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Soil-cement tanks and drip irrigation

Enhancing water storage and its efficient use for smallholder farmers

Irrigation for mountain farming: Essential but scarce

Water scarcity plagues mountain farmers across the Hindu Kush Himalayan (HKH) region. Although the HKH is known as the water tower of Asia, farmers are largely dependent on rain-fed farming. Only 35% of mountain agriculture is irrigated, because settlements and farmlands lie uphill from rivers. Moreover, many springs which supply groundwater for agriculture are drying up or becoming seasonal.

Water scarcity coupled with growing youth outmigration has also led to increasing agricultural land abandonment and falling productivity. Climate change has further exacerbated the water scarcity problem – with increases in temperature, prolonged droughts, and shifts in the monsoon pattern compounding the woes of mountain farmers. Moreover, women and girls, given their traditional roles, have to toil hard to fetch water for drinking and irrigation.

These changes have hit farming households of the HKH mid-hills and mountains hard.

Only 27% of agricultural land in Nepal has access to irrigation while others are rainfed!

Innovative solutions for water storage and efficient use

With water scarcity placing food and nutrition security at peril, mountain farmers have to adopt water management and efficient use practices such as rainwater harvesting, water collection ponds (soil cement tanks, plastic-lined ponds), drip irrigation, and mulching. These technologies are scientifically tested, low-cost, simple, and gender-responsive solutions that can be easily replicated and scaled out.

Among these technologies, soil-cement tanks and drip irrigation are popular among smallholder farmers because they are simple, affordable, eco-friendly, and durable (15–20 years). They perform much better than plastic-lined ponds, which are common in the HKH mid-hills but are susceptible to damage by rodents when the water level is low during the dry season.

What is a soil-cement tank?

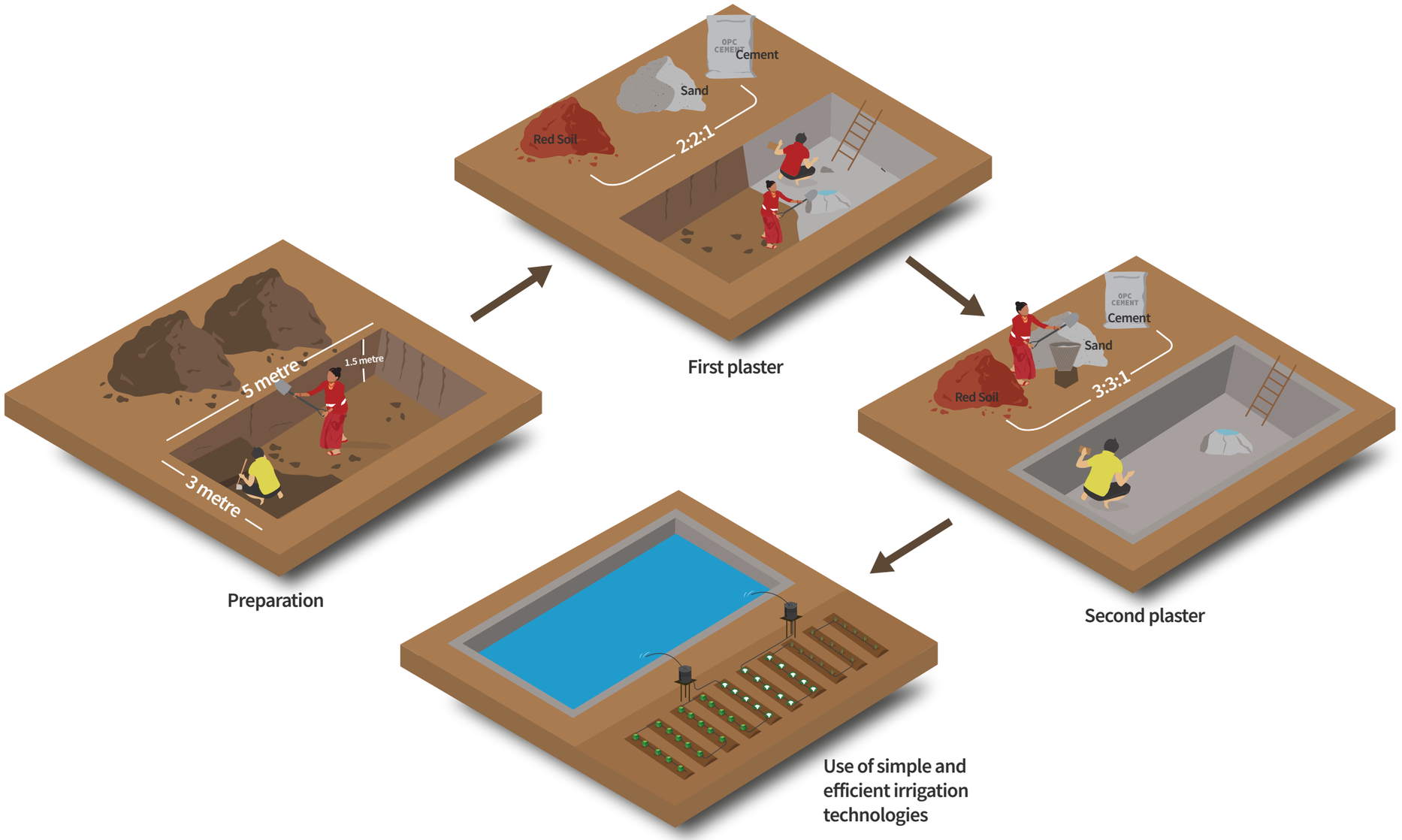
A soil-cement tank is a semi-permanent structure constructed by mixing red soil, sand, and cement. It is used to store residual tap water, rain water, and spring water. The tank's size may vary depending on the space available and the water required for irrigation.

The tank should be constructed preferably on an elevated space to aid proper water discharge and gravity-fed irrigation. The site should be close enough to collect residual or excess tap water, rain water or water from the nearby springs. The tank can be enclosed by low-cost bamboo fencing for safety and surrounded by trees to minimize evaporation loss.

Materials and costs

Materials like OPC cement, well-sieved sand, and red clay soil are required for the construction of soil-cement tank. The red clay soil should be dried, crushed, and sieved to remove any pebbles and plant parts. If PPC cement is used instead of OPC, it is essential to add a water-proof mix.

The minimum recommended capacity is 22,500 litres (3 × 5 × 1.5 m3), which costs approximately NPR 19,050 (USD 1 ≈ NPR 120 as of July 2020).



Construction

Preparation

- Select a suitable site with a sufficient catchment.
- Design the layout as per the preferred size.
- Dig out soil and remove any protruding stones and roots.
- Make the floor and side walls compact and smooth.
- Use gravel and pebbles for the base and level off the floor and side walls.

First plaster

- Apply initial mixture of soil, sand, and cement (3:3:1) to roughly plaster all the side walls and mix gravel in the mixture while plastering the floor.
- The following day, the roughly plastered tank should be watered and covered with wet jute sacks to keep it moist. This should be continued for 3–4 days.

Second plaster

- Apply a second mixture of soil, sand, and cement (2:2:1) to smoothly plaster the floor and side walls.
- Water the tank for the next 3–4 days and cover with wet jute sacks.
- Around 4–5 days after the second plaster, fill the tank with water.
- For safety, the tank can be enclosed with a bamboo fence (or using other locally available materials).

Maintenance

The sediment that accumulates in the tank should be carefully removed manually every year. If cracks are seen on the surface, they should be sealed with a mixture of soil, sand, and cement (3:3:1).

Drip irrigation and its benefits

The soil-cement tank can be used in combination with a drip irrigation system to produce seasonal and off-season vegetables through efficient water use during the dry season. Drip irrigation is a simple, low-cost, water-efficient irrigation technology that offers around 50%–90% greater water savings when compared with traditional irrigation systems such as flood, furrow, and bucket irrigation. It supplies water to the root zones of individual plants from evenly spaced water emitters embedded into a small-diametre plastic pipe. In doing so, it avoids water loss from surface evaporation, infiltration, and percolation, and also prevents soil fertility loss due to surface water runoff.

Use of drip irrigation saves two working days for each crop season. It has a relatively low initial cost: around NPR 4,000–5,500 (USD 33–46) for a drip set that can cover 60 m^2. Labour and maintenance costs are also low compared with other irrigation methods. This technology is particularly beneficial for smallholder farmers as it enables early fruiting and production of off-season vegetables when used in green houses, poly houses, and combined with mulching during dry season in water-scarce areas.

Drip irrigation also offers other farming benefits. Localized irrigation reduces leaching and minimizes fertilizer and nutrient loss. This system also maintains moisture within the root zone at field capacity and reduces weed growth.

Success across districts in Nepal

Water-efficient technologies like soil-cement tank and drip irrigation are simple, low-cost, and women-friendly solutions that are replicable in water-scarce areas. ICIMOD's Resilient Mountain Solutions Initiative – in collaboration with the Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED) – has piloted these water-efficient technologies and practices in Kavre, Dadeldhura, and Rasuwa districts of Nepal.

Altogether, 16 soil-cement tanks and 25 drip irrigation technologies have been piloted in in small farm landholdings in Kavre and Dadeldhura districts to address water scarcity. The uptake has been highly encouraging, with the number of farmers adopting these technologies doubling within a year and a half and more than 80% of women farmers are using. The farmers have also integrated other water-efficient technologies like mulching and micro-sprinkler irrigation.

The integrated system of efficient water use technologies has helped hill and mountain farmers adapt to water stress and build agricultural resilience. Most importantly, these technologies have reduced the drudgery of women, led to increased incomes through the sale of off-season vegetables like cabbage, cauliflower, tomatoes, bitter gourd, and cucumber, and contributed to dietary diversity and nutrition security for farming households in the pilot districts.

For further information

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