Rejuvenation of the drying springs in the Himalayan mountains

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Himalaya is also known as the water towers of Asia but the uneven distribution of water both in space and time comes in the way of development needs of the people. Rainfall is the major source of freshwater, which is concentrated (>80% of the annual rainfall of 100–250 cm) within three months of the monsoon season that leads to a situation of "*a too-much and too-little water syndrome*" (Valdiya *et al.,* 1991). Researchers in the region have indicated that many natural and human induced reasons, such as, erratic rainfall, deforestation, forest fires, soil erosion, road and building construction, mining etc. over the hill slopes have reduced the "*sponge function- the water retention capacity*" of the fragile watersheds, and much of the rainwater run away downstream (flash floods) without infiltrating into the soil stratum that recharge the groundwater (Negi *et al.,* 2002).

Fig. 1. A typical micro-watershed in Pauri-Garhwal (Inset: Stepwell on the bottom left and spring on the bottom right; in the middle inner view of a stepwell). A step well is under lock-and-key arrangement to collect water and distribute it equally).

In the western Himalayan mountains *naula* (vary shallow 1-2 m deep, appropriately lined wells to recover water from seepage) and *dhara* (springs) are the main sources of water for drinking and household consumption (Fig. 1). Unfortunately, in the recent decades, these sources either have become seasonal with low water discharge, and some of them have dried up forever. Long queue of people at water sources in the most populated belt of this region can be witnessed almost year-round (Fig. 2). In such a situation ladies and children bringing head loads of water from distant sources is a common scene in this region and they suffer the most.

Various strategies to cope with the water shortage and reducing the waste of water have emerged in the villages, such as, modifications in the *naula* to be locked to distribute the overnight water store equally among the people, roof-top water harvesting, pumping water from the nearby streams, use of household waste water in the kitchen gardens, etc. In such a situation people are forced to reduce water consumption, consume unhygienic water, prone to water borne diseases and face social conflicts over water issues. The availability of potable water during summer drops to a low of 25-30 liter (a bucket) per capita per day (lpcd) in the densely populated localities of the region that is half of the WHO norms. Sometimes a distance of 4-5 km has to be traveled thus spending about 2-4 hrs to fetch a pale of water. of human labour. Several instances are there when water is sold @ Rs. 20-25 / container of appx. 20 liters during summer in the hill townships of Uttarakhand. As the concern over water demand is increasing in this region, understanding of the intricate relationship between ecological factors (like vegetation type), hydrological factors (like water retention and saturated hydraulic conductivity) and geometric factors (like shape, size of hill slope and channel network topology), which governs the hydrological response of watersheds is also gaining importance in water resource management.

Spring Sanctuary Development:

GBPNIHESD devised a R&D based eco-technology which emphasizes that infiltration of rainwater into the recharge zone need to be increased through engineering and vegetative measures, so that there is an augmented discharge in the springs down slope. This eco-technology also named as "*spring sanctuary development*" was applied in a micro-watershed of Pauri-garhwal, Uttarakhand by treating the recharge zone with engineering, vegetative, and social measures (Table 1).

In 1994-95 water year (1 July - 30 June), of the total rainfall, discharge was measured only 0.7% in the experimental spring before it was treated with bio-engineering measures. Subsequent to the implementation of the bio-engineering measures the discharge increased up to 1% in 1995-96 water year and 6.8% of the annual rainfall in 1996-97 water year. When considered in terms of monthly discharge, the increase in spring discharge during summer was found 3.7 times greater, from 595 L/d in June 1995 to 2170 L/d in June 1998, indicating the positive impact of ecotechnology executed by us to revive the spring discharge.

It can be pointed out that spring recharge needs multidirectional approach and action, scaling from engineering and vegetative measures in the recharge zones to social measures for management, rational use and aftercare of the water sources. There is also a need to take into account the traditional water conservation and management knowledge. Massive efforts are required to implement this ecotechnology for rejuvenation of drying springs in the western Himalayan mountains and enhance the water supply to the people.

Table 1. Ecotechnological measures applied in the recharge zone of a drying spring (Source: Negi *et al.,* 1992).

Engineering measures	Vegetative measures	Social measures
Trenches (15-30 cm deep and 1-20 m long) dug along contours	Planting of *Alnus nepalensis, Prunus cerasoides* (deciduous), and *Quercus leucotrichophora* (evergreen) trees and native grasses in micro-catchment of the spring	Local community was involved in implementation of engineering and vegetative measures in the spring recharge zone
Mud-and-stone walls (1 m high and 10 m long) constructed for water retention and pounding of rain water	Mulching leaf litter on barren spots to enhance infiltration and reduce soil moisture evaporation	People were convinced that water scarcity could be overcome if spring discharge was stored in leak-proof tanks, and if water distribution was rationalized
Pits dug for plantation and water infiltration, and barbed wire fence built around the spring	Protection of recharge zone from grazing, cutting of fuelwood and grass, and wildfire	

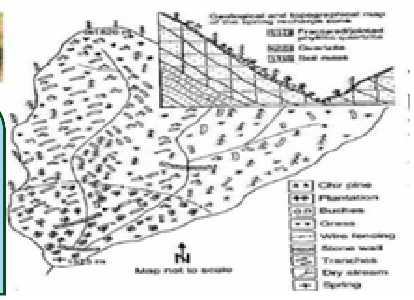

Fig. 2. Vegetative and engineering measures applied in the recharge zone of a spring in Dugar Gad watershed (Inset: Rainwater harvested in contour trenches) (Source: Negi & Joshi 2002).

References:

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