

COLORADO SOIL HEALTH FUNDAMENTALS

PRIMER 9: GRASSES, PASTURES & FORAGES

PRIMER 9 SUMMARY

The goal of the Colorado Soil Health Primer series is to demonstrate the core principles related to soil health management as practiced and researched within the boundaries of the State of Colorado. Colorado scientists studying the effects of management practices and the state's farmers and ranchers implementing and measuring the changes on the land participated in this project.

This series is not about instructing the exact tactics a farmer or rancher would need to improve soil health. The individual tactics and strategies must change from property to property — or even field to field — depending on the goals of the land manager, and the available natural and financial resources. This series of information will give readers the resources to understand and evaluate practical and proven ideas to explore and adapt into a new or existing operation.

This primer is about how overgrazed and eroded pastures can come back to life by implementing soil health principles. Healthy pastures support more than farms and ranches. They improve the food production industry as a whole — combating soil



▲ Healthy pasture planning begins with understanding warm and cool season grasses, plant and animal diversity, and how all of these organisms respond to the local climate. *Source: Colorado Department of Agriculture and Travis Harvey*

erosion, recovering water quality, mitigating drought, and reviving wildlife habitat. Healthy pasture planning begins with understanding warm and cool grasses, plant and animal diversity, and how all of these organisms respond to the local climate. Colorado State University Extension specialists are working with farmers, ranchers,

and land managers across the state to develop soil health management plans, resulting in lowered inputs, healthier animals, and steady yields, in addition to improved habitat for bees and endangered species. Managing pastures for soil health contributes to Colorado's ecological, environmental, and social priorities for agriculture.

COMMON TERMS

Cover Crops: The act of keeping the ground covered and maintaining living roots are two principles of soil management, and cover crops are a key tool to help farmers transition and measure the gains.

Pasture: Fields for grazing, wildlife passage or soil remediation are common across the state of Colorado.

Soil Biology: The life in the soil, from the smallest microbes to earthworms and dung beetles. The biology is responsible for helping break down organic matter and turning it into available nutrients for your crops.

Soil Chemistry: The ratios of elements in the soil are important and go beyond N-P-K.

Soil Health: The concept of maximizing an ecosystem's ability to feed soil microorganisms, leading to efficient nutrient cycling and turnover, which creates more nutrient availability for plants, increases soil water storage, and improves ecosystem sustainability and resiliency.

Soil Testing: The process of quantifying certain attributes of soil, including macro- and micro-nutrients, soil organic matter, cation exchange capacity, soil biology, water and/or air.

NRCS: The Natural Resources Conservation Service.

Source: Jim Ippolito & Megan Machmuller, Colorado State University



USDA-NRCS Soil Management Principles

1. Limit disturbance
2. Keep soil covered
3. Strive for biodiversity
4. Maintain living roots
5. Integrate animals



▲ A summer multi-species cover crop mix in the San Luis Valley. *Source: Brendon Rockey*

Colorado ranchers are improving their pastures across the state through soil health practices that are designed to heal their fields, nourish the livestock that graze them and preserve precious water resources.

“It’s one of those things where all of those soil health systems work together,” explained Jason Wrich, a holistic rancher in Crawford, about why soil health practices have become his business. “It’s just amazing how all of those microecosystems are mutually beneficial if you’ll just pay attention.”

And Wrich would much rather pay

attention than pay for unnecessary inputs.

“I’m not paying the seed guy, not paying the diesel guy to drag equipment back and forth and back and forth,” he said. “I’m not tearing up the ground to then replant. If you’re in a perennial pasture, you’re not doing any of that.”

Born and raised in Hotchkiss, Wrich would come to catch the “farming bug” from his grandparents, who raised Sweet Olathe Corn. Today, with his wife, he is a calf/cow man operating on 4,000 acres of rented land and

practicing soil health via Allan Savory’s Holistic Management methods. The Wrich Ranch is a predominantly registered Black Angus outfit that sells registered Angus bulls and direct-markets grassfed, grass-finished, all-natural beef. His pastures are all perennial, but some fields are irrigated, some are seasonally irrigated, and some are high-mountain meadows. He is an intensive, rotational, continuous grazer, moving his animals across fields of legumes, clover, and alfalfa.

“Just because someone tells you it can’t be done, doesn’t mean it can’t,”

Wrich said, adding that his system has all come together over only a few years. “When someone says that won’t work, that is a personal challenge.”

Beginning the Process

Managing pastureland for soil health, livestock health, and water retention starts with asking many, many questions.

Annie Overlin, a Pueblo-based Colorado State University (CSU) extension specialist, recommends beginning the process by taking into account what a swath of land has experienced, its current condition, and the land manager’s vision for its future—i.e., the past, the present, and the desired future. There is no one-size-fits all option.

“I want to know what kind of livestock is on that pasture” she said. “Is it for cattle? Is it for goats? Is it for hay? Forage? Then I take a soil test and we learn about the minerals. And then we look at the weeds.”

Mineral availability, she said, is of the utmost importance when it comes to photosynthesis, which is the foundation of a pasture with healthy soils. The tests help her understand the soil’s limitations and assess if the surviving plant life is worth working with or if rehabilitation should begin with a seeding.

“Those trace minerals are really important because they are crucial for enzymatic reactions and for building energy for plant photosynthesis,” Overlin said.

Weeds, she added, often reveal the pasture’s history. They communicate that the pasture species are not properly interacting with sunlight, water, and soil, and they could represent an ecological niche that could support a different plant species. After taking this inventory, she often starts digging around to determine whether compaction is present and where there is bare ground. She takes into consideration the pasture’s water resources and forecasted availability.

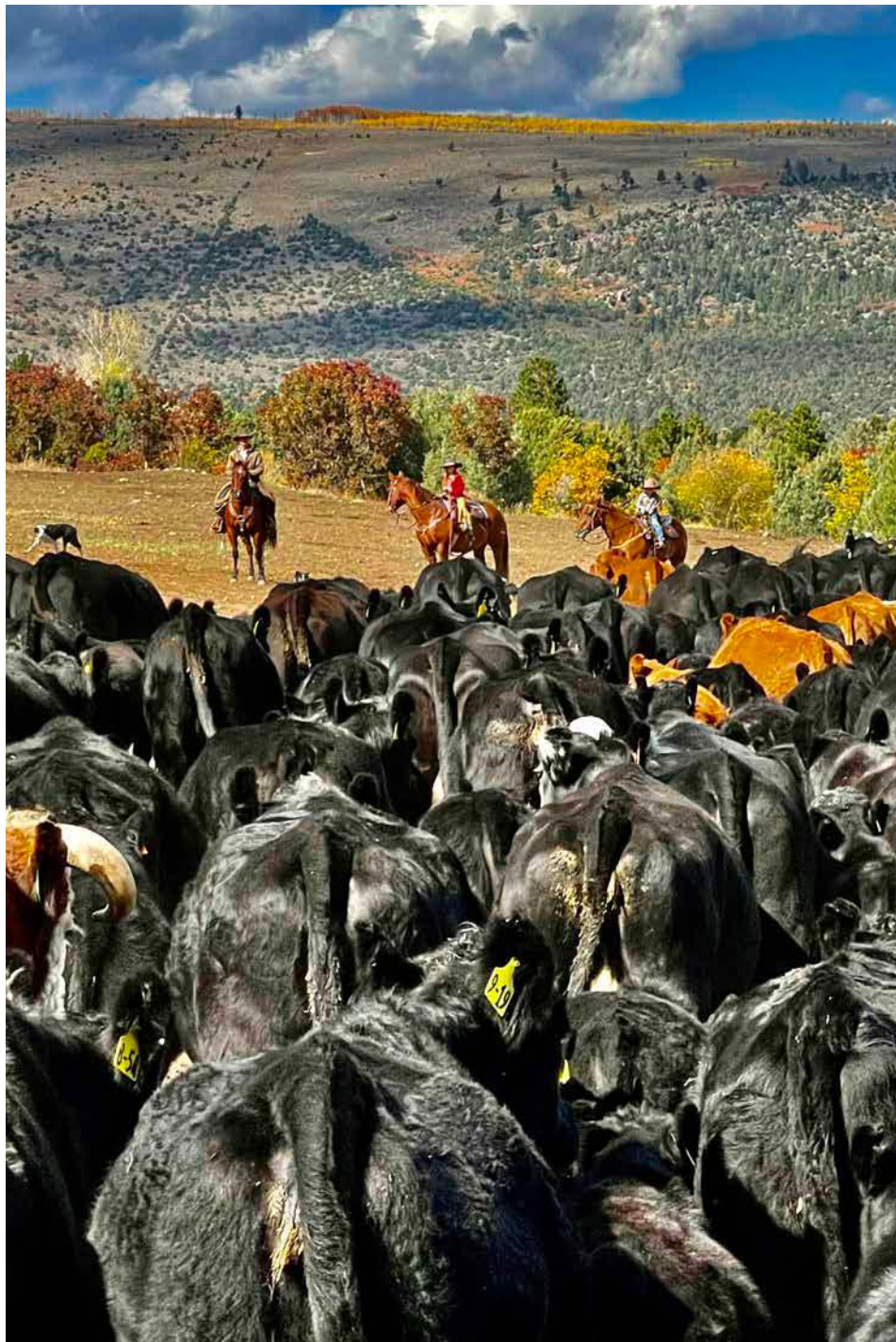
“Does it make sense to plant timothy or grass in this area, when actually we don’t get that much moisture?” Overlin

posed as an example. “Or what kind of species can help pull those minerals up and help moderate mineral deficiencies? It’s all based on its limits and capabilities.”

Overlin’s datasets and soil tests are providing guidance for Colorado

Rancher Steve Oswald. The Oswald Cattle Company is located at the foothills of the Sangre de Cristo Mountains in Cotopaxi. Oswald found himself regeneratively farming in 1995 after completing the Ranching for Profit program, a training rooted in

▼ The STAR program encourages ranchers who graze livestock at altitude to carefully rotate their herds. Source: Colorado Department of Agriculture and Samantha Kujala



holistic ranch management that combines grazing management and animal husbandry with business skills. He was now cross-fencing, figuring how many pounds of beef to put on an acre, breeding for summer calving, and no longer putting up hay.

“It was a life-changing event,” Oswald said. “You can heal the land with cattle.”

After working with Overlin, Oswald has learned how to recognize soil deficiencies and to make the 4,500-acre system work as a whole. Together, they are introducing high fungal extracts into the pastures through compost slurry to nurture the ranch’s irrigated and sub-irrigated meadows, which boast an established, diverse mix of sedges, alfalfa, clovers, timothy, orchard grass, meadow brome, and other forages. The plant diversity, biological inputs, and intensive, high-stock grazing are bringing him closer to his goals of capturing moisture, building organic matter, and improving overall soil health.

Jason Wrich in Crawford, whose pasture management goals are quite similar, takes a bit of a different approach, foregoing lab-based soil tests. He takes a daily inventory of his surroundings, putting to work what he calls “observational science.”

“So many people need a soil test,” Wrich said. “So many people need a liver biopsy on beef. So many people need a forage analysis to see whether they’re doing something good or not, or whether they’re doing it right. I look at my happy cows. I look at how much weight they are gaining. I look at the variety and diversity in my pastures.”

He added, “We introduce all of these plants, especially these nitrogen-fixing plants, and you could just almost immediately see the grasses next to it—their neighbors—doing better. One thing leads to another.”

Above- and Belowground Growth

Managing pasture with a soil-health mindset can positively impact food production, soil erosion, water quality, drought mitigation, and wildlife habitat. When it comes to choosing forage

blends or polycultures, there are many possibilities.

“You have plants that establish early and grow in certain times of year, and that is very beneficial to their sister crops,” Wrich said. “For example, your cool season grasses at one time of year are greening up and do their thing, like shading any bare ground. This then helps with your other species like alfalfa and clover and all of those things that come on a little bit later.”

A mix of plants—cool- and warm-season grasses and broad-leaves—work together to make the soil function through gas exchange and root exudation, nitrogen fixation, soil stability, and improved water infiltration. They also contribute to the physical pasture management.

“Everything is palatable at different stages in a polyculture, so you should have different things that are valuable nutrient-wise at different times,” Wrich said. “You can cut a really good mixed hay forage with an exceptional pro-

persistent through that drought or maybe greening up.”

Bruegger works with land managers on the western slope, focusing on using soil health to navigate drought. Keeping soils covered with a diverse plant mix while maintaining a healthy diet for the livestock that graze them is not the easiest of tasks when water is not an available resource.

“Drought management is just critical for soil health,” she said. “We honestly need to be pretty simple about it. We need to be good managers of photosynthetic tissue. Any below-ground growth is generated by aboveground growth. We need to have production above ground, and then we also need clay belowground to have that organic matter bind to the clay.”

“One big difference between western Colorado and eastern Colorado is that the eastern plains have the high component of warm-season grasses,” she said. “Those grasses grow at warmer temperatures when compared to

“Diversity is like hedging your bets, because plants are going to be impacted differently.”

Retta Bruegger

file of nutrients. If you have a straight timothy field, once your irrigation water dips or once the season temperature changes, you’re done. In the early spring, if you have a hard freeze and it freezes you out, it kills all the alfalfa; there is nothing left.”

When plant cover is gone, either because of acts of nature or overgrazing, the pasture’s photosynthetic tissue is lost and soil health greatly diminishes.

“Diversity is like hedging your bets, because plants are going to be impacted differently,” said Retta Bruegger, a Grand Junction-based CSU extension specialist. “You give them more chance; you have different species being

cool seasons—as the name implies. On the prairie—or the shortgrass prairie, as I call it—you have that opportunity of growth.”

In western Colorado, she further explained, warm-season grasses grow at lower elevations, but they contribute little to forage. The cool-season grasses do not offer the same opportunities eastern Colorado has to capture water later in the growing season.

“The east also has a longer history of grazing and more precipitation,” she said. “Where I live, it’s much more snow melt. We don’t have that summer moisture or the history of grazing to contribute to a more resilient situation.



◀ A bee takes nectar from a mustard plant in a San Luis Valley cover crop field. Source: *Brendon Rockey*

It's grass out here, and we have fewer adaptations to deal with grazing. That's not to say we shouldn't graze."

With this in mind, stocking numbers and rotation timing should be actively managed to avoid overutilization.

"We do really need to be gentle over here," Bruegger said. "Rotational grazing is awesome, but it's not going to make up for it if you are overstocked."

Wrich can prove her point positively. He's reduced his herd to 70 cows—down from 130 in past seasons. Decline in annual snowpack prompted the choice to sell, and he has adjusted gracefully.

"We weren't going to be able to raise any feed for them," he said. "We learned in the 2018 drought that you can't just leave the cows out because you don't have anything else to do with

them."

On the other side of the mountains, Oswald is able to utilize native pastures composed of prickly pear cactus, cholla, mountain mahogany, wild plums, gooseberry bushes, and many other forbs, along with grasses: blue gamma, sand drop seed, western wheatgrass, and Indian ricegrass.

"It's all a part of strategic feeding," he said.

Pasture Management in Real Time

Depending on their available resources, these Colorado ranchers are stocking and rotating their herds with slightly different interpretations of the same set of soil health fundamentals.

"People are experts in their own operations, and they are the ones who need to make those decisions that are

best for them," Bruegger said. "Be a part of your own system. Get in there. Do your part."

Curtis Sayles, a dryland farmer and mixed grassfed livestock producer in Kit Carson County on the eastern plains, said he still runs into the old mindset that the livestock must eat it all down before taking down the fence.

"We try to take about a third of the forage and leave two-thirds and move on," Sayles said about maintaining the integrity of his pastures. "The impact the livestock have on the soil surface is taken away by the growing plant—and that's the key. That's what's driving our thoughts on bringing the sheep in—to diversify the grazing."

Diversity in livestock to promote soil health in fields that serve as both cropland and pastureland is part of many farming systems in the San Luis Valley. In potato and barley country, cows and sheep are regularly spotted grazing annual mixed green-manure crops and grain stubble. Ranchers are teaming up with growers for the feed and water, and the latter are more than happy to reap the nutrient-cycling and soil-building benefits.

Wayne Brown, a rancher based in Mosca, has embraced a nomadic grazing system that includes grazing national-forest lands and farmers' fields. Over the past three decades, the family has increased their herd numbers and found economic stability through long-term grazing agreements with farmers.

"We don't have a ranch with enough acreage to do the ranch thing," Brown said. "We are buying feed wherever I can find it throughout the year. Knowing you have a place you can go back to is big. It is a relief."

On 120-acre irrigated circles, he uses electric fencing to create pie-shaped paddocks. Taking time, tonnage, and water into account, along with the fencing, he works with farmers to create a mutually beneficial environment in regard to plant mixes

and to set a schedule to move the herd based on the farmer's land management needs—the chief of which is often weed control.

Throughout the year, he employs a shepherd and dogs to serve as a living fence to manage around 1,000 head of Marino breeding ewes to either follow up the cattle or graze green-manure and stubble fields. Farmers across the San Luis Valley are welcoming this grazing arrangement because they are witnessing biological changes in their soils, reducing their

tillage, and packing out more of their harvested crops. In some cases, additional nutrients are being introduced and cycled into the soil if extra roughage is required for the livestock's diet or to supplement what is available.

“I just love to talk to people about how important it is to allow the natural biological controls to do their job,” Wrich said about the relationship between cattle and cropping fields. “What we have to do is pay attention to what's happening and do what we can to feed it.”

Feeding the pasture has resulted in all sorts of great things for Wrich—moisture retention and water cycling being at the top of the list.

“You can dig down through that litter and find moist ground and seedlings starting to grow,” he said.

His pastures are not free of weeds. In some instances, he said, he will burn off the unwanted plants like reed canary grass, which his cattle do not find palatable, to allow the more desirable grasses to access sunlight and grow.

▼ Healthy pastures can benefit cattle, and also wildlife like sage grouse. *Source: Feyza Yildirim/Pexels.com*



“They would just be shaded out if we didn’t,” he said. “We’re getting a lot more healthier grasses, in addition to managing the hay.”

Bees and Birds

Pastures managed for soil health also benefit Colorado’s beekeepers and wildlife.

San Luis Valley fifth-generation beekeeper Tom Haefeli vividly recalls fields of sweet clover woven into the common crop rotation. He tells the history of a great number of ditches that were once lined with yellow flowers and of corners of potato and barley circles blooming purple with long-rooted alfalfa stands. These fields were gently grazed, and chemicals were not applied.

“They would rotate the sweet clover in the different pastures and let it grow up about five to eighteen inches high,” he said. “They would run the animals across it once because it can thin the blood. One run, the animals would reap the benefits; it would grow back up and bloom for the rest of the year. Tons of pollinators and fixing tons of nitrogen.”

Thirty years ago, he said, his family could keep their colonies in the Valley all but four months out of the year, making for 800 barrels of local sweet-clover honey. Today, his bees are producing as much as 90 percent less.

“The reason being there’s no water, right?” said Haefeli, addressing the most obvious reason for the decline of the region’s potential. “Well, alfalfa is now under a center pivot. They harvest it for the dairies, and it never blooms. Even when the center pivots first came in, they used to water their corners, and it would volunteer. It took all summer, but we still made a little bit of honey. Now all the corners are sterile.”

Forage legumes, including clovers and alfalfa, are not strangers to diverse or even monocrop pastures, according to SARE research. These plants have a higher crude protein and mineral content compared to their grass counterparts, enhancing the forage’s nutritional value to livestock. Some studies have found that if 30 percent of the

pasture is composed of legumes, nitrogen fertility requirements are satisfied.

Biodiverse pastureland is a nectar and pollen resource for bees and other pollinating insects. Honeybee and bumblebee population declines over the past few decades are attributed to many factors, including pests, diseases, pesticide exposure, and loss of nectar and pollen resources. Reduced pasture and hay crop acreage across North America and new hay cutting practices have limited forage legume bloom periods and, in turn, their contribution of nectar flows for bees.

“Another big factor is the invasive noxious weeds,” Haefeli said. “White top and ragweed have become so pervasive. It has choked out all the volunteer sweet clover and alfalfa on the banks. You walk out there and look around and there’s nothing for a pollinator. I’ve seen that in just the last ten years.”

When considering bee-friendly plants for a pasture, Haefeli recommends finding a mix that always has something in bloom during the growing season. In Colorado, he said, if more land managers could find a way to incorporate the Rocky Mountain bee plant, buckwheat, and sunflower varieties into their mix, bee health would surely benefit.

“It starts with the dandelions in the spring,” he said, adding that previous generations would take their hives wherever the flower would first come to life in Colorado. “They last for about two weeks, and the sweet clover starts to bloom, and right after that alfalfa. They’ll be in bloom most of the summer. Then the first of September is when the rabbit brush starts blooming, and that takes you into October.”

“This is an issue with our farming culture,” he said, considering the possibilities of more land managers embracing soil health. “In this culture, everything blooms at one time.”

Colorado’s domesticated animals often share their pastures with many wild creatures, including elk, deer, antelope, rabbits, rodents, birds of prey, and birds worthy of protection, like the Gunnison sage grouse. Its habitat

is the wet meadowlands that benefit livestock production. Actions to protect the species include government agencies working with ranchers to manage their pastures with wetland restoration and erosion control in mind; this includes cheatgrass and conifer mitigation.

“Grazing for grass health and for soil health would also hypothetically benefit the sage grouse,” CSU extension specialist Bruegger said. “Yes, this is another area where we could see great growth. We are seeing a ton of cheatgrass coming in.”

She added that considering pastureland water availability can foster wildlife populations.

“It’s about how you distribute the water in the pasture,” Bruegger said. “We can benefit wildlife in all of these areas.”

Healthy Pasture, Healthy Animals, Happy Customers

Investing in pastureland soil health is an investment in livestock that results in healthier animals and, ultimately, a tastier steak.

“My cows’ eyes are brighter, my cows’ coats are shinier,” Wrich said. “People are starting to pay attention to all of that stuff. They are willing to pay for it, and I am willing to supply it. It is all based on what we do. The meat is delicious.”

Oswald said he, too, sees healthier livestock on healthier soils. “They are healthier,” he said. “There is no propping them up. No back pain for me, and no supplements for them. No hay. They are working for me.”

As far as the quality of the final product coming off these fields, science has yet to decisively prove that it is healthier for the consumer. But Oswald and Overlin are working with the Bionutrient Institute to learn more about the meat’s nutritional density. The study’s proposed intention is “not only to define nutrient density, but to connect it directly to the nuances of farm management practice, particularly as it pertains to animal forage and feed.” Datasets will include forage species present and relative mix, pasture

establishment date, stocking rates, recovery time, relative forage quality, and the movement of animals in and out of paddocks.

“That’s really a new frontier,” Overlin said. “We’re starting to look at meat quality in relation to soil health, but the data isn’t really there yet. However, when you have deficiencies in the forage, that does show up in livestock. Sometimes you get things like clicking heels or low birth rates or different deficiencies that are associated with different maladies. But in terms of the nutrient density of the beef, we just don’t have a lot of data on that yet.”

In the dairy industry, milk producers also are seeing a better-quality product when soil health is part of the equation.

Mollie Wells, owner of the Rio Grande Dairy in San Luis, can attest to changes in the overall animal when pastures are managed for soil health.

“I know that the soil’s health and the plant nutrition is going to affect your animal’s nutrition. The soil’s health is going to affect the hay, too. Overall, you have a better-quality product.”

Wells raises dairy goats, beef cattle, hogs, chickens, and rabbits for her

farmshare business, and she is in the process of rejuvenating 80 acres of native-grass pasturelands that were exhausted from years of sheep. Past pasture overstocking, she said, can result in the soil harboring lethal livestock diseases, in addition to poor water infiltration and areas where vegetation ceases to exist. With very limited flood irrigation, she is sowing cover crops one paddock at a time and changing her grazing rotations to begin the healing.

“I’ve decided what’s more beneficial, for example, is that the goats need to stay and the cattle need to leave—to a rented pasture, for a little while,” said Wells. This is among the first steps she is taking to reunite soil health and livestock management. “Goats are gentler on the pasture. They browse rather than graze. They are more economical to feed during the winter, too.”

Experiencing two years of drought and legal water challenges has Wells hoping to see the native pastureland come into its historical potential.

“Right now, there’s a lot of bare spots,” she said. “I’m also seeing erosion. I’m starting to see prairie dogs moving in, which is not beneficial, either. That’s hazardous to my animals,

as holes, and prairie dogs carry diseases.”

Wrich, too, is working on rejuvenating pasturelands that are coming out of years of overgrazing. A new neighbor on an old, conventionally managed pasture approached him at a farmers market and, after hearing about Wrich’s unconventional approach, asked him to manage his property.

“I told them about what I do, why I do it, and how I like to do things a little different,” he said. “Then he asks what it would take to get me on his land. That was four years ago. Now, we can stock more head and stay longer. Now it is unbelievable.”

Produced by Acres U.S.A. for the Colorado Department of Agriculture’s STAR program. Primers written and edited by Andrew French, Amy Kousch, Lauren Krizansky, Lydia Lazar, Paul Meyer, Ryan Slabaugh. Thanks to contributions from Jim Ippolito, Megan Machmuller, Ryan Taylor, and the many Colorado farmers and ranchers who provided us on-the-ground information. Copyright 2023 Acres U.S.A. and Colorado Department of Agriculture. To be distributed for free.

Endnotes

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The STAR program was originally developed by Champaign County Soil and Water Conservation District (CCSWCD) in Illinois and is now also administered in four other states: Colorado, Indiana, Iowa, and Missouri. The Colorado STAR Plus program grew out of a stakeholder process launched by the Colorado Department of Agriculture and other partners in 2019 that was facilitated by the Colorado Collaborative for Healthy Soils, involved more than 250 stakeholders and resulted in passage of HB21-1181 and SB21-235, which authorized and funded the launch of a state soil health program based around STAR. This state stimulus funding and additional grant funding received from the Gates Family Foundation, Colorado Department of Public Health and the Environment, Colorado Water Conservation Board, NFWF, and NRCS have enabled the launch of the first round of the STAR Plus program.

Getting Involved with Colorado STAR

In the summer of 2021, legislation was passed in the Colorado House of Representatives funding the Agricultural Soil Health Program for 2022. [The Colorado Soil Health Program](#) is built around the framework of an Illinois program called STAR, which stands for Saving Tomorrow's Agriculture Resources. STAR was developed to be a free resource for farmers and ranchers, helping them evaluate their current land practices, and particularly focusing on nutrient and soil loss. The STAR program encourages best soil health practices, and rewards producers with recognition, a high rating, and a field sign. While the STAR rating system is a useful metric for farmers to measure their own conservation efforts, it is also a tool for consumers interested in a farmer's soil health practices.

The program was originally created in the Champaign County Soil & Water Conservation District in 2017, with the assistance of the Illinois Department of Agriculture, as a means to facilitate specific environmental and agricultural goals that were outlined in the state's Nutrient Loss Reduction Strategy. Colorado, as well as Iowa and Missouri, have adopted this program framework.

Best management practices for agricultural land use have been developed since the 1930s by the United States Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS). The STAR program utilizes these best practices, and also relies on a panel of experts, including university researchers and scientists, to establish appropriate ranking systems based on different resource factors. STAR Plus is an additional level of producer support that "facilitates capacity building by providing matching state funds towards the cost of these projects and activities within each district". This means that the state provides technical and financial assistance to producers over the course of three years, through grants and services like soil testing that are facilitated through the state's conservation districts.

Any farmer or rancher can visit the STAR website and fill out these forms in order to receive this rating. The first 100 participants in a year also receive a free soil test.

To participate, the only requirement is that the farmer or rancher [fill out a form](#) to the best of their knowledge, describing their farm practices in detail for a specific field chosen by the producer. The forms include questions about cropping practices, tillage regimes, fertilizer and nutrient applications, and other management practice information. The producer then receives a STAR rating from 1-5 that demonstrates their incorporation of the five principles of STAR: Soil Armor, Minimize Soil Disturbance, Plant Diversity, Continual Live Plant/Root, and Livestock Integration in their cropping system. Earning five stars in a field means that a farmer or rancher is implementing all five soil health principles on that field, while earning one star means that they are following only one.



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