COLORADO SOIL HEALTH FUNDAMENTALS

PRIMER 8: LIVESTOCK INTEGRATION

PRIMER 8 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 incorporating animals into your operation to improve soil health while adding to farm profits. Livestock are a soil health tool that, when properly managed, can amplify carbon and nutrient cycling and can result in healthier pastures, reduced soil nutrient losses, mitigated weed pressure, livestock waste reduction and an overall improvement in animal health. To gain the most from this practice, producers must make the effort to define their resources and expectations both for the soil and for the livestock operation. Cattle, sheep, goats, pigs and chickens can offer different soil health benefits to the land, and each has its own requirements and limitations. Colorado State University and the Colorado STAR program promote livestock integration through numerous educational opportunities.

▲ Livestock are a soil health tool that, when properly managed, can amplify carbon and nutrient cycling in a system. *Source: Colorado Department of Agriculture and Zach Chapman*

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.

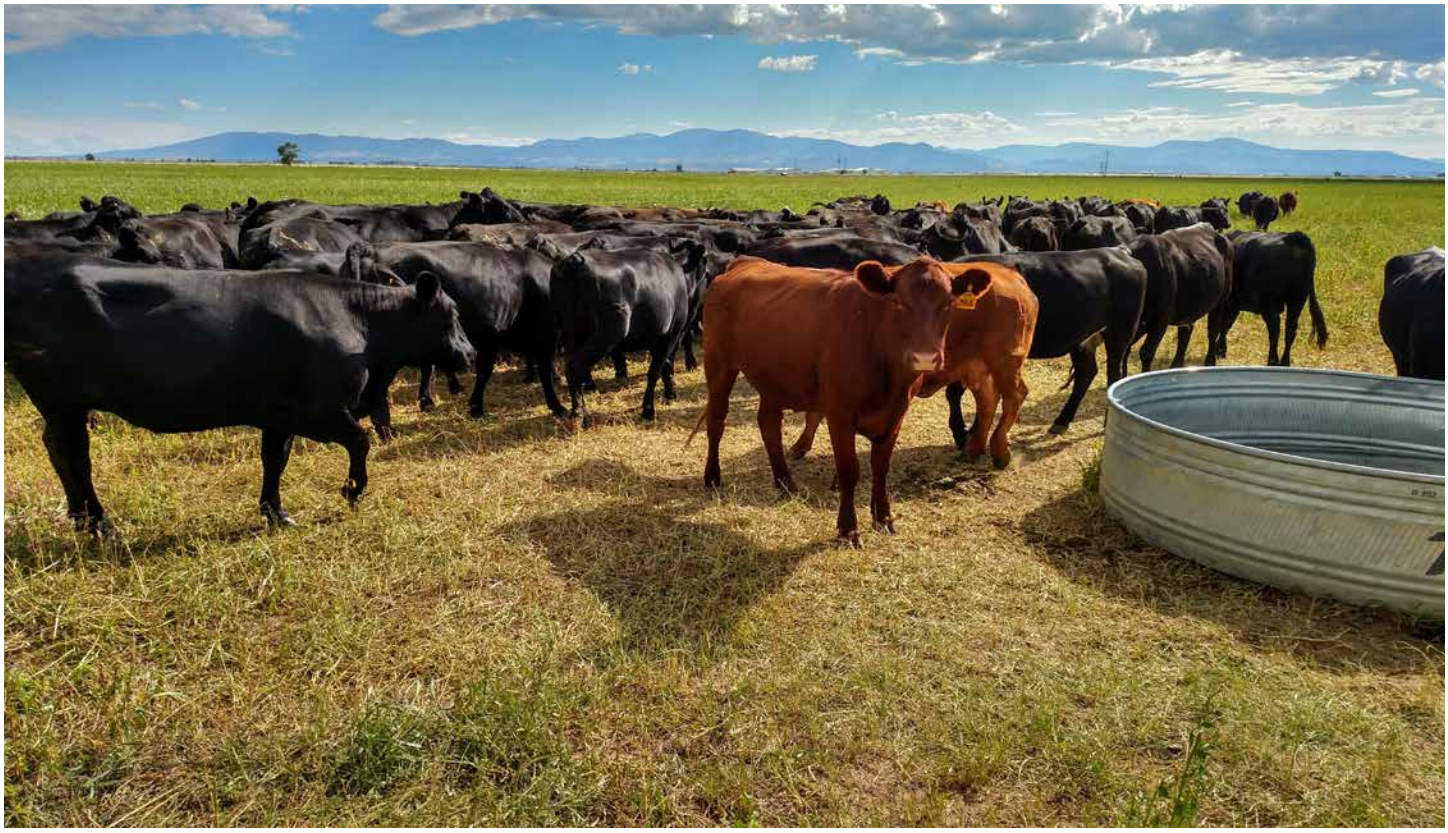
Soil Testing: The process of quantifying certain attributes of soil, including macro- and micro-nutrients, soil organic matter, cation exchange capacity, soil biology, water and/or air.

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



▲ Experienced ranchers recommend that if livestock are being managed for soil health, understanding the limitations and potential of the perennial or annual pastureland and seasonal forage availability, as well as water availability, are absolute musts. *Source: Colorado Department of Agriculture*

Livestock give to the soil something neither man nor machine can synthesize or impersonate. The relationship between animal and land is mutually beneficial, each relying on the other to sustain, to thrive, and to profit. Integrating livestock into a farm or starting a ranch to raise livestock is a commitment, a responsibility, and one of the most efficient ways to enhance soil health.

Animals can play several roles as a soil health improvement tool. According to the United States Department of Agriculture (USDA), livestock can provide the following benefits to the soil:

- They can convert high-carbon annual crop residue to low-carbon organic material via fall and/or winter grazing. This action will balance carbon/nitrogen ratios and manage crop rotation residue for no-till producers.
- They can promote perennial pasture regrowth through spring and summer grazing. Short exposure periods followed by long recovery periods allow plants to keep growing and to harvest additional sunlight and CO_2.
- They can reduce nutrient export from the soil. When livestock graze in the field, nutrients, minerals, vitamins, and carbon are recycled.
- They can manage weed pressure without herbicides.
- They can graze cover crops and/or crop residues, allowing perennial pastures to rest, while providing the livestock a higher-nutrient diet.
- If put on pasture instead of being in confinement, they can reduce waste and can help manage water quality and nutrient management concerns.

The benefits of using livestock are plentiful, and there are many ways to integrate them into soil-health-driven farming systems. USDA recommends starting with grazing cover crops on annual-crop residues in the winter and fall. The next step could be summer grazing on a full-season cover crop, following up on the same field during the fall or winter. Cattle can also eat bale feed on fields for added nutrient inputs. Yet another option is to seed perennial pastures to use as part of a crop rotation.

These actions will stimulate the life in the soil and can be an alternative to confined feeding.

First Steps

Before bringing the cows home, it is critical that anyone thinking about livestock take an inventory of their available resources, said Larry Brown, a Monte Vista–based Colorado State University (CSU) extension agent. If livestock are being managed for soil

health, understanding the limitations and potential of the perennial or annual pastureland and seasonal forage availability is a great place to start.

"The forage is the source of the wealth," Brown explained. "It's not about the animal, because the animal is just another chosen method of harvesting. The forage — the plant growth, the crop aftermath — is the source of the wealth."

Keeping that in mind, he said, farmers should also consider profit motives when deciding what kind of livestock to introduce.

"A wise choice for conversion efficiency would be the smaller animals — sheep and goats — when compared to cattle and even poultry," he said. "But you need to ask yourself, 'Do we need to make a profit with this? Can we afford to have it? Will it cost us money?' You've really got to think about it and do some planning."

Taking the time to learn how and why to integrate livestock will result in greater success, Brown said. CSU Extension and many other state agencies provide resources directly related to livestock integration and soil health. He also recommended that those wanting to integrate livestock of any kind seek out formal and informal learning opportunities.

"Find somebody in your area and ask if they would be your mentor," he said. "See if you could ride with them for a few days. Ask them if they would share their life experiences, especially in the basics of facilities and fencing and everything that has to do with health."

Fencing and Facilities

Livestock must be contained, and many experts in the integration of livestock for soil health benefits recommend leveraging the power of electricity. Whether for large or small livestock — including chickens — electric fencing has the ability to make livestock integration for soil health a reality. It keeps the animals in while keeping predators out. It is movable and can be powered through solar chargers, which are also nonpermanent.

"Electric fences are our backbone," said Steve Oswald, a regenerative rancher in Cotopaxi. "We can make various smaller paddocks. We can control our animal impact."

When developing the layout for a fencing system, electric or not, consider the following:

- Fixed resources, including acreage, soils, and, especially here in Colorado, water resources.
- Semi-fixed resources, such as existing fences, existing pasture, and water.
- Changeable resources, including forage type, temporary fences, and livestock numbers
- Other factors, including seasonal usage patterns, economics, and land use for other enterprises.

Water supply, Brown said, is a crucial consideration. Beef cattle, for example, need to drink 8 to 20 gallons of water a day per 1,000-pound animal unit. There must be access to water in every paddock; this is often one of the most limited resources. Grazing experts recommend that, for small paddock operations, water is available within 900 feet at any point (if possible) and that animals are restricted

▼ Providing cattle good access to water can be one of the challenges for high-altitude ranchers. *Source: Colorado Department of Agriculture and Samantha Kujala*

from entering and wallowing in water sources.

Additionally, water points that could be developed include wells, ponds, spring developments, and pipelines. Gravity and pumps are two methods of transporting water through PVC or HDPE pipes. The latter is tough, flexible, and is used aboveground in non-freezing temperatures and will not burst during a freeze. In prolonged freezing weather, however, pipe must be buried underground to move water.

According to replicated industry studies, fencing and water stocking will add costs to the farm, but they should pay for themselves in a soil health–based, rotational grazing scenario.

Some Colorado ranchers are working with sheepherders to move their flocks from the forests to farmers' green-manure and grain stubble fields.

Shelters, feeders, and corrals are additional infrastructure that should be considered when planning for livestock. If dairy or egg production is part of the integration plan, further facilities will be necessary.

▲ Poultry can be an affordable way to introduce livestock into your crop operation. *Source: Colorado Department of Agriculture and Daniel Bedell*

Managing Livestock for Soil Health

Livestock integration and pastureland management go hand in hand—or hoof in hoof—when soil health is the priority.

Oswald subdivides parts of his Sangre de Cristo Mountain meadow pastures into 100 paddocks and sometimes moves his herd five times in a day to keep his livestock from overgrazing. Some pastures are grazed once a year, some twice a year, and some not at all. He utilizes other available public and private lands so his cows can eat prickly pear cactus, cholla, mountain mahogany, wild plums, gooseberry bushes, and many other forbs—along with grasses, including blue gamma, sand drop seed, western wheatgrass, and Indian rice grass. This intensive approach is all to meet his goals of capturing moisture, increasing organic matter, and keeping the soil covered through diligent grazing.

Oswald said he aims to "capture as much solar energy as possible through maximizing optimum plant growth and health. Adequate rest periods between grazings, ground cover to capture any snow/rainfall, and plant diversity are just some of the many things we measure."

For much of the year, he said that he "runs all animals in one herd to maximize animal impact, moving to a fresh pasture at least once daily. This process provides the animals the freshest, most nutritious plants while allowing the just-grazed plant the beginning of its rest and recovery period."

Jason Wrich, a holistic rancher in Crawford, manages his pastures using a set schedule, he explained. For example, he notes how much time was spent with how many cattle in one paddock. As the seasons pass and the herd of cattle changes, he adjusts the days or the hours the paddock is grazed. Sometimes the herd grazes a paddock for thirty hours, other times only six.

"We make sure that we're not there long enough to take a second bite," he said. "We are taking off what we need, which changes because there are different species in different paddocks."

If pasture production is scarce, bale feeding or feeding cull or farm by-products, like potatoes, can meet the livestock's dietary requirements and introduce nutrients into the soil.

Low profitability in beef cattle in particular, according to industry research, is often linked to excessive costs for hay feeding and morbidity loss due to scours and poor animal performance. **If there is profit to be made in integrating beef livestock, pasture management is the most significant factor.**

Small Ruminants, Hogs and Chickens

Sheep and goats have a different relationship with the soil than cattle. They can thrive on acreage too small to sustain cattle; they are safer to physically handle; they reproduce sooner than cattle and tend to have multiple babies; and the investment to raise a sheep or goat herd is much cheaper than a cattle herd of compara-

ble size. Disadvantages include a need for high protein and highly digestible diets, internal parasite problems, and becoming prey for wild animals; also, sheep can eat very close to the ground if not closely managed. They will, however, eat plants that cattle refuse, making their ability to clean up weeds unparalleled, incorporating the plants' nutrients into the soil.

Pasture-raised swine benefit soil health through the introduction of nutrients. The pastureland alone does not provide enough energy for the animals, so they must have supplements like grain in their daily diets. The supplemental nutrients add fertility to the soil through manure. One way some pastured-pig producers are supplementing their animals' diets is through integrating them into fruit- and nut-producing orchards. This relationship not only cycles nutrients but also desirably flavors the meat. Rotational grazing is a must for swine since they enjoy rooting up pastureland, but they are known to clean up any grain the combine happens to miss.

Chickens are also being integrated into farms and ranches in the most creative of ways.

"There are guys that are following their cattle with chickens to eat all the maggots out of the cow pies," Wrich said. "As far as insect problems, fly problems—let that biological system work."

The manure offers the chickens an additional protein source, according to those practicing this insect control method. The chickens' scratching also spreads the manure over a wider area, which encourages nutrient cycling and destroys the fly habitat. If the chickens receive supplemental feed, the soil will be rewarded with even more nutrients.

When grazing chickens, mobile protection should be considered for predator protection—including hunters like owls that strike from above. Shade and, if egg production is part of the integration, a coop for egg laying is required.

Challenges of Livestock Integration

Adding any enterprise to an agricultural operation always means new risks. Livestock can contribute to soil health, but just as plant disease is a risk for growers, so animal disease presents challenges for ranchers and herders.

"Within the last couple of decades, more people are starting to understand biosecurity," said Mollie Wells, owner of the Rio Grande Dairy in San Luis and a veteran of both commercial and community supported agriculture (CSA) sectors. "I'm working towards a completely closed herd. I'm only bringing animals in if it becomes an economic issue."

Wells' livestock operation includes

▼ Forage quality can often depend on soil quality, and both can help determine the health of a herd. *Source: Colorado Department of Agriculture and Beth Weisensee*

thirty dairy goats, ten meat lambs, six meat cows, and a rotating population of hogs, chickens, and rabbits on eighty flood-irrigated acres. She said she has recently reduced her animal count after relocating to new pasture two years ago because, between the history of overgrazing sheep and the present drought situation, the soil was not in good health.

"I've already done a lot of culling that I didn't want to do," she said. "Now, part of my plan is leasing pasture so I can concentrate on improving those fields, starting with seeding cover crops and rest."

In addition to bacteria, overgrazed pastures can harbor parasites. Her herds, she said, are slowly building up resistance, and rotational grazing plays a major role in reducing the risk of soilborne disease.

"There has just been so much livestock, sheep, on this pasture for so long," Wells reiterated. "There's definitely a lot of parasites and different things that I am figuring out and learning how to deal with."

Colorado's high altitude is also a factor to consider when integrating livestock. According to CSU Veterinary Extension, High Mountain Disease (HMD)—also known as brisket disease, high-altitude disease, dropsy, or big brisket—is a common condition in cattle raised at altitudes greater than 5,000 feet. As altitude increases, less oxygen reaches cattle's lungs and pulmonary artery. Temperatures below freezing, which are frequent across the state, are connected to increased susceptibility to high-altitude-related conditions, as is the consumption of locoweed, which contains swainsonine and can increase the incidence and severity of HMD in calves.

"So much of it is watching for disease," Brown said. "Understanding the basics of nutrition, the GI tract, things like diarrhea, scours, and being aware of managing feeds and changing feeds. Being aware of the respiratory diseases. You get into these windy days and there's a great change between the lows and the highs. These are the kinds of conditions that can cause respiratory problems. That's just conditions and not necessarily the disease organisms."

When Jason Wrich, the Crawford rancher, puts his cattle on a pasture that is rich and lush with living biomass, he said he has had pinkeye breakouts. This is common when livestock are grazing pastures that have plants with multiple protruding seedheads. Mowing can help this problem if the pasture is facing maturity.

"One thing that I have been very aware of is if you let a pasture get ahead of you, and it gets really tall, inevitably, I do have problems with pinkeye," Wrich said. "What we've done is we moved through the pastures more rapidly so we can get cattle on it before it actually goes to seed; and, of course, it's more palatable then anyways."

While integrating livestock into an existing operation is perhaps the most challenging of the principles of soil health to implement, it has the potential to bring the greatest benefits.

"When integrating any livestock of any kind, start small," Wells advised. "People do get very excited and sometimes bring in a whole bunch of animals. Then there is disease. Then there is overgrazing. Once you have a system in place, then bring in animal diversity. There are soil health and economic benefits once you are educated."

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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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