# My Soil Health is Excellent, Now What?: Improving Efficiency at Blue Mountain View Farm

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*Cow grazing at Blue Mountain View Farm*

**This case study is part of a series on soil health challenges and innovations revealed through our Soil Health Benchmark Study, a participatory research project we began in collaboration with farmers in 2016. Each case study examines a soil health challenge a farmer participating in our study is experiencing, and considers possible solutions offered by other farmers who attended a workshop we hosted in March 2019. Find other soil health case studies at pasafarming.org.**

Matt Bomgardner is a third-generation dairy farmer at Blue Mountain View Farm in Lebanon County, Pennsylvania. When Matt was growing up, his father managed the farm in a way that was typical of many Pennsylvania dairies at the time—the goal was for each cow to produce as much milk as possible to earn as much income as possible, and most of the farmland was devoted to growing row crops for feed.

Over time, Matt's father began to consider new ways he could reduce his expenses. Like most dairies, feed was

## METHODS

Farmers participating in our Soil Health Benchmark Study choose three fields that span their typical crop rotation. We collect soil samples from these fields in October, which we then submit to the Cornell Soil Health Lab. The lab assesses the samples according to a set of indicators covering physical, chemical, and biological aspects of soil health—such as available water capacity, aggregate stability, and extractable phosphorus.

Cornell rates the soil samples on a 100-point scale (see chart to right) relative to thousands of other samples from similar soil types—in other words, a sandy loam will be rated according to a different set of standards than a soil high in clay.

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|---|
| OPTIMAL (80-100) |
| EXCELLENT (60-80) |
| AVERAGE (40-60) |
| LOW-LEVEL (20-40) |
| CONSTRAINED (0-20) |

We also collect farmers' detailed management records for each field, and generate our own indicators for days of living cover, tillage intensity, and organic matter and fertilizer inputs.

We compile both the soil health data generated by Cornell and our own measurements into a custom benchmark report for each participating farm. Our benchmark reports collate the soil health data of all of the study participants, so that farmers can see how their soil health outcomes compare to peer farms. With their benchmark data in hand, farmers can collaboratively explore ways to improve their soil health management systems.

one of his largest. Primarily as a business strategy, Matt's father began incorporating rotational grazing into his operation so he could improve his business' profits by decreasing the amount of money the farm spent making and storing feed for the herd. Since grass-fed cows are not as prolific milk producers as grain-fed cows, he expected milk production would drop a bit, but he anticipated the commensurate reduction in the amount of feed the farm bought and stored would compensate for this loss.

Matt joined the operation soon after his father's shift to rotational grazing, and within six years the farm had expanded its pastured acres from 40 to 100. Like his father, Matt's continued interest in grazing was primarily driven by his concern for the financial health of his family's operation. "My focus was not soil health, but profit," Matt shared. "What I've found, though, through studies like this [Soil Health Benchmark Study], is that what's profitable for our farm tends to align with what's good for the soil health on our farm."

## Growing organic matter, sequestering carbon

The soil health test results from Matt's farm were fairly typical of other grazing dairies participating in our Soil Health Benchmark Study. Ratings in all soil health metrics were superlative, typically falling within the "optimal" range and often receiving a rating of 100 on a scale of 100.

One of the most remarkable aspects of Matt's soil test results were the organic carbon levels. All three of his fields that were tested had organic matter levels higher than 6 percent; six years ago, his average was 3 percent. This means that in the last six years, one acre of perennial pasture on Matt's farm has sequestered about 110,000 pounds of carbon dioxide equivalents.

If we extend this calculus to all of Matt's 100 acres of pasture, we can say that his farm has sequestered 11 million pounds of carbon dioxide equivalents over the last six years. For comparison, the Environmental Protection Agency estimates the average car's annual emissions to be 10,381 carbon dioxide equivalents per year. While a substantial body of research has demonstrated that well-managed perennial grass systems can protect waterways, such as by mitigating runoff and erosion from agricultural fields and conserving nutrients like nitrogen and phosphorous, the power of pastures in sequestering carbon is only beginning to be understood.

### GRAZING DAIRY SOIL HEALTH TRENDS

The grazing dairies participating in our Soil Health Benchmark Study have, overall, received soil health test results in the optimal range. These data help substantiate the claim that well-managed perennial pastures are powerful drivers of soil health. In some ways, this isn't surprising. For one thing, unlike vegetable and many row crop farmers, graziers do not need to disturb their soil through tilling. Their perennial pastures remain in living cover year round, and are often abundant in organic matter. Nutrients like nitrogen and phosphorous are often supplied by plants and naturally applied animal manure.

If there is one area in which the grazing dairy cohort showed weakness in their soil tests, it was in some of the biological measures—particularly soil protein, which can indicate the amount of nitrogen stored in organic matter, and soil respiration, which measures the abundance of microbial life in the soil. However, it's difficult to discern the reasons for this.

One possibility is that these scores could have been impacted by the unavoidably wet conditions in which many soil samples were taken. Farmers participating in the study experienced near-record rainfalls in 2018. Wet soil lacks oxygen, which limits microbial activity and therefore soil respiration.

A possible cause of low soil protein scores could have been low legume stands in the pastures, but anecdotal observation did not appear to support this. We hope that by compiling long-term data sets measuring soil health, quandaries like this can be investigated and untangled over time.

## Increasing efficiency and profitability

So, with an optimal soil health rating, what's there to improve? At a March 2019 soil health benchmarking workshop hosted by PASA in Lancaster, Pa., Matt shared with a group of fellow pastured livestock farmers that he continues to strive to make his farm more efficient, and in that way more profitable.

One of the places he sees potential inefficiency in his operation is in his periodic need to reseed his grazing pastures in order to maintain a good sward. Although his

pastures are dominated by perennial species of plants, perennial systems are not permanent systems—they are always changing, and some plants are always deteriorating with age. Even optimally performing perennial herbaceous species can die as quickly as three years after planting.

Currently, to keep his pastures productive over time, Matt relies on interseeding. He uses a no-till drill to seed a commercial mix of rye grass, orchard grass, fescue, clover, and chicory into his existing pasture. Many of the graziers in the room spoke to this practice—they discussed proper timing (fall was deemed best) and considered frost seeding in early spring when the ground freezes at night and thaws during the day (okay for legumes, they agreed, but ineffective for grasses). But how might a farmer avoid the seed purchases and tractor passes required by interseeding? Can skilled grazing management create a truly self-sustaining perennial system?

**INTERSEEDING**

A dairy grazing operation optimizing forage intake off pasture is likely to graze in a way that keeps pastures in a moderate to late vegetative state, where plants are developing roots and storing sugars, while avoiding energy depression through flower and seed development. Annual plants depend on seed for propagation and, although perennials depend far less on propagation by seed than annuals, they typically do require some propagation by seed in order for the sward to stay vigorous and productive. In systems such as a dairy grazing operation, where, ideally, plants rarely go to seed, interseeding can be an effective way to replenish pastures.

### Summer fallow

One dairy grazier raised the notion of the summer fallow, where a pasture is allowed to go to seed and is not grazed until late summer, at the earliest. At that point, the herd will trample much of the forage, their hooves helping press seeds into the soil. Trampling the grasses will also feed the soil organic matter, and likely improve soil health and grazing in the future.

While the benefits of a summer fallow were widely acknowledged by the group, the practicality of the practice was questioned. Many in the room, if not all, were already pushing their land base to provide adequate rest before having to be grazed a second, third, and even fourth time.

### Bale feeding

A beef producer in the group spoke to the benefit of bale feeding in pastures as a way to build fertility, increase the seed bank, and even provide a kind of no-till mulch to desired pasture species.

Bale feeding is a practice that involves unrolling large round bales in grazing paddocks to feed livestock. It is typically practiced in the winter, and can include bales of lower quality forage. The producer stated that, in his experience, the cattle will select the most palatable parts of the bale, and the rest will be left to build organic matter and carbon in the pasture. Bales with mature seed can also replenish the seed bank as cattle trample the forage into the soil. Some farmers will even rotate their cows through the same paddocks in the winter as they do in the summer, to apply this supplemental fertility evenly to all ground. Bale feeding can also be used as a diet supplement in-season, such as by balancing protein-rich spring legumes with higher fiber bales, or to help stretch the forage in the paddocks during the summer "slump."

### Seeding annuals

A dairy grazier from Bradford County, Pa. approached the question of improving efficiency from a different direction. Rather than reseeding pasture with perennial species, he's experimented with seeding an annual: corn.

To make this work, he grazes a pasture much lower than he ordinarily would. This "over-graze" temporarily hinders the ability of perennial plants to grow back. Into this gap, he then interseeds corn. When the corn is at tassle, he grazes it and realizes a substantial increase in forage yield per acre over traditional pasture. Once the corn is gone, the perennial pasture has recovered from having been over-grazed and, the grazier noted, seems to come back stronger than ever, particularly in the following year.

While this practice does not avoid the expense of seed, it is worth considering whether the strategy could increase a farm's profitability. Grazing a crop of corn would certainly boost both forage yield per acre and milk production. If that corn crop is also having a positive synergistic effect on the perennial pasture below it, those seeds and tractor passes might be worthwile.

## Skilled graziers are adept at adapting

While Matt's peer graziers offered several possible solutions to his question about keeping perennial pasture productive over the long term, there was no single silver bullet—there rarely are within regenerative systems, where there are myriad variables to account for day to day and year to year. The skilled grazier has to be able to apply different management techniques depending on the situation in which they find themselves—be it drought or flood, cold snap or heat wave.

Often, it can take employing a variety of approaches to improve efficiency, and the total can often equal more than the sum of its parts. This speaks to the notion that skilled graziers are not necessarily relying on a single, rigid and unchanging management regime; they are adapting their methods to anticipate and respond to the inevitable fluctuations of dynamic, living systems. In the end, such an approach can be more than simply a union of science and art—it can be good business, as well.

### PART OF THE PROBLEM, OR THE SOLUTION?

Many decry animal agriculture as one of the leading issues driving climate change today. But, like most issues, there are nuances to consider.

Industrial confined animal operations are often problematic socially and environmentally, supplanting thousands of small farms across the country every year, while consuming massive amounts of nonrenewable resources. Additionally, these types of operations are often at the center of debates regarding animal welfare.

Farms such as Blue Mountain View, the grazing dairy featured in this case study, highlight the notion that some of our most destructive industries may have the potential to be among our most restorative. Extractive agricultural operations can transform into regenerative ones, building soil organic matter and reducing pollution while serving as economic engines and social assets within their communities.

### LEARN MORE

Find more information about our Soil Health Benchmark study—including how to participate—on our website at pasafarming.org.


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