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Hopí Gardens

Daniela Soleri

The Hopí Native Americans of northern Arizona are famous for their skillful management of scarce productive resources in an agricultural system that has sustained them for centuries. In addition to their dry farmed fields and orchards, some Hopís also cultivate irrigated gardens.

The Hopís’ high desert environment with an average of 250 mm of precipitation each year, frequent drying winds, and short growing season (between 120-160 days, depending on the location) would create challenges for any agriculturalist. These conditions encourage high rates of evapotranspiration, and water is the resource most limiting agricultural production.

The topographical and geological features of the Hopi lands and those north of them have had a major effect on the availability of water to Hopí agriculture and settlements. Most field production, located between 1,433 to 1,768 m in elevation, uses runoff water both directly through water spreading of runoff from summer rains, and indirectly using water stored in the soil from winter precipitation. The area to the north is higher in elevation, approximately 2,400 m, and receives more precipitation. Much of this water infiltrates through a permeable sandstone layer until reaching an impermeable layer of shale which slopes down as it runs south to the Hopí mesas. Water from snow and rain falling north of Hopí is trapped on top of the shale and follows its downward and southerly path until reaching the mesas. There the water may seep from the mesa sides, running under a layer of wind-blown sand, and moistening the heavier soil underneath. The seeps are where fruit trees, melons, squash, gourds, and beans are planted. When a large, concentrated volume of water emerges from the mesa side it creates a spring. These springs provide both drinking water and irrigation water for nearby gardens.

A number of these springs around each of the three Hopí mesas have been used for irrigating gardens over the years. In 1940 Page estimated that approximately 14 acres of gardens were under cultivation on the three mesas (1). In October 1935 researcher Volney Jones visited six springs being used to water gardens at that time (2). A number of other researchers working in the first half of this century mention these spring-fed gardens (1, 3, 4). Of these, Page offers the most detailed description of the sandstone “bench” terraces built for garden plots. He also describes the system of small ditches and channels built to carry irrigation water from storage tanks at or near the spring to the terraced plots below. Forde described the storage tanks at First Mesa built of rock, with leaks being plugged with a mixture of mud and dried plant fibers. “The tank is ... provided with an outlet, stopped with a bung of cloth, or hide and grasses. Removing this bung, water is allowed to run from a main discharge channel a foot or so deep and about two feet wide to the various distributing channels” (4).

The most common observation of Hopí gardens by these early researchers was a description of the crops being grown. Forde describes small plots of "chile, onions, vegetable

![Squash, corn, chilies, and peaches are grown by Norman Honnie in his garden at Wepo Springs.](image-url)
dyes...a kind of cress and sweet corn" (4). Page lists chile, onions, sweet corn, beans, and cress as being grown in gardens. He also noted that fruit trees such as peach, pear, apricot, apple, almond, cherry, and grape vines were planted on the lowest garden terrace or on the garden periphery (1).

In 1935 Jones was collaborating with Alfred Whiting on a survey of Hopi agricultural seed sources (5). His description of crops being cultivated in Hopi gardens in the fall of 1935 is the most detailed account of the time. The following is a list of the crops he saw growing in Hopi gardens: amaranth, apples, apricots, beets, cabbage, cantaloupe, carrots, chiles, cilantro, gourds, grapes, green beans, lettuce, mint, muskmelon, onions, peaches, peas, radishes, safflower, squash, sweet corn, sunflowers, tomatoes, and watermelons (2).

During 1989 I visited the Hopi reservation monthly, interviewing farmers about their agricultural crop repertoires. During these visits I also interviewed many gardeners and visited gardens at Hotovilla and Wepo Springs. The following description of contemporary Hopi gardens is based on those visits and interviews with ten gardeners.

Hotevilla Gardens

The gardens at Hotevilla village on Third Mesa are located on the steep, northwest-facing slope, midway down the mesa between the village and valley floor. Numerous narrow terraces are staggered down the slope creating flat areas where gardens are cultivated. With the exception of a small mortared section of one wall, all the retaining walls are built of unmortared sandstone, a common, local building material. Although there are two springs at this site, gardeners say the smaller one is drying up and the larger one appears to supply almost all irrigation water to the gardens today.

Steps carved into the sandstone mesa wall descend from the village to a large rock and earthen water tank where the spring water collects. Inside the tank and well above the normal range of water levels the stone wall forms a basin on the side of the tank closest to the terrace edge. Using small buckets, bowls or cans, water from the tank is scooped or splashed up into the basin where it runs through a steel pipe in the tank wall. The water then drops down to the first ditch in the gardens' irrigation system. To maintain a steady flow of water requires nearly constant scooping of water into the stone basin. Children often help out with this work.

The ditches and channels of the irrigation system are all earthen or worn into existing stone surfaces. In some places pieces of metal or ceramic pipe, tin sheeting, rubber inner tubes, and cut-off pant legs are used to guide the water. Side channels are blocked with the heavy, sandy clay soil reinforced with rags to prevent washouts. Some gardeners have arranged stones in front of the opening where the irrigation water enters the plots to break the water’s strong flow, thus avoiding erosion of the garden soil and washing away of garden plants.

All of the gardeners I saw and spoke with at the Hotevilla gardens were women, although those interviewed said there is one male gardener. Young women often take over their mother's, grandmother's or maternal aunt's garden plots, especially when the older women can no longer climb up and down the steep stairs to reach the gardens. The village men are responsible for cleaning the tank each spring. Individual men help their wives or other female relatives with repairing walls and preparing the soil for planting. Children also help in the gardens, with irrigating, or play nearby while the women are working.

The irrigation system at the Hotovilla gardens is a locally developed social organization which appears to have functioned effectively for nearly a century. The gardeners are divided into seven irrigation groups, with groups ranging in size from about three to six members. Member control and decision-making may be one reason for the success of the irrigation system and thus the gardens. According to the gardeners I spoke with these groups are not necessarily clan or kinship based, nor are they based on location of garden plots. All those interviewed stated that a gardener could change irrigation groups as long as the new group agreed to let her join them. I interviewed one woman who has four small plots above most of the other gardens and next to a seep. The water from this seep runs into a depression in the stone and she uses this water to irrigate her plots and so is not a member of an irrigation group.

Through a combination of tradition and innovation Hopi gardeners have developed strategies to cope with some common dryland garden problems...

I was told that unless the water level in the tank is extremely low, each group completes its irrigation in one day, with members taking turns, first come first served. The time it takes to irrigate depends on the location of your garden, the number of plots, and the water level in the tank. The gardeners I spoke with said they usually spend 30 to 90 minutes irrigating their plots. When the water level in the tank is very low the group whose turn it is posts a sign telling the others that the irrigation schedule has been delayed until the water level rises.

With seven irrigation groups each gardener can get irrigation water through the channel system once a week. Should her plants need more frequent watering she makes a small basin around each plant, carries water from the tank and hand waters each plant individually. The gardeners noted that using the basins concentrated the water on the plants, avoided having to fill the whole bed, and saved them both time and work.

The gardens are planted in late April or early May, depending on the weather. Retaining walls and garden plots are often damaged by winter precipitation and runoff, and are repaired before preparing the soil for planting. Although
some gardeners add manure (especially sheep manure which
is locally available) to their plots and some use manufactured
fertilizers, many do not add any organic matter or fertilizers.
The soil is leveled and the plot is usually irrigated before
planting to moisten the soil. Gardeners carry buckets of
yellow-orange sand up from the fields in the valley to use
when planting seeds. Each planting hole is dug approximately
5 to 8 cm deep with a trowel or other hand tool. After
a large number of seeds are dropped into the hole it is filled
with the field sand. Gardeners explained that this sand is
easier for the emerging seedlings to break through, compared
to the heavier sandy clay soil of the garden plots which tends
 to form a crust when wetted.

The availability of irrigation water makes it possible to
produce vegetables that would not survive under dry farming
conditions. The gardeners spoke of experiments with many
different garden crops, some of which were successful and
others which were not. Gardeners plant both traditional and
new crop varieties in their gardens. Chiles are the most
widely grown garden crop in Hotevilla today, just as they
were in 1935 when Jones visited. Several varieties, including
yellow wax and jalepeño are grown from purchased transplants
or seeds, seeds saved from purchased fruit, or seeds
passed down from older gardening relatives. Chile plants are
grown in an evenly spaced pattern with 20 to 30 cm between
each plant and they occupy most of the plot, especially the
central area. Along the sides may be planted commercial
dole beans, sweet corn, cucumber, zucchini, crookneck and
yellow squash, carrots, radishes, tomatoes, onions, and
cilantro. I also saw strawberry and asparagus plants. Hopi
sweet, blue, white, yellow, and Kachina (mixed colors) corn
were grown in some Hotevilla gardens this year. Seeds of
\textit{nana'kofii} (\textit{Monarda mexicana}), a wild culinary and
medicinal herb, are gathered in the wild and planted in the
gardens where the plants become established by self-seeding
each year.

Gardens are also used to start some fruit trees from seed.
Both apricot and peach seeds may be planted on the edge of
garden plots. When the seedling is about 5 cm tall it will be transplanted to
its permanent growing site. In addition, some peach trees are growing perma-
nently in the bottom level of terraces in Hotevilla.

A Wepo Springs Garden

The gardens at Wepo Springs on the
northwest side of First Mesa are far from
any village. According to Jones (2)
there are three springs at Wepo—I
visited only one of these. This spring
emerges from beneath a large rock
outcropping below the mesa top. The
water is led down approximately 6 m
through a large steel pipe into an
above-ground holding tank of mortared
stone.

The gardens at this site are on several levels of wide
terraces supported by sandstone retaining walls. Earth berms
divide the terraces into smaller garden beds which can be
easily irrigated. From the 3-m-high tank built in 1963, a pipe
runs down to several faucets in different parts of the garden.
Much of the pipe was salvaged from an abandoned
windmill by the most active gardener at the site. Hoses
are used to carry water from the faucets to the individual
garden beds. Hose attachments, called bubblers, are used to
break the water flow out of the hose so that it does not erode
the garden soil.

The gardener I spoke with is able to use this site because it
is under the control of his wife's clan. He and his nephew
are the only two people gardening there today. They water
their plots about once every three days, flooding each with
approximately 7 cm of water. Even so, the water level in the
tank never drops more than 450 to 600 cm, and an overflow
pipe is necessary to direct excess water down into a wash
below the gardens.

During the winter the soil is prepared with manure. The
corn is planted in April in small planting holes and covered
with fine, yellow-orange field sand, as described for the
Hotevilla gardens. Late frosts can cause problems for early
plantings in this high desert. When a late frost freezes back
young corn leaves the gardeners use scissors or knives to cut
back the dead parts, encouraging new growth. Grasshoppers
can be devastating and crops may need to be replanted more
than once to finally survive their damage.

Strong winds and blowing sand, especially in May and
June, dry and damage tender crops. Gardeners use a variety of
materials for windbreaks such as pieces of sandstone, tin
sheeting, tin cans, newspaper cones, and plastic or paper food
cartons.

Crops grown in this garden from commercial seeds in
1989 were zucchini, two varieties of sweet corn, a number of
hot chile varieties, and two varieties of onions. Two kinds of
Hopi squash were being grown as well. This gardener also
grows radishes, cabbage, and lettuce. Several old peach trees of two different varieties are scattered around the garden and a cluster of yellow and red apple trees is growing below the lowest terrace.

Discussion

Like most agriculturalists, Hopi gardeners are constantly experimenting. They test new techniques or plants that if successful would be feasible for them to use. Keeping their experiments small requires little investment and minimizes losses should they fail.

Hopi gardeners frequently experiment with new crops and crop varieties. The availability of water makes it possible to grow a wide variety of crops that would not survive under dry farming conditions. Reasons for trying new garden crops vary. New varieties of standard Hopi garden crops such as chiles or pole beans are tried to compare agronomic or culinary qualities with varieties already in use. Some crops are tried out of curiosity.

Cultivation of Hopi or commercial sweet corn, or other short-season Hopi corns in gardens is sometimes a response to conditions in field agriculture. If a dry winter makes field conditions poor, or other circumstances prevent a household from planting any early corn in their fields, then it may be planted in the garden instead. Early corn which ripens in July is used in the Ninam or Home Dance ceremony. This important ceremony marks the beginning of the harvest season. It is also a farewell to the Kachinas or spirits that come each year to assist with the agricultural and ceremonial cycles and bring rain and fertility. Although it is possible to purchase corn at this time of year from Anglo farmers in the region, Hopi farmers and gardeners whom I interviewed said it is preferable to grow your own.

All of the gardeners I spoke with said their gardens saved them money, supplying fruits and vegetables both during the growing season and into the winter months, especially in the form of dried chiles. To really understand the net economic return to investments in these gardens would require careful, long-term study. Because of the availability of free water and garden sites, labor is the major investment made in these gardens. Determining the value of this labor based on alternative uses of it may be one way of assessing the cost of gardening. However, garden work is not perceived as equivalent to other types of labor. All gardeners I spoke with said they enjoyed their gardens and garden work. The women gardeners at Hotevilla often meet in the late afternoon and early evening in their gardens and socialize with each other while working in their plots. Non-quantifiable positive attributes such as the pleasure these gardeners said they derived from their gardens make standard economic analysis irrelevant.

Evidence from this brief, preliminary investigation of Hopi gardens shows that discussion with Hopi gardeners and careful observation of their work has much to offer those interested in dryland gardens as a development strategy. Through a combination of tradition and innovation Hopi gardeners have developed strategies to cope with some common dryland garden problems; social and technical difficulties of water management and distribution, soils that harden and prevent seedling emergence, damage from drying winds and wind-blown particles, and the difficulty of establishing perennial seedlings under harsh conditions.

References


The interviews and observations reported in this article were made while the author was conducting research on Hopi crop diversity for Native Seeds/SEARCH (NS/S). NS/S is a nonprofit seed conservation organization focusing on the traditional crops of southwestern United States and northern Mexico. The research was funded by the Pioneer Education Fund.

Hopi seed corn. (Drawing by Daniela Soleri.)