Science Societies

Soil health management practices in the diverse Intermountain West

More local information would help farmers, crop advisers

By Megan Sever

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Producers and crop advisers in the Intermountain West rely on diverse sources of information about soil health management, from YouTube videos to demo day events. Photo courtesy of Tony Richards.

The Intermountain West spans the basin and range between the Rockies to the east and the Cascades and Sierra Nevada to the west. Its features diverse agricultural terrain and activity.
Soil health management practices this region remain significantly understudied compared with other areas, according to a commentary published in the journal *Agricultural & Environmental Letters*.

A survey of crop advisers and farmers across Utah explored their role in promoting soil health practices and identified barriers to and opportunities to expand soil health management practices.

It may be hard to come up with a more varied agricultural terrain than the Intermountain West. The region spans the basin and range between the Rockies to the east and the Cascades and Sierra Nevada to the west. This area features dry rangelands interspersed with montane forests and fertile valley floors among elevated plateaus. Agriculture here is as diverse as the physical landscape: Ranching and livestock dominate, but farmers also irrigate cornfields, milk dairy cows, grow small grains and alfalfa, and cultivate orchards and vineyards in the valleys.

Despite this diversity, agriculture in the region—and the specific soil health management practices it requires—remains significantly understudied compared with other areas, according to a commentary published in in *Agricultural & Environmental Letters*. Most farmers and crop advisers acknowledge the importance of soil health management, says Society member Matt Yost, an agroclimate extension specialist at Utah State University and co-author of the study. Their livelihoods and those of their children and grandchildren depend on it, he says. Farmers have a sense of commitment to stewardship of their land. But they may not know what "soil health management" means for their particular property.

"A lot of the research that has been done on soil health management has been done in other places," like the Great Plains or the Midwest, says Jessica Schad, a rural sociologist at Utah State University and a co-author of the commentary. This leaves farmers in areas like the Great Salt Lake Basin facing challenges like salt management and compaction with little relevant guidance.

To address this gap, Schad, Yost, and their colleagues launched a study under a USDA-NRCS grant, in partnership with the Utah Department of Agriculture and Food (UDAF). They surveyed 50 crop advisers across Utah to explore their role in promoting soil health practices and to identify barriers to and opportunities to expand soil health management practices. A follow-up survey targeted farmers, offering insights tailored to their perspectives. Together, these efforts aim to pinpoint gaps and refine outreach strategies for effective soil health management in the region.

Intermountain West's diverse farming landscape

Idaho is the only Intermountain West state to rank among the top 20 in gross agricultural receipts. Idaho leads the nation in potato production, ranks second in

sugarbeet production, and ranks third in cheese production. In Montana, ranked 29th in agricultural receipts, agriculture is the largest industry with 56 million acres of farmland—second only to Texas. The state exports billions of dollars' worth of wheat and beef annually. Nevada boasts the third-largest ranches in the U.S. with cattle as its top agricultural product. Nearly half of Colorado's land is farmland with 80% of the state's Colorado River water used for agriculture. Utah's agriculture generates $2.8 billion in direct receipts annually with significant economic ripple effects from industries like flour milling. Despite this, the Intermountain West often gets overlooked in national agricultural discussions.



The Intermountain West. Source: USGS.gov.

Throughout the high desert region, key crops include alfalfa, grass hay, silage corn, and grain corn, says Mark Piper, an agronomist and crop adviser working in Utah, Nevada, and western Colorado. Cattle and sheep ranching are also major industries, and Utah, better known for its striking landscapes like Moab and Zion, has a robust dairy industry. The state also produces wheat, safflower, and small grains.

The recent study on Utah soil health began with a statewide survey more than a decade ago, revealing limited adoption of practices like no-till and cover cropping. This led to the establishment of Utah's Soil Health Program in 2021 through a legislative amendment. The current Utah Soil Health Partnership program builds on this foundation, promoting practices to improve soil health statewide.

Utah's two biggest soil challenges are salts and water. "Salts are decreasing our yields more than anything else," says Piper. Salt in the soil causes compaction when livestock or farm equipment tread on it, reducing porosity and hindering crop growth. Addressing salt issues is a key focus of the state's soil health efforts.

Water scarcity, driven by reduced snowpack, is the other major concern. Most of Utah's irrigation relies on snowmelt, and the devastating 2022 drought—when reservoirs like Lake Powell hit record lows—spurred changes in water management practices, Yost says.

Principles of soil health management

"Soil health management" can be a vague concept, so the UDAF developed a program to offer a framework for understanding and implementing soil health practices rather than prescribing specific methods, explains Tony Richards, the agency's soil health program manager. "We identify six principles, starting with 'know your context,'" Richards says.

The other principles include keeping soil covered, minimizing disturbance, maximizing biodiversity, maintaining living roots, and integrating livestock where appropriate. These principles guide specific decisions, such as using cover crops or reducing tillage. However, what these practices look like in Utah differs from regions like the Midwest, Yost notes. "Our lands aren't dominated by annuals, so we already plant perennials and till less," he explains. (This is one of the researchers' chief points: that what works elsewhere doesn't necessarily work in the Intermountain West.)

Every farm is unique with differences in climate, soil type, equipment, and producer capabilities. Each soil health journey must be viewed through the lens of that context.

Tony Richards discussing the six principals of soil health practices and giving a demonstration.

In Utah, cover crops keep roots in the ground and maintain soil biological activity, which helps avoid compaction, Piper says. “It’s not like a true cover crop, like you’d see in the Midwest though,” he says. “It’s more of a ‘Hey, I have some cheap wheat seeds. I’m going to cover my ground and keep roots in the ground, so we can continually keep our soil active and alive and open for salt penetration and keeping our soils healthy.’” Managing soil compaction through reduced tillage is also key, but there’s a balance because true no-till can lead to severe compaction where the ground basically shuts down, he says. Because the compaction is so tight, salt levels increase and plants die. “So you have to find the balance of these activities on each farm.”



Maintaining living roots in the soil is a key soil health practice. Screenshot from this video by the Utah Soil Health Partnership

Other strategies include crop rotation, crop diversification, organic amendments, interseeding, water management, and introducing legumes and forbs in rangelands. Rangelands present unique challenges, particularly on public lands where management options can be limited, Schad says.

Even when they can't plant or manage tillage, ranchers are also adopting innovative soil health practices, such as managed intensive grazing, rotational grazing, precision grazing, and adaptive grazing, Richards says. For example, rather than just letting the livestock on rangelands graze freely, ranchers may institute rotational grazing using virtual fencing. Utah's Soil Health Program supports the adoption of virtual fencing, which uses GPS collars on cattle to control their movement without physical barriers (like the invisible fencing used for dogs). Virtual fencing is particularly useful for grazing on public lands and other areas where traditional fencing is impractical, Richards says.

Strategic grazing can protect sensitive areas and enhance vegetation, Yost adds. “Cattle can aid or have negative effects on vegetation, “so ranchers are becoming more deliberate about when and where they graze to balance the impact on the land, he says.

Ultimately, the focus of the soil health management conversation needs to be on building resilience, Richards says. Creativity also plays a role, Schad adds, especially in designing sustainable food systems and smarter foodscapes.

Soil health management communication and collaboration

When Schad, Yost, and their colleagues surveyed crop advisers and producers, they found notable differences in how each group views their role in, and gathers information about, soil health management. For example, Schad says, crop advisers view themselves as key sources of information, but producers don’t rank them as highly. Advisers believed their clients’ top sources of information were other producers (80%), themselves/crop advisers (70%), and university extensions (56%), the researchers wrote in Agricultural & Environmental Letters. Advisers relied most on in-field experience (94%), their customers (82%), and colleagues (82%). The survey of 500 producers (unpublished data) revealed that other producers were the top information source (28% used often), not advisers. Other top information sources for producers included: Government entities (19% used often), university extension (15% used often), and crop advisers (13% used often).

This aligns with what Piper observes: Producers often look to their neighbors and replicate successful practices. “Social networks among farmers are tight,” Yost adds. “They watch and talk to each other. Innovators try things, succeed, and others follow.”

Producers also turn to diverse sources. Surprisingly, Schad says, YouTube has become a significant tool for some. More traditional sources like the NRCS, university extensions, and demo day events also play an important role. Demo days, where new technologies, equipment and practices are showcased, are particularly valuable, Richards notes.



Grants from the Utah Department of Agriculture and Food to local conservation districts allow farmers to rent tools like interseeders, mowers, and no-till drills, pictured. Photo courtesy of Tony Richards.

The disconnect between where advisers think producers get their information and where producers actually do highlights the need for better communication, Schad says. Additionally, the information from these sources often conflicts. Scientists,

advisers, and extension specialists “need better collaboration and more consistent messaging,” Yost says.

Barriers to adoption

Most producers reported that they have a high interest in—and use of—soil health management practices (90% agree or strongly agree soil health is important to them). The Utah Soil Health Partnership “program has moved from the leading edge to the mainstream," Richards says, with more producers willing to try new practices after seeing success in others. Cultural barriers and past failures, such as with no-till equipment, have been significant challenges, he says, but there is growing interest as input costs rise and water shortages become more prevalent.

Piper notes that many of his clients embrace soil health practices, with about half “aggressively” working to improve soil health for better returns on investment (ROI). Economic pressures and rising input costs are pushing farmers toward practices like minimum tillage and cover crops to boost profitability.

One grower Piper worked with reduced irrigation water use by 6 inches/ac by adding residue and choosing water-efficient grain and cover crop varieties. “We call it crop per drop,” he says, referring to maximizing crop yield per unit of water. Understanding the ROI of soil health practices, including water savings, drives adoption. For well users, water efficiency translates directly into cost savings, while surface water users benefit from lower operational expenses. “That’s the future,” Piper says—increasing soil health to sustain or increase yields with less water as precipitation patterns shift.

Ultimately, economics will determine whether producers make changes. Equipment costs, however, remain a major obstacle. New equipment like no-till drills, for instance, can cost tens to hundreds of thousands of dollars, Yost explains, and the survey

revealed that financial constraints prevent many farmers from investing in needed equipment.

Even so, seeing a neighbor increase yields or lower costs by adopting reduced tillage, cover crops, or more efficient irrigation can tip the scales toward change.

Overcoming barriers

On the economics front, there are programs to help. Grants and financial assistance are offered by NRCS, UDAF, and others. Grants from UDAF to local conservation districts allow them to rent no-till drills, interseeders, and mowers for farmers to test these tools before making long-term investments, Richards says.

Both crop advisers and growers often lack adequate economic data on soil health practices, especially localized insights. The survey revealed advisers feel underinformed, limiting their ability to guide producers effectively.

Better communication among advisers, producers, and government programs is also crucial, Richards says. Misalignment can cause conflicts, such as when a producer unknowingly violates an NRCS conservation program due to conflicting advice. Many

producers are also unaware of available government support programs, he says.

Efforts like the Utah Soil Health Partnership Soil Health Network Project address these challenges. With 16 demonstration farms in varied landscapes and climates across the state, the program works with local farmers on trial plots and then gathers data through interviews and economic assessments to provide actionable insights. Field days and field visits are key components, Schad says. These events allow farmers to see practices in action, hear from agronomy experts referencing data, and learn directly from peers about implementation and challenges. “Hearing from both the expert and the farmer who’s tried it on his property creates a powerful way of disseminating information through statistics and storytelling,” she explains.



Field days and field visits allow farmers to see practices in action, hear from agronomy experts referencing data, and learn directly from peers about implementation and challenges of soil health management practices. Image courtesy of Jessica Schad.

Hundreds of producers attend these events, Yost adds, underscoring their impact. Richards agrees that while research and success demonstrations are vital, peer-to-peer sharing and local examples have proven especially effective in driving adoption.

Future of soil health management

Farmers are often among the first to respond to climate changes, including more frequent and severe droughts and heavier rainfall during storms. Practices like no-till farming and cover crops are increasingly popular as producers adapt to drought conditions and seek profitability, Piper says. Likewise, leaving crop residue improves water retention, making it easier to grow during dry spells. Soil health is fundamentally about resilience, Schad says. Producers are adopting these practices to adapt to changes like shifting precipitation patterns and to boost their bottom lines.

The Utah Soil Health Network Project aims to provide data and evidence supporting these practices over the coming years. Now in its third year of a five-year project, it focuses on building momentum for soil health through statewide field days and demonstrations that showcase successful practices and gather producer feedback. The team plans to resurvey participants at the end of the project to track changes in attitudes and adoption of soil health practices, Schad says. The ultimate goal is to deliver practical, region-specific tools for producers.



The Utah Soil Health Network Project focuses on building momentum for soil health through statewide field days and demonstrations that showcase successful practices. Image courtesy of Tony Richards.

Economic sustainability is the primary driver for producers, encompassing both soil and water conservation. However, Richards advises caution: Soil health management isn't a quick fix. He suggests starting small—experimenting with one field and seeing how it goes before scaling up. "Have patience," he says. "Then try new things."

Dig deeper

Check out the study in *Agricultural & Environmental Letters* here:

Petrzelka, P., Ulrich-Schad, J. D., Yost, M., & Barnett, M. J. (2024). Crop advisors in the intermountain west and the challenges of soil health. *Agricultural & Environmental Letters*, 9, e20142. https://doi.org/10.1002/ael2.20142

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