Crossroads Resource Center

7415 Humboldt Ave. S. / Minneapolis, Minnesota 55423 / 612-869-8664
kmeter@crcworks.org www.crcworks.org

Tools for Community Self-determination

Building Soil Health in New Mexico

Photo provided by Charles Hibner.

by Ken Meter

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Executive Summary

A steadfast core of ranchers and farmers have proven they can build soil health in New Mexico, one of the most challenging environments in the US. The state's combination of arid weather, unpredictable rain, and hot sunlight poses huge complications, but several farmers and ranchers have overcome them. In so doing, they carry forward soil health practices that have been pursued on these lands for over 4,000 years.

Challenges are legion: in the best of years, rainfall may reach average levels, but may not fall when the crops most need it. Weather patterns are changing unpredictably. Markets are chronically fickle. Reliable buyers are scarce. Each region of the state poses unique challenges since soil types, climates, and elevations differ so drastically from place to place. Indeed, conditions can vary from field to field on each individual farm. Crops may be easy to grow on one parcel, and exceptionally difficult on another; water access varies across fields and pastures.

As financial margins have diminished over time, growers are increasingly forced to balance demands of a "day job" with the needs of their land. Policy may throw curve balls of its own — or unleash resources that help a grower to prosper. As growers scale their operations up or down, based on changing circumstances, unforeseen obstacles emerge.

To learn how New Mexico growers have benefited from following the 5 universal principles of soil health, we interviewed 12 ranchers and farmers chosen by the Healthy Soil Working Group. Each of the farms we spoke with considers soil health as a long-term quest, placing healthy soil at the center of their operations. Some proudly carry forward strong farm operations their forebears cultivated. Others try to repair damage inflicted by their own ancestors.

Several remarked that they began to enjoy farming and ranching more after they placed a priority on building soil health. Crops and animals are healthier, and they feel less stress. Overall, they find their farm operations are far more *resilient.*

Greater resilience means any given farm is *more likely to be profitable*, even in bad years. Still, for ranchers and farmers to enjoy sustained economic benefits from following soil health principles, society will need to build both market mechanisms and public incentives that reward those who pursue soil health strategies. Resilient commerce requires strengthening community trust.

The five principles of soil health offer a foundation for managing the complex, living systems that make ranching and farming possible. They are:

Five Principles of Soil Health

1. Keep soil covered
In nature, bare soil is an anomaly. Cover is critical to protect soil from wind and water erosion, provide food and habitat for macro- and microorganisms, buffer soil temperature, cut down on evaporation and make the most out of scarce water resources. Protect the soil by growing a dense carpet of plants or with a layer of mulch.

2. Minimize soil disturbance on cropland & minimize external inputs
Avoid both physical and chemical disturbance as much as possible. Tillage destroys soil structure, including aggregates and pore spaces that allow water to infiltrate the soil, leading to erosion. Synthetic fertilizers, herbicides, pesticides, and fungicides are harmful to life in the soil as well. Alternatively, compost boosts soil health, promoting stronger plants and resilience towards disease, and supporting microbes that feed directly on parasites.

3. Maximize biodiversity
Diversity above ground is mirrored below. Each plant, insect or animal has something different to offer and plays a role in maintaining soil health. Together they provide a varied diet for soil microorganisms, break disease cycles and create habitat for wildlife and pollinators. Nature does not know monocultures, instead diversity enhances ecosystem function and resiliency.

4. Maintain living roots
Soil organisms cluster around roots, where they exchange nutrients with plants. Those living roots provide their basic food source: carbon. In turn, the soil biology fuels the plant nutrient cycle. To ensure roots in the ground year-round, plant perennials or multi-species cover crops, or encourage a variety of warm and cool season grasses through planned grazing.

5. Integrate animals
A healthy ecosystem provides habitat for animals large and small. Planned grazing is essential for soil health on rangeland: mimicking migratory herds of ungulates, cattle are moved quickly through pastures, allowing adequate recovery time. Animals can be used to graze cover crops, beneficial insects find food and shelter in hedgerows or pollinator strips, and earthworms thrive in healthy soil.

See https://www.nmhealthysoil.org/2019/09/07/principles/

The growers we interviewed applied these principles in whatever ways made sense to their own farm operations at a given time, keeping in mind the uncertainties of markets and weather, and guided by their own visions. Each principle is complex, and each practice may bring several benefits. As only one example, a grower might grow cover crops for several reasons: (a) to keep soil covered; (b) to minimize soil disturbance; (c) to increase biodiversity; (d) to maintain living roots; (e) to build soil organic matter; (f) to attract pollinators; (g) because a certain crop looks good in the fields or prepares the soil for another crop, (h) to feed livestock; (i) to sell as food for humans; or (j) because their family has always raised a certain crop and has loyal buyers.

Soil Health: A Four-Millennia Tradition

Building soil health has been a tradition on the lands that are now called New Mexico for at least 4,000 years. That is how long the Diné (Navajo) have grown food on the same soils. Thousands of small gardens once scattered across the arid landscapes wherever water could be found, and sheep grazed remote pastures. Maize adapted to these arid conditions.

James and Joyce Skeet, (farmers who came from Diné and Mennonite families, respectively) integrate tribal traditions of growing food with insights from contemporary science at Spirit Farm in Vanderwagen. They told a story of a neighbor who looked over their fields and gleefully told them, "The scientists have finally learned what our ancestors knew all along." When the Skeets asked her to tell them the Navajo word for "compost," she said its traditional name *[bił k'é dilyehí]* translates as "what you plant with." Traditional Navajo also has a term for the microbes that flourish in the compost *[ch'osh do t'iinii]*: "the unseen bugs."

Navajo-Churro sheep, James added, exemplify traditional practices, even though the animals were introduced by Spanish conquerors, and science informs herding today. "Sheep have eyes that are positioned horizontally, so they can survey the landscape," Skeet added. As they graze they deposit their saliva on the pastures, transferring microbes to the soil. The action of their hooves works their urine and manure into the desert soils, building organic matter and fostering microbial growth. Thus, sheep are emblematic of listening to the land and making it better: an empathy with the creation. "After we learned how to raise the sheep, we had some of the tallest grasses on the continent," he continued. That evolved into a "sheep economy" in which wealth was measured in the number of sheep that thrived, not in money.

The first step the Skeets took as they launched Spirit Farm was to apply compost, seeking to bring soil microbes back to life. Joyce Skeet said that this allowed them to learn what the microbes could teach them. She augments those lessons with considerable insight from a scientific perspective. She articulates the basic mechanisms of soil health drawing upon this rich background.

Among the important microbes are bacteria and fungi (mycorrhiza), Joyce explained, that "break down the organic matter in the soil, forming aggregates." This process, in turn, creates open spaces in the soil — passageways that both trap air and allow water to move through. As these microbes digest the organic matter, they make nutrients available for the plants. Fungi also form long networks that help transport water to the plant roots. Protozoa and nematodes continue the digestion process by eating the remains of bacteria and fungi when they die. Each of these microbes adds it own manure into the soil, injecting even greater fertility. In this regard, microbes are livestock, just as sheep are.

Plant roots also play an essential role, Joyce continued. "The roots exude fluids that are full of sugars and carbohydrates. These are the favorite foods of the microbes, so this draws the microbes toward the roots of the plants. This is why it's important to keep a living root in the soil at all times."

James emphasized that Navajo tribal ceremonies historically helped people celebrate their connection to these natural cycles, and allowed them to honor their participation in them.

Through ritual, agricultural insights were conveyed from generation to generation. These ceremonies also reminded Navajo people that time was circular, not linear, and that the "microbiome in our guts is connected to what is in our soils. Microbes lay down their lives so the rest of us can eat."

The Growers We Interviewed

The Healthy Soil Working Group identified 12 growers who were willing to share stories about their soil health practices. Each grower has carved out unique strategies that suit their individual farm or ranch. They partner with a variety of local and national organizations. Each has broken from the concept that natural resources, including soil, should be "mined" until exhausted, preferring a strategy of building soil health so that other benefits will accrue.

These growers also represent a diverse cross-section of the state. The operations they manage range from northeast, to northwest, to southwest New Mexico. They farm in vastly diverse bioregions, at vastly different scales — from a 3-acre vegetable farm to a cattle ranch covering more than 70,000 acres. Some are remote and some urban. They manage a mix of private and public lands. Some are new to growing, others are fifth-generation. Each is at a different stage of their journey in building soil health. Some make their living selling livestock, while others sell cotton, pecans, hay, or produce. They hold diverse management styles. Each has applied soil health principles closely to suit their own unique farm operations. Yet we found exceptional commonality in their approaches, unified by their attention to the 5 soil health principles.

Vegetable farms

James and Joyce Skeet, Spirit Farm — Vanderwagen. James and Joyce Skeet launched Spirit Farm because they noticed that indigenous people are getting sicker by eating commodity foods. They view the farm as an educational facility that can bring traditional practices back, integrating them with insights from contemporary science. They took over tribal land that James' grandfather once farmed, but had burned out by following conventional practices. Here, the Skeets grow vegetables, rotated with an array of 18 cover crops including perennials. Considering microbes as livestock, they strive to keep living roots in the soil at all times to foster microbial health. Some fields serve as pastures for their Navajo-Churro Sheep herd. Since the farm stands on a high plateau, they sequester rainfall into storage tanks. The Skeets view their farm as a "visual model of rebuilding kinship." They invite their neighbors to harvest their own produce, leaving some barter item or payment in exchange as they are able. They have helped 37 neighbors form gardens of their own. The Skeets are New Mexico Soil Health Champions.

Matt Draper, North Valley Organics — Albuquerque. Draper farms three separate parcels totaling 3 acres in the Rio Grande River Valley, with business partners Sylvia Alvarez and the landowner, Minor Morgan. They grow certified organic vegetables and cover crops, and maintain a small peach and cherry orchard. The partners formally agreed to a written set of soil health principles and practices. In addition to keeping soil covered and maintaining living roots in the soil at all times, they apply compost intensively, carefully rotate crops, and reduce tillage, but do not exclude it entirely. Sales doubled from $2.50 to $5.00 per linear foot from 2015 to 2020 as the new farm gained experience. North Valley Organics serves as official demonstration

farm for the US Dept. of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Draper also serves as a New Mexico Soil Health Champion.

Don Hartman, Hartman Farm — Deming. Hartman raises 130-140 acres of green chile for processing by a Japanese firm; as well as 80 acres of onions and 40 acres of watermelon for fresh market sale. He also grows 150-175 acres of grain sorghum (milo) and 80 acres of hay. These are primarily raised to build the soil, but some is sold to farms that raise cattle and horses. Hartman makes his own compost for his vegetable fields, believing that the biology he creates on the farm is most important for fostering microbes. He also rotates with diverse cover crops and reduces tillage, in part because he installed drip tape for irrigation. After years of experimentation, he has concluded that it is more effective to nourish the helpful fungi and bacteria on his farm, rather than try to control the bad. Working in collaboration with NMSU, he developed a regime of beneficial fungi that he grows for himself and applies to his fields to reduce soil pathogens. After increasing soil organic matter to 2%, he finds he uses less water and can allocate more to his cash crops. The Hartmans were named New Mexico Farm & Livestock Bureau Family of the Year in 2019. Don serves as president of Luna County Farm and Livestock Bureau, and is a member of board for Deming Soil and Water Conservation District. He has won several awards including Conservation Farmer of the Year, and Outstanding Farmer of America.

Pecan orchard

Laura Harper, Del Valle Pecans — Mesilla Valley. Laura and her brother Todd took over the family's 34-acre pecan orchard several years ago. Farm chemicals had never been used. Their mother Sally had started marketing shelled organic pecans thirty years ago, driving across the state in the family car to sell directly to independent grocers. Over time, Sally found that reducing tillage lowered weed pressure and trimmed costs. Laura and Todd added 18 new acres after taking over the orchard. They now incorporate shredded tree branches into the soil, and apply manure from nearby dairy farms, to add organic matter. They plant cover crops between the trees and introduce beneficial insects to reduce pest pressure. One key to their financial success is selling a unique value-added product, organic shelled pecans, and collaborating with other growers in marketing.

Hay farm

JJ Sánchez, Adelino Legacy Farms — Adelino. JJ raises hay mainly for nearby horse owners. He took over his father Lawrence's farm 3 years ago, growing 10 acres of hay in addition to a full-time job as an engineer. He leases another 290 acres to a cousin. Minimum tillage has been a core principle to the family. One 3-acre hay field that has been in production continuously for 16 years with no tilling outperforms all of his others. His hay has achieved protein levels of 20%. He is currently re-configuring the farm for an even more resilient future.

Livestock ranches

Jim Berlier, Berlier Ranch — Encino. Berlier's home ranch of 10,000 acres occupies gentle rolling hills southeast of Albuquerque. He normally keeps 150 cattle, but cut back to 75 in 2020 because of drought. In partnership with other ranchers, Jim also leases thousands of other acres across the state. Berlier took over his great uncle's farm after it had been depleted by grazing too many animals; he now focuses on optimizing health for those cattle that the land can support. His first step was to reduce the herd; then he installed irrigation systems and waterways to reduce labor costs and improve access for his herd. Next he cross-fenced the pastures into paddocks for more intensive grazing, and removed established weeds such as juniper. Manure from the cattle and hoof action allows native grasses to flourish. These practices have doubled soil organic matter to 2%. He says he now raises three times as much grass with the same rainfall. Berlier serves as immediate past president of New Mexico Soil And Water Conservation Districts, and also serves on the executive board of the SWCDs nationally. He is also a New Mexico Soil Health Champion.

Charles Hibner, Hibner Ranch — Cebolla. Hibner runs a 250 head cow-calf operation covering more than 20,000 acres, not all contiguous. He leases both public and private land. In dry years he reduces the herd by about half; his cattle are mostly Black Baldy and Black Angus. Hibner's rangeland includes forest, dry land, rolling hills, scattered meadows, and wilderness areas containing steep canyons, so he has developed unique strategies for each land type. He also irrigates 208 acres to grow hay to feed livestock. Increasing soil organic matter is critical for retaining water and fostering the growth of microorganisms. He now counts 20-30 earthworms per square foot of soil. Hibner received the Land Steward Award from the New Mexico Association of Conservation Districts in 2019. A retired soil scientist who performed soil surveys across the state to create soil maps for NRCS, Hibner serves as a New Mexico Soil Health Champion, and is the Rocky Mountain Farmers Union policy representative for New Mexico.

Gilbert Louis III — Acoma Pueblo. Gilbert Louis is a fourth-generation rancher; his son is the fifth. The family holds grazing permits for 17,000 acres of land, all owned by the Acoma Pueblo. They also raise 5 acres of corn. Their herd expanded from 80 in 2010 to 140 in 2018 after they selected feed-efficient varieties of cattle and collaborated with Native buyers. However, they reduced the herd to 100 in 2020 because of drought. The family rotates their cattle through seven pastures, adding feed supplements as needed. Working as a family to carry on their shared farming heritage is central to their vision.

Tanner Mitchell, Tequesquite Ranch — Roy. Tanner Mitchell raises 1,000 head of cattle on about 70,000 acres in Harding County in the transitional zone. The Mitchells built the first registered Hereford ranch in New Mexico, but now primarily breed Black Baldy cattle. The family installed extensive water feeding systems, and devised its own nutrient mix for the herd. Mitchell tracks the benefits of his soil practices by weighing a standard sample of hay each year. He adds that his family once used riparian pastures as a "line of credit," overgrazing to earn added income; now he focuses on investing in the soil across the entire farm.

Cotton farm and horse ranch

Ramon "Dosi" and Norma Alvarez — Mesilla Valley. Dosi and Norma farm 1,100 acres of land organically. By rotating cotton, wheat, and alfalfa crops and applying seasoned cow, horse, and poultry compost, they have doubled soil organic matter to 2%. Through crop rotation and careful management, they were able to contain an outbreak of boll weevil without spraying. They sell their cotton to Japanese firms that value the high quality fibers, and feed alfalfa to their quarter horses.

Each of these farms is profiled in depth below. Before we get to their stories, we offer some background on conditions in New Mexico.

The New Mexico Context

With its hot weather, unpredictable rainfall, desert soils, and a broad variety of soil and climate zones, New Mexico is one of the most challenging environments on earth to pursue soil health practices.

Yet this also makes the state a challenging one for conventional growers, as well: several of the farmers we interviewed took over land from an elder family member who had exhausted their land by focusing too much on short-term profitability, and not enough on constructing a healthy farm.

The growers we interviewed have all found ways to thrive financially despite the constraints posed by the New Mexico climate. All view soil health as critical, but view it as only one of several important farming strategies. Mostly they find their farms are more *resilient:* given the inherent uncertainty of weather and markets, building healthy soil is crucial to farm survival.

For a farmer to have the most profitable year possible given these ever-changing conditions, several critical factors must harmonize:

Water is critical but unpredictable

Water is the most significant determinant of soil health to these growers. Without adequate clean water, soil microbes cannot grow. Unless soil organic matter and soil structure are at life-sustaining levels, the soil cannot hold onto the moisture it receives from rainfall or irrigation. No plants or animals can survive without water. Boosting soil organic matter increases its capacity to retain water, and opening air passages (as microbes and earthworms do) allows water to disperse through the fields.

Yet water supplies are threatened. Rainfall has diminished in recent years. The year 2020 was especially challenging, with one rancher reporting only 3 inches of rainfall. Produce farmers sequester water in tanks and have installed drip lines to minimize its use. Cattle ranchers have minimized the unpredictability by installing watering stations that are supplied from wells, but several ranches sold animals because they could not grow enough forage to feed their entire herd. Others dug deep into hay reserves.

Rainfall is also variable from place to place, season to season, and year to year. When this rain falls is just as critical as how much falls. This is one of the inherent uncertainties ranchers and farmers face — and is one of the primary reasons no single formula can fit every farm or ranch.

Commodity markets are fickle

Commodity prices fluctuate due to global pressures New Mexico growers have little power to shape. As just one example, the price of cattle varied from $95.33 to $183.52 per hundredweight over the past two decades. That means that a 1,000-pound steer that was worth $1,830 in 2015 was worth only half as much — $953 — in 2020. Since prices change on a daily basis, ranchers cannot be certain of the prices they will receive until they arrive at the buyer's venue. They raise each herd on faith.

Produce, cotton, and hay prices vary as well. Commodity prices often fall below the costs of production. So the farmers we interviewed have pursued several strategies for keeping prices at a rewarding level:

1. Reduce dependence on undifferentiated commodity markets, in which each farm competes with all other producers globally.
2. Develop loyalty from a buyer who will offer premiums for high-quality or organically certified products, or independent grocers who favor products from a nearby farm.
3. Add value to farm produce (for example, shelling pecans, selling specialty Pima Cotton, adding an educational experience, etc.)
4. Ask consumers to invest in the farm by purchasing CSA shares, or similar investments.
5. Collaborate with other growers in marketing to build greater market power.
6. Collaborate with researchers to develop new varieties of crops and livestock or innovative growing methods.
7. Grow more of the inputs the farm requires, rather than purchasing them.
8. Reduce operating costs, especially chemical, irrigation, and tillage costs.
9. Diversify income streams by incorporating additional crops or livestock.
10. Plant cover crops that add a new source of income, or at least pay for themselves.

It could easily be concluded that prioritizing selling farm products outside of the impersonal commodity markets constitutes a "sixth principle" of soil health, since soil health practices cannot be sustained without a fair return and loyal buyers. Resilient commerce depends on building community trust.

Dry hot weather makes it difficult to build soil organic matter

The intense summer heat that bears down on some parts of New Mexico can easily burn off organic matter, frustrating efforts to increase fertility. Incorporating organic matter is the key strategy for reducing losses. Living roots in the soil, and a canopy of green plants also reduce losses. Several farms consider holding 2% soil organic matter to be a viable goal.

Most growers depend on outside sources of income or investment

Margins are so small and unpredictable in agriculture that most of the ranchers and farmers we interviewed depend heavily upon personal savings, outside jobs, investors, or federal support to manage both farm finances and cover conservation practices.

While soil health principles and practices are critical to maintaining health and promoting resilience, they are not sufficient in themselves for economic success. They also depend upon market mechanisms that build market power for growers, and offer incentives that reward farmers and ranchers who pursue soil health strategies. When market power and community trust are lacking, farming cannot pay for itself.

Benefits of Soil Health Practices

Soil, crop, and animal health

- Robust beneficial microbial action
- Higher earthworm counts
- More beneficial insects
- Native grasses recover
- More diverse species of grasses, cover crops, food crops, etc.
- Fewer disease challenges
- Better weight gain for livestock
- Better integration of wildlife into the farm operation

Family happiness

- Carry forward a heritage of farming, a cultural heritage, or an ethical stance
- Taking independent action, rather than feeling forced by market pressures
- Better personal health
- More leisure time
- Working with nature rather than against it
- Managing adaptively as conditions change

Higher profitability when conditions are favorable

- Reduced input costs
- Reduced tillage costs
- Higher sale prices (especially with organic certification or an especially loyal buyer)
- Adding value to raw products produced on the farm
- Higher yields / animal weight per unit of work, land, production costs, etc.

Greater resilience in uncertain times

- Increased water holding capacity in the soil buffers against drought
- Open pore spaces in soil allow more water to soak in and disperse
- Better air and water flow through soil helps microbes grow, adding fertility
- Incremental changes often provide flexibility under changing conditions
- Collaborative research and marketing increases options
- Beneficial animals and insects promote health

The late Lawrence Sánchez, father of JJ Sánchez profiled in this report, told NRCS that he had pursued soil health practices for over 12 years. “You have to be patient in building soil. It’s long-term. It took three years for us to see some effects in soil analysis and in our production. We didn’t see the bigger differences until five years [later]” (NRCS Sánchez profile).

Measuring Soil Health

"Soil Health" depends on its function

Researcher David Powlson argues that soil health should be determined from the perspective of natural systems themselves, not simply through the lens of their functional use to humans. He notes that there is "no such thing as a pure soil." Each soil type carries its own unique complement of minerals, microbes, and nutrients. Whether soil is considered "healthy" or not depends primarily on the *ecosystem function* that one imagines the soil will fulfill (Powlson, 2020).

In Bowmans's view, 'healthy soil' can look very different in different places. (Bowman et al, 2016). Considering agricultural uses, they added, "Healthy soils have high levels of microbial activity, higher levels of organic matter, and good soil structure, because soil properties differ according to climate, geology, topography, and land use and management history on a field or farm."

Soil Health is complex

Andrew Stevens argued that while "soils with vibrant microbial ecosystems have proven especially productive and resilient," science has a great deal to learn about why this happens: "the specific mechanisms are still poorly understood." And soil systems are so complex that scientists are challenged to come up with adequate measurements of soil health: "A truly complete list of all health measures is not only overwhelming, but infeasible." His work focused on the fact that soil systems involve uncertain, dynamic processes (Stevens, 2015).

Peter Donovan, director of the Soil Carbon Coalition, and an expert who has partnered with members of the Healthy Soil Working Group through the years, cautions that measuring the health of the soil is "not an answerable question. We think we can measure soil health, but our science is more adapted to understanding pathologies" (Donovan, 2020).

What is most valuable, he added, are the insights gained by the people who are making decisions on the land." He argued that the important measures are ones growers can integrate into their daily activities, because they will be used most reliably. He added that following this approach is unlikely to result in a "one size fits all" approach, because landscapes and farm personalities are so diverse.

Donovan focuses his work on engaging community members in building "shared intelligence" by participating in common efforts to understand the complexity of a rapidly changing environment. He has identified three measures that are the most meaningful when resources are limited:

1. Soil organic matter
2. Water infiltration rate
3. Soil aggregation qualities

Simplified measurement is easier to integrate into farm operations

Detailed scientific studies have solid value for showing the impacts of various soil health practices. Yet on a daily basis, farmers and ranchers rely upon simpler measurements that are

less expensive and fit into demanding work routines. One ranch harvests hay from several one-meter square sections of their fields, weighs the forage found in that sample, and extrapolates the ranch's overall yield from that weight. Comparing these production measures with rainfall and the final weight of the animals he sells, this rancher tracks how his soil is faring.

Others take occasional soil tests, but find that as they gain experience, they develop more visceral tests of their own: smelling the earth to gauge microbial activity; assessing organic matter from its blackness; estimating nutrient value by tracking deep green coloration of plant leaves, or tasting the final product.

Lawrence Sánchez, the late father of one of the ranchers we spoke with, told the NRCS that he can tell when the soil is healthy "by smelling the soil and seeing that it's full of earthworms. Dig it up and you see the pores and channels through it. Several years ago a farmer walked across my land and said he noticed how soft my ground is. He said it was like my land was cushioned." Sánchez added, "You can tell your soil is healthy by looking at your crops. They're dark green, not pale green. If you can't tell healthy soils by all that, just look at your production" (NRCS Sánchez profile).

Several growers measure production, not as an absolute value, but as a ratio compared to the costs of production, the amount of rainfall, tons of hay, acreage of land, or other units.

Advancing heritage is important to New Mexico growers

Measurements often focus on "hard" numbers, overlooking "softer" measures that mean a great deal to farm and ranch families. Several of the most advanced growers pursue soil health practices because they want to carry forward their family or tribal tradition of farming. This often means upholding ancestral practices because they are effective in contemporary conditions. For others, the quest is to help their family's land recover from conventional practices that devastated the soil or fragmented culture.

Family happiness is important

Several growers reported that taking better care of their soil made them happier. This is obviously an important element of both commercial success and farm resilience. One important reason has been developing a sense of working in harmony with natural forces, rather than opposing them or trying to control them.

Longitudinal studies will be most informative

Since progress is not linear, it is important to measure conditions over several years, and show the bad years as well as the good. When economic impacts are measured from one particular starting point to one end point, considerable detail is lost. Greater resilience means any given farm is *more likely to be profitable*, even in bad years. But pursuing soil health does not in itself create economic rewards if other factors interfere.

This serves also as a reminder that the choice of which strategy to implement at which time is unique to each farm or ranch. Decisions must be based on business cycles as well as the special qualities of each place, including climate, soil type, available rainfall or irrigation, the business goals of the operation, and the personality of the owner. There is no standard method that can be applied everywhere.

Farm and Ranch Profiles

James and Joyce Skeet

Spirit Farm
Vanderwagen, New Mexico

James and Joyce Skeet. Photo by Brian Dawson for the New York Times, 2020*. Used with permission.*

The co-owner of Spirit Farm, James Skeet, whose Diné (Navajo) clan name means "Red Cheek, Born of Leaning Tower," recalls working for NGOs fostering childhood development, and then serving as financial watchdog for the tribal government. "We were always creating transformative adaptations" in the face of the extractive nature of colonial power structures that emphasized a commercial mindset, he said. "The tribe was very good at systems thinking, but our approaches were always constrained [by the demands of funders and regulators]." He began to seek ways to express his spiritual understanding that "all things are sacred." He felt inspired by a strong memory from when he was young: His grandfather, Money Skeet, had taken him out to look over the land where the Diné had dwelled for thousands of years. After they had walked a couple of miles, Money showed him a grand view of the Zuni buttes and asked him, "Do you know where you came from?" More poignantly, he asked, "Do you know the way back [to that way of life]?"

Creating a new farm struck him as one potent way to seek that way. “Joyce and I asked, why are indigenous people getting sicker? We concluded that it is the faulty relationship we have with all kinds of foods. Our people became dependent on commodity foods and gave up the ones that used to offer us health.”

Joyce Skeet, his partner at Spirit Farm, broke from her career in social services for similar reasons. She grew up as a Mennonite in Pennsylvania Dutch country, and learned rapidly that growing conditions in New Mexico were vastly different than she had encountered at home, where she had tended a 2-acre garden and raised pigs organically. When she applied what she knew to the arid soils of New Mexico, “whatever I did just didn’t work. My whole background had been focused on dominating plants, dominating nature,” she lamented. In her new home, people cautioned that she should “listen to the plants. It took me years to figure out what that meant. To do this, I had to learn that I was only one part of a much bigger whole. I was not the master, but an equal to the plants, and equal to the soil. That set me on a completely different type of journey.”

> **I had to learn that I was only one part of a much bigger whole. I was not the master, but an equal to the plants, and equal to the soil.**

Joyce and James’ quest took them to a small plot of tribal land on a high plateau that Money Skeet had farmed half a century earlier. “He had plowed the hell out of this land,” James recalled. “He literally destroyed it. The topsoil had blown off. Invasive species were taking up all of the water. You literally could not grow anything.” Swept up in a push to plant annuals as monocrops in dense rows, his grandfather had inadvertently absorbed a colonial legacy.

For James Skeet, this echoed the 1864 Fort Sumner relocation, when an occupying government forced 8,500 Diné men, women, and children to make the Long Walk more than 400 miles to a barren, 40-square-mile reservation in eastern New Mexico. That winter march killed thousands of Diné. This brutal relocation uprooted people from the land and natural world where they had once belonged, but also separated them from the wisdom that had helped them flourish.

By taking over the management of this small plot of land, the Skeets hoped to “build a small symbolic garden” that would foster a more diverse approach to agriculture, and create an island of self-sufficiency that stood as an alternative to the exploitive economy that surrounded them. It would be a place that valued the process of learning from nature, rather than one that foolishly attempted to dominate natural cycles. “Our farm becomes a visual model of rebuilding kinship,” James added. “When people come to visit, we take them to look at the animals, we walk through the garden, and we taste the foods that grow there,” instilling a sense of connection.

While some view the Southwest as forbidding terrain for farming, the Skeets see it as an area rich with both heritage and promise. “It can be very harsh, or very sustainable, depending on how we treat the land. The grasses provide lush pastures, and wild plants provide exceptional herbs and effective medicines.” Wild perennial plants — which James calls “pre-annuals” — grew everywhere. “Many consider those plants weeds,” James remarked, but “often they hold higher nutritional value than the annuals we plant today.”

Hoophouses provide an indoor growing environment. Photo submitted by Spirit Farm.

Spirit Garden invokes the 4,000-year Navajo tradition of growing and harvesting plants for food and medicine on the lands where they dwell today. Thousands of small gardens scattered across the arid landscapes wherever water could be found.

Diné herders also carry forward stories that date back to Spanish times. James Skeet recalled that "The oral tradition states that we connected with horses when a herd bolted from the conquistadors during a winter storm that erupted in our homeland. The introduction of the horse forged a powerful symbiotic relationship between the horse and the Diné." Although this mutual connection was not recognized by Europeans, it energized the Diné, he added. "The Navajo were the first indigenous people to incorporate the horse into their pastoral prowess." By adopting these animals, "Navajo were put in a powerful position in the Southwest."

The Navajo-Churro sheep, James added, exemplify traditional practices, even though the animals were introduced by Spanish conquerors. "Sheep have eyes that are positioned horizontally, so they can survey the landscape." As they graze they deposit their saliva on the pastures, transferring microbes to the soil. The action of their hooves works their urine and manure into the desert soils, building organic matter and fostering microbial growth. Thus, sheep are emblematic of listening to the land and making it better: an empathy with the creation. "After we learned how to raise the sheep, we had some of the tallest grasses on the

continent." That evolved into a "sheep economy" in which wealth was measured in the number of sheep that thrived, not in money.

These traditional insights were disrupted by the dislocation of the tribes and imposition of the currency economy, he continued. This strange worldview valued how much was produced over the process of observing, listening, and learning. "Everywhere we went we destroyed the land: we removed the indigenous plants, removed the indigenous animals, and removed the indigenous people." The Skeets hope to bring back this indigenousness.

> **Everywhere we went we destroyed the land: we removed the indigenous plants, removed the indigenous animals, and removed the indigenous people.**

Starting with one plot of land that had been decimated by pursuing a distorted vision, the Skeets turned to scientific advisors who encouraged holistic approaches rather than reductionist thinking. Joyce pointed out that Dr. Elaine Ingham and her Soil Food Web School was one of their first. They are also learning from grower networks convened by Dan Kittredge and the Bionutrient Food Association. The first step in their journey was to apply compost, seeking to bring soil microbes back to life.

Joyce Skeet said that this allowed them to learn what the microbes could teach them. She has augmented that with considerable insight from a Western perspective. This allows her to articulate soil health mechanics very clearly.

Among the important microbes are bacteria and fungi (mycorrhiza), she continued, that "break down the organic matter in the soil, forming aggregates." This process, in turn, creates open spaces in the soil — passageways that both trap air and allow water to move through. As these microbes digest the organic matter, they make nutrients available for the plants. Fungi also form long networks that help transport water to the plant roots. Protozoa and nematodes continue the digestion process by eating the remains of bacteria and fungi when they die. Each of these microbes adds it own manure into the soil, injecting even greater fertility. In that regard, microbes are livestock, just as sheep are.

> **Microbes are livestock, just as sheep are.**

Even the roots of the plants play a role, Joyce continued. "The roots exude fluids that are full of sugars and carbohydrates. These are the favorite foods of the microbes, so this draws the microbes toward the roots of the plants. This is why it's important to keep a living root in the soil at all times."

James emphasized that Navajo tribal ceremonies historically helped people celebrate their connection to these natural cycles, and allowed them to honor their participation in them. Dancing and singing in ways that expressed these understandings, insights into agriculture were conveyed from generation to generation. Burning sage and cedar released these prayers back to nature. These ceremonies also reminded Navajo people that time was circular, not linear, and that the "microbiome in our guts is connected to what is in our soils." Even the stones are alive, he added, and participate in these cycles. "Rocks came before the plants, and the plants came

before humans. The microbes bring the trace minerals from the stones into the plants and then into our bodies. Microbes lay down their lives so the rest of us can eat."

Navajo rituals help keep these cycles in our awareness, James continued. "Western society has a concept called 'seize the day.' But our tradition tells us to 'receive the day:' this involves taking the energy you have and focusing it on facilitating natural processes, not looking at production as the goal. You allow the creator to do the growing."

Our tradition tells us to "receive the day:" this involves taking the energy you have and focusing it on facilitating natural processes, not looking at production as the goal. You allow the creator to do the growing.

Joyce added that the ceremonies emerge organically. They are not about following a certain prescription, but rather, "taking time to celebrate and reflect in whatever way seems natural to you. In traditional culture, there is always an understanding that there's life in the soil." To the Skeets, ritual helps remind humans of these interconnections. Traditional prayers and ceremonies guide Navajo peoples to celebrate their participation in these wider webs of life, treating plants and animals (including microbes) as equals and learning from them, rather than seeking to reduce them into component parts.

People can get trapped trying to pull things apart into different components to analyze them in isolation from each other, Joyce added. What is missing is the synergy created by the whole. "The farmer is the catalyst that unlocks the DNA of those processes." These processes are revealed more completely in *stories* than in analysis. As soon as they applied the compost, the Skeets saw that the soil was richer. One of their Diné neighbors gleefully told them, "The scientists have finally learned what our ancestors knew all along." When the Skeets asked her to tell them the Navajo word for "compost," she told them that its traditional name *[bił k'é dilyehí]* translated as "what you plant with." Traditional Navajo also had a term for the microbes that flourish in the compost *[ch'osh do t'iinii]*: "the unseen bugs."

Next, the Skeets planted new crops and added additional livestock to see what else they could learn. "It is remarkable how much we have to learn, and how little we understand what our ancestors knew in such detail," James said. Joyce added that after planting cover crops to boost organic matter and soil fertility, it became clear that they needed to "plant cover crops that people can also eat," to make the most efficient use of the land. She described their learning process as one of continually thinking outside the box, adding new diversity at every turn and "opening ourselves to spirit."

The Navajo word for "compost" *[bił k'é dilyehí]* translates as "what you plant with." Traditional Navajo also had a term for the microbes that flourish in the compost *[ch'osh do t'iinii]*: "the unseen bugs."

Once they gave ten corn seeds from a plant they had grown in their garden to a neighboring farmer who planted them in her fields. James took another ten seeds and planted them in his

plots. As James tells the story, “One grandmother still grows corn down from us a couple of miles. They do a lot of dry farming. She went out and plowed the field and grew the corn. We mulched heavily, covered it with compost, and put a lot of aeration into the soil. At the end of the season she came by, and I asked her, ‘How’s your corn?’ She said her corn grew about 3-4 feet tall. She was standing in front of the corn that I grew, and it was 8 feet tall.”

Green tomatoes were harvested at the end of the season. Photo by Brian Dawson for the New York Times, 2020*. Used with permission.*

James continued, “If we heal the land, we heal the people.” Pursuing this quest, the Skeets have grown a wide variety of vegetables with special emphasis on chile peppers, cucumbers and broccoli. They find their carrots are sweeter than those they find at the stores in Albuquerque. Diverse berries have flourished in their fields, with Saskatoons doing especially well. They have grown sun hemp and sorghum to take advantage of their biomass, and cultivated 18 diverse cover crops that their flock of sheep can graze. They’ve learned that trash popcorn and cull beans make excellent animal feed, if they ferment the kernels to increase the bioavailability of its nutrients.

Rather than selling the food they grow, the Skeets invite their neighbors to harvest their own produce, leaving some barter item or payment in exchange as they are able. Their neighbors are also welcome to attend learning sessions where the Skeets offer cooking demonstrations, and swap stories on topics as diverse as composting, baking, using solar ovens, dehydrating foods, and fermentation. They call their effort “covenant pathways,” evoking their quest to restore connections to the soil, water, and land that were abandoned as European values came to

dominate. The couple said they have grown, preserved, and stored enough food to last their household for two years.

Joyce added that this is not only their preference, but also a necessity. "Growing our own vegetables and raising our own meats is really the only viable option we have. The better, nutrient-rich food in our markets is priced out of our reach." Moreover, "Most modern produce is grown to look good, to ship without sustaining damage, to be large in size and mass produced," Joyce cautioned. "But it is not grown to be healthy, and people's health suffers greatly for it."

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Spirit Farm is constrained by its natural setting on a high plateau. No waterways bring water to these heights, so one key element of the farm is sequestering water by installing gutters that can trap rainfall and channel it to storage tanks, from which water is pumped through garden hoses to the growing fields. When rainfall is sparse, they must haul water 20 miles from Gallup. Still, the more organic matter that is built in the soil, the more water it will hold, and the more resilient the mycorrhizal networks will be.

Yet they also recognize limits to their own discovery process. The land on which Spirit Farm stands is currently owned by the Bureau of Indian Affairs, and this constrains some of the choices they can make. Some of their tribal neighbors, even as they suffer health conditions related to commodified food and life, find it difficult to embrace traditional practices.

The Skeets say they are "indigenizing" themselves through their own learning process, and they hope the lush, nutritionally dense produce raised on their farm "speaks for itself." Their hope is to both recover and cultivate what they call an "indigenous regenerative intelligence." As James puts it, this allows them to celebrate the "joy that takes place in making new connections." They beamed as they recalled the excitement that an 8-year-old from a Navajo housing project exuded as she sat in her garden, proud of the food that grew in the desert. They relished the moment that one lawyer's eyes sparkled as she suddenly realized, after touring the farm, that she had been confined by her own sense of linear time. The Skeets were proud to relate that a tribal medicine man visited the farm and concluded, "You're doing what our ancestors used to do."

Now Joyce is thrilled that with the help of donors, Spirit Farm has supported 37 growers to raise food for themselves across the Navajo reservation. "At most sites, we could see for miles the bare, sandy soil. In the midst would be a small, green oasis of a garden. The momentum is growing and indigenous people are flipping food insecurity, one grower at a time. Some families have added chickens and pigs. Several are setting up their own composting bins and 11 families now have the materials to build small hoophouses this fall."

Looking back on their path, the Skeets emphasized that they produce food to be engaged in a process, not as an end in itself. They hope to combine indigenized growing practices and spiritual insights into what they call a "bio-cosmology." James concluded, "This is just the tip of

the iceberg of what we need to know. Our overall goal is to leave the land in better shape than what we inherited." That process requires investment today. As a next step, the Skeets plan to introduce more "pre-annual" crops into their fields, to move even further from the currency system and its annual cropping rotations.

Spirit Farm displays the Diné term for compost on a sign near the compost pile.
Photo provided by Spirit Farm.

Matthew Draper

North Valley Organics
Albuquerque, New Mexico

Matthew Draper co-manages North Valley Organics. Photo provided by Matthew Draper.

We're an urban farm with 3-4 acres in the North Valley of the Rio Grande as it passes through Albuquerque. We're an official demonstration farm for the US Department of Agriculture.

The business is owned by Minor Morgan. I manage the farm and we share management decisions. He takes charge of office logistics and marketing. Our land is broken up into three major parcels, so the space we have to farm is less than we would have on one large plot. Minor owns one farm plot and also the tractor and implements. A second larger parcel is owned by my parents, and another parcel is owned by another person.

Farmland in Albuquerque lies along the river between outposts of urban sprawl, because that is where the best soil and water are located. The North and South Valleys have some of the best soil in New Mexico. They used to support farms of 50-100 acres. But the area has become suburbanized so there are only a few small parcels of farmland left. The Valley is a real mix of heavy clay and very sandy soils. We're fortunate that our main field has a good bit of loam. It is called the Gila Loam Deposit. We have a heavy clay with loam mixed in.

All of the high desert soils here are very alkaline. We have fields with a pH of 8 and higher. All growers try to acidify the soil to get better yields. On our farm we trust that our growing practices will gradually lower the pH, so we don't do anything in particular to change that.

We get an average of 9 inches of rain per year. There is not really a way to grow any crops via dry-land farming with so little rainfall. So we draw water from the river, some of it drawn up through an old gravity-fed distribution system of ditches known as *acequias*. We supplement that with water from our well.

The weather here averages 5-10 degrees hotter than in Santa Fe. We have a long, hot summer, with temperatures that often get into the 100s. Even more difficult, we have days in the spring where it can get to 80 degrees in the daylight and almost freeze at night. It is a particular challenge to grow cool-weather crops here. The temperature changes are often more than they can take.

We grow mixed vegetables organically. We sell at the main farmers' market, to a couple of aggregators that fill CSA shares, and to the school districts. New Mexico is unique in allocating funds to schools so they can purchase food from local farms.

We follow a set of written principles that my business partner and I agreed to.

We follow a set of written principles that my business partner and I agreed to:

1. ***We try to keep the soil covered at all times.*** We cover our garlic and tomato fields with straw and all other crops receive a landscaping cloth that performs the same services as straw mulch. We plant perennial cover crops (mixed grasses and clovers) in the walkways between the rows where we grow produce. After harvesting, we seed the growing areas as best we can with annual cover crops. We use landscaping cloth around the plants, because it is porous and allows water through. We never use plastic field covers, because we don't want to have to throw the plastic out. Also, most plastic systems we are aware of would require us to till the whole field. We like to say that the whole farm is a canvas that needs to be painted with something.

2. ***We try to have a living root in the soil at all times.*** We plant a mixture of hairy vetch, peas, and turnips over the winter. Everywhere where crops aren't growing, we try to establish perennials — either cover crops or pollinator plants.

3. ***We rotate crops carefully.*** We are challenged by space limitations on fields this small, and we have to grow something productive on each plot. So we cannot leave a field totally fallow. Still, we never plant the same crop twice in consecutive years in the same row. Our goal is to get to a four-year rotation where we would never use the same row for any one crop more often than every four years. We also never plant two rows of the same crop next to each other. This helps reduce the spread of pests and disease. We actively foster biodiversity by planting a minimum of six different crops in any one field in a given year.

4. ***We bring in a lot of compost every year.*** We're lucky in Albuquerque to have the Soilutions company that makes compost. It is made mostly of green wastes from residences in the city of Albuquerque where our food is consumed. There is some horse manure in their mix, and we bring in other chicken manure. There is a farmer in Arizona that sells chicken manure (Hickman Farms). Eventually, I would like to incorporate poultry into our operation, probably laying hens. We don't have enough space for larger animals to graze here. But I have to get the crop production down first. Each crop requires its own set of infrastructure and systems. We're still fashioning those systems.

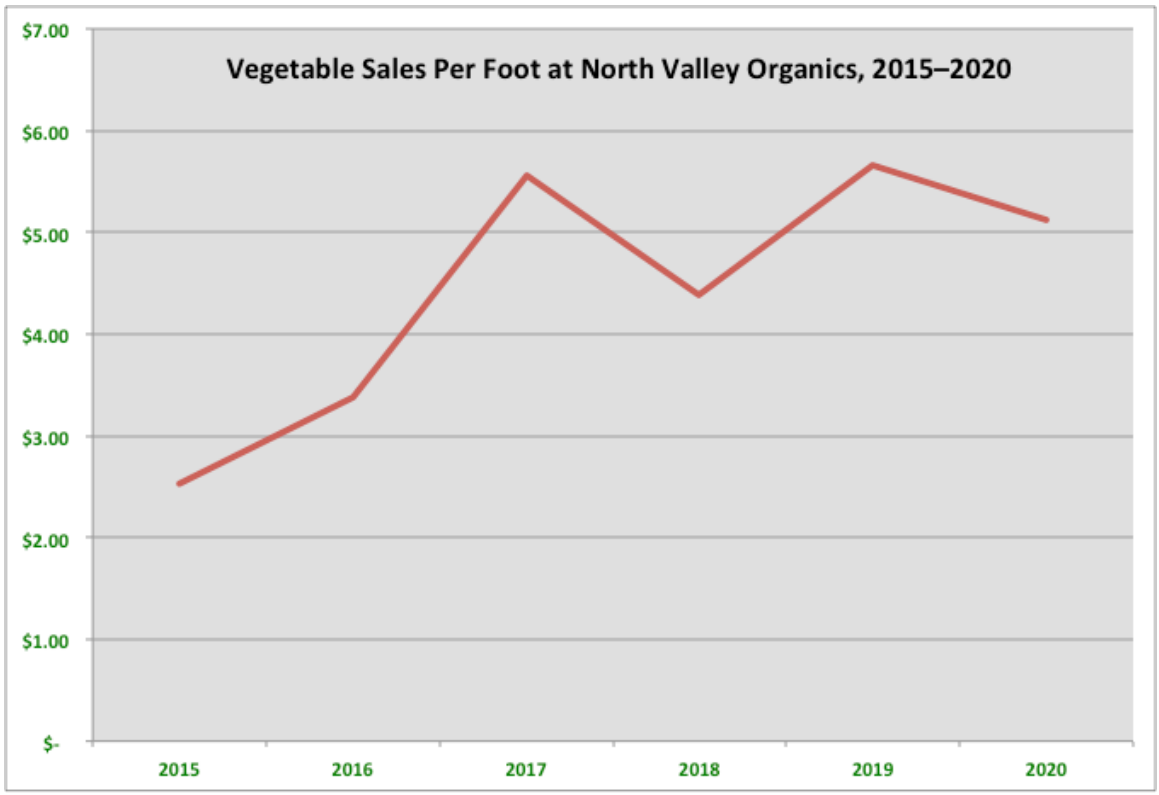
5. ***We strive to reduce tillage as much as possible, but still recognize that it is at times a necessary practice to give our crops an advantage over the competition.*** Our approach is that less tillage is better. If we can leave the soil undisturbed, the fungal networks remain in place, and live longer. But we have discovered that we need to till sometimes, to successfully grow some crops. We have a narrow gauge tiller that cuts a swath that is three feet wide, and we use that for some of our cash crops when needed. We never till an entire field. We are also using a broad fork to till in our two hoop houses. This seems to be effective in opening up the soil without hurting the fungal networks. If I could dedicate the time in the spring, I think broad forking is the best method of tillage with respect to soil health. Unfortunately, the weeding and time required to till this way are obstacles I have not yet overcome on a farm-wide scale. At one time we planned to till our walkways from time to time, and move our crops over to that soil. But our cash crops have done so well, increasing yield so much, that we are reluctant to move from those established plots.

I started with North Valley Organics in 2015, so this is my sixth year of farming here. After the first year I became more or less the farm manager. The entire reason I am a farmer is because I developed an interest in healthy soil practices. I was a teacher before this, and then I received a masters degree in ~~c~~ommunity and regional planning with an emphasis in natural resource planning. I read *One Straw Revolution*, and started a garden during this time. Gary Paul Nabhan's work also influenced me a great deal. While doing my masters thesis, I studied local agriculture in Albuquerque and then I began to meet people in Albuquerque who were farming and simultaneously building soil and community health. I wanted to be a part of it. I wanted to be involved in transitioning away from the industrial food system and helping improve the natural environment. I firmly believe we can be the solution to the problems we have created.

The entire reason I am a farmer is because I developed an interest in healthy soil practices.

I interviewed at several farms before I came here. Minor had been farming here for 20-25 years. He was using a lot of practices on his farm that I wanted to try out. I wanted to be farming full-time, so we added the new fields. Minor owns the tractor and the implements we use. I am leasing his land. I characterize myself as a tenant farmer. It is his business, but we share power in making decisions.

Healthy soil, healthy carrots. Photo by Matthew Draper.



Source: North Valley Organics. Vegetable Sales per foot ranged from a low of $1.21 per foot to $14.02 per foot for specific crops.

Don Hartman

Hartman Farms
Deming, New Mexico

Don Hartman applies a self-produced microbial formula. Photo provided by Don Hartman.

I grow vegetables. I also plant grain sorghum (milo) and hay, but not for the money. I do that for the soil. I do what I do. That's it. I've been pretty successful at what I do.

I farm year round. There is no idle time. I raise 130-140 acres of green chile for processing. I plant them in stages so there is always something ripe to harvest throughout the season. I plant from March to mid-May. I sell these to Mizkan. It's a Japanese firm and the largest pepper processor in the US. They can them in vinegar. I also plant 80 acres of onions, and 40 acres of watermelons, all fresh market. They are processed and packaged by the buyer for sale by brokers throughout the western states. I have 150-175 acres of grain sorghum and 80 acres of forage for baling. I sell that to people who raise cattle and horses. I used to sell to some of the dairies, but milk prices have fallen, so now they don't want to pay anything. The dairies used to send me manure to make compost in return, but that's limited now. They would ship me 3,000

tons, enough to get me through the year. But since it is such a hard time for them, all that has stopped.

Nobody gives me a premium price for what I grow or for taking care of the land. The buyers only give you mandates, certain procedures they insist that you follow.

Rainfall is really the critical factor.

Rainfall is really the critical factor. Everything depends on how much rain we get, and you never know that from year to year. Most all our water is pumped from wells and we have a limited amount.

Chiles thrive in healthy soil. Photo provided by Don Hartman.

Every year is different. What worked for you 5 years ago may not work for you next year. Everything is in relation to what you can see, and what you can feel. I have successes and I have failures. If it doesn't work, then I try something else. We have to be quick to recognize, adapt, and react.

I am not an environmentalist, but I do want to take care of my land. Farmers are always the best people at taking care of the land. That said, I think efficiency is often the problem, not the

answer. I do whatever works, and sometimes that just takes time. If it's not economically viable, I don't do it.

I don't know that compost is all its cracked up to be. It is true that for every one percent of organic matter you have in the soil the water-retention capacity doubles. But in my experience, it is expensive to make compost for the benefits I get. I invested in a composting machine, but it cost $40,000-$50,000. Then you have to add water to the compost so it doesn't get too hot. I try to keep it at 130–160 degrees. But that is water that you do not get to add to your fields to grow your crops. You also use a lot of diesel to make compost. You're driving your tractor at a very slow pace, 0.3 mph, so it is not burning fuel efficiently. It takes a lot of electricity to pump the water. Then you use more diesel fuel to haul the compost onto your fields. Still, I think I come out ahead or I wouldn't keep doing it. I tried compost tea as well. It's beneficial but it takes a lot of time to make.

I tried purchasing the commercial stuff, but it was not that good. What works best is the biology you create on your farm. That is mostly about the microbes you have in your soil.

What works best is the biology you create on your farm. That is mostly about the microbes you have in your soil.

My basic principle is to always have a living root in the soil. That is why I like cover crops. I try to get them in the ground early, so there is always a living root. I also make sure they are in place for the winter, to avoid evapotranspiration, and minimize water consumption.

We practice minimum tillage but eventually, I would like to do strip tilling. So many grants are for technical support only and that is money that never hits the dirt. So then I feel that I am just putting money in someone else's pocket, and just creating another job for a pencil pusher. It is so easy to get money for technical support, but not for the capital investment it would take to have the right equipment. I can't afford the $60,000 to $70,000 price for buying equipment that may or may not work. But I do tinker with my tillage attachments to make it more like minimum tillage.

We have a real problem with verticillium wilt (Vert), a soil pathogen. It's a fungus. It can last in the soil as long as 20 years. It is a little like cholesterol. It constricts the entire vascular system of the plant, so it can't take up water. We used all three of the main soil fumigants, and none of them really did the job. I became friends with one of the soil pathologists at NMSU. I asked him to help me do a study. I told him, "I want you to culture some verticillium, and insert it into the soil in a few places. Then I would like to apply some fumigant, to see how much of the fungus is really killed. He was hesitant to add any pathogen to the fields. I told him, "I already have it in the soil, so you can't hurt anything." We worked in one 20-acre field and inserted the fungus in 11 random sites. We ran six samples at each site. We did four tests, varying the placement of the Vert. Then we added the fumigant through the [irrigation] drip tape that is buried just below the surface of the soil. We waited the 45 days as per label instructions, then we dug up the different samples. We tested the viability of the pathogens and determined that the chemicals only worked closest to the emitters and not near the surface where the seed gets planted.

We discovered one sample that had verticillium in it, and we set it aside. We discovered a beneficial fungus in it that ate all the verticillium. I studied it and learned how to propagate the beneficial fungus on my own. I now grow my own blend. Now I add this to all my fields.

Some of the commercial seed treatments you get are just chemical fungicides. The beneficial fungus I apply protects the plant from pathogens and also releases phosphorus already in the soil that is bound up with calcium. This beneficial fungus is also a cellulose digester, which helps break down leftover plant residue.

Before I added compost, I would need to irrigate every week. Now I can wait 10-14 days between irrigations, and I use less water. That means I have more water left to give to my crops.

Most of the commercial amendments being sold are simply snake oil. When a salesman comes to me, I tell him, "If your product is so good, then give me some to use. If it works, I will pay you for it. If not, you can go right on down the road." There was one study done with mustard cover crop, it releases methyl isocyanate. It works in the lab, but when you apply it to the soil it kills off all the beneficials in the soil. I noticed a host of other fungal diseases like fusarium and rhizoctonia quickly attacking our plants, so there was no benefit or net gain. Other additives are just bugs in a jug. If they are not native to your environment, they don't work over the long term. They have to be native to your soil, and your climate.

After a while I quit trying to kill the pathogens. I decided to quit trying to control the bad biology, and I started trying to propagate the good fungi and bacteria, to build the natural biology I already had, and to overwhelm the bad stuff so that bad stuff becomes ineffective, or simply leaves the plants alone. This new way of doing things also boosts the immune system of the plant itself. I've tried 13 commercial biological additives, and none of them stand up next to the beneficials I raise and use.

We have other problems with fungi, wilt, fusarium, and more. I've come to the conclusion that it's because we don't have enough water. We live in a desert. I think that the dry cycles keep good bacteria and fungi from propagating so they can't work against the pathogens, which are heartier and survive longer. That is why I want to keep a living root in the soil at all times. And I apply water to cover crops to keep the beneficials in the soil alive and growing. With the added organic matter in the soil, it takes up water like a sponge. Before I added compost, I would need to irrigate every week. Now I can wait 10-14 days between irrigations, and I use less water. That means I have more water left to give to my crops.

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Hartman produces his own compost. Photo provided by Don Hartman.

But I don't apply compost to all the fields, but only to the fields where I plant the vegetables. It is just not that effective or feasible. Crop rotation plays a huge role in this. I plant watermelon right after sorghum, because the sorghum has a lot of carbon that the melons need. If I am planting onions or chiles, the seeds are small, so I want a clean field to plant them in. We minimum-till onion and chile ground that has compost added. This maximizes the seed to soil contact, so you have good germination because the seeds are so small. I like to use annual rye because it results in a good clean field. It is my favorite. I will plant it in October or November, even though it does not grow a great deal until the weather turns warm.

I also love Austrian Winter Peas. They are fantastic. The stem of the plant is hollow, so it breaks down rapidly in our soil. Some of the other summer cover crops that are often recommended compete with our cash crops for water, so I don't plant them. I've experimented with clovers and hairy vetch, and I don't like them very well because they form such a thick root ball. It's hard to break them down. They're also very hearty and tend to root back; then it's just another weed to deal with. I've also tried various kinds of winter wheat. It's all a matter of finding what works for you in your soil, your climate, and with your need, then going with it. You have to play with stuff. You have to see what works. Taking small steps is the best. Sometimes academia's recommendations aren't always correct or practical.

It's all a matter of finding what works for you in your soil, your climate, and with your need, then going with it.

I had a guy who would test my soil fertility and make recommendations, but I wondered where he got his recommendations for what amendments to apply, and how much. How do they know what makes a plant healthy in my fields? A lot of consultants tell you (in my opinion) to over-fertilize. They seem to think that more is better. I tell people, all fertilizer is salt. Applying it may increase your water needs. When I went with compost tea and saw what a difference that made, I started cutting back on all fertilizers in favor of biologicals and pursuing different practices. I can't go back to the old ways any more.

I did something really wild one year. I did foliar spraying and drip irrigation with compost tea. I applied a lot less fertilizer. Mizkan (the processor) called me and asked, "what did you do differently?" the chiles were all smaller than usual, but they had 10-15% less blossom end rot compared to everyone else delivering chile. Blossom end rot happens when the plant starts pirating water from the fruit in order for the plant to survive. My chiles didn't do that because I had made more calcium available, which better utilized the water under stressful conditions.

I've tried using tensiometers. The results were misleading. Early in the morning it showed ample water, and by the afternoon the plants had pulled so much water that it looked like they needed a drink. But they were really OK.

Nothing is better than going out in the field and digging in the dirt. If it forms a ball in your hand, you're good, no need to irrigate. If it crumbles it's too dry and you need to irrigate.

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I haven't had my soil organic matter (SOM) tested for a long time. I started with less than 1% and got up to about 2.3%. It is very hard to get more than 2 to 2.5% SOM in this country with our arid soils when your water is limited, and our annual rainfall is less than 5 inches a year. You can't really get enough organic matter in our soil no matter what you do. So why keep testing? I know I've increased to a level I'm capable of so I'm comfortable with it.

We need grants and programs that allow us to invest in capital such as equipment. It is expensive to do this experimenting on my own. I can't buy a piece of equipment just to see if it's going to work. Once I was going to share some equipment from California, but that plan fell apart. Towing something all that way is a big thing. Even more important, when it's not your equipment you can't tweak it to make it work better for your purposes, and also the timeframe you need it is the same timeframe everyone else needs it too.

I like to plant watermelon after milo, because they leave a lot of stubble, and that gives the melons something to tie onto. The milo's high residue acts as a mat on the ground when we transplant the seedlings. Our melons come out sweeter, with more intense flavor than most. We

do Brix tests because our customers only want melons with a high sugar content. But everything is about timing. Once the melons get too sweet though, they tend to have a shorter shelf life.

With onions, so much depends on the variety you plant. It is easy to over-fertilize, more than the plant needs. You can ruin a crop if you fertilize too late. Over-fertilizing onions will cause them to break down during the shipping and storage and basically rot. So, I fertilize early and make sure I run out of fertilizer toward the end.

I plant cover crops that are low cost. Austrian Winter Peas and annual rye are cheap, and so is wheat. Other seeds get more expensive. Clover has a small seed but also requires a lot of water, and it can be allelopathic to the plants that follow. So can rye, so care and timing need to be taken. I just have to see how my operation reacts to each of them. There is no doubt that clover is good, but I am not sure it gives a better response for the crops I grow. I look for the long-term effects. The plants look healthier when the soil is healthy. *After* that I look at the numbers, each of the inputs I used and how much they cost.

For example, rye can regrow itself after plowing, so you must watch for that. Still, I like rye because it is more drought-tolerant, it suppresses weeds and my crops that follow it respond well to it.

My farm operation changed dramatically when I installed drip tape. At the time it cost almost as much as buying a parcel of land. I thought it would take 10 years to recover the cost. But it only took 3.

I can't really pinpoint which practices make the most difference economically. It's a combined effect. The basic point is that my farm operation changed dramatically when I installed drip tape. I was only the third person in the county to install it. That means I can't plow any more, so I have to manage everything differently. There is no going back. Installing drip irrigation at the time cost almost as much as buying a parcel of land. It cost $2,000 per acre and more. I thought it would take 10 years to recover the cost. But it only took 3.

I don't think that anything I do will make any difference with climate change. Those are just cycles that rotate over time. But it's hard to manage for change.

We used to have more than 100 farmers in our county, now you can count on two hands the number of operations that are left. Those guys who had only 100 acres just couldn't make it. At that size you had to get bigger or sell out to someone with a bigger farm. It's a vicious cycle. All it does is squeeze the little guy out.

I don't have a lot of time to crunch numbers. I try to go by what I can see. I can't really pinpoint which practices make the most difference economically. It's a combined effect. It's about the quality of the crop and the quantity. But I do know

that if you don't take care of the soil, the soil can't take care of you.

I don't have a lot of time to crunch numbers. I try to go by what I can see. It's about the quality of the crop and the quantity. But I do know that if you don't take care of the soil, the soil can't take care of you. Sometimes you just have to do your own thing. You have to try things so you can find out what needs to happen. When your neighbors and fellow farmers start asking what you're doing different and start asking for your help…you know you're on the right track.

My other rule is, don't spend more than you make. I print out a profit and loss statement at the end of each year and pay attention to inputs. Some guys spend their whole crop revenue buying inputs trying to make the biggest yields — I guess so they can have bragging rights — whereas I want to be profitable. To me the word sustainable means that my farm and my soil will continue to produce and be profitable for not only me, but for future generations of family that follow me. After 30 plus years, I'm still farming.

Don Hartman inspects his soil for color and structure. Photo courtesy of NRCS.

Laura Harper

Del Valle Pecans
Mesilla Valley, New Mexico

Laura, Sally, and Todd Harper. Photo supplied by Del Valle Pecan Orchard.

Laura Harper grew up on the Del Valle Pecan orchard in the Mesilla Valley. Her parents Sally and Wilmer Harper launched the business in 1986. “It was supposed to be their retirement,” Laura said. But it became a full-fledged business that grew in creative directions, adopting no-till practices early and farming organically, so pioneering that Sally Harper was named New Mexico’s Organic Farmer of the Year in 2008. Perhaps more importantly, the Harpers instilled in their children a love for the land.

Laura recalled that she had embarked upon a successful professional career in a completely different field. Yet as she lived this life in Central Pennsylvania, she developed a yearning to return to New Mexico. Harper added that there is no English word that fully conveys how she felt. But there is a Welsh word, *hiraeth*. “It was something like being homesick, but much bigger.

It was much bigger than nostalgia. I was missing that feeling you get when you are in a place that has been familiar to you, and all of the things you loved about it. If you grow up in New Mexico you realize that no other place is like New Mexico. We have this wonderful mix of Native Americans, Hispanic, and Anglo people. We all co-exist and we all bring something wonderful to the state. The mountains to the east of our city are very distinctive. I missed the mountains and the expansive sunsets, the smell of the desert in the rain. I missed the days when I was climbing upon the orchard trees and catching tadpoles."

Summer orchard view. Photo supplied by Del Valle Pecan Orchard.

Although her mother had never hinted that her children should come back to the farm, Laura and her brother Todd independently made decisions to return. "Although this has always been unspoken between us, I think we both felt it would certainly be nice to have a second generation of Harpers run the farm," Laura recalled. She added that they were lucky to hire a foreman, Miguel, who "really loves to farm and is doing well learning the many different tasks of farming. Between the three of us, we make it work." Laura takes charge of managing the business end, while Todd and Miguel share management of the orchard. Todd juggles his farm time with a professional career as an engineer.

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The siblings took over a 34-acre orchard that had been created in a careful manner. Laura's family has a favorite story about its origin. "The farm they purchased had never been exposed to chemicals, so it was technically organic. They were harvesting pecans, but markets were fickle.

Sally wanted to sell shelled nuts because they commanded a higher price. Wilmer, an agricultural economist who had taught at New Mexico State University, suggested it would be important to perform a feasibility assessment first, to make sure there was a market for shelled organic pecans. But, busy as he was with professional duties, he never got around to completing the study." Then Wilmer was called abroad for six months to work in another country. While he was away, Sally hired a nearby firm to shell 2,000 pounds of pecans. She piled her three children into the family pickup, and drove across the state to visit every grocery store and restaurant she could locate to sell them. All the pecans had been sold by the time Wilmer returned. "That was our feasibility study," Laura chuckled.

Always looking for new and better ways of doing things, Sally had learned about minimum-tillage farming practices. Implementing these approaches worked well for the orchard. Moreover, it cut costs. Rather than plowing 8 or 9 times each growing season to reduce weed pressure, the family mowed them once a month. Fewer weeds took hold, and the costs for field labor and tractor operation fell. The soil looked better. It confirmed her sense that "if you take care of the soil, the soil will take care of the trees."

Implementing minimum tillage worked well for the orchard. Moreover, it cut costs. The soil looked better.

Adding value to the pecans: Sending pecans to the sheller while retaining ownership was innovative at the time. Laura recalled that "pecan markets were especially volatile then. If you sold at the right time, you could earn a decent amount. But if you sold one week later, when everyone's pecans were on the market, the price would plummet. They're a little less volatile now, but still fluctuate from year to year." Sally had the insight that shelled pecans commanded a bit more stable price, because fewer farms offered them. And they were attractive to restaurants, bakers, and grocers because they were ready to use. "It gave us more price stability." Yet Laura also recognizes that as more organic growers come on line to sell shelled pecans, this advantage is dwindling.

As pioneers, the Harpers also faced considerable resistance to the concept of growing pecans organically. "There were several growers in the area who had a lot more experience than my mother had in raising pecans who warned her that if hers became the only farm in the Valley that didn't use chemical sprays, all of the pests would congregate on her farm." Luckily, Laura added, this didn't happen.

This was also before the USDA had set up the National Organic Program. No standards were in place to guide either farmers or consumers. So a group of farmers in the state got together and wrote their own standards. They lobbied to create a New Mexico Commodity Commission to enforce these guidelines. Although Sally and Wilmer were not part of the standards group, they were one of the first two pecan farms in New Mexico to obtain organic certification.

Since taking over the farm, Laura and Todd have added 18 acres of new seedlings and expanded into far wider markets. "Now we ship all over the country, and occasionally to Canada," Laura reported. We primarily sell to independent grocers and bakers, and a few candy makers and restaurants. We are just starting to sell online so we can sell direct to household consumers. But we never got too big for our own britches."

Incorporating wood refuse into the soil: The siblings continue to innovate in the orchard. "We've developed a novel way of dealing with the broken branches from the trees, and the refuse from our trimming," Laura added. "In earlier years, we would gather all of this up into piles and burn it. But that created a lot of smoke, and we didn't want to continue that." So the family began to shred the branches and incorporate them into the soil. "At the time, people thought you couldn't do that, because some walnut branches can't be incorporated. But we've done it for 20 years, and nothing bad happened. Now it is a pretty common practice across the Valley."

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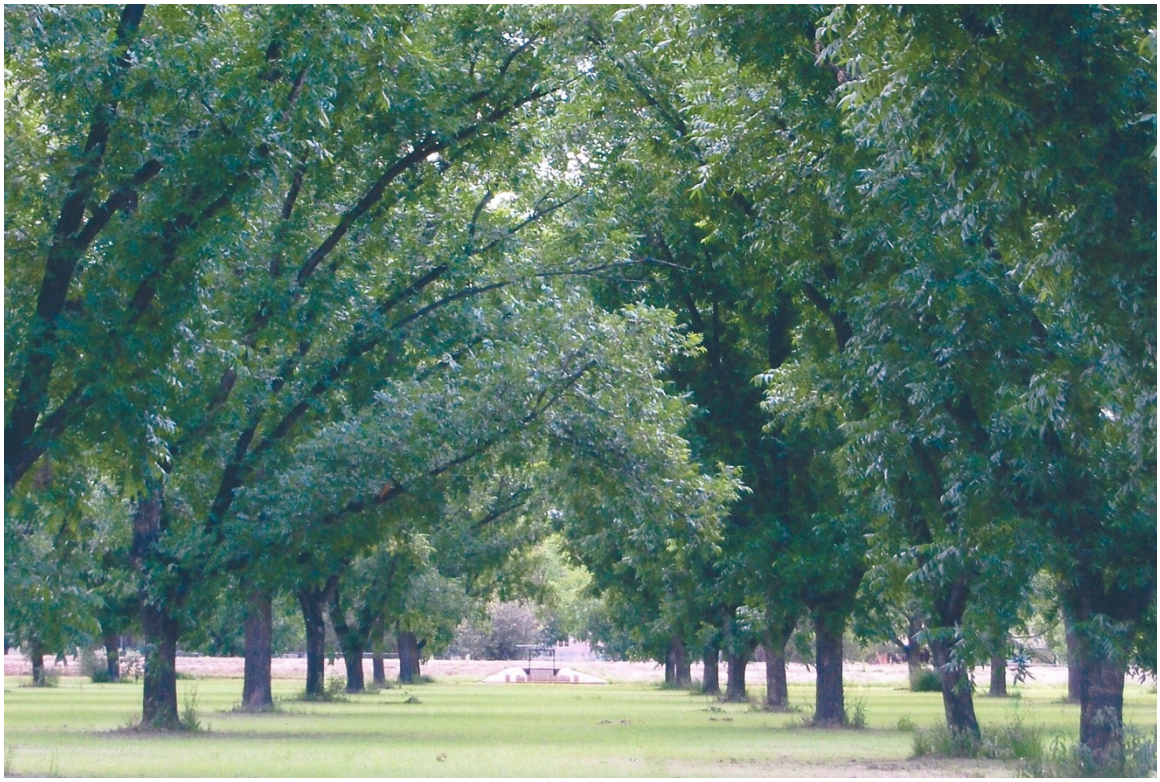
Laura and her brother also continue to do the minimum tillage possible. "Once a year, we make a pass with a deep claw that digs 4 or 5 feet into the soil to reduce compaction," she continued. After that we disk and then pass over the disked soil with a tool that smooths the soil to set the orchard floor for the year. We don't have to do any more tillage after that."



Careful management keeps the soil green during the growing season. Photo supplied by Del Valle Pecan Orchard.

Incorporating manure: The Harpers apply manure from nearby dairy farms to add organic matter into the soil. They use the disk to incorporate the manure. But this has to be done more

than 120 days before harvest, because the nuts are gathered by shaking the tree with a machine, and they fall to the ground. If the manure hasn't fully decomposed, it would risk contaminating the nuts. For the same reason, the Harpers do not graze livestock on their orchard. "The orchards would be an ideal place to graze small livestock," Laura lamented, "and their hooves would incorporate the manure into the soil. But if we were to try that, we'd have to reconfigure land use because we would have to have other pastures for the sheep for the 120-day period before pecan harvest. That would probably create more work than it was worth."

Cover crops: While the family uses cover crops to fill the rows between the trees in the orchard, to make sure there is a living root in the soil at all times, "We just let whatever grows on its own to grow. When we mow, we leave the trimmings on the ground as a mulch that breaks down over time to add organic matter to the soil. We've never planted specific cover crops. We prefer this kind of a closed system, where the nutrients stay right on the farm." She adds that she knows of farmers who grow cover crops that can be harvested for sale, but she is concerned that that takes nutrients away.

We prefer this kind of a closed system, where the nutrients stay right on the farm.

Harper added that it is difficult to find cover crops that work in the Valley. "We have a severely hot summer, so it is tricky to find cover crops that will thrive here. We have long periods where it is over 100 degrees with strong sunshine. We irrigate our orchard by flooding our fields for about 24 hours every 3 weeks from the end of March through mid-October. The trees create fairly deep shade, especially if we haven't pruned the trees for a while. Those crops that grow well in the shade may not survive the flooding; those that tolerate the flooding may not like the sunshine.

She continued, "All in all, we really don't have terrific soil here. We have a lot of heavy clay that has to be broken up, and a lot of sandy sand that gets better structure when we add organic matter. We find that the less tillage we do, the better." Laura added that they do test the organic matter content every few years, and "We have slightly higher organic matter levels than other farms in the Valley."

Nurturing beneficial insects: Another critical soil health practice is harnessing the work of beneficial insects that will help keep pests at bay. "We don't usually introduce beneficials into our orchards, but we are happy when praying mantises appear. We rely upon ladybugs and lacewings to prey on harmful insects like aphids. We also have a tiny wasp that is a parasite to the moth of the Pecan Nut Casebearer, which wants to chew the pecan nuts. We have little spiders that are carnivores, so they must be eating some of the insects we don't want," she continued.

So far, the Valley has been able to fend off a more troubling problem. "The pecan weevil is endemic to the Southern and Midwestern states, as well as eastern Texas. If that came into the Valley, we would have to forfeit our certification."

Aggregating pecans from several farms: Del Valle has also built economic resilience by making solid connections with neighboring pecan growers. About 9 growers who have more than 35 acres of pecan orchards currently sell organic pecans through the Harpers. "We have several growers near us who have small orchards. But it's more challenging to market smaller quantities of pecans. They could only supply a single store, even if they shelled them out. So they sell them to us. We contract with a sheller who cracks, shells, and sizes the nuts for us. Their firm is completely mechanized. The shelling equipment is real expensive, so only a few places can offer that service. We sell all the pecans under our own label. That way we can offer our grower partners a higher price than they could get on their own, especially if they were trying to sell conventional pecans in their shells. At the beginning of each year, I establish a set price so each grower will know what to expect. We can usually get a few dollars more per pound for shelled organic pecans. Both the shelling and the organic certification add value to the product."

Laura does not try to dictate which practices the other farmers who supply Del Valle should follow. "As long as they follow the organic standards, we will work with them. Some of the farmers in the Valley have a lot more farming experience than I have, or even than my mother had. I don't have the knowledge or the desire to tell them how to farm. Each farm is different, and has to make different choices based on the conditions they face. Most farms have to do a foliar spray to help compensate for the fact that our soils don't release zinc very easily. That is not a problem I have. All the same, we chat back and forth all of the time, to keep information flowing.

Selling shelled pecans from several growers helps assure a reliable supply.

Laura added that this also benefits the Del Valle business because the extra supply helps assure customers of a reliable supply. In fact, "These 9 growers provide a little more than half of what we sell, so they are important to us. Harper added that as more growers enter the organic market, prices are pushed lower. "Customers are more concerned about the ecological benefits of farming organically than about the economic benefits," she added.

Benefits: Laura concluded, "My main way of telling whether our soil health efforts are successful is to look at the health of the trees. Do I see any kind of nutritional deficiency in the leaves? How do the pecans look at the end of the summer? Are they big and healthy?" But pecans also cycle between large and small harvests. "If we have a heavy crop this year it will be light the next. These cycles can be tempered somewhat by pruning the trees. This reduces the highs and makes the lean years more productive. So I look at whether our pecans have the same high quality year after year," more than the pounds harvested, Laura added.

In this respect, too, the business benefits by purchasing from a larger number of farms. "Generally the Valley orchards cycle up and down together, but it is not uniform from farm to farm. For some reason, our orchard cycles the opposite of the rest of the Valley. I don't know why." By combining the harvests of several farms, these cycles are also minimized.

Harvest time at the orchard. Photo supplied by Del Valle Pecan Orchard.

JJ Sánchez

Adelino Legacy Farms
Adelino, New Mexico

JJ Sánchez checks the hay crop to make sure it has the optimum baling moisture. Photo provided by JJ Sánchez.

My father Lawrence used this place as a showcase for various farming related projects, seminars and working groups. We're on a main highway down in a valley. A lot of people used to drive by and see a great farm. Everything is as it was when my father was farming it. He left a turnkey operation.

I was pretty much raised here. The landscape looked a lot different then. I went away to college, began to raise a family, and went to work in Arizona. I stayed there much longer than I anticipated. But I returned home to visit whenever I could. Looking back on it, I wasn't up to speed on everything that was going on here. I was a laborer, and I let my dad do his own thing, making decisions as he wanted. I really don't know a lot about his thinking behind the farm operations.

[My father] had started to work with a couple of people, soil consultants, and so forth, to put back the soil to the condition it used to be in…. I want to make it even better.

He had started to work with a couple of people, soil consultants, and so forth, to put back the soil to the condition it used to be in. In the last couple of years of his life, I had conversations with him about how to sustain the farm. I know that he set specific goals for improving the soil, but it was really his project and I was living at a physical distance.

As I grew older I discovered that I really liked farming and ranching. I looked at the rural landscape and I loved it. Urban life did not appeal to me. I still have a high tech job, and that allows me to farm and ranch today. But I have returned here to my roots, where I want to live, and to farming. I've been here full-time since March, 2019 after commuting from Arizona for two years. I own 300 acres, but I am only farming 10 acres right now, which is as much as I can do with a full-time job. My cousin Clarence farms most of the land my father helped to manage (See the NRCS profile of Lawrence Sánchez). They helped each other out a lot.

I have put my own land into hay crops for now. I sell mostly to people nearby who have horses. I don't charge premium prices, even though I can say with confidence that they're getting a premium product. I have one set price for all of my customers. In any case, there really isn't a great deal of money in growing hay. There are some really large farms in Idaho that ship hay all over. They have lots of water, and they can get a high price. I feel my acreage is too small scale to compete with that type of farm even though I have the same or better quality product. Perhaps I just have not found the right market in this area for a premium hay product that should be able to command a premium price.

I also may want to change crops, perhaps grow some vegetables. Dad grew some a number of years ago, and they were the best I have ever eaten. He mainly grew chile. Back then we set up our own farm stand. People still stop by to ask if we will be selling again this year. He also raised potatoes, melons, tomatoes, squash, and pinto beans. But vegetables are a lot of work. We grew a test garden this year and were able to sell some chile, Mexican melons, watermelons, squash and zucchini.

Or I may convert back to row crops someday, to maximize the profitability of a small acreage farm. We also have horses of our own, so we will always need hay crops to at a minimum to provide for the needs of our own livestock.

When I took over, my first goal was to make sure that land didn't get any worse than it was. Second, I thought that if you can take what you have and make it better, that's all you can ask for from any farmer. I saw my father fulfill that on the land he took over from his parents. He made it better in many ways. That approach is ethically instilled in all of us. They aren't going to make any more land, so at some point in the future I would like to make it better.

In the time I have been here, it has increasingly become easier for me to manage the farm, as I gain more experience. Dad's notes help me a lot, but I don't think he wrote down all of the practices he followed. As a materials science engineer, I am very data driven. I spent the past

three years logging data to see what works and what doesn't work. I don't want to waste money. My quest is to find out where the sweet spot is with any of the crops I grow.

Should I measure my progress by counting the number of bales of hay I produce? That is not enough, because it also depends on what the quality of the hay is, and how much each bale weighs. Each year I try to compare my yields with previous years, to see whether I progressed.

One 3-acre field has been in production continuously for 16 years without tillage, and outperforms other fields in many cuttings.

I have learned a couple of interesting things. For one thing, I have one 3-acre field that has been in production continuously for 16 years. My father and uncle always used to say that after every few years you need to plow up each hayfield to renew it. But when I check my data I found that this small field is outperforming all of my others on many cuttings, so I don't want to disturb it. Those results also show me that I have work to do on reclaiming my other fields.

My father sent out some soil samples for analysis. I found some old records for these, but only a couple. The lab was very generous; they sent me some of the data they had in their files. These are several years old, but they give me a reference point for my own plans.

I don't have my own equipment. I hire out (mainly Clarence's) for cutting and raking hay. Over time, I am starting to get my own. If I can build my own fleet, I can have more control over my operation.

Luckily, I don't HAVE to do anything different with the land right now. Whenever the time comes, we have enough water to raise whatever we want to raise. But I want to have a plan ready. I may plow all of the hay up and plant something similar, or plant something else entirely.

A couple of things have come up. One big bare spot has come up. I want to ask my dad, "What do I do about this?" I have no conclusive understanding yet. I spent the entire season trying to get the hay production back, but the weeds kept coming in. This may force me to make some different decisions.

We went from about the best year for irrigation in 2019 to the worst year in 2020. Our water got cut back in August because it was so dry. Normally I can get 6 cuttings of hay per year. That is about one more than most people get. We try to irrigate twice between each cutting. I fertilize once before each cutting. But we got only one watering before the September and October cuttings, and it was unseasonably warm when we cut. It was more like a clipping than a cutting. I was thankful to get anything at all. But I felt the hay with my hands, and it had good moisture. There seemed to be good moisture in the field. It's common knowledge that organic matter and nutrients — good soil health in general — help minimize the "stressful" times like drought and heat.

All told, the lack of irrigation didn't affect me as much as it did other people. When we got the results back from the lab, they told me that I had 20% protein in that final cutting. This was above our yearly average of 17%. They told me, "Your stuff is top shelf." It was even higher

protein content than the alfalfa my wife has been buying for her performance horses. So we're going to rely on our own hay from now on. It seemed that whatever rain we got seeped into the ground, and did not run off.

All the same, with the pandemic, cattle prices fell through the floor. So lots of ranchers decided to simply sell their animals, rather than pay for the costs of feeding them. So I couldn't charge any higher prices for my hay.

The next generation — Clancy Sánchez, 13 — cleans up the corners and windrow ends, preparing to bale. Photo provided by JJ Sánchez.

When I started out it was scary, too. I told myself, "I don't know anything." But if I don't make any decisions, right or wrong, I won't learn anything, either.

I am loving every single day of farming.

All in all, I am loving every single day of farming. Even with only 10 acres. In the past, I was only able to be here every two weeks. Now I can be here every day. But I am monitoring conditions every single day, too. I can see why people resort to what seems easiest in weed management by spraying herbicides, etc. I don't want to do that. Therefore I hoe and pull weeds as much as

possible and continuously work to understand what the crop needs to resist weed and insect infestations rather than resorting to chemicals.

I had 20% protein in that final [hay] cutting. This was above our yearly average of 17%.

Selling hay is only part of my income. I like having things to trade, too. “Back in the old days” the barter system was commonly used rather than money. If I have a commodity that someone needs and they have something I need and we can work out a mutually beneficial trade, in many ways that is more satisfying to me than having the money to buy what I need. For example I might trade chile for lumber, or hay for labor and small equipment, and so forth.

I am up front with my customers, I tell them what they want to know. I show them my hay analysis, the weight and protein.

Jim Berlier

Berlier Ranch
Encino, New Mexico

Jim Berlier works with his cattle. Photo by Virginie Pointeau.

I have a bit less than 10,000 acres on my home ranch. That's not very big for around here. I also lease several other ranches. We have gentle rolling hills. Normally I keep about 150 cattle on the property, but I have cut back to 75 this year because I am having a wind farm installed. It will have 53 turbines. There are hundreds of people working at the wind site day to day, and it is just too much activity. It was easier to reduce the herd.

I've separated the ranch into 5 paddocks, all having more or less the same capacity to grow grass. Those 75 animals can easily survive on just one of those paddocks. Cattle grow well here. Since it has been so dry (we only had 5.8 inches of rain in Albuquerque in 2020, that's just over the ridge) I have focused on raising yearling cattle so I can sell them in the fall. Then I have fewer animals to feed in the winter.

My great uncle started this ranch in 1937. His generation didn't have any idea about managing soil health. He started with dryland farming, raising pinto beans. Then he kept buying land nearby until he had amassed 28,000 acres. Over time he added cattle. He had no soil management practices whatsoever. I have no idea how many cattle he had. He used to say that he put as many cattle on the land as he could, "until their tails were hanging over the fences." He would graze continuously. There was an attitude back then that if the Good Lord gave you a blade of grass, you were supposed to make sure a cow ate it. The condition of the range had deteriorated badly. At the end there were a few patches of blue grama grass here and there. No other grasses were growing.

Our first step was to reduce the herd to alleviate pressure on the land. Then we started rotating our pastures…. As soon as we did the grasses started coming back.

My father and I took over the ranch in 1982. I had just come out of college with a range science degree, and he invited me to put it to use. The first thing we did was cut back on the number of cattle we grazed. Then we started rotating our pastures. I am still not following all of the practices I would like to pursue. Of the 5 pastures, I keep two or three fallow each year, so the grasses can recover, then I graze the cattle on the others. Almost as soon as we made the shift, other grasses started coming back. We did not plant any grasses; the seeds were in the soil or they got carried in by birds or the wind. Now we have ring muhly, big bluestem, little bluestem, sand dropseed, fourwing saltbush, winterfat, Bigelow sagebrush, and feathergrass.

Of those, the winterfat and the Bigelow sage are the best indicators, in our area, that our soil has recovered. The Bigelow sage is one of the first things that gets killed off when the soil gets out of balance, so I am always happy to see that. The livestock especially enjoy the feathergrass. It comes out in late March, and the cattle and wildlife really go for it. It can grow on the high ridges where there is almost no soil. After it is grazed, it comes back with a vengeance. Two species that tell you that things are not working well: when you have lots of tumbleweeds, or Russian thistles.

We installed 16 miles of water pipe, and 8.5 miles of cross-fencing.

The next thing we did was to improve the water distribution. That was easy for me to do because I used to run a tunneling and backhoe business, installing waterways and irrigation lines. We put in nearly 16 miles of water lines on this ranch. They are all fed from a single well that is 1,000 feet deep. Things were pretty bad before this. My great uncle had installed water storage tanks on scattered sites across the property. They were ceramic. There was a lot more rainwater in those days, and after a rainfall they would fill up with eroded soil as well as water. But most importantly, the cattle had to walk as much as three miles to get to these water stations. I reconfigured them so no cattle had to walk more than a mile to find water. They don't mind walking that far.

Next, we put in miles of cross-fencing so we could divide the pasture into paddocks and rotate our grazing. Our fencing was in bad shape at first, too. My great uncle didn't really care about

cross-fencing since he would graze every square inch of the property every year. At first, I just fixed the fences as best I could. Then I began to replenish entire sections. Finally, starting three years ago, I put in all new fencing. We now have more than 8.5 miles of fence.

An old rock house on Jim Berlier's ranch. Photo by Virginie Pointeau.

When the cattle graze on these pastures, the combination of their manure, urine, and hoof action is absolutely essential. The grasses just came back on their own, even though the land had been degraded so much. The microbial action deteriorates if there is no manure. The grass cover also lowers the soil temperature as much as 30 degrees when the sun is shining. That shade is also important to keeping the microbial action strong.

The microbial action deteriorates if there is no manure. The grass cover also lowers the soil temperature as much as 30 degrees when the sun is shining. That shade is also important to keeping the microbial action strong.

We've also removed some weeds. I've done nearly 1,000 acres of juniper removal. People tell me, that's biomass, why remove it? My answer is that you get more biomass with grass. Cactus

has been a problem as well. I've removed more than 1,200 acres of cactus since the 1990s. We've used NRCS funds to do those removals.

I have not been taking soil tests, but I have a good sense of how the soil is doing from looking at it. Historically, soil organic matter used to be 4–5 percent here. I am thinking it had degraded to less than 1 percent, and has grown to almost 2 percent since I took over. We work closely with NRCS. They love to have field days out here. They tell me they cannot believe the improvement we've had in the past 10-12 years. They bring samples of soil from other ranches, and compare it to mine. I'm getting a 90% rate of water infiltration, with no erosion or runoff. Those watering tanks that used to collect eroded soil — they are bone dry now. Other ranchers are really impressed when they see that.

Another way I can tell this is working is that I used to have to buy 5 loads of hay each year so I could feed all winter. Now, I only have to buy one load. We raise three times as much grass as we did before, with the same available rainfall.

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This system also gives me more flexibility. For example, prices for yearling cattle were really low this year — cattle markets are always taking wild swings — so I didn't want to sell them. I had the flexibility to not have to sell, because I knew I could feed them from my own pastures. When that's not possible I can take them to a feedlot, or I could take them to one of my other ranches if the pastures are better there.

[Our] system gives me more flexibility. Cattle markets are always taking wild swings, and prices were really low this year. I had the flexibility to not have to sell, because I knew I could feed them from my own pastures.

I sell my cattle under an All Natural label. I don't get any premium for my grazing practices, but on one of our ranches we follow Global Animal Partnership (GAP-4) standards, and have a biannual inspection. We certainly get premium prices under those standards.

Today, I believe I sell as many pounds of meat as my great uncle did off this land, but my input costs are at least 30 percent lower, so the farm is more profitable. Rather than maximizing the number of animals, like my great uncle did, I want to optimize the herd I have.

Today, I believe I sell as many pounds of meat as my great uncle did off this land, but my input costs are at least 30 percent lower, so the farm is more profitable. Rather than maximizing the number of animals, like my great uncle did, I want to optimize the herd I have.

I am immediate past president of the New Mexico Soil And Water Conservation Districts, and also serve on the executive board of the national SWCDs. I've used my presence on the SWCD, and the fact that I use rotational grazing, to get contracts to run larger farms. I formed a partnership with four others, and we lease three other ranches. We raise about 500 cattle on a 125,000-acre ranch in Northern New Mexico, have another 200 cattle in Southwest New Mexico, and run an irrigated pasture in Texas. My position with the SWCDs certainly helped us get the northern lease. It's a landowner with oil income who is now diversifying into property. They liked our proposal to use rotational grazing. We're also installing cross-fencing there, because we have 2,000 resident elk in the area, and they move into the areas where the grass is the best, if we don't keep them away from the cattle.

All in all, though, I would like to be able to stay at my home place. I'm jealous of guys who get to stay home all day. If I could find some part-time help that would do what I tell them to do, then I could take more time to improve our land right here. I want to continually improve what we've got. I don't think we ever get to an end point. My son-in-law wants to expand.

It's an educational process. Nowadays, it takes someone who is an absentee owner to own a ranch. They are able to hire these young folks coming out of college with degrees in animal science, range science, or agribusiness, to run their operations.

Historically, soil organic matter used to be 4–5 percent here. I am thinking it had degraded to less than 1 percent, and has grown to almost 2 percent since I took over.

Jim Berlier's spurs. Photo by Virginie Pointeau.

Charles Hibner

Hibner Ranch
Cebolla, New Mexico

Charles Hibner sets out with his trusty dogs to monitor the ranch. Photo provided by Charles Hibner.

I'm a cattle rancher west of Cebolla. I attended NMSU and met my wife there. As a soil scientist I performed soil surveys across the state for the National Resource Conservation Service (NRCS). Now I'm retired, but I continue to farm.

I operate a total of more than 20,000 acres, not all contiguous. This includes:

- 6,500 acres of BLM land for grazing
- 5,000 acres National Forest Service for permit grazing
- 3,000 acres of deeded land
- 3,000+ acres of leased private land
- 640 acres of state land leased through another person

My land includes considerable forest, dry land, rolling hills, scattered meadows, and wilderness areas containing steep canyons. I also have 208 acres of irrigated land in hayland that I grow to feed my livestock. Some years I can grow extra hay but I never sell hay. I save any extra hay for

the following year. Last year I put up twice as much hay as I needed. But I will use all that was left over, and also will need to buy extra, this year.

I don't know who ranches to make a living. I do OK, but that is not why I farm. I ranch because I love it as a way of life. I loved my job with NRCS, but I retired as soon as I could because I love ranching even more. I don't worry about the returns. I want the cows to have the best chance they can. Sometimes I get a premium price for that. My animals come in at the top price for their weight class every year. The buyers get to know me and they pay a little more.

There is one individual I sold cattle to for 4 years in a row. He told me the third year that he has never had one of my animals get sick. That meant a lot to me. He paid me a little more per animal than most people do. Another individual bought my steers for a couple of years and sold the meat at farmers' markets as grass-fed beef, and gets a pretty good price for it. I don't have the patience to sell at the farmers' markets myself. I have explored selling animals through rancher collaborations, but for some reason I can't get people to pay what I can get by going through the market.

I ranch because I love it as a way of life. I want the cows to have the best chance they can.

All I sell is cattle. My herd is about 250 head in a cow-calf operation (although I have taken the herd down to 120-130 in dry years such as 2013). Mostly I have Black Baldy and Black Angus. I keep a few Herefords for breeding. I keep about 40 per year as breeding heifers. I almost always sell my calves in the fall. Once in a while I sell a few smaller calves the following spring.

I hold the young stock 45 days after weaning before I sell to keep them healthier. If you were to sell the calf right after weaning, typically you can expect about a 3% loss of the animals you sell through illness or death.

I manage different types of land in different ways:

Forest: I live in the forest. I have juniper, piñon, and ponderosa pine. I do everything I can to improve the understory. I plant lots of grass. It definitely needs light, so I have taken out some of the trees to allow more sunlight in.

Open land*:* All the fields that I have disk-harrowed are in good shape. That is not as intrusive as a moldboard plow. I am a no-till person. I am glad not to compact the soil. But once in a while you do have to loosen up the soil to allow rainfall to enter the ground.

To qualify for their programs, NRCS requires a 90% brush kill. In my case, that means Wyoming big sagebrush. I cannot get that with a single pass of the disk harrow, so I go over each field twice. With two passes, I can get a 95% weed kill. Hopefully, then, I can lay off the plowing for 40-50 years.

Charles Hibner's ranch includes vastly different natural zones. Photo provided by Charles Hibner.

In most cases, fields that were plowed and seeded 50-60 years ago are in pretty bad shape today. The exception would be those fields that are grazed during winter and early spring. This appears to be the best time of the year to graze. There is no impact to grass that is dormant through the winter, and minimal impact to grass that is in its rapid growth state. My fields that are winter-grazed were planted in grass 70 years ago, and they're still in very good shape.

Meadows: I have taken good harvests off of meadows I plowed 50 years ago (all except for one small meadow, where I haven't been able to get the sage out). I put triticale in, harvest the grain, then roll over the stalks and disk the field. By now I have about 20-30 earthworms per square foot in the meadows. Meadows need a lot of scrutiny. It takes a lot of work to get one established. After that I don't like to bother it. The soil is higher in organic matter in the meadows, so it is easier to get water penetration. The biggest reason to break it up is to get water into it. I have also fenced most of the meadows separately to minimize the impact by cattle during sensitive times. I only graze these meadows in the middle of winter, when the ground is frozen solid.

This calf seems to be thriving through intensive grazing. Photo provided by Charles Hibner.

Wilderness: We have a wilderness study area. It is hard to get anything done there, because the policies are so restrictive. Some of the area has steep canyons, but also rolling hills. But as I talk to the officials in charge, they are starting to change their thinking.

Each ownership type involves different restrictions:

- You can do pretty much whatever you want to do on your own land.
- BLM is the least restrictive after that.
- Forest Service won't allow some practices that are in fact allowed by BLM, such as aerial application of herbicide. I keep talking to them, and they listen since I used to work at NRCS. It is a shame that they hear me more often than they hear other ranchers. There are some very smart ranchers out there who don't get heard.

Frankly, one reason I can do this work is through the Environmental Quality Incentives Program (EQIP) funding. I have used their support for several different practices: brush management, seeding, building fences, tree thinning, and water impoundment for wildlife and livestock. It really costs me very little to do this, using these incentives.

The farm made a profit almost every year for the last 10-14 years. Before then we were at a deficit almost every year. We did lose a bit last year. A little bit of the gain is government projects like EQIP. The Farm Service Agency (FSA) helps us a lot, too. They have an insurance

assistance program that will pay if we have a loss. We made no claim for irrigation losses last year, because we had all the water we needed. That was the first time in several years. We did get some upland insurance payments last year. These two agencies have made it possible to perform practices that have improved the soil health.

I was talking to forest service staff several years ago, and asked them what was the most important resource they managed. Some said it was the trees. Others said it was the grass. I said both are good, but the best is the soil. If you lose the soil, you lose the ability to grow anything. Unless there is a good understory, the trees will be gone.

The bottom line in any western soil is putting water into the soil. You have to have good structure. Any organic matter you can put into the soil is helpful. Biological activity is a key thing…. If you lose the soil, you lose the ability to grow anything.

The bottom line in any western soil is putting water into the soil. You have to have good structure. Any organic matter you can put into the soil is helpful. Biological activity is a key thing. You want to raise the level of micro-organisms. They finish the job of breaking down organic matter into levels that will benefit the plants. No-till is a good thing for the most part, but you may have to plow once in a while to loosen the soil. Burning is a good option, but very dangerous. No one is burning this year.

In the hot arid parts of New Mexico the organic matter will burn off in the summer heat. The best way to reduce that is to incorporate the organic matter into the soil.

Organic matter is a big part of soil health. In the hot arid parts of New Mexico, like where I am, the organic matter will burn off in the summer heat. The best way to reduce that is to incorporate the organic matter into the soil. Disk harrowing does a little bit of this, and even the cattle hooves do some. But tilling can be risky if there is a salt layer beneath the surface. You might bring these salts up. This can be detrimental to your seeds. Primarily we have what we call *caliche*: white soil. It is mostly calcium carbonate. It can harden into a hardpan layer beneath the topsoil. There are other salts to watch out for, too: sodium sulfate and calcium sulfate.

There are three major soil parent materials in our area: one is alluvial, washing in from a higher landscape position after a rainfall. We also get aeolian parent material, soils that are wind-transported [blown] in from Arizona. It is a reddish soil, and it will favor certain species of grass. These soils react very differently than alluvial soils. Another is residual, or building soil in place. It takes a long time to build soil. Some experts say that it takes a thousand years to build one inch of soil. So, there is nothing more important that preventing erosion and keeping the soil that we have in place.

There is so much that goes into figuring things out, all the dedication that is required to do it right.

Now I have about 20-30 earthworms per square foot in the meadows.

All of my recent plantings have been native grasses: Indian ricegrass, western wheatgrass, thickspike wheatgrass, and slender wheatgrass. I like the fact that grass has an extensive root system. Sage has a deep taproot, but it doesn't have short roots holding the soil in place. I also plant a bit of triticale. I tried grama grass twice. It seems to do well in the SE part of the state, but not here. Being a warm season grass, it is too cold for it here.

I seldom graze a single pasture more than 2 weeks at a time. Sometimes it is only 2 weeks per year. It matters a great deal what time of year you graze. You can't do any better than grazing in the winter when the ground is frozen. But, of course, the animals have to eat all year long, so proper grazing practices are essential.

A neighbor was talking to my dad a few years ago. The neighbor was complaining that he had planted grass in one field 6 or 7 times but it wasn't taking hold. He asked my dad how he got his grass to be 1.5 to 2 feet tall. My dad asked him how he had managed the field after planting. "Did you keep your cattle out?" The neighbor replied. "As soon as the grass came up, I put my cows on it" My dad replied "You have to keep your cattle out until you can pull on the grass without it coming out by the roots." The neighbor had allowed his cattle to graze the grass before the roots were established, and the cattle had pulled it all out by the roots.

I planted grass on one field, and kept my cattle out. But then a herd of elk came through. They pulled everything out by the roots. They just yanked the plants out of the ground as they were feeding. I am kind of waiting to see if any of it will come back.

This year was a bad year, with so little rain. Then we had grasshoppers, and they took the grass right down to the roots.

Still, I just got through recovering 2 sections of land on a neighbor's lease land. It was a hard project but I got a big return. Before we began, I could graze about 9-10 cows per year on those 2 sections. Now I can graze 40 per year. That is a marked increase. The cattle are doing better, too. They don't have to walk as far to find the grass.

The bottom line is; we have to be mindful of managing our natural resources in a way that we can keep them around. Long gone is the day when ranchers would take every blade of grass grown out there. I like to manage in a way that will have at least a little grass left over on the worst years. That means that you will have an abundance on good years. We have to be mindful to keep the grass in the best shape that we possibly can, because good grass means a good root system that will keep the soil in place. If you lose all your soil, your soil health means nothing. We need to do everything that we can to keep the soil from eroding, either by wind or water. Along with that will be an increase in soil health. A healthy soil begins as one that you can keep in place. Then, you can begin incorporating other practices that will make it healthier.

Gilbert Louis III

Acoma No. 8 Ranch
Acoma Pueblo, New Mexico

Gilbert Louis II and Gilbert Louis III. Photo courtesy of NRCS.

Ranching here is not easy. There is always a constant hint of risk, given our land. This year [2020] it was drought.

I am the fourth generation to ranch this land, and my son is the fifth. My great-great grandfather farmed and ranched in order to take care of our family. It was a safety net for them. I am proud that I am still ranching for the same reason — to take care of my family.

We have a grazing permit for 17,000 acres of land. The land is owned by Acoma Pueblo. At our peak, we had 144 head of cattle. Last year we cut the herd back because it was so dry. So we're at about 100 now. We will cut the herd again soon. It's pretty bad right now. We had 6 inches of rain in 2019, and only 3 inches in 2020.

Ranching here is not easy. There is always a constant hint of risk, given our land. This year it was drought.

My grandfather started to farm this land in 1981. When he retired he told me I should grow whatever I want. He raised alfalfa, but with the drought that has become more difficult. It turns out it is better to buy alfalfa than to grow it for ourselves. We can buy it from a Native-run farm in Farmington. They have huge pivots so they can grow corn, wheat, potatoes, alfalfa, whatever they want. They deliver it by the semi-load for much cheaper than we can grow it. Of course, we have to unload the truck by hand, but it still costs less. Now we raise some corn on the land where we used to raise alfalfa. Corn takes less water, so it does better when there is a drought.

We also have 30 acres of farmland, but we only have 5 acres in production right now. We don't have enough water to farm the rest. We took some of the field and laser-leveled it, and we seeded it with alfalfa. But we couldn't get enough water to it, so we lost it all. We have a small ditch from the San Jose River, and we're the last on the pipeline. We could drill some wells, but it would cost too much.

View from Acoma Pueblo. Photo by Ken Meter.

We started rotational grazing in 2011. We have 7 pastures, and we rotate the cattle around those pastures. How long they stay varies from year to year. If one pasture gets enough rain, we might pasture the cattle twice in a single year. If there is no rain, we might keep them off the pasture entirely. So we don't use each of the pastures equally. You have to pay attention to everything.

Our overall business plan starts with the cattle.

It all starts with managing the land. Our overall business plan starts with the cattle. The core elements of our strategy are:

1. ***First of all, we have feed-efficient cattle.*** These are special breeds developed by NMSU. They process feed more efficiently. We've purchased a couple of bulls. One is a bull that placed first in the 2015 Tucumcari bull test. This breed can eat less and still gain weight. We hope to raise more animals like him over time, to get maximum efficiency from the forage we have. We just received certification that we have a registered herd of Black Angus cattle.

2. ***We rotate the cattle onto different pastures.*** We got some help from EQIP to build our fence lines and drinkers. We try to take half of the forage that's there and leave the other half for wildlife, so that we're not overgrazing.

3. ***We monitor the pastures closely and work with whatever the land provides.*** You have to pay attention to everything. We set out rain gauges at each of our pastures. We pay attention to how much forage is ready, which wildlife are living in each field after the cattle graze — did we leave them enough grass? — and how the cattle are faring. If it is not what we like, then we adjust our approach. So, for this year since we didn't get much rain last year, we are culling our herd, both bulls and cows.

4. ***We provide feed supplements.*** We set out protein tubs, feed cattle cubes, and alfalfa. If the cattle eat these supplements, it provides added nutrients when the local forage is lacking those key ingredients. Some of the supplements make their stomachs more efficient at processing feed. If any animal doesn't have these nutrients she won't be productive, so we try to assist her in any way possible.

5. ***We work as a family.*** I'm the ranch manager for our group. We are 7 owners, all family. We include my grandfather, father, uncle, brother, nephew, cousin, and my son. Only three of us make our main livelihood on the farm. One is assigned to monitoring the range, and another is in charge of the EQIP projects. Two are retired. My son saves any earnings made from the ranch for college.

When we went to sell our cattle last week, we took 19 animals. We weighed all of them together. The woman who checked us in asked twice, "don't you want to weigh them separately? Some of you will earn more money that way." I said no, weigh them together. One of us had only one heifer to sell. Since we sold them together he earned the same as each owner per head. It turned out we sold the animals for a higher price than we expected. When we divided our earnings, three of us decided to give $500 each of our share to the one owner who only sold one animal. This goes back to my great grandparents' reason for doing agriculture, to take care of one another. It is acts like this that keep us deeply rooted to who we are.

We try to stay away from selling through commodity markets. About 90% of our cattle are sold through private treaties, with customers who know us well and will pay a little more for high quality.

6. ***We try to stay away from selling through commodity markets.*** About 90% of our cattle are sold through private treaties, with customers who know us well and will pay a little more for high quality. 90% of those treaty sales are to Labatt Food Service. They agreed to partner with a Navajo Beef program. That grew into an effort that incorporated more tribes, so the name

changed to Native American Beef. On Saturday, we brought 19 cattle in, hoping to get $1.40 per pound. They paid $1.67 for steers, and $1.61 per pound for heifers. Right now the prices are running from $1.25 to $1.40 at the sale barn, so we earned a premium of more than 20 cents. We were ecstatic. In 1991, we got no premium at all, even though we had 14 inches of rain that year. And the price was only 90 cents per pound.

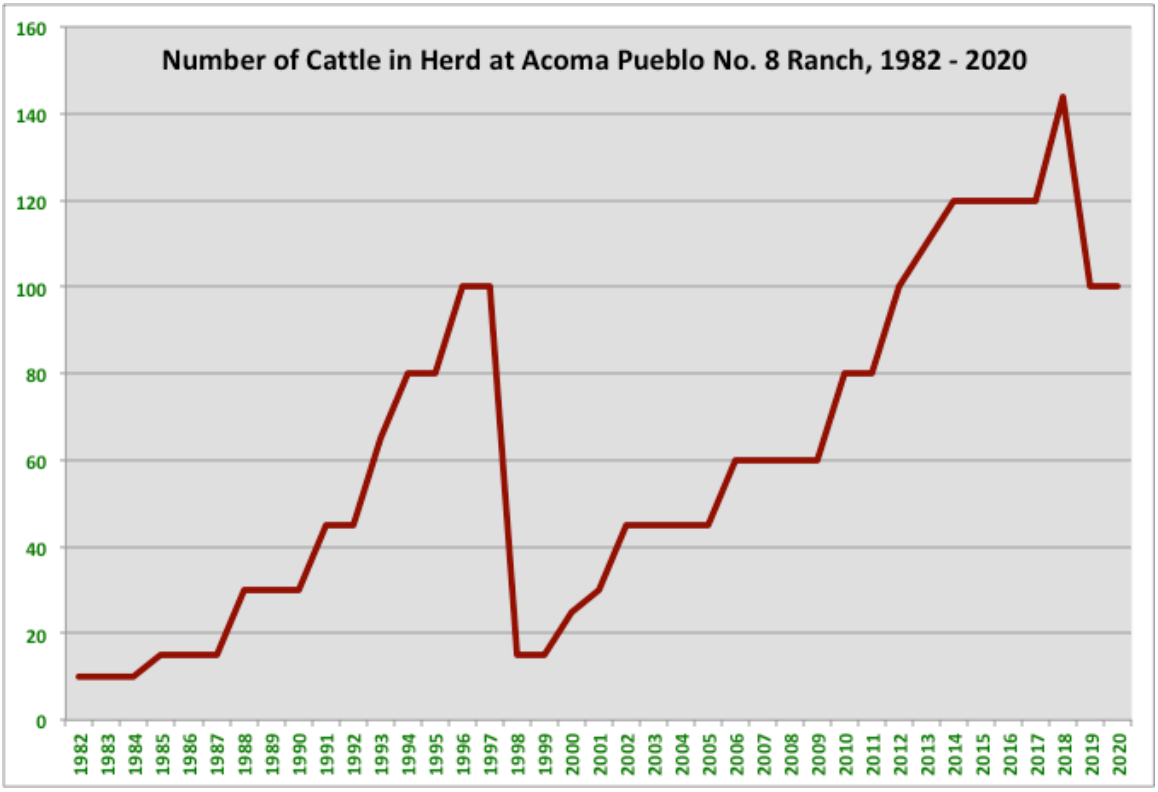
Labatt loves our cattle. Every time we take cattle in to sell, they say, "You gotta bring us more cattle." They are happy with our management practices. They came out for an initial inspection and we passed. We retain ownership of our animals until they get processed. That means we get more money for each animal depending on how they grade — premium or quality. Last year we got $773 per head. This year we got $907. Prices were a little higher after the 2020 election.

Labatt also sells Native American Beef to La Montañita Co-op grocery in Albuquerque. The Co-op also has a set of practices they enforce on their own. Their staff came out to the ranch for an inspection, and approved us. We are always adapting, looking for different markets. But we try to stay within the local cattle markets.

7. ***We are careful about purchasing drought insurance.*** Basically, we need insurance every year because rainfall is so sparse. The ranch is about an hour away from where I live (Albuquerque), so I can't be there every day to check the rain gauges or inspect the pastures. Some of the insurance payment formulas are based on average rainfall as measured by NRCS gauges some distance away. Last year, they wouldn't pay us very much because the NRCS rain gauges had collected half of an inch of rain, but our pastures only collected one-tenth of an inch. Then we went to private insurance. They also paid less than we needed. So we went to a less expensive policy. Through trial and error we learn what works and what doesn't.

8. ***We have some difficulties and try to work through those times.*** The Bureau of Indian Affairs *(*BIA) still retains power over the land, and they are not always easy to work with. Several years ago, we treated 20 acres in a tree-thinning project. We left some of the trees for wildlife. We left the larger oaks, all of the ponderosa, and some pine. We did all the work by hand. This was paid through a Conservation Stewardship Program (CSP) grant. It worked well. The wildlife and forage came back. We want to treat 400 more acres the same way.

This goes back to my great-grandparents' reason for doing agriculture, to take care of one another.



Source: Herd counts provided by Acoma Pueblo No. 8 Ranch. The ranch purchased feed-efficient cattle in 2010, adopted rotational grazing practices in 2011, and started selling through Labatt in 2015.

Gilbert Louis explained that the family made a large sale of cattle in 1997 "in part to a gentlemen named Buddy Major who was passing by our ranch and stopped by as we were having cattle work and said, 'I like your cows and I'm having a family reunion, can I buy some?' My grandpa replied, 'Sure how many?' Mr. Major replied, 'All of them!' Once in a lifetime experience!"

Tanner Mitchell

Tequesquite Ranch
Roy, New Mexico

Our ranch is in the northeast part of the state, in Harding County. It is the transitional zone. Mesas surround us, they're about 1,000 feet high. We're primarily in the valley, but we have a bit of land at the top of one of the mesas.

It's a commercial operation. We farm about 70,000 acres. We have about 1,000 head in a cow/calf operation. We've done this for 40 years. We were the first registered Hereford ranch in New Mexico, but we have changed our focus. During the past 10 years we breed primarily Black Baldy cattle. We have a few Herefords for breeding stock. The balance of animals depends on the cattle and the markets. In the past 5 years we've relied heavily on selling calves through feedlots.

We retain ownership of the calves until they are finished and sold. We have a choice of several feedlots in Texas and Kansas, and we like to work with those who can get a good price for us. Some will work with us, others won't. I have to rely heavily on the yard manager. He knows the selling business; I know how to raise cattle. But we've found people we like to work with, and they get us a higher price.

The majority of feedlots are run like a hotel. You've got so many rooms and you've got to keep the rooms full until the cattle are sold to a third party. We sell to anyone and everyone. Cargill, JBS, you name it. That's where the market is. We've been playing the market a little. The packers have grades they sell on. If the yard manager is good, he can work his relationships with the buyers, and boost the price a bit.

We also sell a few horses, but that is incidental to our income. My great-great grandfather was one of the founders of AQHA (American Quarter Horse Association), but there is not as much money in horses as there was back in the day. Now we do it mostly for nostalgia.

Our overall purpose is to recover from the damage we have done on our land since we started farming in 1896.

Our operation has changed a great deal. When my grandfather ran the farm, he followed a very traditional method called the Colorado method. The cattle would spend most of the year on the same large range. We would add cubes with mineral feed supplements. The animals were pretty much on their own.

Then we began to look at the ranch as a whole. That led us to focus our attention on the health of the grass. Allan Savory was coming around then. Later, HMI (Holistic Management International) took the lead. We learned we needed to put organic matter back into the soil. We use the hoof action of the cattle to incorporate it. We always keep the soil covered with some crop. We don't plant any grasses, we just let the native grasses emerge. The seeds are in the

soil, just waiting for enough water. We mostly have blue grama and grama grass. They are perennials, some of the best grasses you can have for this climate.

Starting in 1991, we broke the ranch up into 5-7 sections. Each section had smaller paddocks with their own cell center, basically a water site. For each center we had to develop a water system. Now we are up to 50 paddocks. To do that we installed lots of water pipeline. We went from 10 miles of pipeline to 45 or 50 miles. Essentially that allowed us to double our herd. All it takes is money. We have become almost 90% dependent on the pipelines. A few of our paddocks have older wells, where we put our tanks. We have a few riparian areas with more water. But for the most part, we need to pipe it in.

We don't focus on a prescribed grazing rotation as much as prescribed rest for the soil.

We don't focus on a prescribed grazing rotation as much as prescribed rest for the soil. If the soil doesn't have a chance to rest, then it develops a hard cap, and it is hard to get rain to soak in. So our goal is to get the cattle off each paddock as soon as we can so the land can rest.

We've come to see that our overall purpose is to recover from the damage we have done on our land since we started farming in 1896. It's because of our previous farming practices, but also mother nature. We used to graze continuously. Now we set out to make our land better so it will produce more. The hoof action of the cattle works the plants and the manure into the ground, incorporating organic matter into the soil. We adjust our grazing time to the season. We let the soil rest, then we graze the cattle intensively, and then we pull them off so the soil can rest again. On average we leave the cattle in each paddock for 7-14 days. This is especially important during the hot season. You can graze as long as you want in the cooler months when it is raining — the grass will grow back. But in the hot, dry weather you have to keep the soil covered with grass the whole time. If you don't, the rain will cap it even further. Ideally, we would keep the cattle off each paddock for at least 180 days. But depending on market conditions, we may have to go as low as 90 days.

We use our grazing plan to decide where to invest our dollars. We have huge pastures on the east side of our ranch where we could create paddocks. We couldn't get water to them until the late 1990s.

We have about 2,330 acres of riparian property. For a number of years, we essentially used it as a line of credit: We relied on that area to pull us through the dry years. But that hurt the soil. We don't do that any more.

About 4% of our property is riparian. That's a total of about 2,330 acres. For a number of years, we essentially used it as a line of credit: We relied on that area to pull us through the dry years. But that hurt the soil. To correct this, at first we put that land into the Conservation Reserve Program (CRP). We don't do that any more (for the past 10-12 years). That takes it out of production for too long. We also made one mistake, we planted salt cedar a number of years ago, hoping that would stem soil erosion. It became an invasion of salt cedar. Starting in 2004,

we worked with the Soil and Water Conservation District (SWCD) to control it. The first thing we tried was bringing a large number of goats in to graze it. It didn't have much effect. Their hoof action was not strong enough to work the organic matter into the soil. Then we tried to spray it back; we hired an independent organization to do that. Finally, the SWCD gave us money (and we matched it) to bring in some backhoes to windrow the stems. That became habitat for wildlife and we also used the windrows to texture the landscape to reduce runoff. We allowed native grasses to come back. We used the cattle to help shape the banks of the creek with their hooves as they grazed. We repaired 2 miles of creek bed that way. Now we are in a phase where we want to make zero changes to the land. We try to leave large sections of it untouched. The riparian areas hold considerable organic matter, and we want to keep it that way.

We also worked with Purina years ago to develop a feed mix we call a "range liquid." It is molasses with some other nutrients in it, specially designed for our animals in our conditions. This works so much better than the mineral cubes we used before.

We monitor our success by measuring how much grass we grow. We used to do more, but it was too much work. Now we just try to keep it simple. We cut a square meter of grass in specific locations, weigh it, and then calculate from there what the total field contains.

We monitor our success by measuring how much grass we grow. We used to do more, but it was too much work. Now we just try to keep it simple. We once ran transepts at various points across the fields, and specific places where we took photos to document the changes. But it was too difficult to take all those measurements, or to get back to the same spot every year to take photos. Folks from NMSU Extension would come out and do it. We never did it ourselves. The biggest issue is that you've got to do it on a regular basis if it is going to help, but the sampling costs time and money.

As we noticed how good our grass looked, and as we built up our organic matter and learned what we are doing, we decided to drop all that monitoring. Today, we take an inventory of the quantity of grass we grow each year. We cut a square meter of grass in specific locations, weigh it, and then calculate from there what the total field contains. That way I learn how much feed I will have to feed all our livestock. Even that can be difficult to do. It is a lot of work to make sure that our people take the sample in the proper spot.

We looked at more technical strategies like radio-controlled drones. But it takes a lot of time to cover the whole ranch with that equipment. We chose to keep it simple.

We have been able to build the herd back because we have restored the grasses.

No matter what you do in New Mexico, it is tough. It is hard to say what a "normal" year is. We had a huge drought in the 2000s, and it seems we have one every 5-10 years. For three years, we had hardly any precipitation. Then in 2019 we had 22 inches. So far in 2020, though, we've

only had 6 inches, so we are not able to give the paddocks the full 180 days of rest. During the severe droughts, we have destocked, so we were down to 400 head. Now we have been able to build the herd back, because we have restored the grasses.

Ramon "Dosi" and Norma Alvarez

Alvarez Farms
La Union, New Mexico

Ramon "Dosi" and Norma Alvarez with their sons and Dosi Ramon (l) and Seth Ferguson (r) relax after their quarter horse, Machismo Moon, qualifies in the Zia QH Futurity at Ruidoso Downs in 2016. Photo supplied by Dosi and Norma Alvarez.

Dosi and Norma Alvarez fashioned their farm around their personal preferences for farming, the opportunities their land provides, and a deep commitment to organic farming practices. Dosi Alvarez said this brought great benefit to the soil. "When we started out 28 years ago, we had 1% organic matter in our soil. Now we are testing at 2%."

Dosi continued, “We have 1,100 acres, all certified organic. We mostly grow pima cotton. It is valued for its extra long fibers. You can’t just grow it anywhere. Our valley is one of the places you can.” The Mesilla Valley has a long growing season, with killing frosts that defoliate the crop without spraying. The Alvarezes reserve seed from their own harvests to ensure their seeds are organic. They’ve connected to loyal buyers in Japan and Italy.

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Adding diversity to the fields

The Alvarezes also positioned their farm to succeed by diversifying their operation, Dosi explained. “We rotate the cotton with alfalfa and wheat. We also raise quarter horses. That’s Norma’s specialty. We let them graze in the alfalfa fields year-round, and they seem to do pretty well with that feed.” Norma added, “We keep a small herd of 20 beef cattle, because Dosi likes his cows.” The cattle will also eat some of the hay that was rained upon, or other feed that would otherwise go to waste. One is destined for the family freezer.

The Alvarezes farm land that Dosi’s grandfather had cleared by hand in the early 1900s, using horses to haul the bosque away. His father expanded the cotton fields, and Dosi took over that conventional farm. But, he added, “We were breaking even at best. So we decided to try something different. A buyer came down from Buhler Mills in Switzerland. He was looking for organic growers, and offered to pay a premium price if we raised our cotton organically. We set out to see if it could be done.”

He added that another incentive to go organic was their young son, Dosi Ramon, who had just been born. “I was sitting in my barn one day looking at all the gallons of herbicides and pesticides. I told myself, this is no place to raise a kid.”

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Taking things slowly

Dosi and Norma decided to convert slowly. “We started out with 20 acres. Of course, it takes three years to make the conversion to organic certification, so we didn’t get any premium for the first two years. But it worked well for us, so we kept on going, adding a few acres at a time until we converted our entire farm.” Norma continued, “It was pretty easy to do.”

To help build organic matter and fertility, the Alvarezes apply 15 tons per acre of aged horse and cow manure to their cotton fields each year. The cow manure comes from a nearby dairy farm. All of this manure is stockpiled for a year to kill both pathogens and weed seeds. On their alfalfa fields they apply pelletized chicken manure, purchased from a poultry farm in Phoenix. The alfalfa plants also fix nitrogen into the soil, adding nutrients for the next year’s cotton crop. Wheat follows the cotton in the rotation, breaks up the weed cycle, and pays for itself.

Norma said the biggest obstacle to making the conversion was "fear." She added, "I can see why people don't do this. We were afraid at first. We were afraid we were going to make some mistake." Since they were barely breaking even on cotton, they decided to focus on growing alfalfa for the first 3 years, knowing that the legume would help build soil fertility. Dosi recalled that at first, "I was afraid we'd have an infestation of pests, especially since we were the only farm in the valley to go organic at the time. I was worried they would all come to our farm." But that fear turned out to be a groundless. In fact, their farm turned out to be better positioned than some of their neighbors' farms.

Lightning flashes over Dosi and Norma Alvarez' cotton field in the Mesilla Valley. Photo supplied by Dosi and Norma Alvarez.

Controlling boll weevils

"In 1998, we had a valley-wide boll weevil infestation. The valley farmers got together and developed a farmer-funded eradication program following USDA guidelines. It stated that whenever weevils were captured the entire field had to be sprayed with malathion. Our farm had 14 captures in different fields. But if our land had been sprayed we would have lost both our crop and our organic certification for at least three years," Dosi recalled. So Dosi and Norma consulted with Dr. Ellington at New Mexico State University and developed a better strategy. Dosi traveled to Santa Fe and obtained an amendment to the Boll Weevil Eradication Act. "We

offered that if we triggered the Act's provisions we would not grow cotton in that field the following year. Boll weevils need cotton pollen in order to reproduce, so that would avoid a repeat outbreak. Doing this was no problem for us because rotation is the heart of organic farming, to help break weed and insect cycles." Boll weevils continue to show up in South Texas, but the Mesilla valley has successfully kept them at bay for more than a decade, Dosi added.

Dosi was relieved. "I didn't want to ruin it for the other farmers in the valley. I was the only one at the time who was organic, and we had a farmer-run program. But I explained to the pest control coordinating committee what I wanted to do. They agreed, and I didn't jeopardize the program."

Once the farmers had established this infrastructure to control boll weevils, they expanded their attention to another pest, pink boll worms. Beginning in July, 2012, the farmers in the valley set out pheromone traps and released sterile moths into their fields. By 2018, the pink boll worm had been eradicated. "We've been free of them for 3 years," Dosi said.

> **I'm probably the one who benefited the most of all the farmers in the valley. Since I didn't get sprayed, my fields were a refuge for beneficial insects. To this day I have a diversity of beneficial insects. There's a balance in nature. The beneficials will come in and help you out.**

In the end, Dosi said, "I'm probably the one who benefited the most of all the farmers in the valley. Since I didn't get sprayed, my fields were a refuge for beneficial insects." These prey on the pests so they can't do much damage. "To this day I have a diversity of beneficial insects. There's a balance in nature. The beneficials will come in and help you out."

Yields Rise

And yields have improved. The Alvarezes say that they had a great cotton harvest in 2020, with yields of 1.9 bales per acre, well above their former average of 1.5. The average yield for conventional cotton is 2 bales per acre, although of course their neighbors also had a better year than average because overall conditions were favorable. Given the price premium they get from selling organically, they are happy with the results. So are several neighbors. As they saw the Alvarez' farm improve, four nearby farms adopted organic practices.

So far prices have held high, because Norma and Dosi have connected to loyal buyers. Norma beamed, "Our Japanese buyers insist on having assurance that everything we grow is organic. So they send a team every year to visit our farm. They come to our house, and we always enjoy them so much. Every year they invite us to visit them in Japan. We've only been able to do that once, but it was an amazing experience. We started out in Tokyo, then went to Osaka where the firm is headquartered. After that we took the bullet train to Hirsohima and Kyoto. I love the Japanese people. They are so *honorable*."

However, the Alvarez family has not always found the same loyalties or rewards among US buyers. "We used to grow organic lettuce. We had a buyer who wanted our lettuce because we

Dosi Alvarez drives his grandfather's first tractor, a 1938 John Deere B. Photo supplied by Dosi and Norma Alvarez.

are closer to the Eastern markets than the California and Arizona growers. We had beautiful lettuce. But the broker broke us." He kept lowering the price he paid to the point that the Alvarezes were only breaking even on the crop. "It wasn't worth it."

Next, the family tried raising chiles. Once again, the economics didn't work out. As Dosi recalled, "Our organic soil was so fertile we had beautiful chiles." Still, due to the crop's need for frequent irrigation a lot of grasses came in. Having learned close cultivation techniques from his father, Dosi could control most of the grasses that emerged. But the fields still required considerable hoeing, and labor costs were too high to make it worthwhile.

Personal satisfaction

When asked how their farm benefitted by adopting organic practices, Dosi laughed. "We have enough money to farm another year! We're not going bankrupt!" He added that there is so much uncertainty in farming that surviving is always a challenge. Still, he continued, "We get a lot of personal satisfaction in doing this. We've taken small steps forward to do what we love to do." Norma chimed in, "We're not extremists in any way."

The couple also measures their success through the satisfaction of their workers. “Our employees really like it that they don’t have to mess with farm chemicals,” Norma added. In fact, Dosi suspects he became ill with Parkinson’s disease from his past use of herbicides and pesticides. Their workers also report that the dirt is much softer now, and easier to work. After they first made the transition to organic, one tractor driver yelled out, “Dosi, there’s earthworms now.”

First Moon Flash, one of the horses that Dosi and Norma Alvarez raised, sets a world record for the quarter mile in 2009 at the championship race at Sunland Park. Photo supplied by Dosi and Norma Alvarez.

Quarter horses add diversity

Just as diversifying the crops they plant in their fields has reaped benefits, the Alvarezes have branched out to include quarter horses on their farm, both for enjoyment and as a source of income. Norma is the one who leads this effort. She tries to keep about 40–50 horses on the pastures. “The horses complement our system,” Norma added. “They graze year-round on alfalfa, and we think they look pretty healthy. We keep it all as natural as possible. One of our horses even became world champion.”

[The horses] graze year-round on alfalfa, and we think they look pretty healthy. One even became world champion.

The horses live on the farm until they are one year old. Then they are offered at one of the world's premier racing quarter-horse sales, which happens to be located close to their farm. "You have to qualify to even get in" to sell at that auction, Norma said. But their diligence has paid off financially. She said that the cost of one of their tractors was covered by selling one horse that eventually broke four world records. "When I raised that horse, I knew it was going to be special." Norma also represents others in the community who sell horses through the auction.

Returning the soil to its former fertility, however, has not always been easy, they added. "It's taken us years to get our soils into better condition. It all takes time." Norma adds that it is made all the more difficult because "small farms are having a hard time. We're losing a lot of ground politically. There is this divide between rural and urban people. I don't know what to do about that." What they can do is take care of their soil. "Organics is one of the few ways I know of to have a chance of getting a premium on the price."

References

Adams, Ann (2020). "How to Increase Soil Health and Productivity in Two Years." Holistic Management International, September 11.

Bowman, Maria; Wallander, Steven; & Lynch, Lori. (2016). "An Economic Perspective on Soil Health." *Amber Waves*. September 6. Viewed February 2, 2021 at https://www.ers.usda.gov/amber-waves/2016/september/an-economic-perspective-on-soil-health/

Danvir, Rick; Simonds, Gregg; Sant, Eric; Thacker, Eric; Larsen, Randy; Svejcar, Tony; Ramsey, Douglas; Provenza, Fred; & Boyd, Chad (2018). "Upland Bare Ground and Riparian Vegetative Cover Under Strategic Grazing Management, Continuous Stocking, and Multiyear Rest in New Mexico Mid-Grass Prairie." Society for Rangeland Management.

Donovan, Peter (2020). Personal communication.

Edge, Aspen (2007). "Arriola Sunshine Farm — Small Farm, Big Results." Savory News, Land & Livestock (Holistic Management International), August.

Goodwyn, Ben & McDermott, Shana M. (2017). "New Mexico Ranching and its Future." Thornburg Foundation, August.

LaCanne, Claire E. & Lundgren, Jonathan G. (2018), Regenerative agriculture: merging farming and natural resource conservation profitably. *PeerJ* 6:e4428; DOI 10.7717/peerj.4428

Powlson, David S. (2020). "Soil Health — Useful Terminology for Communication or Meaningless Concept? Or Both?" *Frontiers of Agricultural Science and Engineering* 7(3), pp. 246-250. doi: 10.15302/J-FASE-2020326

Stevens, Andrew (2015). "The Economics of Soil Health: Current Knowledge, Open Questions, and Policy Implications." University of California Department of Agricultural and Resource Economics, June 19.

Stevens, Andrew (2019). "Economic Theory Provides Insights for Soil Health Policy." *Choices.* Published by the Agricultural and Applied Economics Association. 34(2), p. 1

Tsiafouli, Maria A.; Thébault, Elisa; Sgardelis, Stefanos P.; de Ruiter, Peter C.; van der Putten, Wim H.; Birkhofer, Klaus; Hemerik, Lia; de Vries, Franciska T.; Bardgett, Richard D.; Brady, Mark Vincent; Bjornlund, Lisa; Jørgensen, Helene Bracht; Christensen, Sören; D' Hertefeldt, Tina; Hotes, Stefan; Gera Hol, W. H.; Frouz, Jan; Liiri, Mira; Mortimer, Simon R.; Setälä, Heikki; Tzanopoulos, Joseph; Uteseny, Karoline; Pižl, Václav; Stary, Josef; Wolters, Volkmar; & Hedlund, Katarina (2015). "Intensive agriculture reduces soil biodiversity across Europe." *Global Change Biology.* Feb; 21(2), pp. 973-85. doi: 10.1111/gcb.12752.

US National Oceanic and Atmospheric Administration (NOAA) (Series). Monthly rainfall data. Available at https://w2.weather.gov/climate/xmacis.php?wfo=abq

USDA Economic Research Service (series). Market and Trade Economics Division.

USDA National Resource Conservation Service (NRCS) (2019). “Soil Health Case Study: Ralf Sauter, Okuye Farms, California.” Published with American Farmland Trust.

USDA National Resource Conservation Service (NRCS) (n.d.). “Profiles in Soil Health: Lawrence Sánchez.” Available at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/health/?cid=stelprdb1101694

USDA National Resource Conservation Service (NRCS) (n.d.). “Hartman Farms: Where True Innovation Happens.”