And the desert shall bloom again

by Bruno and Maryvonne Robineau

Run-off irrigation was successfully practised by the Nabatheans in Israel's Negev desert 2,000 years ago. Bruno and Maryvonne Robineau report on an experiment to revive these ancient techniques today.

THERE IS 'Nothing new under the sun'. This saying is perfectly illustrated by the work of the Abda farm in the Negev desert in Israel. Using simple irrigation techniques over 2,000 years old, the farm has successfully managed to sustain an agricultural system in the middle of a desert which has less than 100mm of precipitation each year.

In the heart of the Negev desert, the road leading from Be'er Sheva to Seder Boquer crosses a rocky landscape with pockets of loess soil. The sparse vegetation consists of clumps of grass and the occasional bush. In sudden contrast, however, at intervals of 500 to 800m, clusters of trees appear growing on small plots surrounded by ditches. Yet this is an area where there is scarce rainfall, no sprinkler or drip-irrigation system, nor indeed any of the sophisticated technology you might expect to find in Israel. So how is this apparent miracle achieved?

'Here we use Nabathean techniques that are over 2,000 years old. It is generally believed that a minimum of 200mm of rainfall per year is required in order to practise agriculture. However, with the run-off principle, 50mm of rainfall is sufficient', says Svi, a 26-year-old Dutchman, who studied tropical agriculture in Holland and who now runs the Nabathean farm of Abda, 10km south of the Kibbutz Seder Boquer. He works with a permanent team of seven or eight people and occasional foreign volunteers. He is excited by the challenge of practising agriculture in arid and semi-arid zones, and has already spent one year at Abda and intends to stay another four years in order to finish his doctorate.

Thirty years ago, Professor Evenari and other scientists from the University of Jerusalem set out to demonstrate that the Nabatheans who lived in the desert 2,000 years ago were self-sufficient in food production. Nowadays only a few Bedouin tribes live there as well as a few Kibbutzim who have managed to grow produce in the desert using the modern techniques of the drip-irrigation system. In earlier times there were hundreds of agricultural settlements in the Negev. Two of these, at Abda and Shivta, have been rebuilt from the ruins. The experiment proved that Professor Evenari and his team were correct since, thanks to these ancient techniques, trees have been growing in the desert for more than 20 years, even during years of drought.

Archaeological research carried out in connection with the experiments on the farm at Abda has also revealed that under the same climatic conditions as now (80mm of rainfall per year), 10,000 people were probably living at Abda. The entire population relied on the agriculture practised in the 'wadis' or dry river beds, which turn into violent streams after rainfall because the water runs off from the surrounding hill slopes which are totally bare of vegetation. This phenomenon happens two or three times a year and lasts for only a few hours each time.

A farm in antiquity

The Abda farm consists of five hectares of terraces and is situated in a wadi enclosed by hills. On the surrounding slopes, they have reinforced the small walls first built by the Nabatheans. These walls are made in such a way that they all converge towards the terrace by following the line of the slope. The catchment area is 20 times bigger than the cultivated plot. In theory, when 1mm of rain falls on the hilltop 20mm accumulates on the terrace down below. A simple calculation demonstrates the genius of the system. If the annual rainfall is 100mm, and the catchment area is 20 times bigger than the cultivated plot, and 25 per cent of the quantity of rain can be retained in the plot, the crops will receive in addition to the 100mm, 20 × 25mm or 500mm of run-off water, totalling 600mm.

The system functions very simply: it causes artificial flooding. After the rain, each terrace which is enclosed by walls becomes a pond and it takes two or three days for the water to penetrate the 2 or 3m of loess soil.

It may seem strange to speak of floods in the desert. In fact, in the desert more people die from

Almonds, peaches and artichokes grow in the orchard at Abda.

drowning than from lack of water. When the water pours into the wadi, it is difficult to escape — one person has already died this year.

Computer-aided design of flow

In order to use the run-off techniques efficiently, three essential factors must be taken into account: the intensity of rainfall, the type of soil, and the topography.

'If God gave me 10mm of rain in 10 minutes only once in one year, I would still have enough to grow crops', declares Svi. The fact is that a sufficiently intense rainfall is needed to cause a quick flow of water. If the rain is light, the water soaks into the soil on the way and will not reach the terrace.

The second important factor is the soil type. Loess soil is the best type for run-off irrigation because it has a fantastic capacity for retaining water. It can retain water for more than a year because of the incredible fineness of the particles (it is composed of about 30 per cent fine sand with particles whose diameters measure between 0.1 to 0.05mm, 40 per cent silt (0.05 to 0.005mm) and 30 per cent clay (less than 0.005mm)). It is only because of the thick layer of loess (2 to 3m) that the water can accumulate to provide for the dry season. On average there are two to three floods per year. For example, in 1974 there were only 20mm of rain and yet the trees survived.

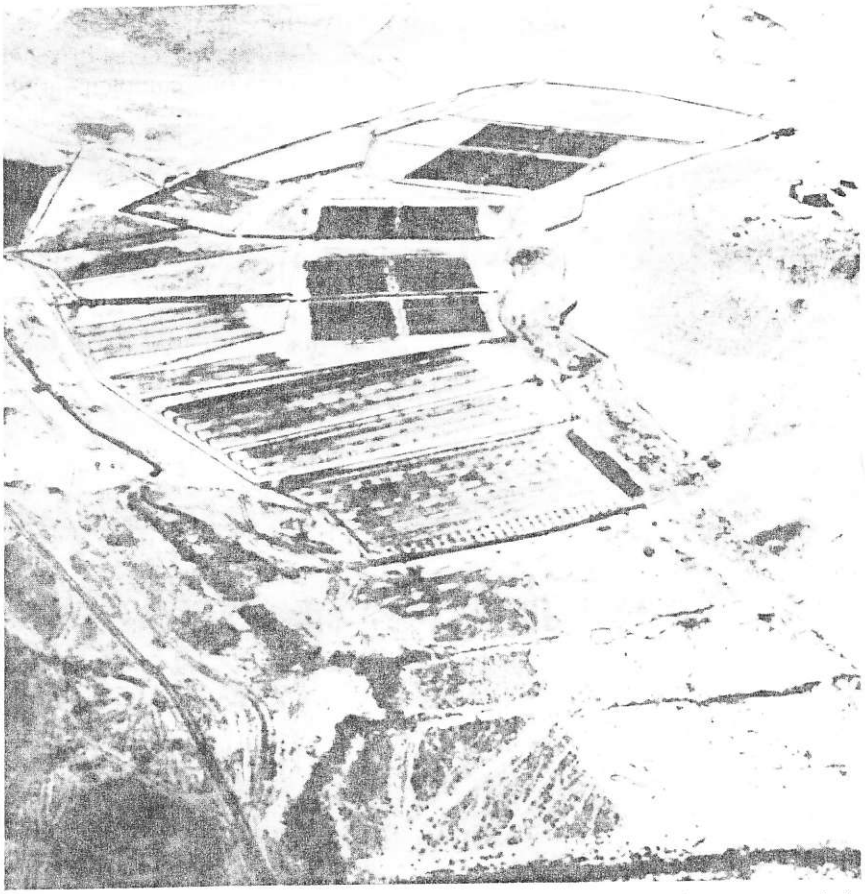
Finally, topography plays a crucial role: the steeper the slope the faster the water descends, and the less time there is for it to soak in. Yet if the slope's gradient exceeds 25 per cent, erosion problems arise. A gradient of around 21 per cent is best. Any obstacles or stones in the catchment area can also affect the flow of water. So by slightly modifying the topography one can improve the efficiency of the system. This idea dates back to the Nabatheans who realized the importance of the topography in relation to the run-off and attempted to alter it by removing the stones. This explains the piles of stones on the hills. Today Svi uses a computer to determine which stones he should remove from the slopes.

The Nabatheans and development

Once it was believed that the Nabathean system could be used to develop an agricultural system in the Negev desert. The Kibbutzim at Seder Boquer even tried to combine both the run-off system and the drip-irrigation system. They soon realized that the run-off system is not well suited to modern agriculture oriented solely towards export sales, because of the irregularity of rainfall. Therefore it was decided to rely more on the agricultural development of Third World countries because the real aim is not only trade but also self-sufficiency in food. There are also very good reasons for turning to simple agricultural techniques in arid countries because it is possible that in the near future the land in temperate countries will no longer be fertile because of over-intensive exploitation. Also, in Israel, irrigating with salty water from the water table risks spoiling the soil irreversibly. Finally, a significant proportion of the world's population lives in arid zones in similar conditions to Abda (less than 80mm of rainfall per year) and they have many problems surviving.

For the last 20 years the farmers at Abda have successfully grown almond, pistachios, peaches and apricots. Experiments with vegetables have yielded interesting results; asparagus and artichokes were particularly successful. Growing cereals on small plots of land has also met with some success with an output of 2.0 tonnes per hectare for wheat, 2.2 tonnes per hectare for barley and 1.0 tonne per hectare for sunflower.

The run-off system offers a potential solution to the agricultural problems faced in arid zones. It proves that people can survive in their environment without resorting to complicated and expensive techniques.



Aerial view showing the Abda farmhouses, the reconstructed terraces and the walls leading down the side of the wadi.

Agroforesty

At Abda they also work on selecting tree species in order to determine those most suited to arid zones. John Maurice, a 72-year-old horticulturalist, joined the Abda Farm for a few months as a volunteer to look after the nursery. 'Trees are the natural vegetation in the majority of tropical zones and there is a growing belief that in most cases trees are better able to thrive in this type of environment than annual crops.' For many years John has been working to improve the trees genetically using grafts and hormones. He has invented a technique for the miniaturization of the root system of trees which means that saplings destined for replanting

The Nabathean walls are reinforced to channel water down to the terrace.

elsewhere in the Third World stand a better chance of surviving the long journey since they require less water and care. Also, thanks to this new technique, the saplings develop a secondary root system which takes very easily and the replanting success rate is 100 per cent.

John, like Svi, is a convinced supporter of agroforestry. The principle of agroforestry is the mixing of different species of trees or plants, each one complementing and protecting the other, while others act as repellents against insects. 'If the trees belong to the same species, they all require the same thing at the same time, in the same place, which causes serious problems in times of drought,' explains John. 'If you have different plants the need for water and manpower are spread over time. Therefore the plants are not in competition. If there is a drought, there will always be some which survive better than others and continue to produce a crop.' In the Third World, manpower can be employed more evenly throughout the year.

At another farm at Maschash, irrigated solely by the run-off system, Svi performs experiments in agroforestry. For example in one field he mixed rows of sorghum, peas, acacia and eucalyptus. 'In the world there are 200,000 species of plants. I am convinced that among this richness we can find trees adapted to arid regions. It's important to discover multipurpose species which provide simultaneously fruit for food, foliage for fodder and wood for cooking and heating.'

'We would like to create a model farm that is totally self-sufficient, which has a few animals and which once again employs the ancient Nabathean cisterns for water storage. 'To build the house, they used the big stones from the old town of Abda. With these stones there was no need for air-conditioning despite summer temperatures of 35 to 40°C.'

These simple techniques are low in cost and can be easily mastered by farmers; to poor people in arid lands they might well provide the key to attaining self-sufficency in food.

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