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Chapter 9

The Role of Cultivation in Conserving Medicinal Plants

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The dried roots, barks, leaves, fruits, and other plant parts found on the shelves of the traditional medicine dispensary vividly display nature's abundance. Each herb, whether wild or farmed, originally came from a living organism within a dynamic community that shaped its healing potential. Through the years, herbs have represented health to the practitioners and patients using them. Conversely, human choices have affected the health of the plant communities where these herbs grow. These choices are the subject of this chapter.

Knowledge of how to harvest healing plants dates from ancient times, probably before agriculture began 10,000 years ago. Then, people were few and wilderness was vast. Nevertheless, in the 21st century—with unprecedented human numbers, shrinking pockets of wild habitat scattered about the globe, and increasing industrialism—most medicinal herbs in China are still harvested from the wild (He and Sheng 1993). As a result, the capacity of many of these plant species to adapt to change, to continue to provide humans with medicine, and, for some, even to survive, is in jeopardy.

For Chinese medicine to sustain its metamorphosis into a world medicine, its students and practitioners must find creative solutions to the problem of medicinal plant conservation. They must develop a deeper understanding of how all those plants got into the jars on the dispensary shelves, just as they have educated themselves about how food reaches the supermarket, where it came from originally, and what was done to it in the process. Consciousness is the first step, followed by education, better choices, and collective action.

This chapter will first examine why plants are still harvested from the wild, and why wild plants are—or are perceived to be—of better quality. Because agriculture still presents a challenge for humankind, and our ability to conserve valuable wild plants is connected to these problems, we will summarize aspects of the history and contemporary redefinition of agriculture. Recommendations for ways that students and practitioners of Chinese medicine can help conserve medicinal plants will then be presented.

Wild Versus Cultivated

Since the beginnings of agriculture, people have shared an assumption that the medicinal efficacy of wild plants is reduced or absent once they are brought into cultivation. With the stubborn character of folklore, such beliefs reflect both our universal longing for a panacea and the will to survive that drives us to seek new cures.

Like other folk wisdom, however, the premium placed on wildness is only one facet of truth. The dichotomy of wild versus cultivated seems as old as the practice of agriculture itself. Theoretically, when a wild plant species is brought into cultivation, its gene pool is diminished, sometimes drastically. Depending on how the plant reproduces and how many individuals made up the original selection from the wild, the plant's ability to adapt to changing conditions and to keep itself healthy may be compromised.

Another aspect of biodiversity also affects plant quality. In general, agricultural ecosystems have been constructed as stripped-down versions of wild ecosystems. Most conventional agricultural practices reduce the numbers and varieties of microorganisms in the soil. The farmer may kill small and large animals competing for the crop and may grow only one crop in a large acreage (monoculture). Since plant nutrition is less a matter of taking in minerals and other nutrients directly from the earth than it is of feeding on the metabolic byproducts of literally millions of other organisms in their environment, any reduction in biodiversity in the environment affects plant health.

Agriculture's history shows a rather spotty record. When practiced badly—and never more so than today—devastation results. Even when practiced modestly with good intentions, agriculture without a holistic vision can lead to unintended negative effects. As industrial agriculture has intensified over the past 125 years, corrective interpretations have been available to those who would listen. Yet only recently—since the 1970s—has a counterforce gained momentum, a counterforce that has questioned all prevailing assumptions and established a series of alternative cultivation practices worldwide.

Nevertheless, as the 21st century begins, the new frontiers in agriculture are not fully visible to the general public, but instead remain the province of pioneers. Among this advance guard, new attitudes, experience, and research are in place, and the resulting practices demonstrate that the quality gap between wild and cultivated can be narrowed or closed.

A Brief History of Bad Agriculture

The roots of the “wild versus cultivated” problem run very deep and reflect our changing understanding of our relationship with nature. At present, when human population pressures have reduced wild habitat, and many medicinal plants have become rare or endangered, many observers regard agriculture as an ecological catastrophe, a problem so profound that a complete reinvention of the concept is underway.

The present crisis is a more widely dispersed version of an old one. Deforestation and plowing caused soil erosion in ancient Greece and Rome, as well as in central Mexico when maize cultivation began (Jackson 1980). Recent archaeological discoveries suggest that environmental degradation underlay the decline of civilizations in many other cases (Diamond 2003). Egypt, however, provides a contrasting example. There, regular flooding of the Nile took replenishment of soil fertility out of human hands until 1970, when the Aswan Dam was completed.

Some cultures fared better than others. Until the 20th century, China was a shining exception to the rule of careless stewardship. The Chinese sustained fertility for millennia, even though the land was intensively farmed, through a highly distributed, small-scale, closed-loop system that recycled everything, including human waste (King 1911).

Throughout the history of agriculture, a spectrum of practices has existed, now wider than ever, from pre-agricultural gathering to high-tech industrial agriculture. Along this continuum, biodiversity in the agricultural ecosystem is inversely proportional to the degree of industrialization (Badgley 2002).

The first synthetic fertilizers came into limited use in England in the 19th century. However, it was not until the end of World War II that the use of chemical products in agriculture became widespread. Huge chemical plants built for making explosives shifted easily into making nitrate fertilizers.

During the same period, a series of oversimplifications changed the practice of plant breeding, leading us into a cul-de-sac in which many of the world's major food crops have become dangerously dependent on chemicals. A group of scientists at the turn of the 20th century, influenced by the belated discovery of Gregor Mendel's life work, developed "pedigree" breeding (Robinson 1996), which produced desirable traits in certain crops. This practice deviated from quantitative or statistical approaches, which work with whole populations and assume the complex action of numerous factors in developing the kind of broad-spectrum resistance found in wild plants.

As an exercise in reductionism, the development of pedigree breeding can be compared to Galileo discounting friction and air resistance so that his measurements of falling objects fit his then-new theory of mechanics. His omissions were not considered important until the 1970s, when measurements became more accurate and chaos theory showed how the irregularities of simple systems act as a creative process (Gleick 1987).

In the case of plant breeding, however, oversimplification has brought us ever closer to the edge of disaster. While 75 percent of agricultural biodiversity in the United States has been lost in the past century, our major food crops have been bred to resist only specific pests. The pests mutate, necessitating another application of chemicals and another round of breeding in an endless cycle. While profitable for the seed and chemical companies, the trend has been devastating to farmers.

From the vantage point of a century later, pedigree breeding can be seen as an artifact of incomplete understanding. In 20th century biology, including both genetics and ecology, the pace of scientific discovery has exceeded the descriptive power of the words we use, including

the term “gene” (Keller 2001). But the profitability of the products created through oversimplification tends to perpetuate the mistakes. Genetic engineering of food crops can be understood as the next step in this sequence of reduction, an increasingly narrow focus on individual parts that disregards the integrity of the whole.

A crop with minimal genetic diversity can easily be wiped out by a single type of predator. The Irish potato famine, a well-known example, resulted in widespread human suffering and the deaths of a million people in three years. In 1845, a wind-borne fungus, *Phytophthora infestans*, arrived by accident (probably on a ship) to Ireland, where the poor relied on a potato monoculture. All plants were clones of a common ancestor, previously introduced from the New World in the late 16th century (Pollan 2001).

The human tendency to oversimplify, whether to save labor, make a profit, or through an attitude that regards nature as “other,” works against us over the long term. The practices that have yielded quick profits in industrial agriculture are all reductionistic. Those practices described here, such as pedigree breeding and monoculture, and others—the systematic elimination of microorganisms through the use of artificial fertilizers, herbicides and fungicides; genetic engineering; the consolidation of seed companies—have resulted in a continuous loss of biodiversity over the past century.

To repair the damage, we must re-learn how to work with nature. This challenge entails not so much a return to the old ways as a new awareness and respect for natural processes—an awareness we gain primarily through scientific investigation.

Corrective Forces in Agriculture

With one-third of the world’s arable land lost to erosion in the last 50 years, with 90 percent of U.S. cropland losing soil above replacement rates, worldwide pollution from agro-chemicals, declining fertility and continued outbreaks of famine and malnutrition, a colossal indictment of industrial-age agriculture is well underway. Beginning with Rachel Carson’s seminal *Silent Spring*, published in 1962, the public has been put on alert.

Older prophets lived in our midst when the depredations of modern industrial agriculture began, and their criticisms supplied the theoretical basis for contemporary ecological practices. Among them were Sir Albert Howard (1873-1947), an English scientist who worked in India and wrote two classics of ecological agriculture published in 1940s: *An Agricultural Testament* and *The Soil and Health* (Barton 2001). In the United States, publisher Jerome I. Rodale (1898-1971) promoted Sir Howard’s work and protected the public’s access to information on natural approaches. Rudolph Steiner (1861-1925), Austrian philosopher and founder of Anthroposophy, also founded Biodynamics, which treats the farm as a whole organism and employs practices such as herbal preparations and use of lunar rhythms to stimulate natural forces (Steiner 1924). In Japan, Mokichi Okada (1882-1955) founded a philosophy called Shumei that gave rise to sustainable farming practices and alternative economic arrangements to support them.

These visionaries advocated stewardship in alignment with nature, creating a distinct counterpoint to prevailing reductionistic approaches. They each attracted a corps of followers that has grown steadily into the present day.

While industrial agriculture spread during the 20th century, the philosophical context changed to follow the direction that emerged after the theories of relativity and quantum mechanics eclipsed Newtonian physics. Holism, systems theory, and the development of the science of ecology in the second half of the 20th century contributed to the changing views of humankind's place in nature (Worster 1994).

The work of the visionaries supported senior, contemporary innovators in ecological agriculture. Masanobu Fukuoka, now 93 years old, a Japanese microbiologist who had a sudden epiphany and went back to the land, founded a series of practices known as Nature Farming (Fukuoka 1987). Inspired by Sir Albert Howard and others, a South African game warden named Allan Savory amassed several decades of observations of fragile grazing systems that demonstrate the counter-intuitive principle that grasslands protected from grazing actually suffer decline. He found that germination of plant species depends on the mechanical effect of animals' hooves breaking up the surface of the soil, as well as other subtle interactions (Savory and Butterfield 1999).

Australian farmer Bill Mollison became preoccupied with the cultivation of perennial plants for food and founded Permaculture ("permanent agriculture"), a practice that emphasizes design to fit the specifics of a particular place and allows for multiple uses of farm elements (Mollison 1998). In Permaculture and other ecological practices, wildness is considered an essential element in preserving biodiversity and the capacity of the system to adapt to changing conditions. Wildness can be maintained in small ways—in hedgerows that separate fields or in biostrips among rows in a mixed cropping system. Indeed, the re-creation of wildness has become the territory for astonishing innovation among our close contemporaries (Imhoff et al 2002).

Wes Jackson, trained as a geneticist, whose innovative research at The Land Institute in Salina, Kansas, challenges the entire concept of soil tillage, is another contemporary leader in the corrective movement following nature as guide or instructor. He calls for "more people who will show us the practical possibility of a research agenda based on a marriage of agriculture and ecology." He also points out that in order to learn from nature, the process must be dialectical—we must ask questions and be prepared to have the questions revised by the answers (Jackson 1994).

The Re-Creation of Wildness

The corrective forces, having gathered momentum in recent years, agree on the value of wildness and biodiversity for its own sake to compensate for what we do not yet understand about how individual species contribute to the whole. The interactions of a wide variety of species create a dynamic, self-regulating system that takes on a life of its own. As ecological farmers and gardeners recognize, beyond a threshold of effort, biodiversity increases without human

interference. Life seems to attract life. “Pests” may be present, but they do not proliferate or attack healthy plants. The balance and resilience of the ecosystem approximates that of the wild.

However, given the extent of the destruction of medicinal plant habitat and other related worldwide threats, how do we maximize conservation without causing further damage? As biologist David Ehrenfeld pointed out 25 years ago, we must assign value to a threatened species to save it, yet it is “easier to develop value than it is to calculate the effects of our valuing” (Ehrenfeld 1998). Humans are part of natural systems, and when we interfere, even with good intentions, we bring along our incomplete ideas of utility and short-term gains, which can lead to unexpected consequences.

The paradox to which Ehrenfeld refers is demonstrated by the example of ginseng cultivation. While the Chinese learned about the North American species (*Panax quinquefolius*) through Jesuit missionaries in the early 18th century and sustained a substantial trade since then, cultivation of the plant in the United States did not begin until the 1870s (Foster 1999). A century later, cultivation was concentrated in Wisconsin, where the conventional practice produced an industry that grew the plants in monocultures under shade cloth, fertilized with agrochemicals and sprayed with fungicides to arrest the inevitable disease. Growers became concerned in the early 1990s over reports of falling levels of ginsenosides in their product (Acres USA 1995), yet restorative measures failed.

Meanwhile, although the amount of cultivated ginseng exported to China from Wisconsin amounted to over 2 million pounds in 1994, farmers in West Virginia complained about the persistence of wild ginseng poaching on their lands. The demand for wild ginseng was so great that local teenagers could bundle immature roots and sell them on the black market for \$300 per pound. Law enforcement officers and the farmers themselves could not adequately patrol the hilly terrain. Some suggested that persuading potential poachers to become ginseng farmers was the only realistic solution (WV Herb Association 1996).

These occurrences suggest that a glut of inferior cultivated product produced an unintended consequence, at least in West Virginia at the time. It drove up the price of the wild root and aggravated the poaching problem, thwarting conservation efforts.

Since then, the Wisconsin farmers have fallen on hard times, largely due to competition from British Columbia and China itself. But recently a countertrend has emerged. Led by progressive farmers and landowners primarily in the Alleghenies, the art of ginseng cultivation has evolved from conventional (industrial) methods to “woods-cultivated,” in which small areas of woodland are tilled and sometimes made into raised beds. Artificial fertilizer and other agrochemicals may or may not be used, according to the situation and choices made by the grower. (Buyers must learn to ask detailed questions concerning specific cultivation practices.)

However, “wild-simulated” or “wild-cultivated” methods are even more closely allied with nature. For those landowners fortunate enough to have inherited a natural population of ginseng with its own genetics, wild-cultivated ginseng means, in essence, wild. No outside seed is introduced, and interference is minimized (Jacobson and Burkhart 2004). Seed may be collected

and either broadcast by hand or returned to the greenhouse, germinated, and the young seedlings set out in imitation of natural spacing, along with their preferred companion plants.

Recent efforts to learn from nature have produced a substantial body of research on ginseng in the wild. Observers have found that the plant seems to prefer certain tree species, with sugar maples at the top of the list. Sugar maples bring moisture to the surface and also concentrate calcium in their leaves, resulting in calcium-rich soil, high in organic matter with low pH levels. Characteristic companion plants—maidenhair, Christmas or rattlesnake fern, blue cohosh, red or white baneberry—indicate moisture levels (Beyfuss 2000). Overall ecosystem diversity ensures pest control.

Other research on the elaborate interdependence among plants in an ecosystem (Golley 1993), including work on the huge variety of soil microorganisms and their symbiotic roles, has led to the recognition that wild ginseng habitat is complex beyond our present understanding. However, stewardship is not only possible, but it is necessary to protect resources. Note that ecosystems with the plant companions, moisture levels, and climate preferred by ginseng are found in highly specific localities. Rather than force ginseng to grow where it is convenient for humans, we have moved toward a concept of first identifying ecological neighborhoods and then choosing crops that fit the locale. The neighbors who have previously established residence—the companion plants, microbes, pollinators and predators—are both indicators and co-determinants of the qualities the plants will express. This principle holds for wetlands, pastures, prairies, drylands, alpine regions, and all the other ecosystems throughout the world.

Economics and Community Choices

The leading edge of ginseng production, with its advancements of the past 30 years, points the way toward resolving the perceived deficiency of cultivated medicinal plants. Yet agricultural ecosystems must always include the farmer. The economics of farming must become as sustainable as the ecology. This subject is too vast to treat in detail here, yet recent innovations in ecological agriculture include two market trends that bear mention.

Community-supported agriculture, which originated independently in Japan, came to the United States from Europe in the mid-1980s (McFadden 2003). This concept involves a group of shareholders who contract with a farmer on an annual basis for the harvest. The object is to support the farm by sharing the risk, with the produce (usually a variety of vegetables) as dividends. The principle is important to high-value crops such as medicinal plants because it allows the farmer to sidestep the commodity basis of production. A commodity is defined as equally valued units, none worth more or less than another. In commodity production, the major incentive for the producer is to hold down or decrease costs. In community-supported agriculture, however, advance payments create an incentive for the farmer to maximize quality and thereby retain shareholders.

A second trend is direct marketing, of which community-supported agriculture is a form. Direct marketing also includes farmers' markets or greenmarkets, farm stands, "u-pick" or customer harvesting, and internet marketing. The value of direct marketing is that it maximizes economic

returns to the grower. Farmers' cooperatives that own their own processing plants and other market vehicles achieve the same result.

Embattled farmers in the United States, who now represent less than 2 percent of the population, use these measures to sustain themselves in the face of imports subsidized by devalued labor abroad and transported by artificially cheap fossil fuels. Customers who become aware of environmental issues are motivated to support these farmers with their business. Recently, communities have begun to take responsibility for supporting their farmers by passing "right-to-farm" laws, creating wholesale markets, and forming land trusts that preserve agricultural land.

Students and practitioners of herbal medicine are, of course, members of wider communities that may sustain ecological farmers with their food purchase choices. Because herbalists advise clients on dietary matters, practitioners have a responsibility to be thoroughly informed about the options available.

How Herbal Practitioners Can Conserve Medicinal Plants

Students of Chinese medicine need to make a connection to medicinal plants that goes deeper than memorizing formulas or handling herbs in the dispensary. Botanical studies should be included in the sciences portion of the curriculum. But learning from texts and lectures has its limits.

Access to small gardens of the living plant species or larger collections within botanical gardens can be invaluable to students. Just as a picture is worth a thousand words, a five-sense experience of the whole plant deepens understanding of the herb's taste, nature, and affinities. Knowing something about the preferences and native habitat of the species can suggest how its healing properties developed. Observing traits the plant shares with its relatives helps develop a sense of the natural order and the ability to see patterns in nature.

The profession as a whole needs a means to identify quality attributes in medicinal plants—quality in terms of the characteristics and potency valued in a wild plant. Quality evaluation will become increasingly necessary as more herbs are cultivated outside Asia. While biochemical analysis can identify species and assess the number and strength of compounds in plant material, it does not at present address this problem. A research group in Minnesota has done groundbreaking work in this area, using a protocol from the food industry that promises an alternative, evidence-based method for the profession to assess quality in its medicinal plants (Hassel 2002).

Herbal practitioners who want to ensure continued access to high-quality medicinal plants must devise new ways to recognize and reward good stewardship. By learning about farming history and the contemporary lexicon, herbal practitioners can begin to specify the cultivation practices they believe to be appropriate. In this way, they can become an active force in the marketplace, capable of creating and enforcing standards of quality and supporting good farmers in the process.

Many people now interpret their own attitude shifts and behavioral changes as a matter of health, if not survival, for our food plants, animals, and human society. The traditional medicine

practitioner must seek allies among those who are earth stewards and learn what others are doing to solve the problems of conservation. Only by understanding the full dimensions of the problem will herbal practitioners learn to make the right choices for themselves, teach their patients to do the same, and ensure a future for their medicine.

In making these connections with farmers, conservationists, and other earth stewards, herbal practitioners directly serve their own mission. As Sir Albert Howard declared more than 50 years ago in an acknowledgment of our interdependency, “the health of the soil, plants, animals and human beings ... is one great problem” (Howard 1947).

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