

SOIL HEALTH

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What it is and
Why it Matters

Photos courtesy of:
Top left: New Mexico Department of Agriculture
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Bottom left: New Mexico Department of Agriculture
Center: Railyard Park Conservancy
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NMDA

New Mexico Department of Agriculture



Photo courtesy CS Ranch

WHAT IS HEALTHY SOIL?

By Kristie Garcia and Katie Goetz, New Mexico Department of Agriculture

health. These ideas are known as “soil health principles,” which include:

- keeping soil covered
- minimizing soil disturbance on cropland and minimizing external inputs
- maximizing biodiversity
- maintaining a living root and
- integrating animals into land management

Soil health principles are universal to all land uses, from small backyard gardens in the city to large farms and ranches in rural areas to forest land.

These principles are at the heart of the Healthy Soil Act, which directs the New Mexico Department of Agriculture (NMDA) to implement a number of activities, often in partnership with others. Enacted by Gov. Michelle Lujan Grisham in 2019, the Healthy Soil Act directs NMDA to measure soil health to establish baseline data; research ways to improve soil health; educate agricultural producers, students and the general public about soil health; and offer grants that fund on-the-ground projects to improve soil health. Some of the parties that can

apply for a grant to improve their soil health are represented in this publication.

There are two applicant categories for grants:

1. Individual applicants. These include individuals, businesses and nonprofits engaged in farming, ranching or other forms of land management.
2. Eligible entities. These include pueblos, tribes, and nations; acequias; land grants; soil and water conservation districts; New Mexico State University’s Cooperative Extension Service; and other “local governmental [entities] with proven land management capacity to support healthy soil”, as eligible entities are defined in the Healthy Soil Act.

The Healthy Soil Program continues to have support from the governor and state legislature. By continuing to fund projects that aim to improve soil health, New Mexico can expect healthier crop and livestock production, as well as increased food security.

For more information and to subscribe to program updates, visit NMDeptAg.nmsu.edu and search Healthy Soil Program.

When enjoying green chile on a cheeseburger, you may not think about the soil from which that chile plant grew. Or, when driving through New Mexico among acres of alfalfa fields, you may not think about the role soil played in producing a healthy alfalfa crop.

Soil is alive, and that’s why it makes sense to think of soil in terms of its health. Healthier soil holds more microscopic life, which leads to healthier and more abundant plants, which lead to healthier and more abundant livestock and wildlife. Healthier soil also means more abundant and nutritious food for our dinner plates. Farmers and ranchers who have improved their soil find that healthier soil is more resilient to drought, as it absorbs more water and holds it for longer periods of time.

By applying a few simple ideas, anyone can improve their soil

FROM THE DUST BOWL ON: NRCS HELPS LAND MANAGERS IMPROVE THEIR SOIL

By Daniel Bloedel, USDA Natural Resources Conservation Service

SOIL HEALTH

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans. Healthy soil gives us clean air and water, bountiful crops and forests, productive grazing lands, diverse wildlife and beautiful landscapes. Soil does all this by performing five essential functions:

- Regulating water: Soil helps control where rain, snowmelt and irrigation water go. Water flows over the land or into and through the soil.
- Sustaining plant and animal life: The diversity and productivity of living things depend on soil.
- Filtering and buffering potential pollutants: The minerals and microbes in soil are responsible for filtering, buffering, degrading, immobilizing and detoxifying organic and inorganic materials, including industrial and municipal by-products and atmospheric deposits.
- Cycling nutrients: Carbon, nitrogen, phosphorus and many other nutrients are stored, transformed and cycled in the soil.
- Providing physical stability and support:

Soil structure provides a medium for plant roots. Soils also provide support for human structures and protection for archeological treasures.

PRINCIPLES TO MANAGE SOIL FOR HEALTH

Soil health research has helped identify principles regarding how to manage soil in a way that improves its function. Those principles mainly include but are not limited to maximizing the presence of living roots, minimizing soil disturbance, maximizing soil cover and maximizing biodiversity.

As world population and food production demands rise, keeping our soil healthy and productive is of paramount importance. By farming using soil health principles and systems that include no-till, cover cropping and diverse rotations, more and more farmers are increasing their soil’s organic matter and improving microbial activity. As a result, farmers are sequestering more carbon, increasing water infiltration and improving wildlife and pollinator habitat—all while harvesting better profits and often better yields.



Photo courtesy USDA-NRCS

NRCS CAN HELP!

Our history: For nearly 90 years, the Natural Resources Conservation Service (NRCS) has helped people make investments in their farms, ranches and local communities to keep working lands working, boost rural economies, increase the competitiveness of American agriculture and improve the quality of our air, water, soil and habitat.

NRCS was born out of troubled times — the Dust Bowl days of the 1930s. Dust storms ravaged the nation’s farmland, stripping away millions of tons of topsoil and carrying it all the way to the Atlantic Ocean. What originally began as the USDA Soil Conservation Service

in 1935 is now known as the Natural Resources Conservation Service, a name change that highlights our broader mission of natural resource conservation.

Our Mission: We deliver conservation solutions so agricultural producers can protect natural resources and feed a growing world.

OUR VISION: A world of clean and abundant water, healthy soils, resilient landscapes and thriving agricultural communities through voluntary conservation.

WHAT WE DO: Today, through voluntary conservation programs, NRCS helps producers, soil and water conservation districts and other partners protect and conserve natural resources on private lands throughout the United States. With approximately 2,300 USDA service centers in communities nationwide, NRCS and other USDA employees work side by side with producers in every state and territory. Producers can learn more or apply for a program by contacting their local USDA service center.

offices.sc.gov.usda.gov/locator/app-nrcs.usda.gov/NM

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Natural Resources Conservation Service

SOIL AND WATER CONSERVATION DISTRICTS: YOUR PARTNER IN SOIL HEALTH

By Katie Goetz, New Mexico Department of Agriculture

Across New Mexico, there are projects underway that are critically important to our natural resources, but often go unnoticed: Projects to control and prevent soil erosion; projects to prevent floodwater and sediment damage; projects to better conserve and apply water; and projects to put impounded water to use by fish and wildlife, agricultural producers, recreationists, urban communities and others.

Soil and water conservation districts (SWCDs) are often leading this work. The purpose of an SWCD is to “conserve and develop the natural resources of the state, provide for flood control, preserve wildlife, protect the tax base and promote the health, safety and general welfare of the people of New Mexico,” according to the state’s Soil and Water Conservation District Act. SWCDs perform these activities on a variety of privately and publicly owned landscapes, often sharing the cost and workload with partners like local land managers and government agencies.

Each SWCD is directed locally by a board of supervisors. These local landowners are elected by the voters within their SWCD’s geographic boundaries. Boards of supervisors usually meet monthly to hear and discuss local natural resource concerns, as well as to consider and vote on district activities. Given that SWCDs are subdivisions of state government, their meetings are open to the public.

While soil health has always been among the things that SWCDs work to improve, it has taken on added importance in recent years. Under NMDA’s Healthy Soil Program, SWCDs can apply for grants to improve soil health within their jurisdictions. Some SWCDs have utilized their Healthy Soil Program grants to distribute cover crop seed to local agricultural producers, help local land managers assess the health of their soil, educate the general public about soil health via demonstration farms and more.

SWCDs participate in NMDA’s Healthy Soil Program in another big way: They sponsor

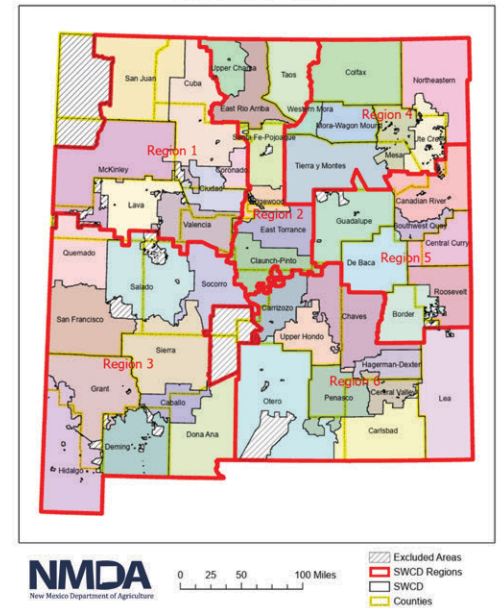
projects implemented by local land managers who have been awarded their own Healthy Soil Program grants. These local land managers – many of whom are farmers and ranchers – can do such things as plant a cover crop on their fields, apply compost across their orchard floors and restore native grasses on rangeland.

To learn more about soil and water conservation districts and to locate the one nearest you, visit nmdeptag.nmsu.edu and search for SWCDs. There you can also learn about NMDA’s Healthy Soil Program.

The New Mexico Soil and Water Conservation Commission is composed of seven SWCD supervisors from across the state who are appointed by the governor. Six of those members are SWCD supervisors (one from each NMDA-designated region), and one is appointed at large. The Commission’s role is to promote cooperation and knowledge transfer among the state’s SWCDs, as well as to collaborate with local, state and national organizations and

New Mexico SWCDs

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government agencies in the conservation and development of the state’s natural resources. As such, the Commission advises NMDA on various matters, including its Healthy Soil Program.

EXTENSION OFFERS OUTREACH ACROSS NM, SOIL HEALTH RESEARCH HELPS PRODUCERS

By Tiffany Acosta, New Mexico State University

The New Mexico State University Cooperative Extension Service in the College of Agricultural, Consumer and Environmental Sciences provides New Mexico residents and communities with effective leadership and collaboration to promote economic, educational and community development. Extension has offices in all 33 counties and many tribal areas across the state.

Educational programs are delivered by NMSU Extension faculty, who often represent the single state-wide or regional source for research-based information on a particular topic.

Extension Specialist and Extension Agronomist John Idowu and Cropping System Specialist and Associate Professor Rajan Ghimire are two faculty members studying soil health. Both have research projects with the New Mexico Department of Agriculture’s Healthy Soil Program.

Idowu leads a long-term soil health research and demonstration project at NMSU’s Leyendecker Plant Science Research Center. The project was inspired by producers asking how different management practices affect soil health in the short and long term in arid irrigated cropping systems. This project aims to help local agricultural producers develop resilient cropping systems against variable weather patterns.



Photos of NMSU Extension Specialist and Extension Agronomist John Idowu courtesy New Mexico Department of Agriculture

Annual field days at the project site allow Idowu and other researchers to train farmers on how to incorporate soil health practices into their farming systems.

Idowu is also studying biochar’s effects on soil health. Biochar is the charcoal that is produced by burning organic materials under reduced oxygen conditions. Results show that integrating biochar into the soil increases soil moisture retention, aggregation, organic matter and biological function.

At the Agricultural Science Center at Clovis, Ghimire is comparing diverse agricultural management practices to see which ones capture and store the most carbon in the soil. Ghimire’s research includes examining how carbon storage

contributes to soil health, minimizes global warming potential, improves the resilience of agriculture and increases farm profitability.

Ghimire is also working to identify which soil health indicators are the most important in arid and semi-arid regions. This project will develop a soil health assessment framework to help farmers be more sustainable in dry environments. Eastern New Mexico is facing rapid change in its irrigation water supply due to a decline in the Ogallala Aquifer, the main water source for irrigated crop production in the region. Ghimire’s research project evaluates diverse cover crops for their agronomic, environmental and soil health benefits under irrigation. He also is looking at what impacts transitioning from irrigated to dryland production might have on the soil carbon cycle and carbon footprint.

Soil health is critical for other land uses beyond farming. Extension Range Specialist Casey Spackman stresses the importance of soil health on rangelands, which account for nearly 70% of the state’s land mass, according to the United States Department of Agriculture’s Economic Research Service.

“Soils play a vital role in the function of water movement, nutrient cycling, physical stability of the land, and a medium for plant and other biotic species,” Spackman said.

NMDA’s Healthy Soil Program will continue to engage NMSU Extension faculty in researching ways to improve soil health on cropland, rangeland and other land use types – a commitment that will benefit the state’s farmers, ranchers and other land managers for years to come.

What are the 5 soil health principles?

1 Keep soil covered.

Keeping soil covered with plants or other organic matter (fallen leaves, mulch, etc.) is one of the best things we can do for soil health. That's because bare ground is susceptible to soil erosion, soil compaction, and takeover by noxious weeds. Bare ground also often gets much, much hotter than ground that is covered, and high soil temperatures can have a negative impact on the many micro-organisms beneath the soil's surface. That's worth noting, because these subsurface organisms cycle the nutrients that plants use.

2 Minimize soil disturbance on cropland and minimize external inputs.

What does "soil disturbance on cropland" mean? In a word, tillage. Minimizing tillage minimizes soil compaction, erosion by wind and water, and the potential for weeds to move in. Fewer external inputs means fewer disruptions in the natural cycles involving soil, plants, and animals large and small. Applying fewer external inputs can often mean that farmers, ranchers, and other land managers save both money and time.

3 Maximize biodiversity.

Maximizing biodiversity means maximizing the number and kind of beneficial plants and animals on the land. A greater variety of plants and animals above ground means a greater variety of life below ground, too. All of that diverse life translates into diverse nutrients cycling back and forth from the soil, to the plants, to the animals, and to our plates.



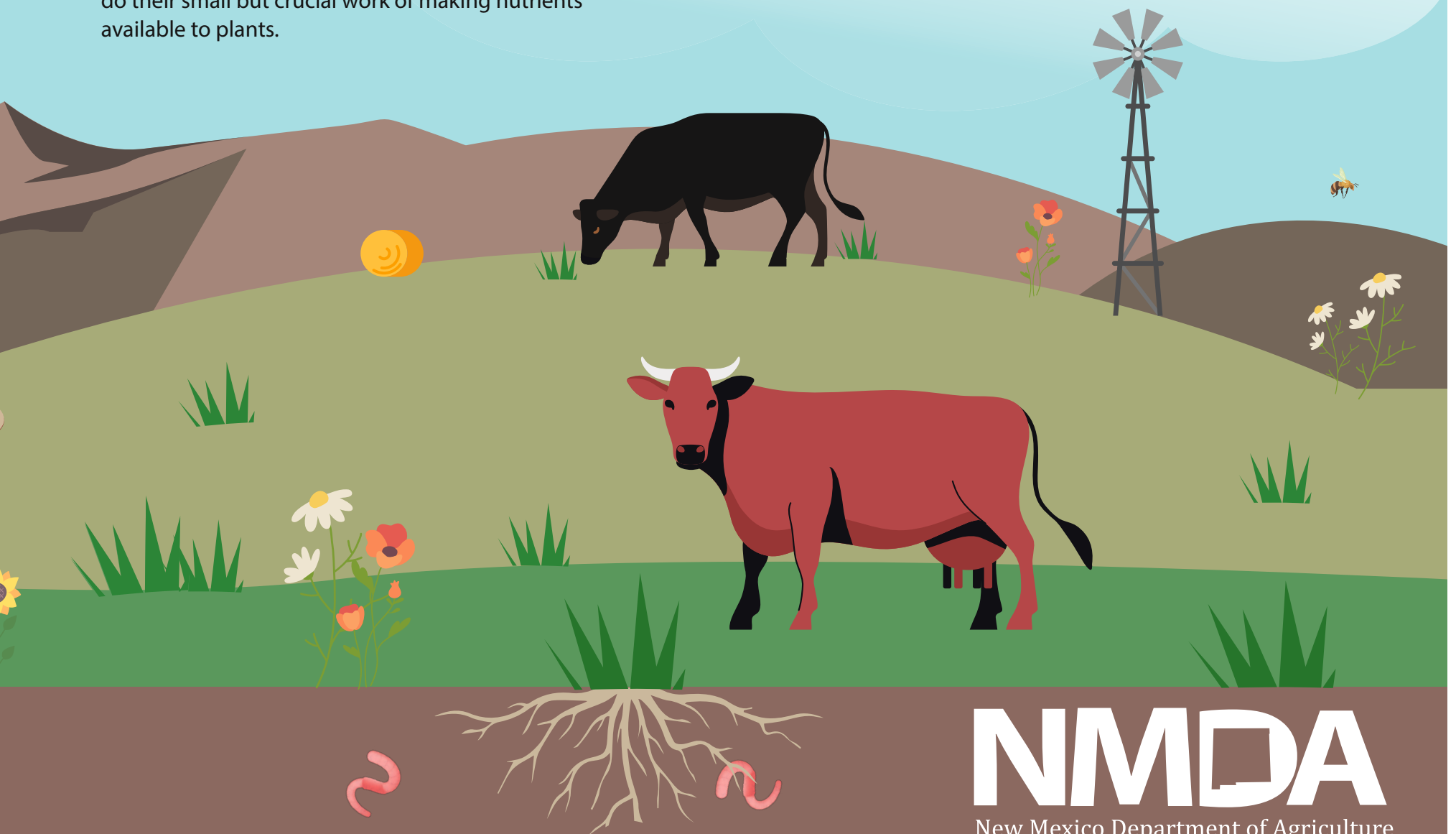
Simply put, the 5 soil health principles are guidelines that anyone can follow to improve their soil health, whether in a backyard garden in Albuquerque or a large cattle ranch in Zuni. This image explains the 5 soil health principles, which are part of the state law that created NMDA's Healthy Soil Program.

4 Maintain a living root.

While keeping soil covered with organic matter like fallen leaves or mulch is good, keeping the soil covered with living plants is even better. Through the process of photosynthesis, living plants "harvest" the sun's energy and store it as carbon-based chemical energy. A portion of that carbon leaves plants' roots, offering a liquid feast to the many microorganisms living in the soil. When these microorganisms are well fed, they can do their small but crucial work of making nutrients available to plants.

5 Integrate animals into land management, including grazing animals, birds, beneficial insects or keystone species, such as earthworms.

Animals of all sizes fertilize soil through their waste. Grazing animals like livestock and wildlife stimulate plant growth when they graze. These large animals also work seeds and nutrients into the soil as they move. Small animals above ground help pollinate plants, while small animals below ground create spaces within the soil, allowing water and nutrients to reach plant roots more easily.



REGENERATING INDIGENOUS AGRICULTURE

By Sherrie Catanach, New Mexico Indian Affairs Department

Indigenous peoples were the first to live in the region that is now known as New Mexico, and they were also the first to care for the soil and other natural resources that are so valuable in the desert.

Indigenous people have known for millennia that soil is alive and that it creates life. We know that large animals like bison, elk, deer, other wildlife and livestock are beneficial to the environment because they graze on plants to encourage plant development, fertilize the soil with their excrement and trample seeds into the ground with their feet. We know that small creatures, such as earthworms, insects and birds, play an equally significant role in moving pollen, seeds and nutrients. We know that growing a variety of crops, like the traditional Three Sisters mix of beans, maize and squash, is important for both soil health

and human health. These notions, which have supported our lands for countless years, are entirely consistent with what many people refer to as “soil health principles” today.

New Mexico is home to 23 federally recognized tribes, including the Apache, Navajo and Pueblo people. Although tribal governments share many values and customs, each is sovereign and therefore unique. The New Mexico Indian Affairs Department’s mission is to advocate for tribal interests at the state and federal levels through policy and legislative work; to connect tribes with the state’s executive branch, other tribes and the tools and resources they need to be self-governing and self-sufficient; and to provide tribes with access to resources, technical assistance and funding opportunities.

One of the funding opportunities available to the state’s Nations, Tribes and Pueblos is the Healthy Soil Program administered by the New Mexico Department of Agriculture (NMDA). NMDA’s Healthy Soil Program offers grants to tribal governments – as well as tribal members who farm, ranch or manage land – so they can improve their soil health. Past grantees have done such things as plant a cover crop or pollinator habitat, apply compost or mulch to a field and even replant native grasses on rangeland.

“Soil health” may be a new phrase for many. For Indigenous people, healthy soil is what you get when you apply the traditional knowledge that all things are connected, that Mother Nature seeks a balance between all living things, and that if you take care of the land, it will take care of you.



Photo courtesy Pueblo of Santa Ana

ACEQUIAS AND SOIL HEALTH

By Ralph Vigil, New Mexico Acequia Commission



Acequia del Toro (Lower Colonias) photo by Ralph Vigil

In the early 1600s, when many of our ancestors formally diverted water from our flowing New Mexico rivers, the acequia and all the ecological impacts of expanding our green belt along our bosques began. Previously the river would flow and meander as naturally as a serpent, but that did not allow for the dependable growing of crops and inhabiting of lands by traditional-use people. Once the rivers became tamed, the soil, previously receiving water and debris from the river, was now prime for growing food for the communities of people who called that place home.

The word *acequia* comes from as-sāqiya, which is of Arabic origin and means “the water conduit” or “one that bears water.” Primarily Spanish, acequias are associated with the Moorish rule of the Iberian peninsula, which improved irrigation on systems that date back to Roman times or before.

Today, there are 600 to 700 independently governed acequias in New Mexico. Acequias represent the oldest form of democracy in the United States, holding elections set forth by their bylaws amongst *parciantes* (members) to elect commissioners to lead each acequia. While most of New Mexico’s acequias are in northern New Mexico, several others deliver water to small farms in parts of Lincoln, Grant and Luna counties.

After hundreds of years of acequias, the soil has been the foundation of the ecosystems and lifestyle in our traditional-use communities. The symbiotic nature of the water quenching the thirst of the earth, which then

provides the complex fungi, microbes and bacteria needed to grow our crops that, in turn, feed our communities, is just a small example of what good soil does for acequias. The corridors and greenbelts created by our acequias are home to many species of flora and fauna that help sustain life in areas that would otherwise be arid and desolate.

As stewards of the land, acequia *parciantes* depend on good soil as much as they rely on the water that runs through their fields. Our soils are not only the basis for growing our food, but they are the filters that provide us with water for the future as we continue to quench the thirst of our land with waters coming from our rivers. Our soils spread that water and life throughout our riparian areas through our acequias. The soil and land deliver water below us to recharge our aquifers. Soil’s ability to capture harmful carbon and transform it into what we depend on makes it so crucial to our livelihood. If acequias are the lifeblood of New Mexico, then our soils are the lungs, breathing life into our lands that sustain us all.

The New Mexico Acequia Commission was established by statute by the 1993 Legislature as an 11-member commission serving four-year terms appointed by the Governor. The Commission is charged with serving as a facilitator for communication between local acequia organizations and the state and federal governments and for reviewing plans or legislation that affect acequias.

LAS MERCEDES AND EJIDOS: TRADITIONAL AGRARIAN PRACTICES IN LAND GRANT COMMUNITIES

By Anissa Baca and Jacobo Baca, New Mexico Land Grant Council

A land grant, or merced, was a gift of land made to individuals or groups to establish a community. The first land grants in New Mexico were granted by Spain in the 1690s, and Mexico continued the practice through the 1840s. Records show that about 300 land grants were granted in New Mexico. Land grants varied in size – early land grants granted near rivers were much smaller than later land grants, which encompassed large swaths of the *llano* (land) but lacked consistent access to water. Of the 300 land grants originally given, only about 30 land grants still exist, and about two dozen of those land grants are organized as political subdivisions of the State of New Mexico. Each is governed by an elected board and is eligible for funding through state and some federal programs.

Perhaps the most unique feature that land grants have is the ejido, or common lands, which are the communally owned lands that are controlled by their locally elected board. Common lands are not owned by any individual heir and are a remnant of a land tenure system that focused on communities having access to varied resources that guaranteed their success. Tragically, most land grants lost their ejido to speculation, and thousands of acres of common land on which communities still depend is under the control of the federal government, managed by the U.S. Forest Service and the Bureau of Land Management.

Land grant communities were among the first agrarian practitioners in New Mexico, combining methods brought from Spain with those learned in Mexico and practices adopted from their Pueblo and other native neighbors and relatives to create a centuries-old agricultural tradition. Colonists imitated their Pueblo neighbors' cultivation of corn, beans and squash and added stone-fruits, wheat, lamb and beef to the Pueblo diet. Across centuries, the populations created



Former land grant Ojo Caliente photo courtesy New Mexico Land Grant Council

foodways built on crops that were hearty and drought-tolerant. Land grants created new riparian areas by digging acequias, pulling water from the river bottom to the tree line and expanding arable lands. Nutrients that flowed in rivers were distributed to fields, and excess waters were returned to rivers through lateral ditches and desagües. Farmers practiced crop rotation, avoided monoculture and used manure from stock and ashes from their fireplaces and stoves to add nitrogen, phosphorus and potassium to the soil. These soil health practices, informed by decades and even centuries of local experience, are carried on to this day, as land grant communities combine traditional practices with modern and advanced methods to ensure New Mexico's agricultural traditions are retained.

NMSU EXTENSION OFFERS HEALTHY SOIL EDUCATION, RESOURCES

By Tiffany Acosta, New Mexico State University

For green thumbs and beginners alike, healthy soil is important for flourishing gardens and lawns.

In New Mexico, healthy soil can be described as soil that is crumbly, contains 1-3% organic matter, has a good water supply, sufficient nutrients and a healthy ecosystem, according to Jeff Anderson, agronomy and horticulture agent with New Mexico State University's Doña Ana County Cooperative Extension Service.

Anderson said having healthy soil in your own home is very attainable.

"It can be done, and you do not need a large budget to do it," he said. "You do need a water supply to keep healthy soil going...that is a soil more productive than a natural desert soil if you are looking to grow vegetables, trees and other plants.

"Desert soil is healthy for native desert-adapted plants," he added. "You also need healthy soil micro and macro flora, i.e., worms, fungi, bacteria and a host of other important soil organisms."

Marisa Thompson, Extension urban horticulture specialist in Los Lunas, often references the five soil health

principles of the New Mexico Department of Agriculture's Healthy Soil Program – keeping soil covered; minimizing soil disturbance on cropland and minimizing external inputs; maximizing biodiversity; maintaining a living root; and integrating animals into land management, including grazing animals, birds, beneficial insects or keystone species, such as earthworms, to achieve healthy soil.

"We can encourage healthier soil in our own gardens by planting the appropriate species and varieties, mulching and watering properly," Thompson said. "If we select desert-adapted plants that are recommended for our area, then the soil is great just as it is."

NMSU Extension offers many resources to help New Mexico residents with their gardening needs.

Established in 1981, the NMSU Extension Master Gardener Program has grown to include active chapters in numerous counties throughout the state. Extension Master Gardeners are knowledgeable gardeners who assist the county offices and provide accurate, research-based information.

Each chapter's programming varies but is focused on the fundamentals of good horticultural and biological land management practices. Each year, Extension Master Gardeners answer 30,000 landscape and plant questions, develop school garden programs and contribute 170,000 hours of volunteer time. Contact your local county Extension office with questions or to learn more about Extension Master Gardeners in your area at <https://extension.nmsu.edu/county.html>.

NMSU Extension also hosts a monthly, free webinar gardening series, "Ready, Set, GROW!" to share recommended gardening practices. Offered on the third Wednesday of each month, presenters include County Extension agents, State Extension specialists, and other local experts with experience in horticulture, insects and food. Each webinar is recorded and can be accessed following the live event.

To register for upcoming "Ready, Set, GROW!" webinars or review past presentations, visit <https://desertblooms.nmsu.edu/grow.html>.



Photo courtesy New Mexico State University

EVERYTHING IS ROOTED IN THE SOIL!

Soil helps provide your food, clothing and shelter!

Discover these connections by drawing a line from the soil to a crop plant in Level 1. Then, connect the plant to an item in Level 2 to which it best relates. Finally, find the two items in Level 2 that connect to the items in Level 3.

Example: **Soil** helps **trees** grow, and trees can be made into **lumber** that can build our houses to provide shelter. Trace the dotted line provided.

LEVEL 3



MILK



HAMBURGER
& LEATHER

LEVEL 2



PEPPERONI
& LIPSTICK



LUMBER



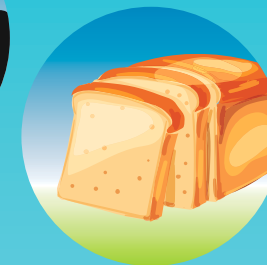
DAIRY
COW



CLOTHING
& MONEY



BEEF
CATTLE



BREAD



ETHANOL

LEVEL 1



TREES



CHILE



RANGELAND
GRASSES



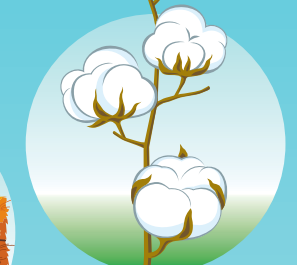
CORN



WHEAT



HAY



COTTON

It's alive!
1 teaspoon of healthy soil is home to thousands, or even millions, of living things!

SOIL

Agriculture is growing crop plants and raising livestock animals.



Check answers!
Request a classroom visit!

SCAN ME