Passive rainwater harvesting

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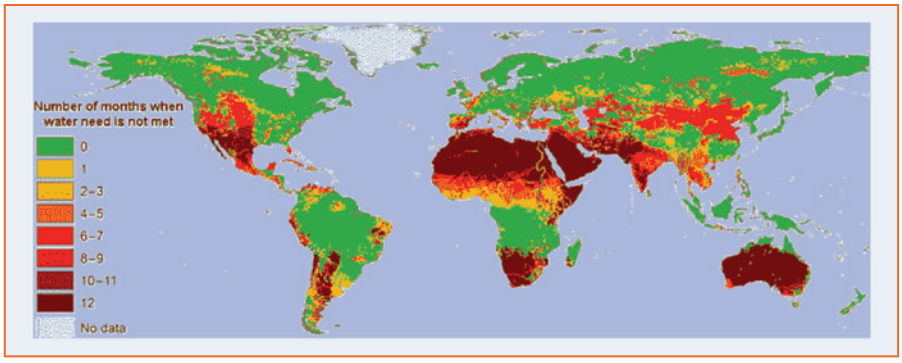
Southern Africa, like several regions in the world, experiences water constraints as well as severe and prolonged droughts. *Figure 1* shows a global perspective on the regions that experience water scarcity.

Typically, rainfall in South Africa occurs in a four- to five-month period, with the remainder of the year remaining dry. Frequent hot, dry spells can occur during the growing season. Therefore, especially in rural areas, the practice of storing sufficient volumes of rainwater can save a crop or secure a good yield. Provision can also be made for household water during the winter months when the summer rainfall areas generally receive no rain.

With municipal service delivery problems in urban areas increasing daily, it is a good idea to harvest rainwater for back-up purposes. It is also possible to reduce peak runoff flood damage if rainwater harvesting is implemented on a large scale in catchment areas.

Collecting rainwater from roofs and storing it in tanks (active rainwater harvesting) are mostly only viable for back-up household use or other back-up purposes. The constraints are usually the roof area (catchment) and/or tank (storage) that prevent the storage of volumes of water sufficient for crop production.

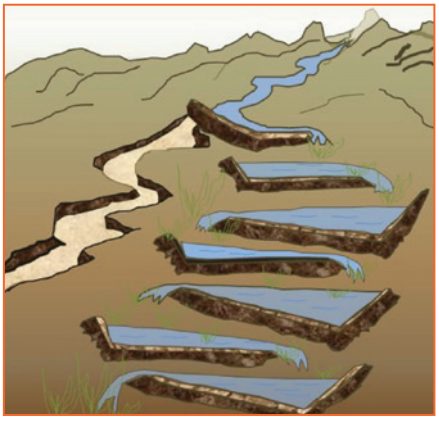
Figure 1: Drought areas of the earth. (Source: MM Mekonnen and AY Hoekstra, 2016)



Passive rainwater harvesting is when the flow of runoff water originating from rain that fell on and adjacent to a catchment area is slowed down, spread over the area, and facilitates the infiltration thereof into the soil profile for storage. This allows for storage of a sufficient volume of water for crop production.

The focus of this article is passive rainwater harvesting.

Figure 2: Typical water spreading banks.



Rainwater harvesting system

A passive rainwater harvesting system consists of:

- A catchment area, which can include soil surfaces, roads, roofs and parking lots.
- A water distribution system acting to slow down runoff water, directing it to appropriate storage areas such as dry trenches, small unlined ponds, berms and swales, rock walls or vegetation hedges on contour.
- An area in the landscape where the water can be stored such as tanks, subsurface reservoirs, small ponds or 'infiltration pits', basins, French drains and in the subsurface soil profile.

Advantages of water harvesting

Passive water harvesting has several advantages, including:

- The materials that are used can mostly be sourced locally, on or near the site, thereby reducing cost.
- Construction and maintenance are simple, making it achievable for anyone who has a basic understanding of the principles involved.
- It causes runoff water to slow down and spread across the soil surface, thereby reducing the erosion potential of the water, and increasing the portion of the water that infiltrates into the soil.

The principles involved

There are a few principles involved in creating interventions for managing and harvesting rainwater passively.

Start with a small intervention and then extend and improve it incrementally – observe the measure of success in actual rain events and make improvements.

Start at the top (highest elevation) of the catchment area – draw a map of the areas involved. Mark the different catchment areas, as well as other sources of runoff water entering the relevant catchment area. Start intervention at the top of the catchment area, proceeding down the slope to reduce the volume and eroding power of the collected water at the bottom of the catchment.

Use several small catchment areas in combination with each other – it is easier to manage water in several small catchments than in one large catchment area. Therefore, utilise the natural topography of the site to subdivide the catchment in more than one sub-catchment. If the natural topography is uniform and sub-divisions cannot be recognised as such, the catchment can be divided into sub-catchments artificially to facilitate easier water management.

Facilitate slowing, spreading and infiltration of the runoff water – infiltrating water into the soil and thereby storing it there is the most economical option. Storing water in the soil has a major beneficial influence on the local climate and environment. By allowing water that is concentrated in a channel to spread out over an area in intervals, slows the flow and reduces erosion potential, causing sediments to deposit and facilitating a larger portion of the water to infiltrate into the soil. Surface stormwater is decreased due to more water infiltrating into the soil. Vegetation should be established in the areas to utilise the water infiltrated into the soil to maximise the environmental and climatic benefits.

Figure 3: Typical permeable timber pole structures.

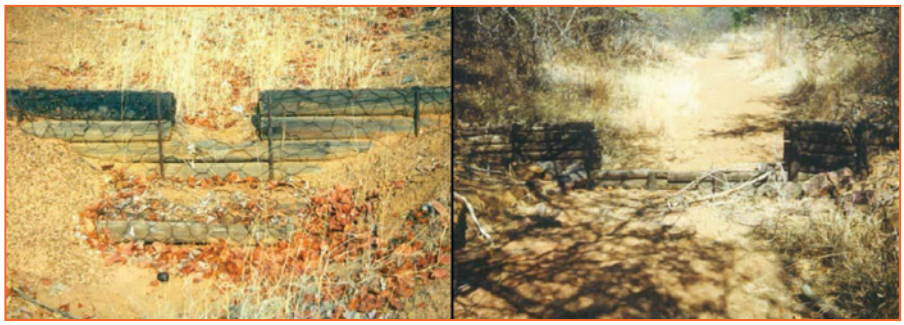
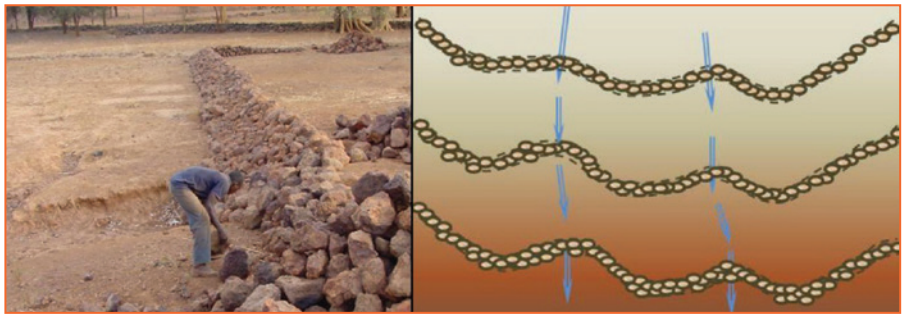


Figure 4: Typical examples of mulching.

Figure 5: Typical permeable rock wall structures built on the contour.



Ensure that overflow areas are of a suitable size and lined to protect the soil from erosion – overflow areas need to be level across their width and lined with rocks for protection against erosion; the overflow structures need to be sized (width and flow depth) to make provision for runoff from extreme rainfall events on the catchment, especially in the case of larger catchments. Overflow structures need to be maintained regularly.

Provide a layer of organic mulch to limit evaporation – this has the effect of making water available for plants over a longer period. A layer of mulch consisting of organic material could be made 75 to 150 mm thick (in the case of rocks or other inorganic materials, the layer could be 50 mm thick). Over time organic mulches decompose, thereby improving soil fertility (therefore, it needs to be replenished periodically).

Utilise the harvested water and perform regular maintenance. The earthworks and especially the overflow structures require regular maintenance to function optimally for an extended period.

For more detailed information on the different interventions as well as the effect that water stored in the soil has on the environment and local climate, consult the publication *Changing climate: The role of water and what you can do to drought-proof your land*. To order a copy, send an email to Elmarie Stoltz at StoltzE@arc.agric.za.
For more information on water harvesting, email Fanie Vorster at vorsters@arc.agric.za.

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