Soil Health

Pay Dirt

Viewing Profitability Through a Soil Health Lens

By Brian DeVore

Last fall, a team of pretty smart people — environmental scientists, supercomputing specialists, hyperspectral remote sensing experts (you get the picture) — released a paper titled, "Recent cover crop adoption is associated with small maize and soybean yield losses." The results, which were based on sophisticated satellite data gathered on 90,000 fields in six states, showed that cover crops caused corn and soybean yields to drop by an average of 5.5% and 3.5%, respectively. These yield drops were recorded on acres that had been cover cropped for three years or more. The researchers' hypothesis was that cover crops were competing with cash crops for fertility, water, possibly even the oxygen present in the soil. Based on crop prices at the time of the research, that calculated out to a loss of $40 per acre for corn, and $20 per acre for soybeans.

When building soil health via practices such as cover cropping, traditional views of profitability need to be reconsidered. (*LSP Photo*)

Those last two figures should catch the attention of any farmer considering diving into cover crops. The researchers concluded that there are a lot of good reasons for planting cover crops — erosion control, organic matter development, water management, weed suppression — but profitability isn't one of them.

The scientific credentials behind this study are rock solid: the scientists represent top research universities and the study was sponsored by NASA. Unfortunately, their conclusions assume higher yields always equal higher profitability. It may look that way when viewed from a satellite thousands of miles up, but the reality on the ground can be quite different. When farmers begin putting in place soil health practices such as cover cropping, traditional ideas around profitability are turned on their head.

The NASA study views profitability through the traditional, reductionist lens of conventional ag: more corn in the bin automatically equals more money in the bank. That makes sense in a world where A = B. But when the diverse world of the soil biota enters the picture, A = Z, and the impact all the letters in-between have on the end result must be taken into consideration. With that in mind, on the next few pages are a few insights generated by people who are looking at farms, and the soil that supports them, from a new economic angle.

Working *On* the Farm

First, a little reality check, courtesy of Dave Pratt. The financial and grazing expert is not afraid to deflate a few myths when it comes to the economics of farming and ranching. Spend any length of time with the Ranching for Profit instructor, and you are likely to walk away questioning your own beliefs about what makes a business a real business, if hard work always pays off, whether you own the farm or whether it owns you, and, when it comes to estate planning, the difference between equal and fair.

And during a recent Land Stewardship Project soil health presentation in Red Wing, Minn., Pratt talked extensively about the difference between working *in* your business and *on* it. When it comes to a farm or ranch, people spend a lot of time doing field work, fixing fence, etc. "We're fabulous at that — that's working *in* the business," says Pratt.

But working on the business is figuring out not just how to manage a cattle or cropping operation, for example, but asking hard questions. Should I be raising cattle or corn in the first place? What impact is my production system having on the long-term sustainability of the soil, as well as the people working the land?

"We're so busy working in the operation that we don't take time to work on it. As a result, we don't really own businesses," says Pratt bluntly. "Most farms and ranches are not businesses, they're just a giant collection of very expensive assets and a whole bunch of low-paying, physically demanding jobs."

Stability = Profitability

Rick Clark is big on spreadsheets, and he has one labeled "Stability" — a title that doesn't exactly light one's imagination on fire. But upon closer examination, the data represented in that chart provides a convincing argument for utilizing cover crops. What it shows is that before he adopted cover crops on his 7,000-acre crop and livestock operation in west-central Indiana, the variance in corn yields from year-to-year, otherwise known as the standard deviation, was 28 bushels per acre. Today, his annual corn yields vary on average less than five bushels per acre. For soybeans, his standard deviation has gone from over eight bushels per acre to less than three.

That consistency is money in the bank, says Clark, who raises corn, soybeans, wheat, alfalfa, peas, milo, cattle, sheep, and, of course, cover crops. Around 5,600 acres of his operation is organic.

Clark plants his cash crops straight into standing cover crops and then uses a roller crimper to lay down and terminate those covers, a technique called "planting green." He also relies on diverse rotations as well as integrating livestock into his operation. Through it all, his number one rule is to treat cover crops as the equal to his cash crops. One of the farmer's goals is to, as much as possible, take advantage of what he calls the "free stuff" available in nature, such as solar energy and natural fertility.

He may not be pulling in record-breaking yields year-after-year, but Clark is getting the kind of consistency that resembles a gentle sine wave when plotted on a graph. And because he's building the kind of soil health that is much less reliant on purchased

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inputs for fertility and weed control, his profitability is also consistent.

"I will sacrifice yield to maintain soil health; I do it every day," says the farmer. "Don't get me wrong — we have to have yields to pay our bills, to calculate our return on investment. But I'm not driving our system for higher yields; I'm driving our system for higher profitability, and that doesn't always mean high yields."

Monitor the Microbes

On a snowy day in southeastern Minnesota, microbiologist Elaine Ingham is showing a group of farmers how to check their soil's balance sheet. Gathered around microscopes set up in a biology lab at Saint Mary's University in Winona, the LSP workshop participants smear samples of compost onto glass slides.

Ingham goes from microscope-to-microscope, helping workshop participants identify fungi and amoebas. One of the magnified images shows a rotifer, which is in a kingdom of its own. It has "rotors" at one end that are used to suck bacteria it wants and spit out bacteria it doesn't need.

"It's like bing, bing," says Ingham as she flutters her fingers in the air like they were Cuisinart blades. "It's like a video game."

The microscope workshop offers a fun, graphic grounding to the message the scientist shared during a presentation earlier in the day: soil has all the potential in the world to cook up the homegrown fertility we need for productive and healthy crop fields, vegetable plots, orchards, and pastures.

"But you have to put that biology back in the soil — the biology just doesn't show up one day," the scientist warns.

Microbiologist Elaine Ingham (*center*) **leads a microscope workshop during an LSP soil health event. "When we start implementing the biological approach, you as a grower have to pay attention to a lot of things," she says.** (*LSP Photo*)

Ingham emphasizes the benefits of utilizing composting and diversity to build the biome and tap into all those willing workers beneath the ground. But such an approach requires farmers to become keen observers in order to build healthy soil, something that's not as easy as it sounds. Without that close attention to how the soil functions, farmers aren't really the masters of their own fate; they are basically relying on input suppliers to determine what's the best way to produce food — a case of ceding the future to outside forces.

"Whereas when we start implementing the biological approach, you as a grower have to pay attention to a lot of things," she says. "It's a very different approach. In a biologically-based system, farmers are really going to be the people doing the thinking."

A Thumb on the Scales

Give and take. Three steps forward, two steps back. Farming with soil health in mind is all about stacking the odds in favor of more biology. But, says southern Minnesota crop and livestock farmer Tom Cotter, such an approach comes with plenty of compromises, lots of fits and starts.

"Pluses and negatives — for everything I do, it's a plus one, or a negative one," he says during a presentation at a recent LSP soil health workshop. But Cotter, who farms 795 acres in southern Minnesota, concedes just knowing what negatively impacts soil health is not enough — there are times when tillage seems necessary or chemicals are called for in the short term. That's where "plus" columns and "negative" columns

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Soil Health by the Numbers

95% …

That's the amount of erosion reduction we would see in the Midwest if 100% of its crop acres was converted to no-till farming systems, according to a recent study by University of Massachusetts-Amherst researchers. The scientists have found that more than one-third of the Corn Belt in the Midwest has lost all of its carbon-rich topsoil during the past century-and-a-half. Most of that soil loss is due to tillage, and it's nearly double the rate at which the USDA considers sustainable.

Roughly 40% of the Midwestern crop acres the scientists studied are currently no-tilled. But modeling showed that if that amount of conservation cropping was upped to 100%, the soil savings would be so significant that it would take 10,000 years to see the same level of erosion and carbon loss that would occur in only a century if we continue business as usual. The study, "The Future of Soils in the Midwestern United States," is available in the May 25, 2023, issue of the journal *Earth's Future*: agupubs.onlinelibrary.wiley.com.

67% …

That's the amount, on average, of nitrogen-based fertility corn gets from sources naturally occurring in soil, according to University of Illinois research. This has major implications for the environmental and economic problems that occur when farmers over apply nitrogen in an attempt to make up for lost fertility, and the role building soil health can play in building natural fertility. "If the soil is the main source of nitrogen for crop uptake, which it almost always will be, we need to take the soil into account," says study co-author Richard Mulvaney. "Otherwise, with factors like timing, rate, placement, and form, we're tweaking, but probably won't find a miraculous increase in efficiency using those approaches."

The University of Illinois research is at phys.org/news/2023-05-nitrogen-corn-fertilizer-farmers.html.

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come in handy — they serve as a biological balance sheet that allows him to grapple with the inevitable compromises that come with building soil health on a farm.

"I'm not perfect, and if I do something bad I have to counteract that," says Cotter, flashing a PowerPoint slide with two columns — one side lists his pluses for a given growing season; the other his negatives. He goes down the list and explains that dropping fall tillage and planting a cover crop puts him two points ahead. But the fact that he used herbicides the following spring to kill the covers is a negative. Cotter has organic acres and is working on terminating cover crops with a roller crimper, which doesn't require chemical use. So that could be a check mark in the "plus" column.

"At the end of the year, I can be a plus three," says the farmer. "That's pretty good, but I have room to get better."

Going Beyond Widgets

Martin Larsen admits that when his farm consisted of just two crops — corn and soybeans — he treated it like a "widget factory." "You put this in and you put that in and pray for Mother Nature to cooperate, and in the end you get some yield, sell it, and that's your widgets, right? You're almost ignoring the fact that it's a biological system," he says.

Since he added oats to his corn-soybean rotation on the 700 acres he farms in southeastern Minnesota, the benefits of that biological system have come to the fore. That addition of a small grain, with its extensive root system and ability to suppress weeds, build organic matter, and in general improve soil health, has a significant positive spillover effect on the other crops.

During a recent LSP soil health workshop, Larsen projects onto the wall what he calls the "mother of all spreadsheets." At first, he simply shows the costs, yields, and profit from a two crop-rotation. Then he tweaks the spreadsheet to illustrate what happens when he adds a third crop like oats. For one, there's a 5% yield boost for subsequent corn and soybean crops. That's great, given that it gives him more of those row crops to sell at the elevator. In addition, since Larsen sells his oats into the food-grade market, growing them provides a third crop — a third widget, so to speak — to sell off the farm.

But it's not all about yield and commodity sales. Larsen points specifically at the columns showing how introducing oats into his rotation significantly cut his dependence on herbicides in subsequent corn and soybean crops. He is also able to slash fertilizer costs because the clover he interseeded with the oats is a legume, which adds nitrogen to the soil. Money not spent is money earned, thanks to the fact that the lines separating the crop categories on that spreadsheet are more permeable than they appear.

"There's more interaction between the years," Larsen says. "Everything we do in a given year affects a year down the road."

Pipe Dream

It's hard to overstate the role tile drainage has played in producing row crops. According to the latest Census of Agriculture, around 56 million acres of U.S. farmland is tiled, which represents 14% of all the country's cropland. That figure goes up every year and over half of Iowa's farmland is now artificially drained. In Minnesota, over a third is.

With its ability to pull excess moisture off farm fields in a short amount of time, this rural version of a storm sewer system has made countless low-lying acres tillable, and thus profitable. But a few years ago, Tom Finnegan realized here was a limit to what all that underground engineering can accomplish. Finnegan farms some 500 acres with his wife, Kim, in the Cedar River watershed near Austin in southern Minnesota. Managing water is a major problem on the corn and soybean ground they manage. As a result, they haven't been shy about investing in the installation of drainage systems.

"Over five years we tiled the whole farm out at a six-figure expense, and then we were still struggling with ponding in a couple of different spots," he recalls.

The tiling company, naturally, recommended even more intense artificial drainage, to the tune of tens of thousands of dollars more. "Well, that wasn't really feasible," says Finnegan.

But through their own experience and by observing other farmers in the region, the Finnegans began to notice the positive impact cover cropping could have on building the kind of soil aggregate structure that allows fields to soak up and store moisture. By planting cocktail mixes that contain as many as 12 species, the Finnegans are now utilizing the ground cover and rooting systems these plants provide to build resiliency. The result is not only less swamped land and lower erosion rates, but fewer weeds.

On top of that, the Finnegans have been able to make their cover crops a source of revenue by grazing their direct-marketed beef herd on them. That rotational grazing is feeding the soil by spreading manure and urine evenly across the fields, "fast tracking" soil health and increasing aggregate structure even more, says Finnegan. Even the tops of hills that had been damaged by erosion when the farm was rented out are now building organic matter.

"We've seen a huge improvement and with not having to spend all the money on extra tile," says the farmer, adding that building soil health isn't just good for the land. "It's kind of addicting because you're seeing change, you're seeing the land respond. Any small amount of change just has a huge effect — it's remarkable how everything is interconnected." ❐

Give it a Listen

On LSP's *Ear to the Ground* podcast, hear the folks quoted in this article discuss some of the economic rules related to building soil health profitably. The episodes are at landstewardshipproject.org/ear-dirt.

- ✔ **Episode 308: Is Your Farm a Business?** (Dave Pratt)
- ✔ **Episode 301: Pipe Dreams** (Tom Finnegan)
- ✔ **Episode 297: Web of Willing Workers** (Elaine Ingham)
- ✔ **Episode 296: Stability is Sexy** (Rick Clark)
- ✔ **Episode 288: More with Less** (Tom Cotter)
- ✔ **Episode 260: Soil Health's Long View** (Martin Larsen)

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Interested in profitable ways to build soil health? Join hundreds of other like-minded farmers, natural resource professionals, and others in the Upper Midwest and become a member of the Land Stewardship Project's Soil Builders' Network. Members get regular updates on workshops, field days, and on-farm demonstrations, as well as the latest soil health and cover crop research.

For more information on joining, see landstewardshipproject.org/soil-health or contact LSP's Alex Romano (aromano@landstewardshipproject.org, 612-767-9880) or LSP's Maura Curry (mcurry@landstewardshipproject.org, 612-767-9882).