Spring sanctuary development: Technique for groundwater and soil conservation

Mountain springs which are natural discharges of groundwater from various aquifers, in most of the cases unconfined, are the primary source of water for the rural household of the Himalayan region. Locally these springs are known as *Dhara* (spring water outflow from rock joints), *Naula* (a lined stone masonry structure harvesting groundwater emanating from a seep or spring) and *Gadhera* (spring branch / run usually of first or second order) in the Kumaun region of Uttarakhand Himalayas. Groundwater discharge from these springs is recharged naturally by rain and snow melt and to a smaller extent by surface water (as in the case of rivers and lakes). Groundwater recharge or deep drainage or deep percolation is a hydrologic process where water moves downward from surface to groundwater table. Recharge is the primary method through which water enters an aquifer. This process usually occurs in the vadose zone below plant roots and is often expressed as a flux to the water table surface. But with the effects of climate change, manifested in the form of rising temperatures, rise in intensity of rainfall, reduction in its temporal spread with a marked decline in number of wet days during winters, the problem of dying springs is being increasingly felt across this region (Valdiya *et al.,* 1989). Moreover, human activities such as road construction, urbanization etc. results in loss of top soil, relatively increasing degree of imperviousness thus, reducing the water infiltration and enhanced surface runoff, therefore, reducing recharge of the springs associated with the landform. Continuous draw down of groundwater, for drinking and irrigation, also lowers the water table thus putting an extra pressure on these water sources. Since rainwater is the only water available for the villages in the mid hills of the Himalayas, and owing to its increasingly uncertain nature, the solutions will lie in storing it either above ground in natural or artificial reservoirs or underground in natural aquifers. Traditionally, afforestation was the main thrust in forests lands, now there is a need to manage mountains also as 'water towers' by enhancing their ground water recharge contribution which will help both upstream and downstream communities, by reduced flooding during the monsoons and increased base flow during the lean season. These issues mark the demand for spring shed development for conservation of these prime sources of water for future water sustainability. Therefore an integrated, landscape level approach was adopted by taking up mapping of these water resources and revival of dried hill-top lakes, critical streams and springs. Some of the experiments taken up over the last few years involve augmenting the infiltration of rainwater in the recharge area of the springs and streams (watershed and springshed), strengthening the water storage infrastructure and undertaking action research (Tambe 2013).

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Spring discharge in the function of rainfall pattern and recharge area characteristics (Negi *et al.,* 2002). Spring sanctuary technology aims at enhancing the infiltration and retention of rain water in the spring recharge zone through vegetative and engineering measures such as implementing groundwater augmentation structures in the catchment of spring under considertaion like digging 45 cm deep and 60 cm wide trenches along contours, recharge pits over geologically permeable spots , gully plugging and raising stone and mud built water retaining structures in the treatment zone. Presence of vegetative cover and organic matter in the soil acts as a sponge and absorbs rain water, which is released slowly in the form of spring water yield. Therefore, the prime focus of this technology is to increase water retention time and improvement in the water holding capacity of soil for greater water infiltration in the catchment zone of springs for ground water recharge.

Major challenges faced in spring sanctuary development are recharge area identification, developing local capacity, incentivizing rainwater harvesting in farmer's fields and sourcing public financing.

Usually the catchment area lying above the water source forms the recharge zone of a spring. Many techniques are also available for recharge zone identifictaion such as isotope analysis of rain and spring water, subsurface mapping using direct and indirect methods like electrical resistivity and GPR etc.

Rock type and inclination of rocks should be favourable for water recharge. If required, fencing of the recharge zone using stone wall / barbed wire or thorny bushes or through the participation of beneficiary community (social fencing) to exclude animal grazing and human interference in the spring sanctuary may also be done.

This techniques not only promotes groundwater conservation but also helps in preventing soil erosion. The vegetative and bio-engineering measures opted reduces the momentum of flowing water thus preventing the top soil fertile from being eroded. Many field experiments using the same technology in IHR has showed promising results for spring rejuvenation and conservation. This technology has definitely enhanced rural water security at the local community in the dry season, thereby building resilience against climate change impacts.

Fig. 1. Groundwater augmentation measures (contour trenches) in the catchment of experimental spring (based on spring sanctuary concept)

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