

## MAN - THE DESERT FARMER

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My rather brief and somewhat oversimplified discussion of the prehistoric desert farmers of Arizona will center around the Hohokam Indians and their efforts to control water resources. These people were only one of several early groups to use and abuse the rivers of the Southwest. The Hohokam occupied major river drainages of central Arizona, especially the Gila, Salt, Verde, Santa Cruz, San Pedro and Agua Fria, primarily within the Sonoran Desert.

From the earliest times prehistoric populations were concentrated in the major river valleys and tributaries in the Southwest. Prior to the Hohokam people the Cochise hunters and gatherers (ca. 5000 - 2000 B.C.) began gathering wild maize. Remains of attempts to control water by these incipient agriculturists have not been found and indeed it is likely there were none. Their effect on the environment was apparently rather insignificant.

The Hohokam were the first in Arizona to have made use of rivers for agricultural purposes. Two types of water control seem to have been utilized. One involved the direct exploitation of rivers through the use of irrigation canals. The other, an indirect use, controlled runoff within micro-drainages at higher elevations before it reached the rivers. This latter method utilized linear and grid borders, terraces and trincheras (check dams across

small and shallow washes) and Ak Chin farming. Both of these types of uses were designed to preserve or improve the productivity of available land suitable for agriculture.

Canals taking water from rivers were apparently constructed and used from the beginning of Hohokam culture. These canals served to take water from permanently or nearly permanent flowing streams and make it available for the irrigation of fields and for village use. Well developed canal systems were found by Haury [1967] from the Vahki phase (beginning about 300 B.C.) onward at the Snaketown site. Most of the canals were constructed on river terraces and often carried water 10 to 15 miles. During Hohokam times several hundred miles of canals and feeder ditches were dug by hand. Not all were in use at the same time, of course. Washouts and the need for new fields necessitated changes in the canal systems from time to time.

With irrigation we have a case where, to meet the needs of an increasing population, a redistribution of land and water resources had to take place at the expense of the environment. Concomitant with an expanding population was an increase in social and political complexity. In order to support the population it became more and more necessary to modify the landscape so as to maximize production.

The soils available to the Hohokam were primarily fine grained alluvial soils laid down by heavy seasonal flooding. This type of soil is characterized by differential deposition - some areas of very fine grained soils and some coarser and more gravel filled. With very fine grained soils it is difficult to drain the subsurface and they are usually dense and hard to break up. The coarser soils are often too well drained. In the dense soils moisture loss

is only through evaporation or transpiration. This introduces a further complication - the deposition of salts and alkalis left behind when the water evaporates.

The accumulation of excessive amounts of salts and alkalis would render a field unsuited for agriculture. Some crops grown by the Hohokam, such as maize, had a lower tolerance to salts than did some types of beans [Woodbury 1962]. Conceivably, if salt levels became too high the dependence on maize as a primary source of food, would have to be transferred to lesser foods such as beans.

At first the Hohokam probably used only those parcels of land best suited for agriculture, i.e., where the soil and drainage were good, the land easiest to irrigate, and so on. The pattern of clearing, irrigating and subsequently abandoning fields increasingly used up the better quality farm land. Later, marginal lands had to be utilized.

Thus, there are two basic limitations caused by soil: (1) the density, either too compact or too loose; and (2) the accumulation of salts and alkalis due to the lack of adequate drainage. Water logging has also been suggested as a serious problem to prehistoric agriculture. The Park of Four Waters canal has been suggested by Woodbury [1960] as a drainage canal for water logged soil rather than an irrigation canal.

In addition, extensive agriculture would require clearing of natural vegetation found where the best farm lands were located. The more clearing, the greater the possibility of erosional problems. Clearing would include removal of mesquite, cholla and similar vegetation which was also a source of food to the Hohokam. Thus, while expanding agricultural fields they were at

the same time reducing the available native food resources upon which they had to rely if crops failed.

Water control devices were primarily designed to reduce the rate of flow of the runoff from rainfall, increase penetration, control erosion and build up soil. This was especially true if linear and grid borders, terraces and trincheras. The Ak Chin method directs water to the mouth of a wash where it is then spread out onto fields located in that wash. The water is controlled so as to brake the rate of flow.

Those water control devices that regulated runoff before it reached the rivers were basically conserving techniques and in general modified the existing runoff pattern without doing appreciable damage to the environment. A balance is maintained between exploitation and conservation in these cases. Salts and alkalis and water logging do not seem to have been problems. Although they are more primitive in construction than irrigation canal systems, this does not imply, I think, that they are necessarily older. In fact, the reverse is probably true. The use of these devices is difficult to date. Archaeologists do not know if these controls were in use by the Hohokam throughout their existence as a viable culture.

So far there is little evidence that these techniques of water control were utilized by the Hohokam for any length of time. I suspect that they came into use late in the cultural sequence after major problems developed in the canal irrigation systems fed by the rivers. By late I mean during the Classic Period or about A.D. 1300-1400. The runoff control techniques appear to have been used from then until relatively recent times. Classic Period (A.D. 1300-1400) linear and grid border fields have been reported near Cave Creek, Arizona

[Ayres 1967].

The water control devices were probably less damaging to the environment than large scale irrigation because little clearing was done and they were usually located where drainage was good. However, there seem to be a few cases where these have been detrimental.

Historically the Papago Indians utilized the Ak Chin method of farming. Recently, Ronald Cooke, a geographer, looking at aerial photographs of the Papago Reservation in the Crow Hang village area suggested the possibility that attempts to control runoff at the head of arroyos actually created those arroyos. Due to poor management small, shallow drainages suitable for utilization for Ak Chin farming became increasingly bigger and deeper. The level of available technology made it impossible to use the water because of increased size and depth of the water courses. Papago informants at Crow Hang village verified this practice. Dunbier [1968] reports similar occurrences in Sonora among neighbors of the Papago Indians. Overgrazing and lack of rainfall are often held responsible for these entrenched arroyos but cultural factors are also involved. The overall effect would be a decrease in acreage of available agricultural land and would cause a shift from main to smaller and smaller drainages. The Hohokam may have experienced similar problems although no evidence of the use of Ak Chin farming by them has been found.

Although the Hohokam use of river water for irrigation began around 300 B.C., it was not until the Sacaton phase, some 1200 years later, that the maximum extent of their irrigation systems was achieved. By about A.D. 1450 the Hohokam had disappeared as a viable culture. These people apparently had been forced to readjust their way of life. The readjustment was so drastic that the Hohokam culture as such ended abruptly. Exactly why they had to change is

unknown, but probably much of their problem can be laid directly to their manner of exploiting the rivers for irrigation purposes. Their lack of suitable technology to control drainage and salt and alkali problems could have been a major factor in the collapse of their cultural system.

Understanding the cultural factors involved is important in determining how, where and why particular types of water control and use took place and why and when they failed. Factors such as prehistoric political and social systems are crucial, although at this point in time they are too poorly understood to be of much help.

There is more archaeological information available on use than on abuse of rivers. Archaeologists until recently have not been particularly concerned with abuse.

## References

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