Cisterns are vital to people in areas where no other source of fresh water is available. This one from NW Egypt is supporting people, livestock and home gardens. Photo: Theib Oweis.

Farming where there's no water

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The drier environments of the West Asia and North Africa (WANA) region, called *albadia,* are characterised by extreme water scarcity, degraded lands and declining livelihoods. These areas have a fragile natural resource base, with very low rainfall and poor vegetation cover. Without appropriate interventions, *albadia* environment will continue to deteriorate and can generate very few benefits for its already poor population. This article presents three cases of interventions that have successfully improved living conditions in this extreme environment.

Background

The climate in *albadia* is extreme, with cold winters and very hot summers. Rainfall, the main source of fresh water, ranges from 50 to 250 mm annually, and is highly variable both in time and space. It falls in sporadic and intensive storms and causes substantial runoff. As a result, a crust is usually formed on the soil surface and this limits infiltration and intensifies runoff. Runoff water generally flows to salt sinks where it is lost to evaporation. It causes soil erosion and further land degradation.

Land tenure in *albadia* is a major constraint to development and varies from one country to the other. In Syria, *albadia* are largely public lands, but other forms of land tenure also exist, such as rented and private land ownership. Most of *albadia* in Jordan is private tribal land. Due to lack of appropriate land tenure systems in these countries, communal land is used as common property, where overgrazing is a common practice and little attention is given to sustainability.

In recent years, traditional migratory pastoralist communities have gradually been transformed into more sedentary communities. The change in lifestyle has resulted in a decline in the traditional, communally managed rangeland system. It has also put pressure on adjacent lands and there is an increasing demand for water for sanitation, home gardens, and supplemental irrigation for subsistence agricultural production. Where groundwater is available, some marginal grazing lands are even used for conventional agriculture.

Albadia in Syria and Jordan have traditionally supplied most of the meat and milk products for these countries. Increasing consumer demand for sheep, meat and milk in combination with rapid population growth and inappropriate government policies have stimulated the growth of the sheep population. This means that more feed is now required than *albadia* can sustainably produce. Mismanagement has resulted in land degradation, a decline in biodiversity and increasingly insecure livelihoods. *Albadia* still has a much higher potential than its current output. Proper management of available natural resources would help improve people's livelihoods and reverse land degradation.

Indigenous practices of rainwater harvesting provide a sound basis for improved resource management. Moreover, innovative techniques of water harvesting built on traditional knowledge can reduce cost and provide people with tools for improving the rangelands as well as their income and livelihoods. Following are three examples of interventions that build on traditional technologies.

Contour bunds and ridges

Mehasseh is a very dry area in southern Syria. It has a mean annual rainfall of less than 150 mm. Vegetation cover is poor and land degradation due to overgrazing is a major problem. In 1995, a water-harvesting project based on traditional technologies of contour bunds and ridges was started, with the objective of improving land management and the livelihoods of the people living in the area.

Half a metre high *contour bunds or ridges* were constructed along the contour lines some 5 to 20 metres apart. The first metre along the upper side of the ridge is allocated for cultivation, and the remaining area between the bunds make up the catchment. Contour ridges are one of the most important techniques for supporting regeneration and new plantations of forages, grasses and hardy trees on the gentle to steep slopes in *albadia.*

The key to the success of these systems is to locate the ridge as precisely as possible along the contour line. Otherwise, water will flow along the ridge, accumulate at the lowest point, and eventually break through and destroy the whole down-slope system. Surveying instruments suitable for small-scale farmers can be used for contouring. The simplest method is a transparent, flexible tube 10 to 20 m long, fixed on two scaled poles. The tube is filled with water so that the two water levels are clear on the scale. Two people can trace the contour by adjusting the position of one of the poles so that their water levels are the same.

To avoid contouring difficulties, an alternative is to develop smaller semi-circular and trapezoidal bunds in staggered rows across the slope. Earthen bunds in the shape of a semi-circle, a crescent, or a trapezoid are formed facing directly upslope. Spacing should allow a sufficient catchment area so that each bund can collect the required runoff water. Water accumulates at the lowest spot on the upper side of the bund, where plants are grown. Cutting the soil to form the bund creates a slight depression directly above the bund. Runoff is intercepted in this depression and stored in the plant root zone. The distance between the two ends of each bund varies between 1 and 8 metres, and the bunds are between 30 and 50 cm high. These bunds are used mainly for the rehabilitation of rangeland and fodder production but they are also used for growing trees, shrubs and field crops.

In Mehasseh, a comparative trial was carried out on two adjacent areas. Both areas were planted with Atriplex (*Atriplex halimus*) shrubs. Water harvesting bunds were built on one site, and an adjacent field without water harvesting bunds was used as a control. In 1997, there was 160 mm of rain. On the site with bunds, runoff accumulated on the upper side of the bunds and was harvested. On the site without bunds, water flowed downstream to salt sinks and was lost. The bushes planted in the field with bunds had a survival rate of over 90 percent, whereas the survival rate for the untreated site was less than 10 percent. The next three years were very dry, with an annual rainfall of less than 60 mm. The few surviving shrubs on the site without bunds died during the first year of drought. The shrubs supported with water harvesting bunds survived the three consecutive years of drought and are still growing vigorously.

The project was considered a breakthrough in this fragile environment. It now forms the basis for a national project based on this low cost technology.

Small runoff basins for fruit trees in Jordan,

This technique is sometimes called *negarim.* The runoff basins consist of small diamond- or rectangular-shaped grid plots, each surrounded by low earth bunds. They are oriented along the slope so that runoff flows to the lowest corner, where the plant is placed. The usual grid size is 50 to 200 square metres. They can be constructed on any gradient. They are most suitable for growing trees but can also be used for other crops. When they are used for trees, the soil should be deep enough (over one metre) to hold sufficient water to sustain the plant for the whole dry season.

The arid land of Jordan receives about 160 mm of rainfall annually. No economic crop can be grown with this amount of rainfall, and farmers in the area depend on livestock and other forms of agriculture using a steadily decreasing amount of groundwater. In 1987, a project was launched to diversify farmer's production by introducing tree crops in combination with water harvesting. The introduction of the *negarim* system to support fruit trees was a great success. Plots of 50 to 100 m^2 were constructed on deep soils and almonds and olive trees were planted in the winter season. Polymers were added to the planting pit of the tree in order to increase the water storage capacity of the soil, so that enough water is kept for the long dry summer. All trees planted survived and grew satisfactorily over the seasons and are still growing. The production was so satisfactory that farmers started adopting the technology. Generally, they were successful, but some problems emerged. These were usually associated with the selection of land, for example if the soil was not deep enough, or the species used was sensitive to drought. It is important that the location and crops are properly selected for this technology to be successful.

Semi-circular bunds in the Syrian badia after a rainstorm. Photo: Theib Oweis.

Cisterns in north western Egypt

Cisterns are an ancient and indigenous rainwater harvesting system, used mainly for supplying human and animal water needs in water-scarce areas. They are usually subsurface reservoirs, with a capacity ranging from 10 to 500 m^3. In many areas, for example in Jordan and Syria, they are small and dug into the rock. In north western Egypt, however, farmers dig large cisterns (200–300 m^3) in the earth deposits underneath a layer of solid rock. Water is used not only for human and animal needs but also for growing cash crops in home gardens. The rock layer forms the ceiling of the cistern and the walls are sealed with plaster. Modern concrete cisterns are now being constructed in places where there is no rocky layer.

Along the north west coast of Egypt where there is an average annual rainfall of about 150 mm, there is no other source of freshwater. Runoff resulting from a few major rainstorms in winter is directed into cisterns from adjacent catchments, or through channels from remote areas. The runoff from the first rainfall event of a season is usually diverted away from the cistern to reduce the likelihood of pollution. Settling basins are usually provided at the cistern entry points to reduce the sediment inflow. In addition, farmers clean the cisterns once every year or two. A bucket and a rope are typically used to lift water. However, there are several problems associated with using the cisterns including the extent of the catchment area, the capacity of the reservoir, the cost of construction and maintenance and the low water use efficiency in agriculture. A project was started in the area to overcome these problems by providing technical and financial support to the local communities in order to improve the management of these systems. Three interventions were found to substantially improve the efficiency:

- Clearing, cleaning and smoothening the catchment area improved the collection efficiency and water quality significantly.
- The cistern's seasonal water capacity was more than tripled through efficient management, without increasing the actual size or cost. Hydrological studies showed that the cistern could be re-filled at least three times during the rainy season and before the last storm of the season, which would fill it for the summer. Farmers were encouraged to use the water from the first and second filling for agriculture and to preserve the third filling for human and animal consumption during the summer. The availability of manual pumps and low cost pipes helped to make the task easier.
- The water use efficiency was improved by providing a small kit of materials and introducing a few changes in the agricultural production system at the home garden level. For example, placing high value crops such as seedlings and vegetables in plastic houses became popular and provided additional income to the farmers without requiring much additional water.

Although the cisterns of Egypt are a very special water harvesting system, the case illustrates the importance of careful water management very clearly. With careful management, harvested water can be efficiently used and the impact of the harvested water can be substantially increased.

Implementation and management

Micro-catchment systems such as contour bunds and ridges and runoff basins are usually within the boundaries of individual farms. This is a simple and low-cost approach, although farmers may experience some difficulty with elements that require precision, such as following contour lines or determining maximum slope. The community should be involved in implementing water-harvesting systems. It is especially important that the community is involved right from the planning stages of any programme.

New systems should be inspected often, especially during the first one or two rainy seasons. Micro-catchment systems should be inspected after every runoff-producing rainstorm so that any minor break in bunds can be promptly repaired. Special attention should be paid to earthen dikes and bunds, water storage facilities and their spillway, and diversion structures. Treated catchments and water harvesting structures should be protected against damage by grazing animals. Silt and rubbish should be removed from the catchment area, from the harvested water and from storage facilities.

These experiences, and many others, show that the productivity of rainwater in the drier environments can be substantially increased when appropriate water harvesting techniques are implemented.

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A typical family living in Albadia. This is in northen Syria in an area called Khanaser. Photo: Theib Oweis.