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Medbundi

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Is it possible to alleviate the acute water shortage faced by the inhabitants of the globe's arid and semi-arid areas? Through careful soil and water management, planned agriculture and animal husbandry, and water-saving industrial production, this goal can be realized. Though water wastage is an integral part of the problem, 'harvesting' and storage systems, based on sound ecological practices, need adequate attention as well.

Imagine successfully impounding raging torrents in watersheds, which receive the lion's share of annual precipitation, in short intense cloudbursts during the brief monsoon. By establishing a system of water harvesting structures in gullies that empty into a larger basin, runoff velocities and erosivity can be significantly reduced. Larger watersheds may have suitable locations for the construction of small dams. Yet, being able to store vast volumes of runoff in regions where the total evaporation exceeds precipitation would be ideal. By recharging groundwater, underground reservoirs are created, and this water may subsequently be utilized through wells.

The scale of these operations often exceeds the financial resources of the rural poor, making the involvement of government and non-government organizations, assisting the predominantly tribal, rural population, implement water harvesting schemes. Seva Mandir, one such registered, secular voluntary organization, working in the Aravalli Hills around Udaipur, encourages village groups to undertake treatment of entire watersheds with soil-water conservation (SWC) and reforestation.

The southern Aravalis receive an annual precipitation of 620mm with over 500mm falling during three monsoon months. Hills, once covered by vast forest tracts, now stand denuded, mere rocky outcrops with parched sandy steppes. The rocks consist mainly of quartzite and feldspar, with weathered schists, while the bedrock throughout the region is no more than 2m deep. Topsoils, rich in organic matter and the region's abundant mineral wealth, have been eroded from the hills and constitute agricultural holdings in low-lying areas. Local dryland farming is entirely on a subsistence basis. The drought conditions of 1985-88 brought on famine, which prompted the generation of relief work to provide wages to the badly-hit rural poor. Although there are certain interesting options, few relief projects meaningfully help in the long-term mitigation of the causes of famine.

Small-scale efforts, often with individual families, strengthen the community's access to its primary resources: water, the
A small storage reservoir contained by an earthen anicut.

Earth, and forests. Tribal settlement patterns among the Bhils consist of individual hamlets located on hilllocks. Private landholdings are generally long, narrow strips including hillslopes, grassland and gently sloping fields lower down.

First hand knowledge surpasses technical analysis

As follow-up to the drought relief activities of the pre-monsoon period, villagers are
actively implementing reforestation and soil water conservation (SWC) activities, with the alternatives they devise. Their first-hand knowledge of flows, velocities and sedimentation surpasses any hydrological analysis that can technically be made. What eventually emerges from the drawn-out but involved planning and implementation stages is an incredible nexus of hillside trenches, terraces, field bunds, diversion channels, outlets, and spillways. The primary technical inputs in this experiment are the optimization of effort and cost, structural control, material and labour management of larger works, for instance, small dams, also termed anicuts.

The physical components of the system are sized according to local conditions. Starting from the highest point in the water shed, alternating contour trenches collect runoff of 3m x 6m micro-catchments. Trenches are designed to fill at least once each season. Half a metre downslope from each trench are two saplings, of species ranging from flame of the forest (kharak) to acacia nilotica (babool) which are selected for their suitability to different soils. Soil moisture levels remain acceptable for eight months, though root stress, termites and grazing take their toll.

Conserving soil

Despite the contouring, gully ing occurs in the rains when the nallahs swell, flowing full with red lateritic sediments. Velocities and sediment transport are alarming. Stone gully plugs squat heavily to calm erosive flows, so causing sedimentation and further reducing transport. Innovations on older techniques include the introduction of spillways and flat stone aprons. Larger nallahs are blocked with structures of dry stone masonry; against this, earth soling is piled, so that natural levelling might result in small fields.

Where watercourses reach the flat land, long bunds are levelled. Debris gets deposited while silt and water are spread across the field. Excess flow can be routed around and down into the ravine, reducing the sheet erosion of the agricultural soil. Care is taken to protect the nallah banks from erosive flow.

Irrigation

To procure good yields of the local varieties of maize, dry paddy, millet and sorghum, seed
should be sown in standing water on land already saturated and ploughed. Water is retained by an extensive system of field bunds, *medbundt*. In order that different crops germinate, the soil must remain saturated up to 72 hours. The water requirements of species vary, hence the depths of water ponded in the fields must be controlled. Dry paddy requires knee-deep water for three days, while maize can survive with ankle-deep water for one day.

Two variations of field bunds are now in use. Basic safety precautions are observed. This includes ensuring the slope stability of earthen embankments, and that stone gully plugs and walls do not overturn or breakdown. Where possible, vegetative cover reinforces the packed earth of the embankments. By increasing the self-weight of earth bunds, stone cores provide foundation and reduce the chance of slippage.

**Mini dams**

At the downstream end of the watershed, appropriate locations are selected for the construction of small dams. The primary function of these anicuts is groundwater recharge. Several wells on small holdings located some distance from the reservoir still benefit from an increased groundwater level that the anicut effects. Waterlifting devices, like the Persian Wheel, *rahat*, and skin bags, *chadas*, make use of draft power to provide protective irrigation. Cattle abound, though they are largely unproductive for lack of adequate fodder and clean water. Bovine mortality reached 70 percent in some areas during the drought.

Depending on the watershed size and characteristics, anicuts are of stone masonry with lime or cement mortar, or of rammed earth. As local soils have a high sand content and little silt and clay, earthen dams contain stone masonry core walls to preclude excessive seepage and the danger of piping. The core is sunk into the foundation at the centre of the embankment’s cross-section. Built to a height where the phreatic surface of a reservoir is expected to intersect the core, the stone masonry in lime mortar walls reduce seepage. Lining, using agriflms, is intended for seepage control from the beds of those reservoirs not critical for well recharge, where the main objective is to provide drinking water for animals and protective irrigation.

The various physical components of a single watershed project must, as a system, be able to withstand the changes endemic to community-based work. Without popular support the long-term sustainability of basic resource management is untenable. Yet, if the model is dynamic and wins approval, its replicability in other watersheds is likely. This has begun in the Aravallis.