

Arid Zone Agriculture in the Aravah in Israel: Unconventional Agroclimatic Resources and Risks

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In the Arava section of the rift valley in the fully arid Negev a string of eighteen villages is spread out along the road to Eilat. They utilize—by means of sophisticated agro-technologies—the unique seasonal climate to supply their market areas in the core region of Israel and especially in Europe with out-of-season vegetables, fruits and flowers. Restrictions inherent in arid conditions, the risk element involved, as well as economic limitations create considerable difficulties. An extreme case is the 'geothermic farm' of Paran village, discussed in detail.

The Aravah is the section of the rift valley in Israel between the Dead Sea in the north and the Gulf of Eilat in the south. It is a prominent example of both the possibilities and limitations of agriculture under fully arid conditions. The abundant solar energy is its major advantage. This is evident in particular in the clear skies and consequently the relatively high day time temperatures throughout most of the winter.

This unique resource base makes it possible to yield early maturing crops which benefit from the seasonal difference between it and other regions which supply the same markets. To put it differently, agriculture in the Aravah is based on out-of-season farming, supplying markets in Europe with out-of-season products.

Being located in a desert environment, the Aravah does not have to compete with other uses for its land. In particular being located far from urban areas, it is not subject to the common threat of suburban encroachment. 'Land' per se is, therefore, inexpensive to a degree rare today. However, by contrast, agricultural soil is at a premium in this desert environment. Most of the surface of the southern Negev has a *hamada* cover, stony and sterile. In some instances, Aravah farmers cover the hamada surface with a layer of sand or turf, mainly turf imported from the Netherlands, and use this as an inexpensive substratum for growing

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crops, mainly in greenhouses. This non-local soil has the additional advantage of having no indigenous salinity in contrast to nearly all local soils.

Similar soil conditions apply to many parts of the Aravah. Other parts of it are mostly equally unsuitable gravel beds of the many branches of the Aravah and its tributaries. The good soil which is available for farming is the softer alluvium in the valley beds or near them, and especially the sandy deposits. But this is exposed sometimes to an environmental risk inherent in arid climate. Average annual rainfall is below 50 mm. But, typical for arid climates, rainfall—both amount and number of rainy days—is highly irregular and average values of precipitation are not representative.¹ Under the pre-modern agro-technical conditions prevailing prior to the establishment of the State of Israel there were no villages in the Aravah. Only a small number of Beduin utilized its sparse grazing resources during certain periods of the year.

Since independence in 1948, Israel has established a loose string of villages in the Aravah (Fig. 1), both to provide a settled presence along the road to Eilat and in order to utilize the special agricultural potential of its arid conditions. The total population of the Aravah villages approaches at present some 5000. Spread out along 150 km, these villages illustrate the distinct contrast between the arid Aravah and the highly dense core area of Israel. Due to remoteness of the region from the economic core area of Israel, strange as it may sound for an arid desert area, agriculture is nearly the sole economic base of these villages, due to the absence of other regional resource.²

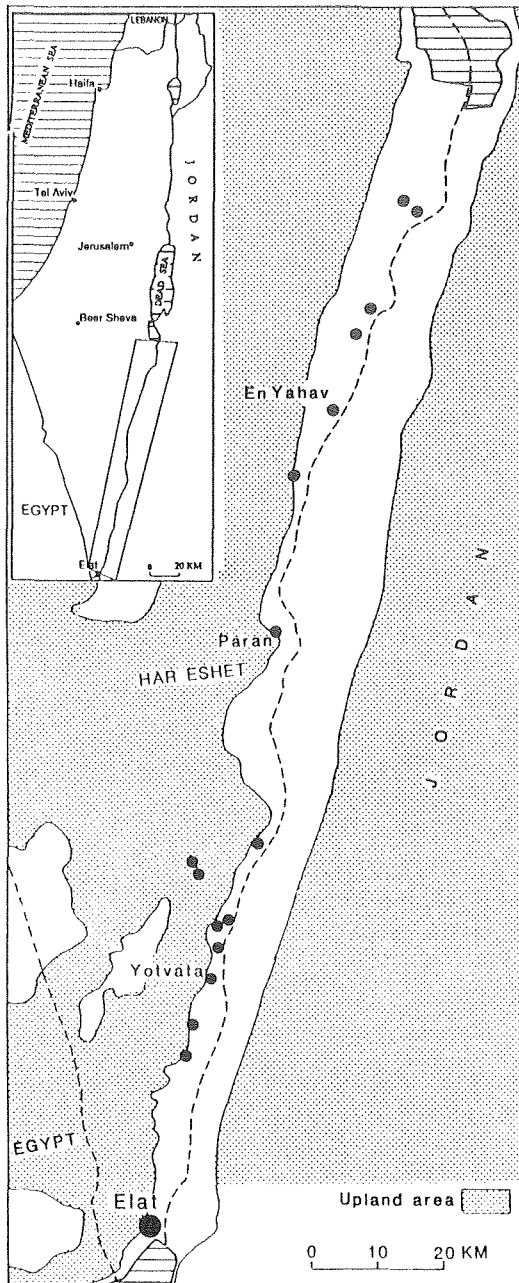
Crops grown in the Aravah are mainly fresh vegetables, fruits and flowers which in good years reach the European markets from November through March and early April, the most important marketing period being, of course, the Christmas and New Year season.

The rare rainstorms affecting sections of the area or its extensive drainage basin create floods in the valley beds. They may flush all crops grown there down the valley, creating severe losses to the farmers. Furthermore, occupying the lowest topographic sections of the area, these crops are exposed in clear winter nights to low temperatures especially damaging if occurring for a number of successive nights. For example, in the winter of 1972/73, Paran village experienced sub-zero temperatures every night for a fortnight.³

Every winter there are a number of storms reaching considerable velocity. If wind force is particularly strong, it can cause damage to all types of crops. A considerable part of crops in the Aravah is grown under plastic cover, either low plastic sheeting, called 'tunnels', or in greenhouses. Both, but particularly the former, may be ripped open by high winds or by hail, normally with a total loss of crops in addition to damage wrought to the plastic cover and often even the structure of greenhouses. The events of early February 1992, with extreme amounts of precipitation and cold temperatures were a painful illustration.

Water is, of course, the other basic resource for agriculture in the arid Aravah. The structure of the rift valley, lying several hundred meters below the Negev Highlands to the west and the fault borders separating the two areas, permits access to groundwater, though in limited quantities.

Figure 1: Villages of the Aravah.



The sparse string of villages in the Aravah and its distance from the urbanized region of Israel involves another disadvantage, typical for an arid region. The dispersal of settlements does not permit provision of regional infrastructure found in other agglomerated rural areas of Israel which have settlements, (as, e.g., the Lachish region). To avail themselves of essential regional services, e.g., schools or medical services, the Aravah residents have to spend more travelling time and distance than in the rest of Israel. This is particularly so with regard to services located at national centers.⁴ The small population served makes regional services more expensive.

THE GEOTHERMIC FARM AT PARAN

One of the most interesting instances of providing water concerns Paran village in the central section of the Aravah. Paran, a moshav founded in 1972, is located on the south bank of the Paran Valley, the major drainage artery of the central Negev highlands into the Aravah, whose numerous gravel beds reach a total width of c. 1.5 km. To the south of Paran is the transversal ridge of Har Eshet which is bordered by faults. Paran village derived its water, 200–300 m³ per hour at salinity c. 170 mg/l, from wells drilled to c. 100 m depth. As this amount was insufficient, another boring was located close to a geologic fault. It provides water from a considerable depth, close to 1600 m.⁵ Fortunately, the water rises by artesian pressure to 30 m below surface, so that very little lifting is required. This is fossil water originating in the Nubian Sandstone formation. It is, therefore, a non-renewable resource, but at present rates of utilization the supply should last for at least 200 years. Salinity in this deep water reaches 350 mg/l.

The water originating at such a depth reaches surface at a temperature of 68°C. As this is too hot for irrigation, the water at first was cooled in the cooling towers. It was decided, eventually, to utilize the high temperature of the water for improving agricultural performance. The result is the 'geothermic farm', a large greenhouse complex covering 40 dunam (4 hectares). The deep hot water is pumped up, flows in two pipes of a specially resistant plastic material and at a depth of 10–15 cm under the floor of the greenhouse it heats up the 'soil' (see below) on which the plants grow. The plants in the greenhouse are also irrigated by trickle irrigation from the additional pipes laid on the surface. The hot water which applies high temperatures to the root area of the plants and to the floor advances harvest time by 2–3 weeks, a valuable added gain for out-of-season agriculture. In addition, the greenhouse can be both heated and cooled, as well as ventilated. Sections of the roof and side flaps can be opened mechanically by a computerized steering mechanism as temperature requires. All of this, however, does not prevent storm or hail damage to the greenhouse structure, ripping open the plastic hull and causing severe losses to the farmers.

Paran village can choose between two types of soil for farming. Next to the gravel beds of the Paran Valley are extensive areas of sandy soil, well-suited to agriculture. Their disadvantage is their exposure to occasional floods. This risk hardly affects the other type—the hamada soils. However the latter are stony and therefore much less fertile. Both types of soil share the disadvantage of a certain degree of salinization, aggravated under irrigation, due to the high evaporation losses, potential evapotranspiration being 2500 mm per year, i.e., 46 times the average annual rainfall. This disadvantage is worse for hamada than for sandy soils. Irrigation is, therefore, very carefully applied and soils are often flushed annually before cultivation starts, to remove accumulation of salt.

In order not to expose the 'geothermic farm' to flood damage and to avoid the problems of soil salinization, crops are cultivated on a non-local soil substratum. Its floor is covered by plastic sheets on which turf, mostly imported from The Netherlands, is spread. This has a high organic content and no inherent salinity. If irrigation by the hot and rather saline water⁶ of deep origin creates salinization, it is easy to change the turf for the next agricultural season.

Paran grows vegetables, mainly tomatoes, green peppers and onions, as well as melons, table grapes and dates. In addition some ten farm units have dairy cattle which do very well in the clean atmosphere of the Aravah and its isolation from other cattle breeding areas.

DAIRY CATTLE IN THE SOUTHERN ARAVAH

The dairy cattle industry is certainly no standard component in the economy of an arid desert. Sophisticated management, modern transportation, and, initially, the vicinity of a major tourist industry made it possible in the southern Aravah.

Paran is the northernmost village in the Aravah raising cattle. The major dairy cattle industry of the Aravah is located in the kibbutz villages south of Paran. Yotvata is the leader. The dairy plant serving the whole region is located there and it processes all of the milk produced by the Aravah villages, including the milk from Paran. In the early years, the Yotvata dairy supplied the needs of the town of Eilat and its many tourist hotels,⁷ but for some time now a wide range of dairy products from the Yotvata dairy, which has a high reputation, has been marketed all over Israel.

CONCLUSION

The eighteen Aravah villages are the exceptional case of agricultural settlements because of their location in a fully arid environment and non-oasis conditions. Farmers here maintain a sophisticated farm economy utilizing the warm

day temperatures of winter months to produce out-of-season products for the national and European market. The unconventional way in which 'geothermic' water is being used in Paran village illustrates the technique by which this is being achieved. In common with many other desert economies, the Aravah has to cope with a whole range of environmental risks, mainly climatic ones. Cool weather or other climatic disadvantages may delay ripening, so that the farmers miss the peak marketing time, around Christmas. Storms or hail may destroy crops and greenhouses. The rare but violent desert floods occasionally flush a field and its crops down the wadi. In short, modern desert agriculture demands expert handling, but it is also a high-risk agriculture with both profitable years and near-catastrophic ones. Fortunately, the former seem to be the majority.⁸

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NOTES

1. For Eilat at the south end of the Aravah 48 years of rainfall records are available, beginning 1940/41; the average is 30.4 mm per rainfall year (August to July). But in 73 percent of the years (35 years) rainfall deviated by over 50 percent from average and in 19 years (40 percent) by more than 100 percent. The extreme years were 1953/54 with 77.6 mm (+155.3 %) and 1974/75 with 76.1 mm (+150.3 %). The extreme deficit years were 1958/59 with 3.7 mm (-87.8 %) and the preceding year 1957/58 with 5.1 mm (-183.2%). There were at least four instances when 24 hour rainfall exceeded the annual average! They were: 67.0 mm on 19-20 February 1975; 50.5 mm on 31 March-1 April 1953; 40.6 mm on 26 December 1980; and 35.2 mm on 1-2 January 1966. (Data, courtesy of Israel Meteorological Service.)
2. From 1959 to 1976 a copper mine operated at Timnah, 25 km north of Eilat. The decline of copper prices on the world market caused its closure. The national total for employment in agriculture was 22 percent in kibbutz villages in 1990 and 17.6 percent in moshavim. Central Bureau of Statistics (1991).
3. In January, 1989, the crop of a large area at Paran planted with green pepper and an additional acreage of tomatoes, were destroyed by a killing frost.
4. The extreme case is the kibbutz village of Yotvata in the southern Aravah which maintains a daily flight for its members to Tel Aviv, returning in the late afternoon. The flight is operated by Arkia Airlines with a 19-seat passenger aircraft.

5. The water company at first intended to supply Paran village by a pipeline from Ein Yahav, a village some 30 km to the north. Geologists suggested trying to drill for water on a fault near Paran. When, at a depth of c. 150 m, no traces of water were found, the original plan was readopted. The geologists continued the bore as a research drill. When, eventually, water was found at a depth of 1600 m, its utilization would have been uneconomic had the water not risen to 30 m below the surface by artesian pressure.
6. Up to 350 mg/l.
7. By 1991, there were at Eilat 24 hotels with a total of 1,049 rooms.
8. Temporal and spatial stages of development of the Arava villages have been analyzed by Hochman et al. (1985).

REFERENCES

- Central Bureau of Statistics (1991) *Statistical Abstract of Israel*. Jerusalem: Government of Israel.
- Hochman, E., Vitkon, G., Just, R.E., and Zilberman, D. (1985) The dynamics of agricultural development in sparsely populated areas: The case of the Arava. In: Y. Gradus (ed.) *Desert Development: Man and Technology in Sparse-lands*. Dordrecht: Reidel, pp. 256–270.