ASSESSMENT OF SPRING FLOW

India runs one of the largest rural water supply programmes in terms of physical and financial dimensions and eighty percent of the water needs of the rural area are met from groundwater. Hilly areas, though receive high rainfall, suffer due to lack of appropriate amount of water in respect of social, economic and health parameters. Springs, which are natural outlets for concentrated groundwater discharge, are ready, viable and clean sources of water. They are found in good numbers in the Himalayas, in Western Ghats, in North-eastern region, in the Vindhyan formation of Central India and in many other places. Great rivers like Cauvery and Jhelum originate from springs.

There are disquieting reports that the spring flow has decreased to the tune of 50% in the Himalayas and places in the north-eastern region during last three decades. Strategies based on hydrologic principles to rejuvenate and nurture spring flow will definitely contribute to augment the rural water supply, particularly in the hills where it may not be always possible to have adequate storage facility due to logistic reasons.

TECHNOLOGY

A few conceptual linear mathematical models that were developed during last two decades to assess spring flow assume that the spring flow is linearly proportional to the dynamic storage inside it and these models can accept only lumped recharge in the beginning. Bear model is one such popular model which is applicable for geologic formations having primary porosity. These models essentially provide a straight-line relationship during recession between spring flow and time on a semi-logarithm plot with spring flow on log scale (Eq.-1, and Fig.-1). The slope of straight-line for one log cycle divided by 2.3 gives the value of depletion time.

$$Q(t) = Q(o) \exp(-t/t_o) \qquad ...(1)$$

where, Q(t) is the spring flow at time t during recession, Q(o) is any reference spring flow at a time previous to t during recession, t is the time increment and t_o

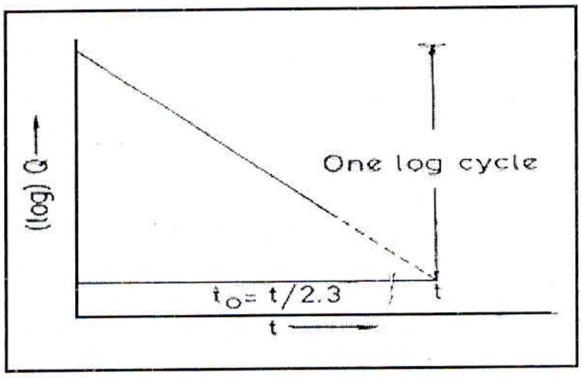

Figure – 1 Determination of depletion time

is a parameter of the spring representing recession characteristics and depends on geology and geomorphology relating aquifer geometry and its properties and is designated as depletion time. Eq.-1 can be used to estimate the spring flow. The dynamic storage at any time during recession is Q(o).

The recharge to spring flow domain between the end of one dry season and the beginning of next one can be estimated by Eq.-2 following the principle of continuity.

$$\int_{t_1}^{t_2} AR(t)\,dt = Q(t_2).t_0 - Q(t_1).t_0 + \int_{t_1}^{t_2} Q(t)dt \qquad \ldots(2)$$

where, R is the recharge (LT^{-1}), A is the recharge area of the spring (L^2), t_1, t_2 are the instances of time at the end of one dry season and the beginning of the next one, and Q_1, Q_2 are the spring discharges at t_1 and t_2 respectively.

At NIH, the Bear model has been adopted to simulate spring flow for the time-variant recharge. The adopted model can also be used to compute the time variant recharge to the spring flow domain and depletion time from an available spring flow series. The monthly recharge was estimated for a spring emerging from karstified limestone aquifer from the monthly spring flow series of seven years. The annual recharge values for seven years computed earlier is in close agreement with the summation of the computed monthly recharge by the adopted Bear model.

ENVIRONMENTAL IMPACT

As the study of spring flow on the basis of hydrologic principles provides means to develop natural resources (forest, water and soil) and rejuvenation of the dying spring, it will have positive effect on the environment.

ECONOMICS

Springs are the lifeline for the hilly areas and as such, the immediate tangible benefit of rejuvenation of springs will be in providing clean and sufficient water to rural hilly population who usually suffer due to non-availability of drinking/ potable water. As a consequence, their health and sanitation would improve and the womenfolk need not to travel far off places to fetch water. Further, it will save the construction of costly overhead storage tank in inhospitable, remote, earthquake prone hilly areas.

BENEFICIARIES

The chief beneficiary will be the hilly rural people, especially womenfolk, who usually belong to economically backward section of India's population.

INTELLECTUAL PROPERTY RIGHTS

No element of intellectual property rights is involved in the use of this technology.