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ON-SITE WATER RETENTION STRATEGIES: SOLUTIONS FROM THE PAST FOR DEALING WITH JORDAN'S PRESENT WATER [redacted]

by
Oystein S. LaBianca

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Oystein S. LaBianca
Institute of Archaeology and
Department of Behavioral Sciences
Andrews University
Berrien Springs, Michigan
USA

Oystein S. LaBianca

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Introduction

A common sight throughout Jordan today is the water truck hauling its life-sustaining contents from pumping stations to agricultural fields and buildings throughout the country. Also hard to miss as one travels throughout the country are the water pipes which criss-cross and dissect villages and the agricultural lands which surround them.

As settlement and plow agriculture has expanded over the past half century in Jordan, so has dependence on deep-drilled wells, water pipes and trucks for obtaining water. *Herein lies a very significant and unprecedented break with the past.* Until this century, it would have been inconceivable to hope to expand settlement and plow agriculture without automatically also expanding on-site facilities for collection and storage of rainwater and surface runoff. Yet, today, this is precisely what has happened!

In light of the fact that, despite modern technology, water supply continues to be one of Jordan's most pressing problems, another look at how previous generations of Jordanian citizens coped with this problem is warranted. Thus, an opportunity has arisen for archaeologists to contribute information which may benefit today's and tomorrow's generations in their search for a solution to this problem. We can contribute information, for example, about how very intensive forms of agriculture were possible during Nabataean and Roman times in the absence of modern technology.

In this paper my goal is to build a case for incorporating archaeological inquiry into the search for solutions to deal with Jordan's current water crisis. I will support my case with four arguments:

First, that the status-quo is not sustainable over long-term.

Second, that archaeological inquiry focuses attention on indigenous time-tested solutions.

Third, that archaeological inquiry can aid in developing solutions that are sustainable over long-term.

And fourth, that yesterday's technology, when wedded to today's technology, may provide a *blended technology* solution for tomorrow.

The Status Quo is not Sustainable

As already indicated, the status-quo in Jordan today as far as water supply is concerned involves reliance on underground sources of water accessed via deep-drilling of wells. This practice was apparently first introduced in the Qaṣr al-Ḥallābāt area circa 1962 by a woman remembered today as "Miss Coats" (Bert De Vries, personal communication). Her purpose in introducing deep well drilling was as a means to help resettle Palestinian refugees from the az-Zarqā' refugee camp.

Since its initial introduction almost three decades ago, deep drilling of groundwater wells has spread to most areas of Jordan. From pumping stations built above the more productive wells, water is transported, as mentioned above, to agricultural fields, villages and towns via water pipes and trucks. The consequences of this practice have only recently begun to be fully comprehended. Among them are the following:

First, it has allowed landuse and settlement to intensify without concomitant grass-roots development of surface water harvesting facilities. As already indicated, in past centuries, this would simply not have been possible.

Second, it has contributed to loss of interest in and widespread devaluation of time-tested indigenous methods of water collection. Thus, today, more and more houses, which do not include in their design the traditional roof catchment structures and sub-basement cisterns which were an integral part of traditional buildings, are being built.

Third, overpumping is making replenishment increasingly impossible in many underground aquifers, making their depletion more imminent. A case in point is the underground "river" which runs from Jabal ad-Drūz to al-Azraq. This aquifer is replenished by precipitation which seeps down between the cracks in the basalt overlayment to pools on the waterproof limestone below. The

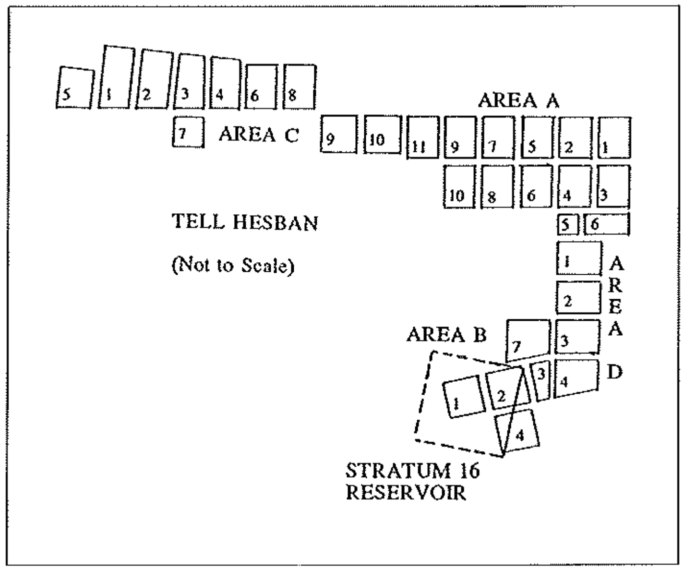
First the use of catchment channels and cisterns for collecting and storing rainwater goes back to the earliest period of occupation of the *tall*, namely to the Iron I period or circa three thousand years ago. Evidence for this is a cistern located in Area D (D.4), and the remains of several water channels (B.2; B.3; D.4), all of which were dated by the excavators to Iron I strata (c. 12th-10th century BC) (FIG. 3).

Second, with intensification of settlement on the *tall* came enlargement of the capacity for collecting and storing rainwater and surface runoff. This is powerfully illustrated in the Iron II period, when the Iron Age occupation cycle reached its highest intensity. During this period a large plaster-lined water tank or reservoir was constructed on the southwestern slope of the *tall* (B.2). The installation measured 7m deep and the distance from its southeastern corner to its northeastern corner was roughly 17m. According to Larry Herr (n.d.), who has computed the tank's capacity on the assumption that it was a square, it would have had a capacity of slightly over 2,000,000 liters. Three layers of plaster were found at the bottom of it and along its sides. Rainwater was fed into it by means of various channels carved out of the bedrock (B.4).

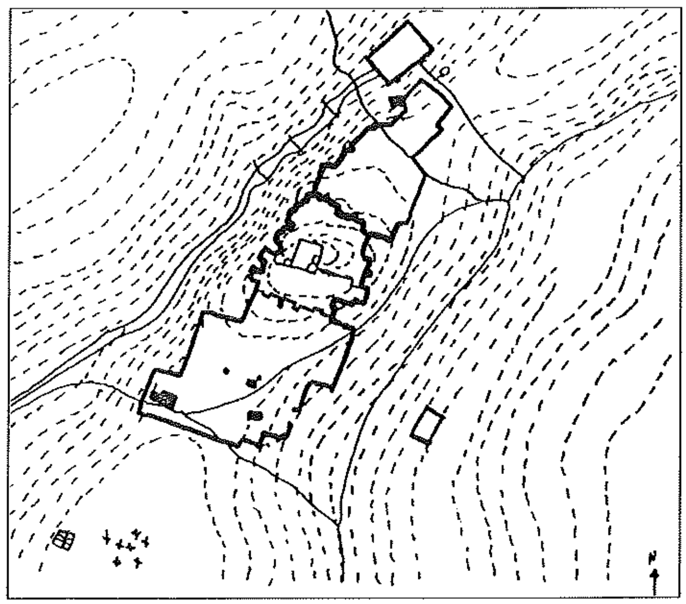
Third, when the *tall* was resettled following periods of occupational abatement, facilities for collecting and storing rainwater built during earlier periods of occupation were as a general rule brought back into use. There are at least two instances of the same two cisterns having been used during all three succeeding millennia of human occupation of the *tall* (D.6 and G.12). In the case of the large number of water channels, cisterns and reservoirs constructed during the Roman period, the majority of them were brought back into use during the Ayyubid-Mamluk period, almost a millennium after they had been originally constructed.

Fourth, during the Roman period, when the greatest expansion of the capacity for harvesting rainwater and surface runoff occurred at Tall Ḥisbān, buildings, courtyards and streets all appear to have been constructed with water catchment in mind. For example, roofs were made so they would catch the rain like a pan. Water thus collected was led via drains to cisterns submerged below the buildings or below adjacent courtyards. Similarly, paved courtyards and streets also doubled as rainwater catchments, as is evidenced by the numerous street level water channels which were built and maintained during this period. Finally, at the base of the *tall* were two large reservoirs, one in Wādī Maj'ar to the west of the *tall* and the other in Wādī Muḥtariqa to the east, each of which no doubt added enormously to the water storage capacity of this Roman town (FIG. 4).

Fifth, the water collected in these large reservoirs was distributed by means of gravity to cultivated fields below them via diversion dams and terraces. The reservoir in Wādī Maj'ar, for example, had a step-wise series of shelves below it, each shelf being held in place by a retaining wall of stones. In this manner plants were irrigated and soils prevented from eroding away.



3. Layout of excavated areas (Letters A-D) and their respective squares (numbers).



4. Byzantine Esbus (Ḥisbān) as sketched by Musil in 1902 showing location of two large reservoirs (see LaBianca 1990: 186).

Sixth, the basic elements of Tall Ḥisbān's water system as outlined above are by no means unique to this site. They are typical of many other *tall* sites in our project area and of *tall* sites spanning the same millennia throughout all of Jordan. Just to give an idea of how common reservoirs were in the Roman period in this region, we have counted 19 of them within a radius of 10km of Tall Ḥisbān (LaBianca 1990: 189) (FIG. 5). The

the areal extent under such management expanded and contracted greatly depending on the cyclic shifts in food system intensity levels over the centuries. By far the greatest expansion occurred during Roman-Byzantine times.

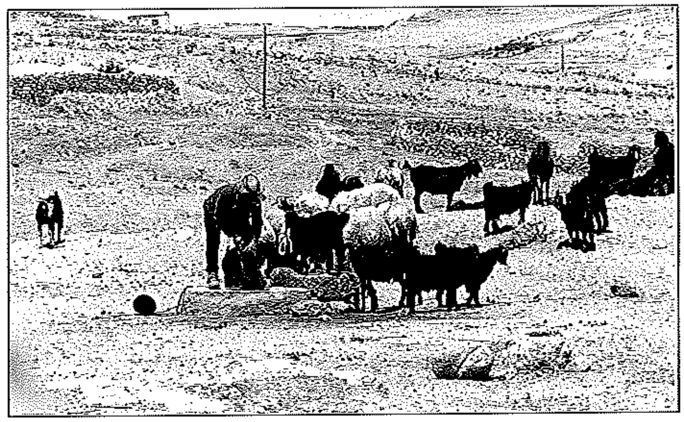
As a method for collecting and storing large quantities of water, the maintenance of reservoirs dates back, as we have seen, nearly three thousand years in our project area. It was not until about two thousand years ago, however, or during the Roman period, that they came into widespread use in this region. Significantly, reservoirs were constructed and maintained primarily during the more intense phases of the food system cycle, such as during the Iron II, Roman, Byzantine and Ayyubid-Mamluk times. This was, no doubt, because they required much more labor and cooperation to maintain and were more difficult to repair in the wake of major earthquakes. Although less resilient than the preceding strategies, their critical role in facilitating intensification of the food system during these periods make them an important strategy to consider today, however.

The above strategies represent only a few examples of the wide array of sustainable methods of water management which our archaeological research has brought to light. Others which have not been touched on include a variety of cooperative arrangements which entailed, on the one hand, strategies involving various forms of kinship-based cooperation, and on the other hand, strategies involving various forms of bureaucratic control. Since our research along these lines is still in its infant stages, I have deliberately limited the discussion here to the consideration of the findings about which we feel the most certain.

As important as what archaeology can tell us about the sustainability of various indigenous methods of water procurement is what it can tell us about the accumulative impact of these methods on the natural environment over the long-term. In other words, while the methods themselves may have stood the test of time, their cumulative impact on the environment is only today beginning to come to light. As an example of this, I would like to end this section by setting forth a proposal regarding the relationship between cycles of food system intensification and abatement and deforestation in our project area.

Briefly stated it is that denudation of the landscape in this region is accelerated in the wake of each intensification phase of the food system cycle. As trees were cleared to open up more land for cultivation during successive intensification phases, soils were initially protected from erosion by terraces and retention dams. Denudation occurred, however, as a result of failure to maintain these terraces and dams during successive abatement phases of the food system cycle.

The reason for this failure, I believe, was increasing insufficiency of people to do the necessary maintenance work. This, in turn, resulted from a general decline in the population occupying the area during each abatement phase and increasing seasonal migration of the population which did survive.



6. Shepherd watering flock of sheep and goats near village of Ḥisbān.

It is my opinion that the most devastating blow to the environment of our project area came in the wake of the Roman-Byzantine intensification drive, during which most of the forested areas remaining from earlier centuries were cleared and converted to terraced agricultural lands. I base this proposal primarily on the evidence for widespread distribution of agricultural sites and installations all over our project area during this period.

Blended Technologies: Wedding Old and New for Best Results

On the strength of the findings presented above, I would urge that more attention be given to incorporating yesterday's concern with rainwater and surface runoff collection in providing for tomorrow's water needs in Jordan. As an example of this, I will refer briefly to a proposal which we have developed on behalf of ACOR for submission to USAID (United States Agency for International Development).

Entitled "Project Rainkeep" (LaBianca 1992), the proposal entails excavating and restoring cisterns and reservoirs and putting them to use in collecting and storing water for use in irrigating crops. But instead of relying on traditional methods for distributing the water to crops, the proposal entails installation of subsurface microporous tubes for distributing it. To this end, solar powered pumps will be used to lift the water up and push it through the tubing to the plants.

The reason for thus wedding old and new technology is that while yesterday's technology — especially the use of cisterns — reduces significantly the amount of water lost due to unmanaged runoff and evaporation, modern technology assures that the water is distributed and utilized in the most efficient manner possible. The use of