



# Water harvesting in Jordan using earth ponds

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**The waters of seasonal streams, or *wadis*, have long been used in water-harvesting systems – in fact the 6000-year-old city of Jawa in Jordan employed such a system for its water supply. This article describes how smaller, simple earth ponds have been constructed at low cost for irrigation, washing and for animals in the villages of the Badia, Jordan.**

**L**ike other Arab countries, Jordan is very poor in its water resources, and the situation is getting worse. High rates of population growth, rapid social development, shared water resources and global warming are all exacerbating the problem. Compared to the UK's per capita water use of 200–250 litres/day, the average daily consumption in Jordan of 85 litres is modest, but if living standards continue to rise, and population growth continues at the present rate of 3.6 per cent per annum, water consumption will also increase. Added to this, Jordan suffers from a high evaporation rate of 1880–4200 mm per year, which reduces surface water resources dramatically.

## Water resources in Jordan

Jordan can be classified as a semi-desert. Only the highlands, which have a width of around 30 km and length of some 300 km, enjoy a Mediterranean-type climate. To meet its increasing water demands, Jordan depends on a variety of water resources, conventional – including surface and ground water – and non-conventional – water from treated and desalinated sources.

Groundwater in Jordan depends mainly on rainfall and is the most important resource that can be tapped, varying in quantity and quality and found at depths of up to 1000 m. Groundwater in Jordan is of two types, renewable and fossil, the latter making up 5 per cent of the total.

Surface-water sources include base flow and flood flow. The former is the water derived from groundwater drainage through springs, and it is

estimated that the total average annual run-off is  $686 \times 10^6 \text{m}^3$ .<sup>1</sup>

Water harvesting is common in the rural areas of Jordan where rainwater is collected from the roofs of houses and stored in concrete-lined wells. This can be expanded by building larger reservoirs, or earth ponds, to collect the water from seasonal streams or *wadis*.

## What is water harvesting?

Harvested water comes from surface run-off of rainwater that has not infiltrated into the ground. The quantity of the run-off water depends upon a large number of factors, the most important of which are the amount and intensity of rainfall, climate, vegetation, and the geological, geographical and topographical features of the area. It may vary from 20 per cent of total rainfall in arid and sandy areas where the rainfall is low, to more than 50 per cent in rocky areas where the rainfall is high. The rest of the water either infiltrates into the groundwater, is stored in the soil, or is lost by evaporation or transpiration.

## Ancient water-harvesting systems

People of the Badia realized the importance of water harvesting in arid lands over 6000 years ago. They used the harvesting system to obtain water resources for their consumption. Ancient water-harvesting systems spread all over the Badia and they vary in size and design. Small water-harvesting schemes making use of small streams or desert wells were located in the small valleys and used for a short time during the grazing

season, others were of a larger scale and were mainly used for permanent settlements, such as Jawa city.

This 6000-year-old city is located 30 km north-west of Safawi (see Figure 1). Jawa city was built of black basalt and the only water supply was from the harvesting of floods of Wadi Rajil. The water-harvesting system was built using very advanced methods, and it consisted of a large dam to capture water in a reservoir, which was used for planting and animal watering. After the dam, a series of rock-lined ponds were dug to allow the filtration of sediment as the water flowed from one to another, and close to the city there was also a number of natural ponds in the *wadi* (the Arabic word for 'valley', but in this case indicating a seasonal stream), which were used to store additional water.

## Modern water-harvesting systems

The Badia is a region of northern Jordan that has seen a dramatic

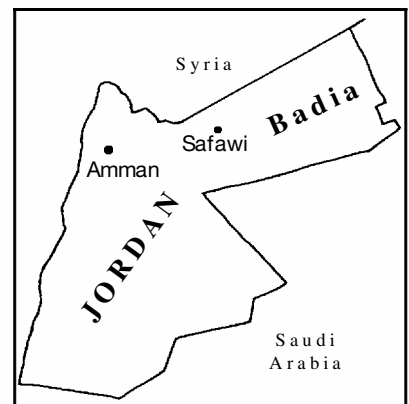


Figure 1 Map showing location of the Badia



The Old Dam of Bowrqa'a near Jawa city  
(Photo: Saad AlAyyash)

expansion in permanent settlement and the amount of land cultivated from the 1960s onwards. Moisture availability in this part of the world is seasonal and irregular, which, coupled with increased demand, leads to water scarcity.

In the 1960s, the Government of Jordan started a programme to build concrete ponds and maintain some old Roman ponds on the ruins of old cities and settlements in the North Badia of Jordan. The ponds had a capacity of less than 10 000 m<sup>3</sup> and were located in small villages and settlements, where they were the main water source for most villagers at that time. The water was used for their sheep and domestic uses but not for drinking. Some of the ponds already existed in the ruins of villages such as Um Quttain and Um Jamal; others were dug and lined with concrete to prevent infiltration.

The design of the new ponds was very simple. A channel that diverts the water from the mainstream or collects water from small catchments is dug and smoothed. This channel leads into one or more small concrete tanks (less than 50 m<sup>3</sup> in volume); these tanks work as sediment traps to catch as much as possible of the suspended solids in the run-off. After that, the water runs into the main pond to be stored there for future use. The main pond has an outlet or spillway to drain the excess water away from the system.

The concrete ponds have been in use in the villages of northern Badia since their completion in the mid-1960s. A simple maintenance procedure, which includes removing sediments from the sediment traps and the main pond and also repairing any cracks in the concrete lining, has been followed over the years.

## Earth ponds

More recently earth ponds have been developed as an alternative system for

water harvesting. Earth ponds are one of the simplest methods of water harvesting. The design is simple and the calculations straightforward, and the ponds are relatively large in size (more than 50 000 m<sup>3</sup> in volume). The only machinery needed to develop earth ponds are bulldozers and trucks to dig the earth hole 4–5 m deep and up to 100 m wide. A smaller earth pond is usually also dug to trap the sediments from the water before it gets into the main pond, and a diverting channel carries the water from the *wadi* channel into the sediment trap. In the northern Badia, many sediment pans occur next to major *wadi* courses. This makes digging an earth pond easier and the soil is less permeable, which means that losses due to seepage are minimized.

In the mid-1990s, Jordan's Badia Research and Development Programme, in co-operation with the Ministry of Water and the army Corps of Engineers, started a project to implement 15 earth ponds in the grazing areas of northern Badia. Four of these ponds have been completed and have been in use for the last three years. The Badia Research and Development Programme is responsible for their design and construction and – to a limited extent due to a lack of resources – for their operation. Most of the operational ponds are fenced to prevent unauthorized access by animals and children.



An earth pond (*hafiyreh*) full of water at Marab Swai'ied, 35 km east of Safawi  
(Photo: Saad AlAyyash)

## The Middle East

The completed ponds are efficient at collecting and storing water year after year. The accumulated fine sediments within the pond help in lowering the infiltration capacity of the bed soil, which leads to low maintenance. The water is freely available to the nearby inhabitants, but depending on the rainfall these ponds may dry up during dry seasons, which means that the local people then need to find alternative supplies, such as from wells. Supplying water by container from other areas is another possibility, but this requires government subsidy due to the poverty of the area.

### Conclusions

Water harvesting is a technique that has never been totally forgotten, but it has been neglected for a long time. The Safawi project is the first step in bringing back this ancient method, even though water harvesting in Safawi does not contribute significantly to the national water resource management of the country.

One question that remains is the effect of pollution on the quality of the water and the nearby inhabitants who

may use it. The main danger is of pathogenic organisms from human activities or animals entering the water as it flows over the ground or when it is in the pool. Some of the constructed ponds have been fenced to prevent unauthorised access, but more probably needs to be done with regard to their operation and maintenance. If these ponds were ever to be used for drinking water, a strict quality monitoring and maintenance programme would be needed and a fair amount of investment in education.

Until then, the ponds should continue to be used for irrigation, animal watering and washing only. This means that drinking water has to be provided from other sources, such as from wells. The problem here is that many wells are illegal which makes the task of monitoring the quality and quantity of groundwater a very difficult one. The only solution to this problem is through a focused programme of education of the locals in order to highlight the danger of over extracting. This should be supplemented by an extensive monitoring and policing programme to prevent any more illegal wells being established.

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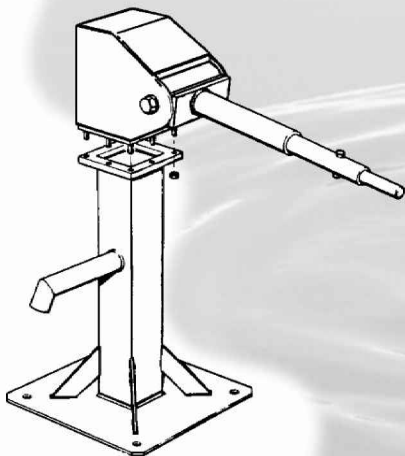
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