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# 1. SEEDS OF STRENGTH FOR HOPIS & ZUNIS

*The Center for People, Food and Environment (CPFE) in Tucson, Arizona, USA, is a non-profit organisation devoted to research, education and action for sustainable farming and food systems. CPFE co-directors Daniela Soleri and David Cleveland are carrying out research on the role of crop genetic diversity in indigenous and industrial agriculture. Because their work with Native American farmers in southwest North America is new to many of us and covers the gamut of issues facing local communities who are working to recover and strengthen indigenous agricultural systems through their seeds, GRAIN asked Daniela and David to share their experience with the many like-motivated people who read "Seedling".*

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The Hopi Native American homeland is in northern Arizona and the Zuni Native American homeland is in western New Mexico. Many members of both these communities continue to farm, garden, and ranch, as well as pursue many other professions. Hopi, Zuni and other Native American farmers in the southwest have developed their own varieties of crops originally from present-day Central America and southern Mexico---for example the yellow, blue, red, white, speckled and black corn and bean varieties, and varieties of squash. In addition, over centuries Native American farmers also adapted crops introduced from Europe, Asia and Africa---like peaches, wheat and watermelons The resulting local repertoire of farmer--developed folk varieties (FVs) is a unique heritage of these peoples.

However, in recent generations, especially over the last 50 years, Native American farming has declined, and a dwindling number of farmers and gardeners are planting more commercial varieties bought from mail order suppliers, stores, and nurseries. Today, many Native American farmers, like indigenous farmers elsewhere, appreciate the agronomic, environmental, and cultural value of growing their own varieties, but there are many difficulties in keeping this up in a changing world. Penetration of the market economy into Native American communities has discouraged food production in favour of income-generating work, although today such work is in short supply. Older members talk frequently of how their ceremonies, agriculture, and ultimately culture are falling victim to the pursuit of the "almighty dollar," and that farming may be dying out with their own generation.

Farmers have successfully maintained their indigenous varieties over the years as a result of keeping household seed stocks, obtaining seed through traditional family and community networks, and through exchanges with nearby communities. However, because fewer and fewer people have been farming over the last several generations, less seed is available through the local networks. Cultural and social changes have also broken down these local networks. Moreover, there are now many sources of non-Native American seeds as well. This is true even for Hopi and Zuni blue maize. Seed from these new sources, however, has not been grown and

selected under local conditions, and therefore must be tried out by Native farmers before large-scale planting. One concern is that in the process of testing out some of these new varieties, they will cross with local FVs, resulting in less well-adapted varieties. Research described below with Hopi farmers illustrates the dynamics of FV maintenance.

In spite of all the difficulties there is renewed commitment by Native American farmers to revitalise Native American farming that includes FVs, but also integrates appropriate modern technologies. The Zuni project which CPFE is involved in is specifically working on ways in which communities can safeguard their FVs for sustainable agriculture.

## **2. Varietal change: the case of Hopi maize**

About 9,000 Hopi Indians live in the high desert of northeastern Arizona, where the growing season between freezing temperatures is short: 120 to 160 days, depending on the location. Frequent drying winds, especially at the beginning of the growing season, and high summer temperatures produce significant rates of evapotranspiration. These conditions, along with the lack of surface water and low and variable annual precipitation, makes water the most limiting resource to agricultural production. In this challenging environment, Hopi farmers and gardeners have developed, through careful observation and skillful management, a sophisticated agricultural system that has sustained their communities for well over 1,000 years. The crops now grown by Hopi farmers are one point in a continually changing Hopi crop repertoire.

Hopi folk varieties accounted for more than half of the varieties in farmers' cropping systems in 1989 and dominated in all crops with the exception of sunflowers and garden vegetables. However, in some crop species dominated by Hopi FVs farmers are also experimenting extensively with commercial varieties. Some farmers, however, point out that commercial seeds are for irrigated agriculture. For some, this was a reason not to try commercial seeds.

The Hopi, like most farmers and gardeners, enjoy experimenting with new crops or crop varieties. As new varieties are added to farmers' repertoires, old ones may be dropped. If retained long enough, new varieties become FVs through genetic changes caused by selection in their natural and social environment. But there are really very few studies of why farmers maintain, replace or eliminate FVs, because they are difficult to do and funding has not been available. Limited evidence suggests that there has been a high rate of retention of Hopi FVs over the last half century. Today, non-Hopi varieties are making inroads largely among fruits and vegetables, and some field crops.

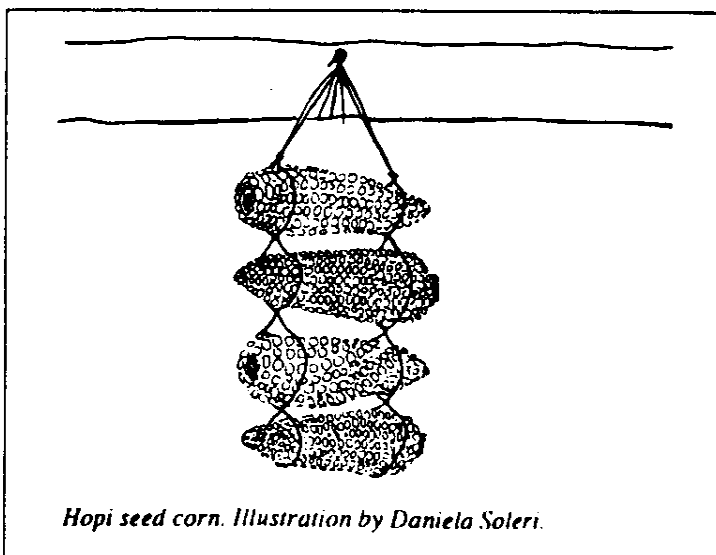
Take the case of maize. Maize is the central crop in Hopi farmers' repertoires and was grown by all of the farmers we interviewed for a survey in 1989. A total of 17 Hopi varieties were reported grown. The mean number of maize varieties grown per farm was 6.3, ranging from a high of 11 to a low of 2 varieties. Twenty-four of the farmers (48%) grew only Hopi maize varieties. For 22 of the remaining 26 farmers interviewed, the only non-Hopi maize they grew were varieties of commercial sweet corn. The other four grew another commercial maize variety in addition to commercial sweet corn

Hopi blue maize varieties can range in colour from nearly black to a powdery grey colour. Ninety two percent of the Hopi farmers we surveyed said there is more than one variety of Hopi blue maize. The varieties included "standard" blue (sakwaqa'o), hard blue (huruskwapu), and grey-blue (maasiqa'o). Despite the high proportion of farmers who recognise more than one variety of blue maize, 62% grow only one variety, 34% grow two and only 4% grow three blue maize varieties. While recognising the different varieties as such, some people added that they are now mixed together, especially sakwaqa'o and maasiqa'o.

One possible reason for this mixing or compression of blue maize varieties may be that some of the attributes or shortcomings of particular varieties are no longer important. For example, because of its hard kernals, huruskwapu was mentioned as being resistant to storage pests.

However, an increasing use of commercially produced foods means that today, households no longer need to store a year's worth of harvest in case of crop failure.

Therefore, storage problems are less important. Similarly, we were told by several farmers that when all the grinding was done by hand, women preferred using a lot of maasqa'o which is soft and easier to grind, even though it may not give as good a blue colour to the food as sakwaqa'o or huruskwapu. The agronomic differences between these blue maize varieties could also affect farmer selection and would be an important avenue of investigation.



Another factor which could be affecting the blue maize varieties in these Hopi farmers' repertoires is availability of seeds. Until recently, in the USA, blue maize foods and seeds were only known and available in a few areas of the southwest. For Hopi farmers wanting to experiment with new varieties of this important staple and ceremonial food crop, the only sources of new genetic material were neighbouring agricultural tribes. The current "blue maize fad" among American consumers---for example, blue corn chips for snacks---has been accompanied by a rise in seed companies selling blue maize seed. The availability of commercial blue maize seeds and blue cornmeal may have an effect on Hopi agriculture and social activities.

Our research with Hopi farmers suggests that folk varieties tend to be lost when changes in the natural or social environment reduce the importance of the FVs adaptation or stability. FVs tend to be retained when the natural or social environment remains the same, or changes in ways that increase the importance of the FVs' adaptation or stability. When ecological or social changes make FV replacement possible, actual replacement is determined by the availability of seed of new varieties that are similar to FVs, or of alternatives to products made with FVs. As in the case

of Hopi maize folk varieties, the interaction between these factors in determining the fate of a particular FV may be complex.

### **3. The Zuni Folk Varieties Project**

Given the urgent need for more sustainable agriculture, and the evidence for the key contribution of folk varieties, a number of actions need to be taken to safeguard FVs for sustainable agriculture at the community level. They are the basis of the Zuni Folk Varieties Project (ZFVP). The over all goal of the ZFVP is to work with the Zuni community to better understand the role of folk varieties, to increase their use, and to ensure that Zunis control their folk varieties for the future. The project includes a range of activities.

In the field of general education we are working with Zuni colleagues to increase the knowledge of FVs, and their role in sustainable agriculture within the community, especially among younger farmers and future farmers. Documentation of FVs and the indigenous knowledge of FV development and maintenance can be used in educational programs on the role of farmer-developed varieties in sustainable agriculture. The educational materials we are developing cover a wide range of issues. We are beginning to document indigenous planting and cultivation techniques and the maintenance of distinct varieties, seed selection, seed storage and conservation, and seed sharing within the community. Other important issues are the contribution of FVs to health and nutrition, increasing awareness about the value of FVs for sustainable agriculture, and the potential for improving ongoing FV maintenance and development by cooperation with formal plant breeders. Finally, an overriding concern is to devise options for managing community control over FVs, detailed further on.

A second area of work is to increase the availability of Zuni seeds. The goal is to make all local FVs available to anyone in the community who wants to plant them. This involves inventorying FVs and working with interested farmers to create a community seed exchange network and community seedbank, including a record keeping system, a management plan, and policies for distribution. The purpose of the community seed exchange network is to create a self-sustaining source of small amounts of seeds of FVs for community farmers who would then maintain their own seedstock. The exchange network will also serve as a system of in situ growout for the community seedbank, minimising the amount of growout required to maintain seedbank accessions, thus avoiding the biological problems and financial and managerial burdens of ex situ growouts.

Third, we are aiming to increase the planting, diversity, and performance of Zuni folk varieties. The goal is to encourage more farmers to plant more local folk varieties, and to ensure the genetic health of those varieties. Future activities may include: distributing educational material on seed saving and seeds from the seedbank to farmers; working with the staff of other projects in the area, for example nutrition, natural resource management. education agronomy, or pest control, to integrate activities to safeguard FVs; working with farmers to explore the opportunities for commercial production of FVs and sales of food products made from them, at the individual, cooperative, and group levels; and farmers working with formal plant breeders to maintain the genetic health of FV populations, and develop improved selection methods.

## **4. IPRs for Zuni seeds?**

Alongside the necessary practical work, the ZFVP is focusing on helping Zuni farmers establish control over their folk varieties. The goal is to establish options for policies to safeguard the intellectual property rights (IPRs) of the community in their FVs. Local leaders, working with agricultural and legal consultants, can develop a series of options for safeguarding cultural and legal rights in FVs based on communities' desires and control. As the project develops, this could include policies for: collection of seeds by outsiders; distribution of seeds from the community seedbank we are setting up; the use of FV seeds already removed from the community---and any that may be collected and taken outside in the future---in regard to genetic manipulation, private commercial uses, and public uses; and, finally, the use of FV names, and other cultural symbols, in connection with the marketing of seeds or food products.

Like many other indigenous farmers around the world, Zunis regard their folk crop varieties as sacred gifts from the Creator. Farmers' intellectual property rights to grow and to control their remaining FV seeds and food products is increasingly threatened by rapidly changing markets, laws, and biotechnologies largely controlled by industrial nations and corporations that also want to use FVs for their own purposes. IPRs in folk varieties include rights to the information encoded in their DNA as a result of selection by farmers and their farming systems, as well as knowledge about production and use of FVs.

How do indigenous farmers' want to define IPRs in their FVs, and how can they protect these rights in an age of gigantic multinational seed companies, genetic engineering in plant breeding, patents on plants and crop varieties, and a global marketplace hungry for exotic foods?

## **Box 1.**

# **THE ZUNI AND HOPI PROJECTS**

The Zuni Folk Varieties Project began in 1992, and is part of the Pueblo of Zuni's Conservation Project at Zuni, New Mexico, USA, funded by the C.S. Fund and the J.S. Noyes Foundation. It is documenting Zuni folk varieties, encouraging more farmers to grow more Zuni folk varieties, and developing policy options to safeguard Zuni's future rights to control their folk varieties. This project is managed by David Cleveland for CPEE. Donald Eriacho, a Zuni farmer and rancher, is assistant director for the Zuni tribe. Fred Bowannie Jr, Andrew Laahty, and Lygatie Laate are Zuni farmers who have helped with the Zuni Folk Varieties Project. The Folk Varieties Project cooperates closely with the Zuni Sustainable Agriculture Project, funded by the Ford Foundation. Donald Eriacho is the director, Fred Bowannie Jr. and Andrew Laahty are assistant directors. Work with the Zuni Cultural Resources Advisory Team, the Zuni Tribal Council, and the Nutria Irrigation Unit has provided much insight into the needs for intellectual property rights in FVs. Research with Hopi farmers, in Arizona, USA, on their folk varieties and why they maintain them, was directed by Daniela Soleri for Native Seeds/SEARCH in 1988-89, and funded by the Pioneer Education Foundation. Ongoing analysis of the agronomic and genetic effects of in situ conservation of folk varieties by Hopi and Zuni farmers compared with ex situ conservation of the same varieties in Iowa, is funded by grants in Daniela Soleri as a Ph.D. candidate in the College of Agriculture at the University of Arizona from the University of Arizona Foundation and the Flinn Foundation. This work is being done with the cooperation of five Hopi households and the USDA maize germplasm programme, who have all supplied seeds.

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## **Box 2.**

# **HOPI FARMER CONSERVATION VS. EX SITU CONSERVATION**

Daniela Soleri and Steven Smith, in the College of Agriculture at the University of Arizona, have been carrying out research to compare the genetic effect of community management versus ex situ conservation of genetic resources. The research involves comparing samples of one Hopi blue maize variety at three levels: (1) between original and subsequent growouts of the same variety held in cold storage by the USDA in Iowa over the past 45 years, (2) within populations of the same variety maintained in situ by farmers and collected at Hopi in January 1992; (3) between the most recent USDA seed regeneration (1985) and the 1992 Hopi populations. Analysis completed thus far on some of the morphological and phenological data shows significant differences between ex situ (USDA) maintained populations for agroeconomically important characteristics such as plant height, flag leaf dimensions and timing of reproduction. These same differences, as well as some related to tassel pigmentation, also appeared between USDA and Hopi maintained populations.

These findings suggest that, in this case, ex situ maintenance may not be achieving its goal of genetic conservation. What appears to be genetic shift should be cause for concern among breeders because it indicates a change in allele frequencies and, more importantly, a possible loss of rare alleles. Although many researchers involved with genetic conservation, including some at the USDA, have suspected such a problem, until now there has been no investigation of it. This shift may also represent a change in elements of a suite of traits that characterised the adaptation of this variety to the Hopi agricultural system.

If this is so, it raises a question about the utility of ex situ programmes for maintaining germplasm of use to the communities who developed it.