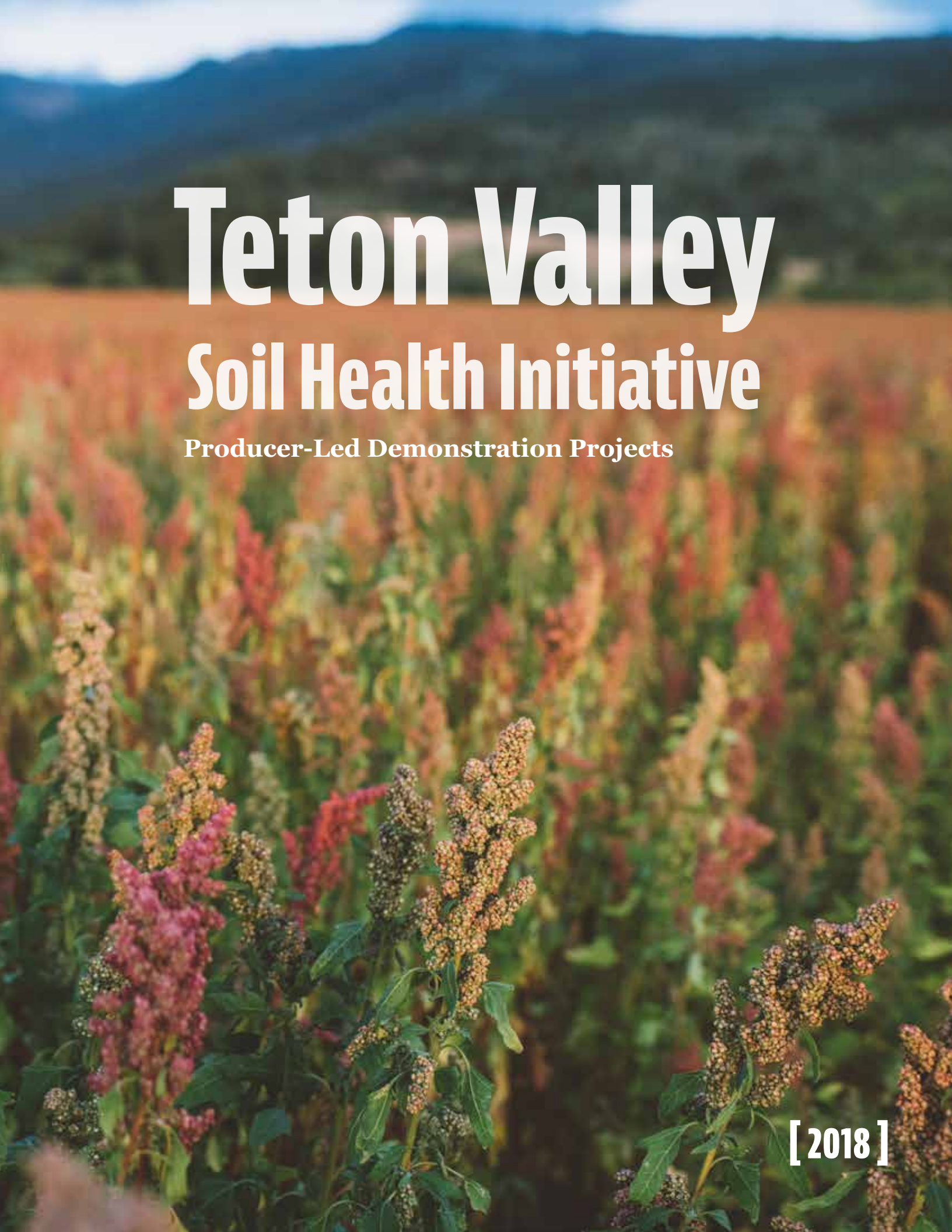

Teton Valley
Soil Health Initiative
Producer-Led Demonstration Projects

[2018]

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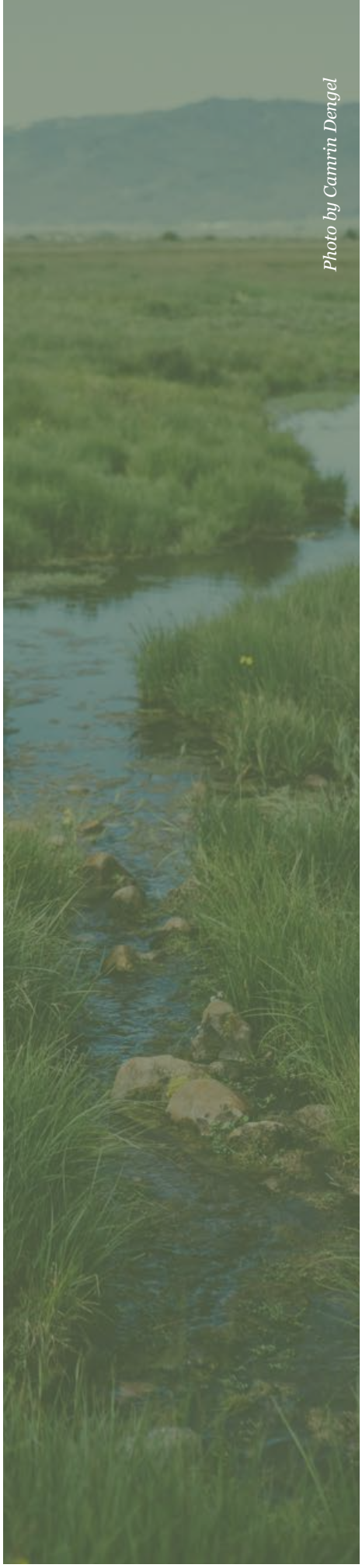


Photo by Camrin Dengel

Growing Conditions at a Glance

- **Lowest elevation:** 5,100 ft
- **Highest elevation:** 8,000 ft
- **49-65 frost-free** days per season
- USDA Plant Hardiness **Zones 4b -3b**
- **Average annual precipitation 12.5 inches** in the lower subbasin to **18 inches** in the upper
- **Primary crops:** potatoes, barley, wheat, hay (forage)

Land in the upper Teton River Subbasin is:

- **68.8 percent privately owned** cropland or pasture (irrigated and non-irrigated lands)
- **7.3 percent rangeland**

Teton River Subbasin Growing Conditions

The Teton River Subbasin is located in eastern Idaho and is one of the three watersheds that make up the Henry's Fork Basin. The Teton River drains just over 1,000 square miles in Idaho and Wyoming with the headwaters originating in the Teton Mountain Range, the Snake River Mountains, and the Big Hole Mountains. It is characterized by a short growing season, approximately 49-65 frost-free days each summer, with average total annual precipitation between 12.5 inches in the lower subbasin and 18 inches in the upper subbasin. Cropland and pasture on private land (both irrigated and non-irrigated lands) makes up just under 70 percent of the land use in the upper Teton Subbasin. Primary crops grown include barley, hay (forage), potatoes, wheat and more recently quinoa and buckwheat. Livestock, primarily beef cattle and a few remaining dairies, also play an important role in the agricultural economy.

Photo by Camrin Dengel

Teton Valley Soil Health Initiative

The Teton Valley Soil Health Initiative is focused on improving the health and productivity of agricultural lands in the Teton subbasin to improve local water resources, increase the viability of family farms and ranches, and preserve Teton Valley's cultural heritage. Soil health refers to the chemical, physical, and biological characteristics of soil. It is well documented that improving soil health on farms and ranches can lead to increased farm productivity, improved nutrient cycling, increased water holding capacity, and increased drought resilience. In addition to having significant benefits on farms and ranches, improving soil health on agricultural lands in the Teton River subbasin will have a significant positive impact on water quality and quantity. Healthier soils can reduce soil erosion and more efficiently cycle nutrients, reducing both sediment and nutrient runoff into local streams and waterways. Healthier soils can also hold more water, making crops more resilient in drought conditions, a valuable asset to farming and ranching in a semi-arid environment.

Soil Health Principles

Soil health is "the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans." A holistic view of soil health considers chemical, physical, and biological properties of soil and can be broken down into five guiding principles:

Keep the soil covered

Keeping the soil covered year-round with crop residue or living plants can help reduce wind or water erosion, reduce evaporation rates, moderate soil temperatures, and reduce weed pressure.

Minimize soil disturbance

Minimizing chemical disturbance (over application of fertilizer, herbicide, fungicide, insecticide, etc.), biological disturbance (long fallow periods), or physical disturbance (tillage) improves overall soil health and structure. Physical soil disturbance, or tillage, leads to soil that is more susceptible to wind and water erosion, reduced water infiltration, and increased soil compaction.

Increase plant diversity

Increasing plant diversity mimics natural systems and in turn reduces disease and pest pressure, improves nutrient cycling, increases water infiltration rates, and can reduce the need for inputs such as fertilizers, insecticides, herbicides, and fungicides.

Maintain continuous living plants/roots

The roots of living plants release sugars that feed the soil food web, improving the biological health of the soil and, as a result, improving nutrient cycling. Soil organisms feed on sugar released from living plant roots, dead plant roots, above ground crop residues, and the organic matter in the soil. By maintaining a continuous supply of sugars released from living roots, there is plenty of accessible food for soil microbes that in turn help efficiently cycle the nutrients that plants need to grow.

Integrate livestock

Livestock can play an important role in building soil health and function. Properly managed livestock in a perennial grazing system or the proper integration of livestock in an annual cropping system can improve soil health, biological activity, moisture efficiency, and nutrient retention and cycling.

These five principles can be applied to any production system to maximize the soil building impact and improve overall soil health. However, the specific tools used to implement each principle will differ for each operation. In the Teton River subbasin, improving soil health on farms and ranches can lead to improved farm productivity, improved water quality, increased water holding capacity, and increased drought resilience.

Photo by Camrin Dengel

Learn More about Soil Health
Menoken Farm is a conservation demonstration farm that provides soil health education through videos, podcasts, and articles.

menokenfarm.com

Photo by Eric Soyland

2018 Producer-Led Demonstration Projects

In 2018, four Teton Valley producers implemented a variety of soil building practices, including cover crop application, conservation tillage techniques, and livestock integration to address soil health concerns in Teton Valley and to gain familiarity with each practice. Although the specific goals and implementation techniques are different for each producer, the 2018 producer-led demonstration projects can be categorized into four groups: full season cover crop application for forage, full season cover crop application, post-harvest cover crop application, and transition to a no-till system.

Cover Crop Application

A cover crop, also sometimes referred to as a green manure, is a plant species or a diverse mix of plant species that can be used in a crop rotation to provide a variety of benefits, while not being harvested as a cash crop. Cover crop benefits can include reduced or eliminated soil erosion, improved nutrient cycling and availability, increased water infiltration, reduced soil compaction, increased soil organic matter, increased plant diversity, and reduced weed pressure. Cover crops can be planted after a cash crop is harvested (if growing season length permits), as a full season crop instead of summer fallow, or as a forage crop to be grazed by livestock. Additionally, it is becoming more common for producers to inter-seed cover crops into a standing crop (a low-lying legume in between rows of a grain cash crop, for example) or "plant green," which means seeding a cash crop into cover crops that are still alive but soon to be terminated.

No-Till Farming

One of the five soil health principles is minimizing soil disturbance. This includes the physical disturbance of tillage. Soil disturbance from frequent tillage leaves soil broken and exposed, and more susceptible to wind and water erosion, which breaks down the spaces between soil aggregates, leading to increased soil compaction and reduced water infiltration. Tillage also physically mixes soil organic matter with oxygen, resulting in the burning-off of organic matter and the release of carbon from the soil into the atmosphere. Many studies have shown that soil health (soil structure, microbial activity, earthworm populations) can increase significantly by adopting no-till practices. In addition to soil health benefits, no-till agriculture can reduce labor and fuel costs by minimizing the number of passes made by equipment per crop.

Grazing Management & Livestock Integration

Well-managed livestock in a perennial pasture system or integrated into a row cropping system can have significant benefits to overall soil health, including increased moisture efficiency and nutrient retention, improved water quality, and better managed weed pressure. Livestock can be integrated into a cash crop system by grazing a full season cover crop, grazing a fall seeded cover crop and annual crop residues, or by seeding perennials to graze and manage as part of the crop rotation. To maximize the soil building impact, livestock must be well managed to prevent overgrazing or other detrimental impacts of grazing. In the Teton River subbasin, livestock integration into a cropping system is no longer a common practice but more and more producers and becoming interested in reimplementing this practice to improve soil health.

Want to know more?

Cover Crops
Sustainable Agriculture Research & Education
sare.org/Learning-Center/Topic-Rooms/Cover-Crops

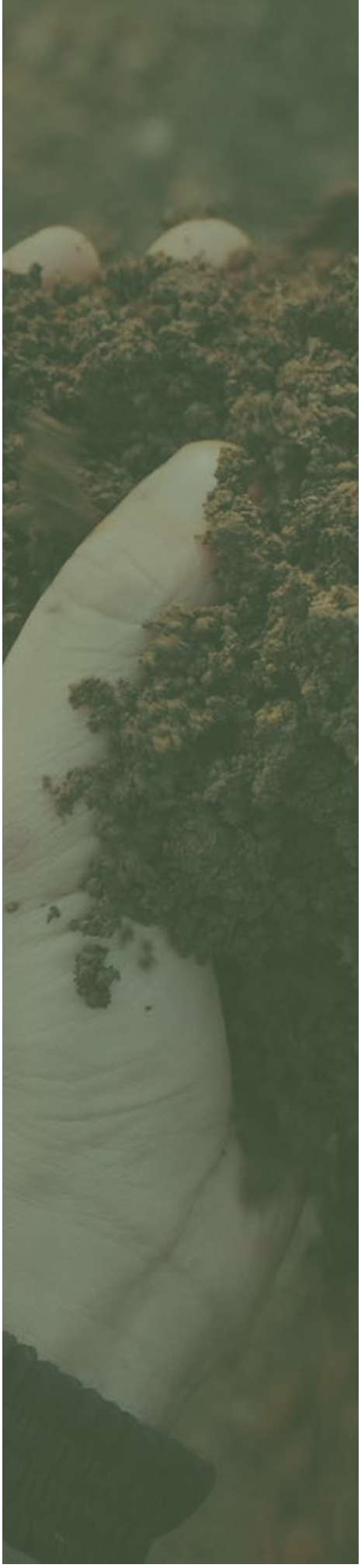
No-Till Systems
No-Till Farmer Podcast
no-tillfarmer.com/topics/494-no-till-farmer-podcast

Livestock Integration
Understanding Ag
Dr. Allen Williams, Consultant
understandingag.com/dr-allen-williams

Purpose of this Guide

Cover crops, no-till farming, and livestock integration have been proven to be effective in improving soil health, farm productivity, water quality, and water holding capacity, but implementation challenges in the Teton River subbasin exist. These challenges include a lack of proven techniques that work in these specific growing conditions, limited experience and familiarity of no-till equipment, and thin margins to implement new management practices. This guide was developed to share the successes and challenges of four producer-led demonstration projects implemented to improve soil health on local farms and ranches. It is intended to be used as a resource for agricultural producers in Teton Valley interested in adopting soil building practices.

Cattle in the Teton River Subbasin enjoy the golden hour just before the sun goes down. Photo by Camrin Dengel.



Soil Health Monitoring

On each demonstration field, soil health and crop productivity tests were performed to help us assess implementation successes, understand baseline soil conditions, and track soil health changes overtime. Baseline soil health test results from 2018 will be compared to future tests on the same fields to monitor changes overtime. Tests conducted on each project include water infiltration rates, soil compaction, Haney Soil Test, crop and weed stand counts, and above ground crop yield. This guide includes test results on water infiltration rates, soil compaction, and Haney Soil Tests. For a complete set of results on each demonstration project, please contact FTR.

Water Infiltration Rate

Water infiltration rate measures how quickly water can move through the soil profile and be available for uptake by plants and soil organisms. A water infiltration rate that is too slow leads to increased runoff, water pooling on the surface of soil, increased erosion, and, consequently, inadequate moisture availability for crop production. Infiltration rates that are too high can lead to leaching of water or any applied nutrient or chemical below the root zone making it unavailable to plants.

When comparing infiltration rates, it is important to note that soil texture (sand, silt, clay) inherently impacts infiltration rates. For example, sandy soil has larger pore spaces and overall higher infiltration rates. Infiltration rates shown below give a general guideline for each soil texture group.

Soil Type	**Infiltration Rate** (inches per hour)
Sands	> 0.8
Sandy and silty soils	0.4 - 0.8
Loams	0.2 - 0.4
Clayey soils	0.04 - 0.2
Sodic clayey soils	< 0.04

NRCS Soil Infiltration Soil Quality Kit-Guides for Educators

Soil Compaction

Compacted soil can reduce water infiltration rates, increase runoff, reduce crop yields, and lead to a decline in soil health over time. With the implementation of soil building practices, we expect to see reduced soil compaction over time. Results listed indicate the feet of penetration in each location with the same amount of force applied. The higher the result, the better or less compacted the soil is. Results listed for each demonstration project will be used to establish a baseline for comparison in future years.

Haney Test

The Haney Test is a soil health test that examines both chemical and biological factors of the soil. Individual parameters such as soil microbe respiration, carbon to nitrogen ration, and water extractable carbon and nitrogen are reported and combined into a weighted-average soil health calculation. Soil health calculations can range from zero to fifty, with scores above seven and increasing over time being indicative of good soil health. Understanding the following testing parameters will help us interpret Haney Test results for each demonstration project.

Organic Matter: The most productive agricultural soils in the United States generally have 3-6 percent soil organic matter. In Teton Valley most agricultural soils have 1-3 percent soil organic matter. Soil high in organic matter has physical, chemical, and biological benefits, including nutrient and water holding capacity, water infiltration rates, and improved soil aggregate stability, all leading to improved drought resilience.

Soil Respiration: This is a measure of microbial activity in the soil sample. In general, a higher number is better. Ward Labs give the following classification for results:

0-15 Very Low
15-30 Below Average
30-50 Slightly Below Average
50-70 Slightly Above Average
70-100 Above Average
100- 200 High

Organic Carbon (C): This is a measurement of the food that is most readily available to soil microbes. Generally, the higher the number, the better, which indicates that there is more food or energy available to drive the microbial food web. Ward Lab reports that most results fall between 100-300 parts per million.

Organic Nitrogen (N): This is a measure of the pool of organic nitrogen that is available to soil microbes. As with the Organic C, the higher the value the better in most situations, but it is important to have a balance between Organic C and Organic N for optimal soil microbe conditions. Ward Lab reports that most results fall between 10-30 ppm.

Organic Carbon to Organic Nitrogen Ratio (C:N): This is a measurement of the quality of the food available to microbes or the "feed value." A C:N ratio that is too high means that soil microbes have more carbon than nitrogen and will use all the available nitrogen not leaving any excess for plants to use. A C:N ratio that is too low means that soil microbes do not have enough carbon to thrive. Ideally this value is between 10 and 12, with good values between 8 and 15. Any C:N ratio over 20 means that soil microbes are lacking nitrogen for optimal growth.

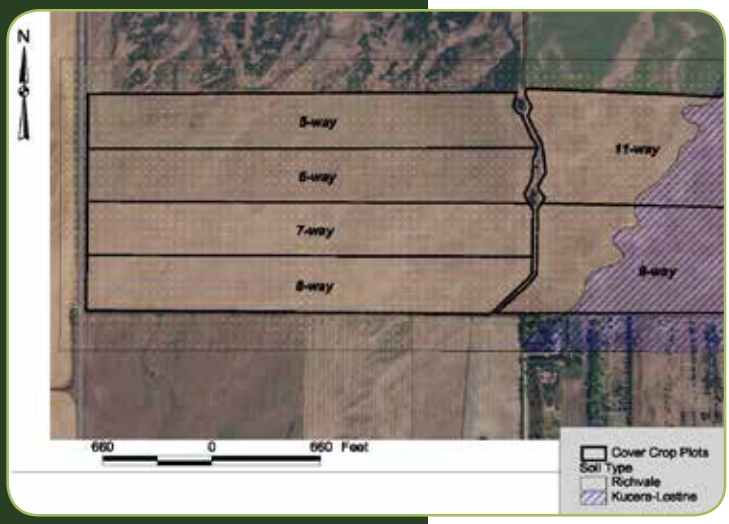
Soil Health Calculation: This number is calculated using the parameters listed above to give a quick snapshot of soil health. This is a good tool to measure the impact of changes in management practices. In general, the higher the score, the better, with scores of 7 or higher a good indicator of healthy soils.

Learn more about the Haney Test

Ward Laboratories provides resources on sampling methods and to help interpret Haney Test results.

wardlab.com/haney-test

Piquet Land and Cattle:
Dryland Full Season Cover Crop for Forage



Piquet Land and Cattle, also called PK, is a 4th generation family owned and operated cow calf cattle operation. In the spring of 2018, Robert Piquet and his family transitioned 120 dryland acres from a barley-summer fallow rotation to a full season, multispecies cover crop mix for forage. Robert's main goals included determining what cover crop mixes would work well in a dryland system for beef cattle forage in Teton Valley, increasing plant diversity, and improving soil health.

To determine what cover crops would work well, Robert seeded six different full season cover crop mixes using the Teton Soil Conservation District's fifteen foot no-till seed drill. Overall germination and stand density across all cover crop mixes was good, producing an overall mean dry matter of 2.05 tons/acre, which is a high yield for a dryland annual crop in Teton Valley.

Seeding Notes

Field Preparation: Fall 2017, chisel plow 4 -6" deep and two passes with tandem disk

Seeding Method: Great Plains 15' no-till seed drill

Seeding Date: May 3 - May 5

Seeding Rate: Varies with mix (see table at right)

Cover Crop Seed Mixes: 6 different cover crop mixes were selected ranging from a 5-way species mix to an 11-way mix

Grazing Notes

Total Number of Acres Grazed: 80

Grazing Dates: July 21st- August 7th

Stocking Rate: 170 cow/calf pairs + 8 bulls grazed 4-5 acres per day

Frequency of Moves: Daily

Cow Days Per Acre (CDA): 37.8

Cover Crop Seed Mixes

	5-way	6-way	7-way	8-way	9-way	11-way
Variety						
Monida Oats	46%	44%	39%	38%	25%	25%
Tritical 141	45%	43%	38%	37%	24%	
Daikon Radish	2%	3%		3%		
Peredovik Sunflowers	4%	5%	5%	5%	5%	1%
Crimson Clover	3%	3%	3%	2%	3%	2%
Purple Top Turnip		2%	3%	2%	3%	2%
Common Vetch			10%	11%	12%	
Groundhog Radish			2%		2%	3%
Plantain				2%	2%	
Common Rye					24%	
Wooly Pod Vetch						2%
Austrian Peas						16%
Maple Peas						20%
Merlin Triticale						21%
Yamhill Wheat						5%
Pasja Turnip						2%
Seeding Rate	55 lbs/ acre	49.8 lbs/ acre	47.54 lbs/ acre	44.22 lbs/acre	43.28 lbs/ acre	56 lbs/ acre
Seed Cost (per acre)	**$29.04**	**$28.13**	**$30.33**	**$33.08**	**$30.29**	**$35.00**

While differences in crop productivity for each cover crop mix were not significantly different, Robert preferred the 5-way mix for forage. The more diverse cover crop mixes added plant diversity but not as much above ground biomass desirable for forage and building soil organic matter.

Grazing Methods

Robert used management-intensive grazing to achieve high stocking densities for a short duration of time followed by a long period of recovery. A total of 80 acres out of 120 acres were grazed, with 40 acres not grazed due to the cover crop stand becoming too mature. The cows were moved daily into 4-5 acre paddocks created with temporary electric fencing.

Cover crop productivity was measured using cow days per acre (CDA). Using this measurement, the 80 acres grazed produced 37.8 cow days per acre indicating that you could graze one cow on one acre for 37.8 days or 37.8 cows on 1 acre for 1 day.

Water Infiltration Rates

The average water infiltration rate was just over .50 inch per hour. This demonstrates that if it rains 1 inch in 1 hour, .59 inches will be absorbed into the soil and available for plants and the remaining .41 inches will run off. Water infiltration rates ranged from a minimum of .21 inches per hour (less than a quarter of an inch) to a maximum of 2.34 inches per hour.

	Water Infiltration Rates (inches/hour)
Minimum	0.21
Median	0.59
Maximum	2.34

Haney Test

The median soil health calculation, prior to cover crop application and the use of adaptive grazing, was 5.8 for the entire 120-acre parcel. If management practices are improving soil health, this soil health calculation should increase over time.

Field	Organic Matter % LOI	Soil Respiration (CO_2- C) ppm C	Organic C ppm C	Organic N ppm N	Organic C:N	Soil Health Calculation
Minimum	2.3	12.5	90	9.9	7.8	4.17
Median	2.45	21.25	116	12.8	9.05	5.84
Maximum	3.8	56.5	138	16.0	9.7	10.02

Key Lessons

- When growing a full season cover crop for forage, start with a simple cover crop mix with a few different species. Add species once gaining familiarity with cover crops.
- In this demonstration project, the more diverse cover crop mixes—8-way, 9-way, 11-way mixes—added plant diversity but not as much above ground biomass desirable for forage.
- For others growing a full season cover crop for forage, Robert would recommend a simple cover crop mix with a few different species for ease of seeding, quality of forage, and cost of seed mix.
- Next time, Robert would start grazing sooner to avoid not being able to use 40 acres of feed that was too mature to graze.

Photo by Robert Warren

B and R Farms:
Dryland Full Season Cover Crop as an Alternative to Summer Fallow

Figure 2. Site Detail Map

Ralph Egbert of B and R Farms raises cattle, dryland barley, and hay for forage. In 2018 Ralph applied a full season cover crop mix on 30 acres of dryland as an alternative to summer fallow between barley crops. This 30-acre parcel has been planted in Barley and managed in a conventional till system with annual fall plowing and spring disking since 2016, if not longer. The main goals for this project included weed control on fallow ground, erosion control, and overall improved soil health. A secondary goal was to use the cover crop mix as a forage for beef cattle.

Seeding Method

Ralph seeded a 9-way cover crop mix using a conventional seed drill. The cover crop was seeded on May 3 at a rate of 40 lbs/acre. All seeds were mixed together without the ability to change seeding rate or depth according to seed size or plant species.

Ralph experienced poor germination and stand development across the 30-acre parcel. Ralph attributes this to poor soil preparation—not enough cultivation to kill weeds and incorrect seeding depth. Ralph noticed that peas, oats, radish, turnip, and safflower germinated but he did not notice that any other species did. Dry matter yield (tons/acre) results also reflect poor cover crop stand with a mean of 1.5 tons/acre as compared to results from a different producer-led demonstration project with 2.5 tons per acre planted on a similar date in similar dryland conditions.

9-Way Cover Crop Seed Mix	
Variety	**Percentage**
Spring Pea	34%
Spring Oat	27%
Common Vetch	20%
Meadow Brome	7%
Safflower "Finch"	4.5%
Collards: Impact Forage	2.3%
Graza Radish	2.3%
Purple Top Turnip	1.1%
Plantain "Boston"	1.1%
Seed Cost (per acre)	**$48.53/acre**

Seeding Notes

Field Preparation: Fall 2017: chisel plowed 12" and disked spring 2018: roller harrow

Seeding Method: no-till seed drill

Seeding Date: May 3rd

Seeding Rate: 30 lbs/acre

Seed Mix: 9-way cover crop mix

Soil Compaction

Soil compaction can reduce water infiltration rates, increase runoff, reduce crop yields, and lead to a decline in soil health overtime. Results listed indicate the feet of penetration in different locations with the sam amount of force applies. The higher the result, the better or less compacted the soil is. With the implementation of soil building practices, we expect to see reduced soil compaction over time.

Soil Compaction (feet of penetration)				
	South Parcel	North Parcel	Control	Fence line (untilled)
Minimum	0.83	0.46	0.93	1.16
Median	1.36	0.98	1.00	1.53
Maximum	1.96	1.33	1.06	1.79

Haney Test

The Haney Test results indicate low soil health calculations across all sampling points with all results below the recommended soil health calculation of 7. This is likely due to low amounts of organic matter, low amounts of microbial activity, and low amounts of available carbon and nitrogen food sources for soil microbes. The Haney Test will be repeated annually to see if management changes and the implementation of soil-building practices improves the soil health calculation over time.

Field	Organic Matter % LOI	Soil Respiration (CO_2- C) ppm C	Organic C ppm C	Organic N ppm N	Organic C:N	Soil Health Calculation
Minimum	1.8	11.7	97	11.1	8.6	4.39
Median	2.2	14.6	105	11.3	9.5	4.8
Maximum	2.5	14.6	142	14.8	9.6	5.77

Key Lessons

Due to poor germination and poor cover crop stand densities, the desired result of improved weed control was not achieved. In response to this, Ralph identified changes to make for future years:

- When transitioning from a long-term conventional cropping system to a no-till system, slowly reducing the amount of tilling over time, while also implementing soil building practices may lead to a more successful transition to a no-till system.
- Seek a less expensive cover crop seed mix that would reduce the financial risk taken on by a producer.
- Start with a less diverse cover crop mix, a 3 species mix for example, to make seeding easier.

Teton Mountain Ranch: Transition to Irrigated No-Till Barley

Teton Mountain Ranch is a 5th generation family-owned and -operated farm and ranch raising livestock (cattle and elk) and forage (hay and barley). In 2018, Teton Mountain Ranch began a multi-year farmer-led research project to transition one 32-acre parcel into a no-till system while keeping an adjacent 31-acre parcel conventional till. The primary goal of this project was to gain familiarity with adopting a no-till system for an irrigated barley crop and to establish baseline soil health data between a conventionally managed barley crop and a reduced or no-till barley crop.

Teton Mountain Ranch seeded the entire 63-acre field in Copeland malt barley using an end-wheel seed drill. All inputs were the same on the no-till parcel (treatment) and conventional parcel (control). The entire field was harvested on September 6 and barley yield was uniform across the entire parcel at approximately 80-90 bushels/acre. After harvesting grain, the straw was baled, and the entire parcel was irrigated to encourage volunteer grain growth. Volunteer grain growth was grazed supporting 50 head for 5-6 days.

Soil Health Tests

2018 was the first year of a multiple year comparison between no-till and conventional till irrigated barley cash crop. The data presented below provides information to establish baseline soil health data and will be compared to future data annually.

Water Infiltration Rates

The average water infiltration rate was 4.3 inches per hour indicating that the soil can, on average, absorb up to 4.3 inches of water per hour. Water infiltration rates ranged from a minimum of 1.7 inches per hour to a maximum of 5 inches per hour.

Water Infiltration Rates (inches/hour)		
	North (Control)	South (Treatment)
Minimum	1.7	1.7
Median	4.3	11
Maximum	51	53

Soil Compaction

Soil compaction was similar on both the north and south parcel when the demonstration project was started. These results will be compared to 2019 soil compaction results, 1 year after the change in management.

Soil Compaction (feet of penetration)		
	North (Control)	South (Treatment)
Minimum	0.81	0.83
Mean	0.91	0.93
Maximum	1.09	1.03

Seeding Notes

Field Preparation - Conventional: spring 2018 moldboard plow and disked 3 times

Field Preparation – Reduced Till: spring 2018 moldboard plow and disked 2 times

Inputs: 42 lb/acre nitrogen, 49 lb/acre of sulfur, herbicide, fungicide

Seeding Method: end-wheel seed drill

Seeding Date: May 14th

Seeding Rate: 110 lb/acre

Variety: Copeland malt barley

Haney Test

The average soil health calculations on both parcels were above 7. This is likely due to good organic matter content, slightly below to slightly above average microbial activity, good organic carbon and nitrogen, and carbon to nitrogen ratio for good microbial productivity.

Field	Organic Matter % LOI	Soil Respiration (CO_2- C) ppm C	Organic C ppm C	Organic N ppm N	Organic C:N	Soil Health Calculation
North Minimum	3.6	8.0	172	13.0	12.7	5.59
North Median	4.05	23.6	187	13.75	13.8	7.455
North Maximum	4.3	55.3	209	14.2	15.0	11.11
South Minimum	4.1	67.9	182	12.4	11.4	7.99
South Median	4.25	42.8	175.5	13.75	12.55	8.27
South Maximum	4.5	30.1	155	15.3	13.4	11.71

Next Steps

In 2019, the north field was converted to a no-till system and the 2018 soil health and crop productivity results on Teton Mountain Ranch provided baseline data to track changes in overall soil health and productivity. Comparisons will be made on soil compaction, Haney Soil Test results, water infiltration rates, crop stand and weed counts, and financial returns.

Photo by Camrin Dengel

Seeding Notes

Field #7 Barley Seeding Notes

Previous Crop: Potatoes

Field Preparation: Lemken disk fall 2018

Inputs: Pre-planting fertilizer, herbicide, fungicide

Seeding Method: Conventional grain drill

Seeding Date: May 5 & 6

Seeding Rate: 100 lb/acre

Harvest Date: August 30

Post-Harvest Methods: No fall till, air seed radish and turnip

Field #3 Quinoa Seeding Notes

Previous Crop: Barley

Field Preparation: Lemken disk fall 2018

Inputs: Pre-planting fertilizer with 85-10-5-25 analysis

Seeding Method: Conventional grain drill

Seeding Date: April 30

Seeding Rate: 11 lb/acre

Harvest Date: September 9

Post-Harvest Methods: No fall

Cover Crop Seeding Notes

Field Preparation: Bale barley straw (as soon as possible)

Seeding Method: Air seeder

Seeding Date: Mid-September

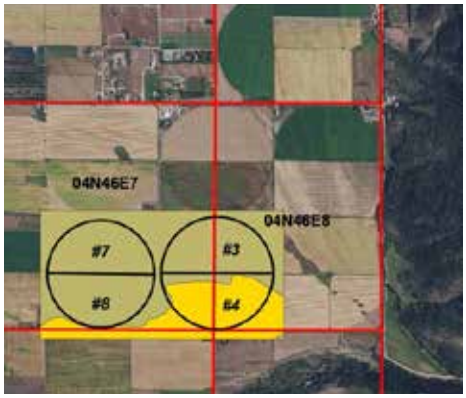
Seeding Rate: 4 lb/acre

Cover Crop Species Mix: 50% turnip, 50% radish

Post-Seeding Method: Pivot Irrigated

Penfold Farms:
Transition to Irrigated No-Till Barley with Cover Crop Seeding Post Cash Crop Harvest

Penfold Farms is a fifth generation farm specializing in growing seed potatoes and barley and, more recently, quinoa and buckwheat. In 2018, Penfold Farms implemented a crop management plan on 300 acres focused on gaining familiarity with cover crop application and no-till farming practices with a goal of improving soil health over 4 years. Two of four fields will be managed with conventional farming methods (fields 4 and 8) and Penfold Farm's typical crop rotations. The other two fields (fields 3 and 7) will have a variety of soil building practices applied including adding cover crops to the rotation and utilizing no-till farming techniques. The comparison of the fields 4 and 8 (the control) to fields 3 and 7 with soil building practices applied, will establish baseline soil health data and allow for documenting the impact of management changes on soil health.



Seeding Method

All fields were disked with a Lemken disk in the fall of 2017 following cash crop harvest. In the spring of 2018, pre-planting fertilizer was applied to both parcels (see inputs below). Field 7 was planted on May 6 and Field 3 was planted on April 30. Both parcels were seeded using a conventional grain drill.

Harvest Methods

Both field 3 and 7 were harvested with a draper header and straw was windrowed. Barley on field 7 was harvested on August 30 with a yield of 92 bushels per acre. Quinoa on field 3 was harvested on September 9 with a yield of 1500 pounds per acre. Straw was baled off on both parcels in mid-September.

Water Infiltration Rates

The average water infiltration rate was 3.7 inches per hour. This demonstrates that up to 3.7 inches of water can be absorbed into the soil per hour to be used by plants. Water infiltration rates ranged from a minimum of 0.2 inches per hour (less than a quarter of an inch) to a maximum of 19 inches per hour.

Water Infiltration Rates (inches/hour)

	Parcel #3	Parcel #4
Minimum	2.1	0.2
Mean	4.7	3.7
Maximum	7	19

Cover Crop Seeding

Following barley or quinoa straw removal, a cover crop mix of turnips and radishes was broadcast on fields 3 and 7 in mid-September using an air seeder. The cover crop was air seeded at a rate of 4 lbs/acre and then irrigated. While some cover-crop plants germinated throughout parcel 7, the plants were so few in the barley chaff row that in ten random samples, zero radish or turnip plants were counted.

Haney Test

Field	Organic Matter % LOI	Soil Respiration (CO_2- C) ppm C	Organic C ppm C	Organic N ppm N	Organic C:N	Soil Health Calculation
Field 7 Minimum	2.9	10.8	103	10.3	8.1	4.76
Field 7 Median	3.2	43.05	119.5	11.9	9.6	8.12
Field 7 Maximum	3.3	60.2	136	16	11.5	9.25
Field 4 Minimum	3.3	31.3	71	7.3	6.1	6.14
Field 4 Median	3.65	37.1	94	12.3	7.15	6.9
Field 4 Maximum	3.9	46.3	114	13.4	15.6	7.22
Field 3 Minimum	2.5	10.2	71	11.9	5.0	5.29
Field 3 Median	2.9	19	138	13.4	9.95	6.02
Field 3 Maximum	3.0	39.8	149	33.9	12.5	6.79
Field 8 Minimum	2.7	10.7	82	8.5	8.2	4.65
Field 8 Median	3	21.5	122	9.75	11.95	5.615
Field 8 Maximum	3.4	34.5	136	15.7	16	6.09

Next Steps

In 2019, barley was planted in field 3 and quinoa was planted in field 7, both using no-till techniques. Comparisons after the 2019 growing season will be made on soil compaction, Haney Test results, water infiltration rates, crop stand and weed counts, and financial returns.

Photo by Robert Warren

Key Lessons

- In 2018 the cover crop seeding rate averaged 4 lb/acre, but it took time and adjusting to get the seeding rate correct. Increased familiarity with cover crop application and seeding techniques will help producers achieve desired seeding rates sooner and achieve desired results.

- Seed the cover crop as soon as possible once the barley is harvested. This was not possible in 2018 due to the custom contractor not being able available to pick up the straw sooner. Penfold Farms is interested in exploring ways to seed a post-harvest cover crop immediately after grain is harvested to maximize the little remaining growing season.

Incentives Available

For farmers and ranchers interested in applying soil building practices on their farm or ranch, many local, state, and federal programs are in place to help you get started.

Friends of the Teton River

Friends of the Teton River leverages local, state, and federal funds to help Teton River subbasin producers implement soil building practices for the benefit of both agricultural producers and local water resources. Support has included cover crop seed purchasing, soil health testing, and purchasing a no-till drill with the Teton Soil Conservation district.

Bryce Contor | (208) 681-9100

Henry's Fork Foundation

The Henry's Fork Foundation supports agricultural producers in the Henry's Fork Watershed, outside Teton Valley, interested in adopting practices that benefit both local agricultural producers and local water resources. Technical and financial support available.

Bryce Contor | (208) 681-9100 | *brycec@henrysfork.org*
Daniel Wilcox | (208) 520-2137 | *daniel@henrysfork.org*

Natural Resources Conservation Service

The Natural Resources Conservation Service offers voluntary programs to eligible landowners and agricultural producers to provide financial and technical assistance to help manage natural resources in a sustainable manner. Through these programs, the agency approves contracts to provide financial assistance to help plan and implement conservation practices that address natural resource concerns or opportunities to help save energy, improve soil, water, plant, air, animal and related resources on agricultural lands.

Lindsay Markegard | NRCS Driggs Field Office | (208) 354-2680 ext. 103

The Nature Conservancy

The Nature Conservancy can provide technical and financial assistance to producers implementing eligible regenerative practices. Support can range from contractual agreements that will help producers by minimizing financial loss associated with implementing regenerative practices or technical support for any producer interested in adopting regenerative practices.

Brad Johnson | 208-521-8058 | *bradley.johnson@tnc.org*

Teton Soil Conservation District

The Teton Soil Conservation District provides educational opportunities for producers within Teton County, Idaho, such as educational workshops, organized farm tours, incentives to attend soil health workshops, and rents a 15' no-till seed drill to any Teton County producer.

(208) 354-2680 ext. 4 | *tetonscd@silverstar.com* | *tetonscd.weebly.com*

Want to know more?

Here are a few recommended books, websites, and videos to get you started.

Books:

Dirt To Soil: One Family's Journey into Regenerative Agriculture - Gabe Brown

The Soil Will Save Us: How Scientists, Farms, and Foodies Are Healing the Soil to Save the Planet - Kristin Ohlson

Growing a Revolution: Bringing Our Soil Back to Life - David Montgomery

Managing Cover Crops Profitably 3rd Edition - Sustainable Agriculture Research & Education

Websites:

No-Till On the Plains, *notill.org*

Understanding AG - Resources, *understandingag.com*

Green Cover Seed - Resources, *greencoverseed.com/resources*

Brendon Rockey - Rockey Farms, *brendonrockey.com*

Videos (You Tube Channels):

Green Cover Seed

Menoken Farm

USDANRCS

SARE Outreach

Teton Soil Conservation District board members, NRCS staff, and Friends of the Teton River staff pose for a picture in front of the jointly purchased no-till drill that is available for Teton County producers to rent.

Working Together

Teton Valley, Idaho, epitomizes a "New West" blend of agriculture and recreation—from farming to fly-fishing, and ranching to rafting—with an economy and ecology that depend on sustaining healthy water and soil. The demonstration projects highlighted in this booklet build upon relationships cultivated between Teton Valley's farming and ranching community and conservation interests. Friends of the Teton River, Teton Soil Conservation District, Teton County Farm Bureau, Teton Regional Land Trust, and Henry's Fork Foundation, as well as local elected officials, agricultural producers, and water managers, are developing locally-based solutions for maintaining the viability and health of our working lands, open spaces, and stream corridors, while improving surface and ground water resources for the benefit of people, fish, and wildlife. Our vision is to implement locally-based solutions that support our valley's economy, community, and culture.

Improve soil health and crop yields

FTR and project partners have secured funding, equipment, and assistance for agricultural producers to implement farming practices that improve farm productivity and soil health. This includes the acquisition of a no-till drill, cover crop seed, and monitoring equipment.

Invest in local infrastructure

FTR and project partners have secured funding and assistance for water right holders to improve or replace outdated head gates and other canal infrastructure. This improves irrigators' ability to manage water, so it can be delivered to farms where and when it's needed most, and ensures that irrigators can divert their full legal water rights.

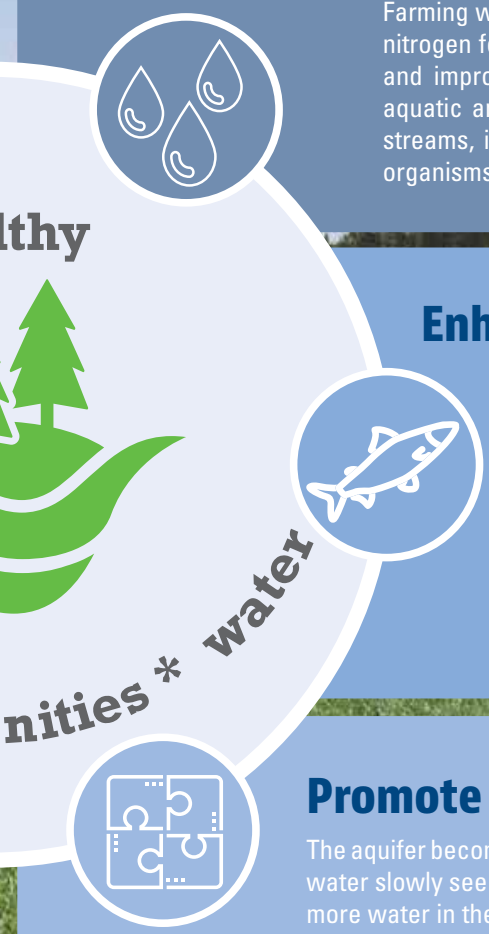
Support agricultural livelihoods

FTR and project partners are working to incentivize the practice of diverting water into canals and flood irrigating fields during the early spring, when water is abundant. This boosts aquifer levels, protecting farms from changes in water availability and increasing water reliability, especially during times of drought. Our goal is to keep working lands working and help sustain farming in Teton Valley.

for Farms & Fish

Improve water quality

Farming with no-till methods and cover crops reduces soil erosion and nitrogen fertilizer use. This means less sediment eroding into streams and improved spawning habitat (cleaner gravel) for trout and other aquatic animals. It also means less nitrogen in drinking water and in streams, improving and protecting the health of humans and aquatic organisms.



Enhance fish and wildlife habitat

Rebuilding or replacing irrigation head gates with fish-friendly ones prevents trout from getting trapped in canals and ditches. Upgraded canals can help recharge the aquifer in early spring, storing cold, clean spring water that wells up in the river in late summer. More efficient water delivery and water management in late summer can help keep tributary streams connected during critical periods for native trout.

Promote sustainable solutions

The aquifer becomes a natural "reservoir" for storing water underground. This water slowly seeps into the river over a period of several months, resulting in more water in the river during the late summer, when trout need it most. This spring water provides cooler temperatures that fish and aquatic organisms need to thrive, and also provides plentiful water for residential and municipal wells. Storing water in an underground reservoir provides a safe, affordable alternative to rebuilding the Teton Dam.

Photo by Camrin Dengel

Photo by Camrin Dengel