

The Currency of Carbon

Protozoa, Pastures & Profits

Innovative Farming Requires an Innovative Approach to Soil Health

By Brian DeVore

It's a bright June day in southeastern Minnesota, and the hilly landscape is in full summer bloom. But as Chuck

Henry watches his dairy herd graze a mix of winter wheat and Sudan grass, he has numbers on his mind:

33,000 bites per day, per cow; 300 pounds of dry matter per inch; six inches of forage harvested during each grazing period; 10 to 15 minutes to string up a temporary grazing paddock. Along with animal science, Henry studied accounting at the University of Minnesota, and he does a quick calculation: during the growing season, he will produce \$500 worth of milk per acre during each 12-hour grazing cycle. His best paddocks can be grazed eight times from May through December. That generates a number that's important to any farm business: gross annual income—\$4,000 per acre in this case. After subtracting the cost of applying seed and manure, the bottom line result makes the farmer smile.

"When you take a look at it, what else can you do, and/or plant, that's going to yield \$4,000 an acre?"

Henry asks. He pauses a moment before adding with a laugh, "And still be legal?"

But Henry, who, along with his wife Sue, farms what is considered prime row-crop ground near Dover in Olmsted County, knows that all those numbers hinge on a figure that's almost too large to innumerate—billions of microbes in the soil. He's convinced life in the soil makes it possible to graze paddocks numerous times a year while maintaining good cover and living

roots, the kind of continuous living plant regime that is building long-term resiliency, cranking up carbon and managing moisture.

"Every step of the way, I try to include biology," says Henry as he watches his mixed herd of Ayrshires, Dutch Belteds,

Shorthorns and Holsteins move through a four-and-a-half-acre pop-up pasture he had created in under 15 minutes using a Polaris

Ranger four-wheeler, a spool of polywire and lightweight fence posts. "I figure with the cows, I have mobile composters-digest-

The Economics of Soil Health



Chuck Henry learned that switching his milking herd to a 100-percent forage based diet required paying close attention to soil health. "We were taking soils that had been literally farmed out, had not had enough organic matter, and we were trying to raise high quality pastures that were going to support a cow," Henry recalls. "It was impossible to do." (LSP Photo)

ers working for me."

Without a doubt, farming practices that build soil health—managed rotational grazing, cover cropping and no-till, for example—have been a boon to the environment by providing the kind of protection on top and aggregate stability below that keeps soil intact and reduces runoff, all the while sequestering greenhouse gases. But if soil smart farming is to become integrated into all types of operations on a consistent basis,

the biological soil bank will need to pay back in financial terms. Fortunately, farmers like Chuck Henry are paving the path toward connecting profitability and protozoa, cash and carbon. But such linkages don't come naturally—sometimes, as in Henry's case, one doesn't realize just how sick the soil is until attempts are made to adopt an innovative farming system. *That's* when the weak links reveal themselves.

Getting Schooled

When Henry started farming his family's land in 1974 after graduating from the U of M, his focus was putting into practice what he calls "my so-called higher education." That involved taking milk cows off pasture, raising more grains and hay, and feeding the herd a high-energy diet. Manure was hauled out of the barn as a waste product. He expanded his dad's 40-cow herd and worked hard to put in place all the trappings of the "modern way," including building silos to store corn silage. But by the mid-1990s, Henry was looking for a different way to farm. His operation wasn't set up for feeding a harvested, grain-based diet to a growing

herd, and he was on a treadmill of chasing ever-increasing productivity to stay profitable. He also noticed that his row crop acres were washing during rainstorms, sending soil and chemicals into the Whitewater River watershed.

At about that time, a growing group of dairy and beef farmers were taking cattle out of confinement and putting them back onto pasture. But instead of allowing the animals to roam at will in a manner that led to overgrazed, eroded pastures with stunted plant growth, these farmers were utilizing various forms of "managed rotational grazing." This system breaks bigger pastures up into smaller paddocks utilizing portable fencing, and the animals are moved frequently—sometimes as often as twice-a-day—from spot-to-spot. This prevents overgrazing, extends the growing season and spreads nutrients in the form of

manure and urine evenly across the landscape. It can also significantly lower input costs for producing livestock.

Henry added increasing amounts of pasture back into his operation and by 2003, he was highly dependent on grass, with the cows receiving some supplemental grain. In 2006, he shipped his first load of certified organic milk.

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Lack of a good infrastructure for feeding grain pushed Henry to increasingly experiment with producing milk on a 100-percent forage-based diet. Today he milks around 200 cows, and hasn't fed grain or corn silage since 2012. Some of the 600 acres of owned and rented land he farms has a corn yield history approaching 200-bushels-per-acre, but Henry hasn't raised row crops for several years.

Per-cow productivity went down when Henry went to full forage, but because of his efficient milking parlor and the low costs associated with managed rotational grazing, he was able to add cows to make up for it. Plus, he had never liked cropping work anyway, so quality of life improved.

"This is fun, this is what dairying should be!" the farmer says excitedly as he guides the Ranger through a series of grazing paddocks, stopping periodically to check on the growth of the various grasses and small grains he utilizes for forage and pointing out how birds such as dickcissels, meadowlarks, killdeer, bobolinks and red-winged blackbirds have returned to the land.

Other critters appreciate the diverse mix of continuous living cover as well. In the spring of 2017, a beekeeper placed 20 hives on Henry's acres. By mid-summer, he had added another 30 hives because the bees there were out-producing their counterparts at other locations. By late summer, there were 100 bee hives churning out honey on the dairy farm.

Benefits of the forage-based system extend well beyond the farm. Three years ago, Henry began receiving a premium from Organic Valley for his 100-percent forage-based milk. Scientists have found that "grassmilk," as it's called, is nutritionally superior to conventional and even organic milk produced with the help of grains.

Research done by the U of M, among others, shows that cows fed a 100-percent grass- and legume-based diet produce much higher levels of omega-3, a heart healthy fatty acid, and lower levels of omega-6, which is an unhealthy fatty acid. And a full forage-based diet produces milk with elevated levels of conjugated linoleic acid (CLA), which is also good for human health.

Investing in the Soil Bank

When one turns an entire farm over to forages, soil—rather than machinery, fuel and chemicals—becomes the core mechanism driving success. In that case, if soil's needs aren't met, then all else fails. Henry concedes he learned this the hard way early on—simply planting grass, erecting fence

and turning the cows out wasn't enough.

"Soil health wasn't a priority at first. We were taking soils that had been literally farmed out, had not had enough organic matter, and we were trying to raise high quality pastures that were going to support a cow," he recalls. "It was impossible to do."

Soil tests taken last fall on a farm Henry is transitioning showed organic matter levels of between 1.5 percent to 1.9 percent overall. Samples taken at the same time from his permanent, rotationally grazed pastures have levels that are more than double that, with some testing as high as 6 percent. This didn't happen by accident. During the past half-dozen years Henry has utilized a combination of rotational grazing, diverse seeding and manure management to build biology.

Henry has a mix of pastures made up of perennials—orchard grass, timothy, brome and white clover—and grazing areas that are

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seeded every year with a cocktail blend of annual species such as rye and winter wheat. He also regularly renovates his permanent pastures by interseeding species such as rye grass, meadow fescue and festulolium grass, along with red and white clover. The farmer utilizes mixes of Sudan grass, vetch, cowpeas, red clover and forage radishes to produce high-moisture haylage, which is bagged up and fed to the herd during the winter; he calls it "total mix ration in a bale." The farmer says many of the new forage varieties are high in sugars, which is important since his cows need the energy they normally would get from grain.

Henry is the first to admit that he spends a lot on forage seed—as much as \$20,000 annually. But he sees that as an investment, rather than a one-off expense. Grazed forage plants are building soil health, which pays off years down the road in the form of increasing organic matter. In addition, when annuals are interseeded into permanent pasture, that extends the life of a perennial plant system. This means there is a living root in the soil 365-days-a-year, rather than just the four or five months of the conventional row crop farming season. That's 365 days of soil-building capacity added to the farm.

Mastering Manure

After the first grazing pass of the year and the forage is growing quickly, he spreads his herd's winter "bedding pack"—a

mix of straw and manure—on his pastures. The vigorous growth of the recovering forages pushes through the bedding pack layer, and within 10 days there is little to no sign the manure was ever applied. With this system, instead of manure disposal being seen as an expense, it's a value-added product being integrated into the operation as a whole.

"It's my fertilizer, it's my soil amendment," says the farmer. "It's probably serving three or four different purposes. I know to some extent it feeds the grass right away. Then there's the soil biological activity after that. I can't explain it. There's got to be something going on with the life of the soil, the flora, the worms, everything. It's just crazy what happens and I don't get it through liquid manure."

Although Henry's bedding back is not fully broken down, the combination of manure and straw may be providing a similar biological benefit as adding fully composted manure to the soil. Research in northern California has shown that composted manure spread on the surface of grasslands actually kick-starts a process in which the plants started building up carbon underground, creating a self-perpetuating cycle of creating more organic matter, which is the center of a healthy soil universe. These composted acres retain more moisture and produce 50 percent more grass.

The bottom line: Henry feels improved soil health has allowed him to put more cattle on the same number of acres. In fact, he is grazing 200 cows on 140 acres of land that once only supported 70 bovines. Not only is his carrying capacity up, but he feels his milk production is much more profitable and the animals are healthier.

Indeed, research shows that healthier soil does equal more productive livestock. Scientists studying rotational grazing in England recently reported animal performance on individual fields was "positively associated with the level of soil organic carbon" in those fields. In addition, fields grazed more intensively had healthier soils and were less prone to water and nutrient losses, according to the researchers. Henry says he's seen a marked increase in his soil organic matter during the past seven years especially, a period that coincides with a significant increase in the number of cows he's rotationally grazing on each acre. More cows on well-managed paddocks means more manure and the kind of positive disturbance that supercharges the soil biome.

Research shows that on average a cow takes about 33,000 bites a day; there's a limit to how many mouthfuls of forage it can swallow. So, if each bite can be packed with

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more nutrition, then the cow can produce more milk per grazing. Careful measurements have confirmed that he has paddocks that are producing as much as 2,700 pounds of dry matter per grazing, which is more than enough to support profitable milk production.

“These cows will probably graze off six inches before I move them,” the farmer says, pointing to his herd, which has just been turned into a paddock after the morning milking. He will move them after 12 hours. “If you’ve got a good dense sward, you could have 300 pounds of dry matter per inch. That’s 1,800 pounds right there, and that doesn’t include what they’re going to leave behind.”

And what those cows leave behind is important. The key to utilizing a grazing system based on soil health is to make uneaten, often stomped down, biomass a part of the plan, not only to reduce overgrazing, but to feed the soil.

Striking a grazing balance that provides adequate nutrition to the animals above-ground and the critters below requires close observation. The amount of milk going into

his bulk tank is an obvious indicator of how things are going in the paddocks. But Henry is also constantly studying the grazing habits of his cows. He also notes how many earthworm castings there are, the rate at which manure—both the applied bedding pack and what he calls the cows’ direct deposit (cow pies)—breaks down, and, of course, the re-growth rate of the forages. But the farmer also notices landscape-wide changes. For example, in an area where crowns of sloping row crop fields have a pale, almost yellowish complexion, a sign that the rich, dark topsoil has been skimmed off, Henry’s fields have a uniform color.

Sometimes one uses unconventional means to monitor soil health. Henry is proud that after a heavy rain he’s able to drive one of his Buick sedans out into the pastures without getting stuck. “Two inches of rain should be absorbed by the land,” he says.

When Opportunity Knocks

At one point on this June day, the farmer drives his Ranger down to a field he’s raising hay on and ponders its near-term future.

“This is kind of a wonder field—I wonder what’s going to happen,” he jokes. Some of the alfalfa stand has suffered from winter kill. Earlier in the season, he had interseeded some grass and crimson clover, which did well, but there are still several bare spots. Henry wonders out loud what his options are, including re-planting the whole thing to

a different kind of forage. He’s faced with a similar situation in the case of a grazing paddock that’s not doing as well as he’d like. If corn and soybeans were the focus of his operation, his options would be severely limited this late in the season.

“There are so many things you can do. It leaves you with a spot to put manure on, or if it’s grazed back hard, you could interseed something into it to beef up the stand,” he says. “There’s opportunity in everything you do, and if you’re not constantly thinking, you’re going to miss those opportunities.”

Taking advantage of such opportunities means experimenting and adjusting on the fly. Henry mixes and matches forage varieties, and experiments with various ways of interseeding pastures. He adds amendments to his manure to increase the biological activity and has even talked about breaking it down completely via composting.

And the farmer, who’s 68, has a long-term goal of making that ultimate connection between soil health and a healthy community by adding another family to the operation.

“It would be nice to get the next generation cooking down here,” says the former realtor while watching his grazing herd, mindful that he often sees crop farmers driving by, eyeing his acres with envy. “Can we actually support two generations on this farm without plowing anything up?” □