Irrigation in an Arabian Valley
A System of Highland Terraces in the Yemen Arab Republic
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The popular image of Arabia is of an arid landscape peopled with nomadic Bedouins riding their camels through the sandy wastes. One hardly thinks of successful farmers or lush agricultural valleys in this part of the world. Yet a rich agricultural tradition did evolve in the fabled Arabia Felix of antiquity and the Islamic kingdom of Yemen. The Arabs called this southwestern part of the Arabian peninsula “the verdant Yemen” because of the variety of crops cultivated on both irrigated and rainfed land.

During 1978 and 1979 I lived in the rich agricultural valley of al-‘Abjir, located in the central highlands of the Yemen Arab Republic. Life in this corner of Arabia had received little attention, due to the political instability following the 1962 revolution. Mine would be the first ethnographic study of highland spring irrigation, which accounts for one-third of the country’s total irrigated land.

The research in al-‘Abjir presented two important problems for anthropological analysis, one dealing with political organization and the other with agricultural development. How suitable was a tribal political organization, with an ideology usually found among nomadic pastoralists, for the allocation of water in highland spring irrigation? How successful were simple, traditional methods of irrigation and what aspects should be considered in future agricultural development of the region?

Most of the cultivated land in the Yemen Arab Republic today is not irrigated, so that the farmer must plan his activities around the two rainy seasons of spring and late summer. In order to determine when rain is likely to fall, he resorts to an ancient star calendar, certain stars being associated with each rainy season. If the rain is late in coming, farmers will gather together and ask God to send the rain. A usual part of

this ceremony is the sacrifice of a camel or other large animal, a practice which appears to be pre-Islamic in origin. Since also the amount of rainfall is not always sufficient for successful crop production, dry farming is sometimes a precarious enterprise.

Thus, irrigation is the most important factor in the overall success of Yemeni agriculture. In the foothills and coastal region the major wells (Arabic for watercourses without a permanent flow of water) swell with floods after the rains. These floods are deflected by low barrages to irrigate fields along the wells. Wells are used to supplement irrigation of certain crops during seasons when there are no floods. In the highlands there are numerous valleys with mountain springs, which are used to irrigate terraced fields on the steep mountain slopes. Wells are used in the highlands mainly for cultivation of gardens near urban centers.

In Yemen there are very few quivets, the underground infiltration galleries which have flourished in Iran and Oman.

The valley of al-‘Abjir is one of the major spring-irrigated areas in the central highlands. From the air this majestic valley takes on the appearance of a giant Roman amphitheater with green carpeted terraces descending below picturesque hilltop villages. Al-‘Abjir is part of the upper catchment of Wadi Sardaj, a major watercourse stretching west to the Red Sea. Most of the three thousand inhabitants live in the northern arc of the valley, which is about four kilometers wide. Here also is a line of springs at 2900 meters above sea level.

Al-‘Abjir is blessed with an abundant supply of water, although the surrounding region is dependent on rainfall and direct flow of surface run-off onto adjacent fields. It is said that there are 360 spring flows in the valley. One man told me that this meant there was water flowing almost every day of the year. The farmers here do not have a word to refer to the spring as a source; rather they call water flowing from springs ghayl in Arabic. It is the flow of water through irrigation channels that is most important here, for that flow makes their crops flourish. It is no surprise that the term ghayl is also used for the flowing of a mother’s milk.
One of the major ghoufs in al-Abjar is the Sanaba. Water here flows regularly to fields owned by residents of three neighboring villages. The rate of flow is not substantial, less than ten liters per second, but it is continuous. Since the water does not flow in sufficient quantity for efficient distribution directly to the fields, it is collected in cisterns. This offers a number of advantages to the irrigators. It would be very dangerous to distribute water through the steep terraces in the dark, so night flow is collected for distribution during the day. Also, it is easier to control the amount and timing of flow from a cistern.

Springs are the only reliable source of water in the valley. No wells are found here, as occur in villages in the coastal region and central plains. Water for drinking and domestic needs is collected by women, who may come as often as three times a day to fetch water. The woman must climb the steep and narrow path to her village, a plastic pall of water poised precariously on her head. She must know the path by heart, since looking down to make sure of her footing would probably spill the water. Men will sometimes stop at a cistern at prayer time, since water is needed to perform ablutions before prayer in Islam. On a hot summer day the cistern can also become the "old swimming hole."

The dominant use of ghouf in al-Abjar is for irrigation in the gravity-flow channel network through the terraces. Access to water for irrigation is determined according to a traditional rotation cycle of turns. The water share is linked to land ownership, being intended for a specific plot of land and transferred with that plot of land when it is inherited or sold. However, water flow of a given turn may be sold or, more accurately, rented on a temporary basis. The existence of a water market allows for greater flexibility in cropping strategy, since an irrigator usually can supplement his guaranteed supply of water at certain times of the year.

The Sanaba ghouf system flows into two cisterns. During the day water is directed into the Sanaba cistern, located just below the spring. This cistern is capable of holding 110 cubic meters of water and irrigating 25 fildes (2700 square meters) of terraced land. After sunset the spring flow is diverted into another channel, which flows more than a kilometer both over and under the ground to the cistern of 'Alit. The cistern of 'Alit is about the same size as the Sanaba, but because of water loss in transport it takes about twice as long to fill.

At the Sanaba cistern the rotation cycle of turns repeats every seventeen days. The basic unit of share is the "mal," a quarter of a twelve-hour period or three hours. The irrigator does not necessarily have to wait seventeen days between waterings, since he may have several turns scattered throughout the cycle. Through inheritance and sale, land holdings are fragmented in al-Abjar, so that an irrigator may own land in different parts of the system. Although each plot has a specific water right, the irrigator may use his water to irrigate any of his plots.

Traditionally, the turn at the Sanaba is measured according to a local shadow scheme. The daily progress of the shadow cast by a surrounding mountain ridge is observed. Fixed markers, such as rocks, large trees, or tall buildings are associated with the times of the day. Some irrigators also measure the time of day by examining the length of their own shadows, but this necessarily varies according to the seasonal position of the sun along the ecliptic. Nowadays it is more common simply to use a wrist watch. Seiko has replaced the shadow.

At the 'Alit cistern a different form of measurement is used. A stick is submerged in the water and a turn is defined according to a certain number of hand spans. At yet another cistern a stone is placed in the cistern with marks indicating fractions of volume. In a few systems in the valley a water clock may be used when water is to be rented or there is a dispute over water. This is a copper bowl with a hole in the bottom. The bowl is filled with water, and the time it takes for the water to evacuate is measured. The type of measure here is largely a function of the need for precision, the water clock being the most precise measure in the past.
Irrigation in al-Ahjur is a simple process that can be handled from start to finish by the irrigator himself. When a man has a turn of water, he opens the exit hole of the cistern. The flow is directed through the appropriate channels on a course toward the plots. Using only a short halved shovelscoop, the irrigator can block off side channels and remove obstacles fallen in the channels. He must keep pace with the flow in order to make sure it is directed into the right channels. To the outsider, the irrigator seems to be figuring out a maze. When the flow reaches the plot to be irrigated first, a mud dam is made on the channel to block the flow and divert it into a specific plot. This may occur more than a kilometer from the cistern, so there is often transport loss in the earth channels.

There are two types of plots in al-Ahjur, but both have earth embankments to contain the water. For wheat, barley, lucern, onions, and many tree crops basins are used. An average field plot may contain eight basins of about 2.5 to 2.5 meters. Water is directed into each basin in a sequence to minimize water loss. This is important, because the irrigator must avoid literally watering himself into a corner. If water is lost or wasted through ineptitude, he cannot replace it by adding onto his turn. The amount of water applied to the plot depends on a variety of factors, such as the water needs of the crop, the dryness of the soil, and the needs of other plots.

Sorghum, maize, and young tree crops are cultivated in furrows, rather than basins. Water is successively diverted in parallel furrows perpendicular to a main channel inside the field. When sorghum is small, the water flows over the shoots. After two months the shoots are thinned and mound up with the furrows constructed in between.

Most irrigation activities are done by individuals. One of the few communal aspects of spring irrigation in al-Ahjur is the cleaning of cisterns. An immn or cleaning is usually called for by the village sheykh or a shareholder elected as wakil (a superficial administrative role) of a particular ghoyl system. Each household receiving water from the cistern is expected to provide male labor, or money to hire labor. Young and old combine for serious work and frivolous conversation. The mud, debris, and vegetation that have accumulated in the cistern over several years are cleared out. This event is usually timed during a lull in the cycle of agricultural activities. Participation is voluntary, not forced, but not helping would be considered shameful behavior.

A variety of crops can be grown on the fertile, irrigated terraces of al-Ahjur. The traditional staple of man and beast is sorghum (dubuul). The grain is boiled to make a nutritious porridge or ground to make flour for bread. The leaves and stalks make excellent fodder for the cattle.
bottom part of the stalk can also be used as fuel for the traditional tannur oven. There is usually a surplus of sorghum fodder, which is an important item marketed throughout the region. Sorghum grain is traditionally stored in underground granaries.

Sorghum is a summer crop, planted by hand in late spring. The field is generally ploughed three times, the last time at the planting. Mature mixed with ashes and soil is often applied to irrigated sorghum plots. The farmer drops eight to ten seeds in a hole in the ploughed furrow, covers it with dirt, and then repeats the process about half a meter down the furrow. In about two months the shoots are thinned to four or five per clump. In September, before the grain is mature, the lower leaves of the plant are stripped and stored as fodder. The main sorghum harvest occurs in November.

In recent years maize has been replacing sorghum in al-Abyar. This is a trend which has been observed in Africa and Asia as well. Maize requires slightly more water, but the yield is also a little higher. Due to a perennial supply of water a winter crop of wheat, barley, or legumes will generally be planted after the sorghum plots are harvested. Lucerne is grown year round and marketed regionally for fodder. In the past few years, tomatoes have become an important cash crop. This is due to a new road easing access to major urban markets on the central plains. Only a few fruit and nut trees are found, and these are mainly for domestic consumption.

If Yemen is noted in the West for any agricultural product, it is for coffee. Our mocha coffee was given its name from the Yemeni port of Mocha, where European and American ships docked more than two centuries ago. Coffee was introduced from Ethiopia into Arabia in the 16th century and soon a lively trade with the West developed. The coffee bean is rarely used in Yemen to make coffee, but is exported. The traditional drink is a kind of 'tea' made from boiling coffee husks. Indeed, in local Yemeni markets coffee husks make up a more expensive, per kilo, than coffee beans.

Coffee production in Islamic Yemen on the map, just as Frankincense was associated with the land of Sheba in pre-Islamic southern Arabia. But the cultivation of coffee has decreased considerably in the last century, due in no small part to the inability of the Yemeni farmer to compete with the large-scale coffee plantations of southeast Asia and South America. Farmers said that coffee cultivation was a major investment. Trees would not bear before three years and were said to bear on an average for only six years. Young seedlings required constant attention and frequent watering. There has been little incentive to continue growing coffee in the Yemeni highlands.

In al-Abyar coffee is rapidly being replaced by a more lucrative cash crop—qat (Catha edulis). This tree is cultivated solely for its leaves, which are chewed as a stimulant. Almost every day Yemeni men gather in the afternoon to chew qat leaves. This provides a convenient forum for exchange of news, informal business arrangements, and negotiation of disputes. Qat is also chewed on festive occasions, such as weddings and religious holidays.

There is a considerable debate in the Yemen Arab Republic over the use of qat. The Marxist Peoples Democratic Republic of Yemen, to the south, has virtually banned qat from the market. There are conflicting claims about the effect of qat chewing on health. However, it is clear that the plant is not physiologically addictive. From the farmer's point of view, qat is a perfect cash crop. Very little effort is required to maintain the plant, and less water is needed than for coffee. In addition, most qat trees live and bear for at least twenty-five years. The only major problem is that the leaves that are plucked must be marketed within about twenty-four hours. With improved transportation in the country, this problem has become less and less significant. One harmful effect on the Yemeni economy is that growing qat is often at the expense of cultivating food crops. Thus, the country must rely more and more on the international market for basic foodstuffs. Selling farmers that they should not grow qat, however, is like trying to convince the National Rifle Association that Americans do not need guns.

Irrigated agriculture in al-Abyar can only be characterized as successful, despite the lack of a sophisticated technology or elaborate system for directing irrigation activities. There is a minimum of conflict over water rights. Most disputes are easily solved through mediation by peers or village shaykhs (leaders). Water and land rights are defined and mediated according to tribal customary law, which is seen here as in harmony with formal Islamic law. No Islamic judge lives in the valley, and few disputes are serious enough to be taken to the nearest Islamic court in the region.

Most of the irrigators in al-Abyar are tribal, independently-minded and fiercely proud of their tribal heritage. They have descended from tribes which have been sedentary in Yemen for at least two millennia. Social organization is regulated by a segmentary lineage system, with each segment having different responsibilities and concerns. The largest functional unit is a lineage of seven generations, which defines the preferred marriage pool for cross-cousin marriage. In practice two or more of these lineages make up a village. Each village, rather than the lineage grouping, has an elected leader or shaykh. He represents all residents of the village, whether they are tribal or not. However, he has no independent authority of his own and must act by consensus of those who elect him. The basic economic production unit and landholding group in the extended family, although sometimes several families will combine to form a single household. Tribal political organization is well suited to the allocation of water from highland springs and operation of the irrigation system. The reason for this is that total control of the water resource is in the hands of the local community. There is no need
for decisions over control of land and water above the level of village sheykh. In a tribal political system, authorities at higher segment levels do not have the authority to impose decisions on local communities. Power is spread rather than concentrated. Given the fact that each irrigator is capable of handling the entire irrigation process on his own, there is little need for directed supervision or external control of the system.

The system of highland terraces in al-Ahjur represents generations and centuries of investment in the land. There is not enough soil on the natural slopes for building up the terraces. Thus, soil has been painstakingly brought in, often by donkey, to fill in the terraces. The farmers here have literally carved a garden into the sides of the mountains. In al-Ahjur an equilibrium has been reached between the water supply, which is constant, and the extent of cultivated land. The traditional lightweight Yemeni ard, pulled by bull, donkey, or camel, is the only practical way of tilling most of the terraced plots. It would be impossible to introduce a tractor here, as is being done in the agricultural development of the level coastal area and plains of Yemen. Indeed, it is difficult to imagine ways for improving the irrigation system here.

Agricultural development policy in the Yemen Arab Republic centers on increasing water supply and introducing more sophisticated technology. A great deal of interest has been generated in the coastal region, where hydraulic pumps have been installed at wells and new barrages in wadis are being designed. There is a conscious shift, as well, away from traditional crops and toward lucrative cash crops for the national and international market. This attitude represents a dominant trend in agricultural development of Third World countries.

The emphasis on new machinery, cash crops, and experimental farms represents a potential threat to viable traditional agricultural systems such as ghayl in al-Ahjur. The role of the small farmer, growing crops both for his own needs and for a regional market, is being challenged. Al-Ahjur represents all that is right with traditional agriculture in the Arab world. It is difficult to improve on the effectiveness of irrigated highland terraces, except in decreasing water loss through transport in the channels. Yet lining channels would be both expensive and disruptive of traditional water and land rights. One area that needs further exploration is the use of directed slope runoff in the rainy season. This marginal practice, which was important for subsistence crops in the past, is rapidly being abandoned. Yet, as has been shown through experimentation in the Negev on ancient Palestinian runoff farming, this can be an effective source for cultivation in an arid environment. Hopefully, the experiences that have led to viable traditional agriculture in Yemen will not be ignored in the future development of the region and its resources.

Suggested Reading

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