from rainfall, R_c is the recharge from canal seepage, R_i is the recharge from field irrigation, R_t is the recharge from tanks, S_i is the influent seepage from rivers, I_g is the inflow from other basins, E_t is the evapotranspiration from groundwater, T_p is the draft from groundwater, S_e is the effluent seepage to rivers, O_g is the outflow to other basins, and ΔS is the change in groundwater storage. Preferably, all elements of the groundwater balance equation should be computed using independent methods.

Groundwater balance study is a convenient way to establish rainfall recharge coefficient and to cross check the accuracy of various prevalent methods for estimation of groundwater losses and recharge from other sources.

By quantifying all the inflow/outflow components of a groundwater system, one can determine which particular component has the most significant effect on the groundwater flow regime. Alternatively, a groundwater balance study may be used to compute one unknown component (e.g. the rainfall recharge) of the groundwater balance equation, when all other components are known. In this manner, the study of groundwater balance has a significant role in planning a rational groundwater development of a region.

The National Institute of Hydrology conducted a detailed seasonal groundwater balance study in Upper Ganga Canal command area for the period 1972-73 to 1983-84 to determine groundwater recharge from rainfall. It was observed that as the rainfall increases, the quantity of recharge also increases but the increase is not linearly proportional. The recharge coefficient (based upon the rainfall in monsoon season) was found to vary between 0.05 and 0.19 for the study area. An empirical relationship (similar to Chaturvedi formula) has been developed by fitting the estimated values of rainfall recharge and the corresponding values of monsoon rainfall through the non-linear regression technique.

$$R_r = 0.63(P - 15.28)^{0.76} \quad \ldots(2)$$

where, R_r is groundwater recharge from rainfall in monsoon season (inch) and P is the mean rainfall in monsoon season (inch). The relative errors (%) in the estimation of rainfall recharge computed from the above empirical relationship were compared with groundwater balance study. In almost all the years, the relative error was found to be less than 8%.

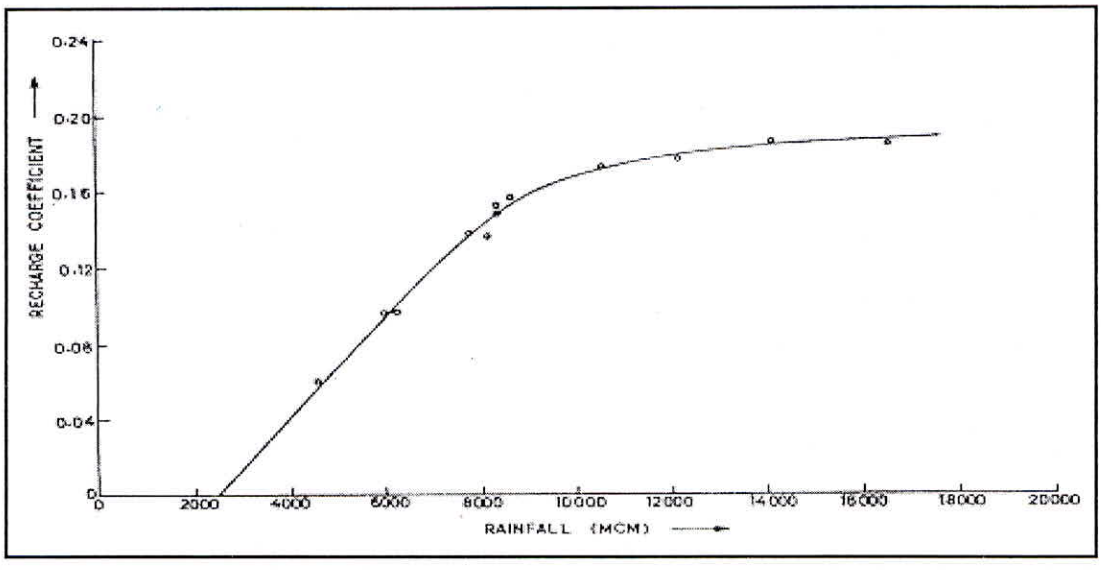

Figure – 1 Variation of recharge coefficient with rainfall

Therefore, Eq.-2 can conveniently be used for better and quick assessment of natural groundwater recharge in Upper Ganga Canal command area.

ENVIRONMENTAL IMPACT

The groundwater balance studies will help in planning sustainable development of groundwater resources that will have only the positive impact on the environment.

ECONOMICS

The implementation of this technique will lead to reasonable assessment of groundwater resources in the country so that judicious and scientific management of groundwater resources could be made. Thus, it will have intangible benefits.

BENEFICIARIES

All Central and State Government Groundwater organisations, semi-government organisations; NGOs, and the public, in general, concerned with groundwater development programmes.

INTELLECTUAL PROPERTY RIGHTS

No element of Intellectual Property Rights is involved in the use of this technology.