Traditional Techniques for Water Harvesting

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A watershed collects precipitation, stores part of it, and directs the remaining flow of runoff components to a common river or lake. Most of the rainwater that falls on upland areas flows away as surface runoff. Only a small portion goes into the soil to recharge soil moisture – 'green water' and an even smaller part sinks deeper to recharge the groundwater aquifers, flowing out later at the base of the incline in the form of springs and seepage water – 'blue water' – that feed the streams (Upadhya 2009). As a result of this seepage, the low lying areas of a watershed are generally water-rich for most of the year, whereas the upland areas are usually water-poor, even in areas that receive high rainfall.

In the Himalayan region, most of the rain and snow generally falls during a short period, and in some places even then only sparsely. Thus to make water available for human use, the water must be collected or 'harvested' when rain or runoff is available. Traditional techniques of water harvesting have played a vital role in supporting the rural population in water-scarce areas (Agarwal and Narain 1997). The techniques chosen depend on the amount and timing of rain, and the soil type, geology, and topography of the area. Some typical traditional techniques used for harvesting rainwater, groundwater, and surface water, are described in the following, and their potential for meeting the challenges facing water managers is discussed.

A village pond is enjoyed by cattle and tourists alike, Nepal (below); Community water harvesting in Pakistan (right)

Harvesting techniques

Ruza or zabo

Rainwater harvesting systems are common in hill areas where water is scarce, despite heavy rainfall, as for example, in the hills of Nagaland in North East India where there is an acute shortage of drinking water. Managing rainwater in Nagaland means combining a typical landuse pattern with water collecting structures The upper part of the hill slope is kept forested, below this are terraces, and below them cattle yards. The base of the slope is used to cultivate paddy. Ponds, 'ruza',

or 'zabo', are built on the ridge tops, and the middle terraces to collect runoff. The stored water is used for the animals, and then runs down to the paddy fields.

In Nepal, the monsoon rainwater is essential for the survival of the mountain communities, but is also the source of major problems. Erosion and landslides destroy lives and properties during the wet season, but there is little water available in the dry season. The general land use pattern in the Nepali hills is similar to that in Nagaland, but settlements are scattered at all levels and cattle sheds and houses are usually found together. Nepali hill farmers have devised a systematic way of managing runoff from the ridge to the valley with drainage channels and ponds built at strategic points to hold, divert, and delay the flow of runoff. These techniques help to reduce rainwater-induced damage during the monsoon, while building water reserves for the winter.

Aahal and pokhari

An aahal, or 'place for wallowing buffalo', is the Nepali name for a type of shallow community pond built to collect runoff in the hills and mountains. A pokhari is larger than an aahal and collects runoff from small catchments. Aahals are usually located close to a village where runoff and, if possible, seepage can be collected. They are around 20 to 50 sq.m and less than two metres deep. A pokhari is around 3000 to 5000 sq.m; but the shape and size varies depending on the space available. A pokhari is made both to lower the peak discharge in the runoff channel and to augment soil moisture. Some pokhari are found strategically located to hold potentially trouble-creating runoff, while some are found in grassland or on rainfed farmland (Upadhya 2009). In areas where the land is more porous, over-topping of the pond during high rainfall can wash the sides away and cause the water to flow in a gush. In such areas, farmers build several small ponds rather than a few big ones. Similarly, more smaller ponds are usually built in grazing areas as they keep a larger area moist for a longer period of time for growing grass. Large landholders also build private ponds in front of their houses which they may use for fish farming.

Johad

A Johad is a commonly used water harvesting technique in western Rajastan in India. It consists of a small but long earthen bund (small checkdam) built on the upper side of the land to hold back surface flow during rainfall and allow every drop of rainwater to soak into the soil and augment the groundwater. The system had fallen into decay until a severe drought in the 1990s when many were restored. Revival of thousands of such johads in one district not only helped farmers to grow food but also raised the groundwater level by almost 6 metres, bringing the once dead Arvari river back to life.

Ahar pyne and pat

Unlike Rajastan, southern Bihar receives a substantial amount of rain, but the area lacks water due to its gently sloping land and sandy soil. The groundwater is deep. People here use an 'ahar pyne' to collect flood water during the monsoon for later irrigation. The ahar is an area enclosed on three sides with embankments and connected to a swollen river via a pyne, a channel which can be up to 20 kilometres long. The pyne passes through farmlands irrigating crops between the river and the ahar. The ahar beds are also used to grow winter crops after the water has been drained for summer cultivation. Further south in Madhya Pradesh a similar system is used to divert water from streams flowing from the hills into irrigation channels called pats via a stone diversion lined with leaves.

Karez

The karez system is widely used in the arid areas of western Pakistan, central Asia, and China where rainfall is very low. It is one of the traditional engineering

wonders of water managment in dry areas. The karez system consists of a series of wells starting from the foothills along the hill slope and linked at the bottom by an underground channel that collects and brings groundwater to the bottom of the hill. The water can be taken out vertically or drawn at the mouth of the channel at the foot of the hill. Wells are used to reach the channel for periodic maintenance and to remove the deposited sediment using buckets. The unique advantage of this system is that it helps access groundwater for irrigation using gravity and minimises evaporation loss in channels that are usually tens of kilometres long.

Hiti or dhunge dhara

The hiti (or dhunge dhara) system is a unique water harvesting system developed in the 6th century AD to provide domestic water to the urban residents of the Kathmandu Valley. A hiti is a stone spout that channels water from springs or a shallow aquifer usually about 10 metres below the surface of the ground. Most hiti were built in a lined pit about 3 to 10 metres deep, while some were built at the bottom of slopes where there were natural springs. Shallow aquifers deplete fast, so canals called rajkulo were built later to recharge the aquifers. The rajkulo brought stream water from hills tens of kilometres away. In addition, ponds were built close to the hiti to augment the aquifer by storing rainwater (Shakya 1993). The hiti system is an excellent example of how a prudently designed system using a combination of structures and methods can help manage even a shallow aquifer to provide a sustainable water supply. Many of the centuries-old hitis continue to supply water in Kathmandu today, but there are hundreds of others that have become dry due to urban encroachment.

Other techniques

Water harvesting is not limited to the above examples. There are many other types of systems used elsewhere in the world. Most of them tap runoff water from micro-catchments rather than rainwater. Farmers in southern Tunisia, for example, use a system called jessour, in which a series of cross walls are made across small streams called wadi that originate from a mountain catchment. Sediment deposited behind the walls is used to grow figures and olives or other crops after the water drains out. Farmers in West Asia and North Africa use earthen reservoirs called tanks and hafaer to store water in gently sloping areas that receive runoff water from a stream originating from large catchments. Similar tanks are also used in southern India. Tanks can store tens of thousands of cubic metres of water, which is used for irrigation, while hafaer store only few thousand cubic metres and are primarily for domestic uses.

Lessons for the future

The different techniques described above are just a few of the different systems developed by farmers living in varied climatic, topographic, and geological conditions. Many of these structures may be able to help meet the growing water demand of an ever-increasing population if they are maintained and promoted. Not every system can be replicated; hiti, for example, cannot be built anymore as the engineering is unclear. But these traditional techniques offer a core message: that only a combination of disciplines including culture, tradition, climate, and forest, land, and water engineering can help manage water sustainably; and that surface 'blue water' sources cannot be sustained if 'green water' is degraded.

In order to understand this core message, we need to realise that the traditional water planners relied on watershed functions by which rainwater is distributed, as surface runoff, soil moisture, and groundwater reserves, unlike the modern water planners, who with sophisticated tools and structures are able to transfer water from any source and are often inclined to view streams as neverending sources. They understood that precipitation is asymmetric and available only for a few months of the year, and that only a small portion is stored naturally.

It is important to understand that for all practical purposes surface or 'blue water' means visible stream flow. Most modern techniques for managing water are related to blue water sources, replenished by groundwater in the upland areas, which in turn is recharged only when the soil above is saturated. The sustainability of blue water sources depends on what fraction of rainwater has gone into the groundwater. This is where managing rainwater in upland areas becomes important for maintaining both green and blue water sources. The traditional water harvesting systems carry a wealth of wisdom. Analysing them can help us understand the limitations of the area-specific water cycle and its components and help us identify sustainable ways to manage water.

References

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