Drive down any backroad in Tennessee and you will see what makes our state beautiful. Rolling hills, clear creeks, and cattle grazing on green pastures are all common sights. While these scenic views are part of what makes Tennessee so special, the foundation behind these views is often overlooked – soil.

Soil health is defined as the continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans. Healthy soils have a greater capacity to sustain life, regulate water, cycle nutrients, filter pollutants and provide physical stability.

As you consider the soil health of your property, please know that The Land Trust for Tennessee is here to support you. Included in this packet are Natural Resources Conservation Service (NRCS) handouts, American Farmland Trust Case Studies, and other resources to guide you on your way to implementing soil health practices on your land. Additionally, we have included the contact information for your local NRCS Area Resource Soil Scientist. The NRCS is an excellent resource to not only connect you to soil health advice but potential funding opportunities as well.

Thank you for the thoughtful stewardship of your land. Through healthy soil, you are providing the foundation for what makes Tennessee beautiful.

Please do not hesitate to contact us for further information or questions.

Sarah O'Rear, Director of Stewardship
Phone: 423-241-8319
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Mike Szymkowicz, Stewardship Manager
Phone: 615-821-0807
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Anna Holman, Stewardship Coordinator
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Mija Nichols, Conservation & Engagement Data Analyst
Phone: 615-821-0802
Email: mnichols@landtrusttn.org

Tennessee Area Resource Soil Scientist Contact Information

Area 1 – Jackson Area Office
Counties: Benton, Carroll, Chester, Crockett, Decatur, Dyer, Fayette, Gibson, Hardeman, Hardin, Haywood, Henderson, Henry, Lake, Lauderdale, Madison, McNairy, Obion, Shelby, Tipton, Weakley

Jeffrey Woodward
Phone: 731-410-4830 / 731-393-3057
Email: Jeffrey.Woodward@usda.gov
Address: 235 Oil Well Road
Jackson, Tennessee 38305-7914

Area 2 – Murfreesboro Area Office
Counties: Bedford, Cheatham, Davidson, Dickson, Giles, Hickman, Houston, Humphreys, Lawrence, Lewis, Lincoln, Macon, Marshall, Maury, Montgomery, Moore, Perry, Robertson, Rutherford, Smith, Stewart, Sumner, Trousdale, Wayne

Jackie Reed
Phone: 615-648-8703 / 615-785-0771
Email: Jackie.Reed@usda.gov
Address: 315 John R. Rice Boulevard, Suite 175
Murfreesboro, Tennessee 37129

Area 3 – Cookeville Area Office
Counties: Bledsoe, Cannon, Clay, Coffee, Cumberland, DeKalb, Fentress, Franklin, Grundy, Hamilton, Jackson, Marion, Morgan, Overton, Pickett, Putnam, Rhea, Scott, Sequatchie, Van Buren, Warren

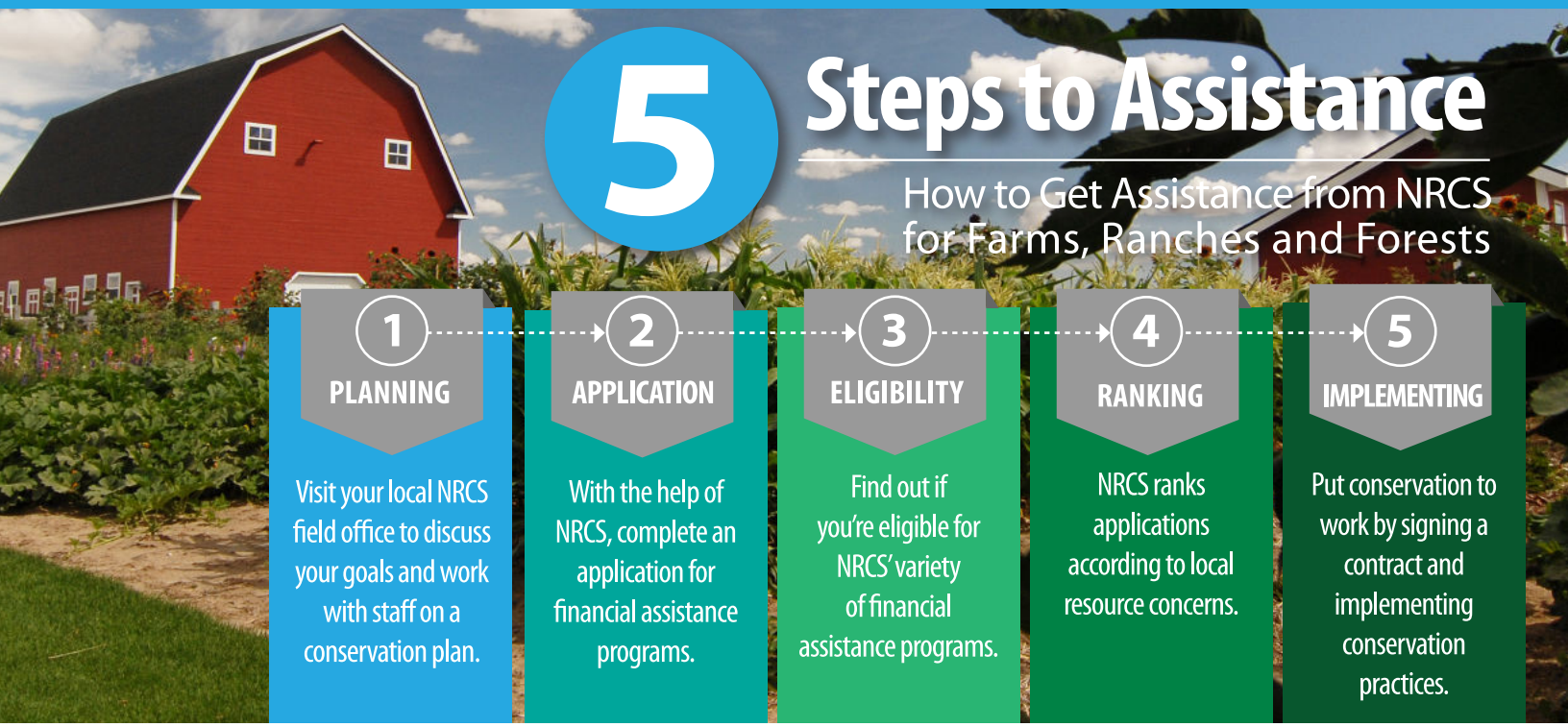
Melissa Oliver
Phone: 931-287-3075 Ext. 119
Email: Melissa.Oliver@usda.gov
Address: 900 South Walnut Avenue, Room 3
Cookeville, Tennessee 38501-3954

Area 4 – Knoxville Area Office
Counties: Anderson, Blount, Bradley, Campbell, Carter, Claiborne, Cocke, Grainger, Greene, Hamblen, Hancock, Hawkins, Jefferson, Johnson, Knox, Loudon, McMinn, Meigs, Monroe, Polk, Roane, Sevier, Sullivan, Unicoi, Union, Washington

Anthony Khiel
Phone: 865-243-0769 Ext. 112
Email: Anthony.Khiel@usda.gov
Address: 4730 New Harvest Lane, Suite 400
Knoxville, Tennessee 37918

USDA United States Department of Agriculture

Natural Resources Conservation Service



5 Steps to Assistance

How to Get Assistance from NRCS for Farms, Ranches and Forests

1 PLANNING
Visit your local NRCS field office to discuss your goals and work with staff on a conservation plan.

2 APPLICATION
With the help of NRCS, complete an application for financial assistance programs.

3 ELIGIBILITY
Find out if you're eligible for NRCS' variety of financial assistance programs.

4 RANKING
NRCS ranks applications according to local resource concerns.

5 IMPLEMENTING
Put conservation to work by signing a contract and implementing conservation practices.

Get Started with NRCS

Do you farm or ranch and want to make improvements to the land that you own or lease?

Natural Resources Conservation Service offers technical and financial assistance to help farmers, ranchers and forest landowners.

1 Planning

To get started with NRCS, we recommend you stop by your local NRCS field office. We'll discuss your vision for your land.

NRCS provides landowners with free technical assistance, or advice, for their land. Common technical assistance includes: resource assessment, practice design and resource monitoring. Your conservation planner will help you determine if financial assistance is right for you.

2 Application

We'll walk you through the application process. To get started on applying for financial assistance, we'll work with you:

- To fill out an AD 1026, which ensures a conservation plan is in place before lands with highly erodible soils are farmed. It also ensures that identified wetland areas are protected.
- To meet other eligibility certifications.

Once complete, we'll work with you on the application, or CPA 1200.

Applications for most programs are accepted on a continuous basis, but they're considered for funding in different ranking periods. Be sure to ask your local NRCS district conservationist about the deadline for the ranking period to ensure you turn in your application in time.

USDA is an equal opportunity provider and employer.

3 Eligibility

As part of the application process, we'll check to see if you are eligible.

To do this, you'll need to bring:

- An official tax ID (Social Security number or an employer ID)
- A property deed or lease agreement to show you have control of the property; and
- A farm tract number.

If you don't have a farm tract number, you can get one from USDA's Farm Service Agency. Typically, the local FSA office is located in the same building as the local NRCS office. You only need a farm tract number if you're interested in financial assistance.

4 Ranking

NRCS will take a look at the applications and rank them according to local resource concerns, the amount of conservation benefits the work will provide and the needs of applicants.

5 Implementing

If you're selected, you can choose whether to sign the contract for the work to be done.

Once you sign the contract, you'll be provided standards and specifications for completing the practice or practices, and then you will have a specified amount of time to implement. Once the work is implemented and inspected, you'll be paid the rate of compensation for the work if it meets NRCS standards and specifications.

To find out more, go to: **www.nrcs.usda.gov/GetStarted**

Summer sunset behind the HaR-Go farmstead and pasture

Grazing dairy cows

ALL PHOTOS: KEVIN KEENAN

DECEMBER 2020

Soil Health Case Study

Steve Gould, HaR-Go Farms, NY

Introduction

Steve Gould, his father, John, and mother, Sue, own and operate HaR-Go* Farms, a 400-head organic dairy, established in 1956 in northwestern New York. They own 600 of their 650 acres. To improve economic viability and environmental sustainability, the family farm transitioned to organic in 2008 and began implementing soil health practices in 2009. The farm is divided into 200 acres of pasture and a 450-acre, five-year crop rotation of three years of hay (270 acres), one year of corn (90 acres), and one year of 45 acres each of soybean and sorghum. This study focuses on the 450-acre rotation where no-till, cover crops, and nutrient management practices have been implemented to varying degrees since 2009.

Steve Gould in triticale cover crop

Typical of New York dairies, the Goulds grow hay for their herd while minimizing erosion and nutrient loss. Between their hay and pasture, the Goulds always have 72% of the farm under perennial cover. The Goulds further increase soil organic matter by using manure as a primary source of fertilizer.

In 2009, to save time, fuel, and wear and tear on machinery, the Goulds experimented by no-tilling 20 acres of hay. In 2013, they began no-tilling triticale as a cover crop between corn and soybeans or sorghum to provide additional feed for their herd. In 2015, they started adding red clover to 30 acres of the triticale. At present, they no-till all 90 acres of hay planted each year and 90 acres of triticale. They observed that switching to no-till improved soil moisture, germination, and crop density. No-till also allowed them time to apply nutrients before planting the triticale. The cover crops suppress weeds while providing extra feed and extra nitrogen from the clover worth about $10 per acre to the following crop. Note, because they are an organic farm and cannot use synthetic herbicides, the Goulds use conventional tillage for weed control prior to planting corn and soybeans.

In 2016, the Goulds developed a Comprehensive Nutrient Management Plan, purchased a manure injector, and hired a manure application firm. They began regularly testing their soil and manure to better match crop nutrient requirements. Planting triticale after manure application in the fall also allows it to scavenge nutrients before going dormant in the winter. The farm received financial and technical assistance from the USDA Natural Resources Conservation Service (NRCS) and the state of New York for these efforts.**

Soil Health, Economic, Water Quality, and Climate Benefits

Partial budget analysis was used to analyze the marginal benefits and costs of adopting no-till, cover crops, and nutrient management on HaR-Go Farms. The study was limited to only those income and cost variables affected by the adoption of these practices compared to the farm's prior performance. The study does not include changes associated with the transition to becoming organic. The table summarizes these economic effects revealing that, due to the three soil health practices, the Gould's net income increased by

Farm at a Glance

COUNTY: Genesee County, NY

WATERSHED: Genesee River Watershed

CROPS: Hay, corn grain, corn silage, soybean, sorghum, & pasture

FARM SIZE: 650 acres; 200 milking cows plus 200 dry cows & heifers

SOILS: Fine-loamy soils on gently sloping to steep rolling hills

SOIL HEALTH PRACTICES: No-till, cover crops, & nutrient management

Manure injector

USDA United States Department of Agriculture
Natural Resources Conservation Service

American Farmland Trust

$11 per acre per year or by $4,780 annually on the 450-acre study area, achieving an 18% return on investment.

The Goulds eliminated two tillage passes by switching to no-till for hay establishment, saving over $13 per acre annually and $5 per acre each year since they no longer need to pick rocks. The use of no-till and cover crops also decreased sheet and rill erosion by 0.6 tons per acre per year, worth about $0.65 per acre per year based on the value of soil nutrients no longer running off. Soil loss was minimal to begin with, because the hay provides perennial cover for three years.

While incurring annual costs from planting cover crops ($56.60 per acre), the farm is increasing their forage (about $180 per acre annually less $100 per acre in harvest costs). The $30 per acre per year for injecting manure on 270 acres of hay and 90 acres of corn are offset by more efficient nutrient use, since manure is now applied in the root zone at the optimum time and rate for maximum plant uptake. The Goulds also spend an additional $1.50 per acre annually for a crop advisor to optimize nutrient management and use of cover crops. Steve estimates spending over 15 hours a year ($415 or about $1 per acre in learning costs) attending soil health workshops, reading articles, and talking with his crop advisor.

The USDA's Nutrient Tracking Tool (NTT) was used to estimate the water quality benefits on one of Steve's 10-acre fields in the study area, finding that the Gould's use of no-till, cover crops, and nutrient management reduced nitrogen, phosphorus, and sediment losses by 41%, 39%, and 29%, respectively. The USDA's COMET-Farm Tool estimates that their soil health practices on the same 10-acre field resulted in a 158% reduction in total greenhouse gas emissions, which corresponds to taking one car off the road each year.

Closing Thoughts

The Goulds' soil health journey occurred by trial and error. John says, "To be successful with triticale, we had to plant and fertilize it by early September, which meant harvesting corn by August. We went to a shorter season corn to do that." The Goulds observed that the soil health practices have improved their soil tilth, and cover cropping has improved their nutrient management by suppressing weeds associated with manure application. They also believe cover crops have improved their bottom line by producing high-quality forage. Overall, the Goulds' investment in soil health has led to reduced erosion, improved soil quality, better allocation of time and equipment, and better weed control.

Economic Effects of Soil Health Practices on HaR-Go Farms, NY (2018)

Positive Effects

Increase in Income

ITEM	PER ACRE	ACRES	TOTAL
Feed value of harvesting triticale as forage	$280.15	90	$25,214
Total Increased Income			**$25,214**

Decrease in Cost

ITEM	PER ACRE	ACRES	TOTAL
Nitrogen provided by red clover	$10.43	30	$313
Machinery cost savings from planting hay using no-till (2 less passes/yr)	$13.55	270	$3,658
Eliminated rock picking	$5.06	270	$1,366
Soil health practices reduce soil nutrient losses due to 0.6 tons/ac less erosion	$0.65	450	$293
Total Decreased Cost			**$5,631**
Annual Total Increased Net Income			**$30,844**
Total Acres in this Study Area			**450**
Annual Per Acre Increased Net Income			**$69**

Negative Effects

Decrease in Income

ITEM	PER ACRE	ACRES	TOTAL
None Identified			$0
Total Decreased Income			**$0**

Increase in Cost

ITEM	PER ACRE	ACRES	TOTAL
Cover crop costs	$56.60	90	$5,094
Cost of harvesting triticale as forage	$100.00	90	$9,000
Increased machinery costs due to injection of manure on hay & corn acres	$30.17	360	$10,862
Nutrient management consultant fees	$1.54	450	$693
Soil health learning activities (15 hrs/yr)	$0.92	450	$415
Total Increased Cost			**$26,064**
Annual Total Decreased Net Income			**$26,064**
Total Acres in this Study Area			**450**
Annual Per Acre Decreased Net Income			**$58**

Annual Change in Total Net Income = $4,780

Annual Change in Per Acre Net Income = $11

Return on Investment = 18%

* HaR-Go comes from the names of Steve's grandparents, Harold and Rose Gould, who bought the farm in 1956. **The Goulds received financial assistance through the Conservation Stewardship Program (2010–19), Environmental Quality Incentives Program (2017–19) & the NYS Dairy Accelerator Program (2016), which is not included in the analysis because it is not an economic effect of the soil health practices. • This table represents costs & benefits of no-till, nutrient management, & cover crops over the 450-acre study area as reported by the farmer. • All values are in 2018 dollars. • Standard prices: Organic hay: $195/ton (Source: NASS National Organic Grain and Feedstuffs Report, Dec. 19, 2018). • Sheet & rill erosion benefits are based on 2018 fertilizer prices & methods from the 2009 NRCS Interim Final Benefit-Cost Analysis for the EQIP Program. • Return on Investment is the ratio of Annual Change in Total Net Income to Annual Total Decreased Net Income, as a percent (i.e., net profit/cost). • For information about: (1) study methodology, see https://farmland.org/soilhealthcasestudies; (2) USDA's Nutrient Tracking Tool, see https://www.oem.usda.gov/nutrient-tracking-tool.ntt; (3) USDA's COMET-Farm Tool, see http://cometfarm.nrel.colostate.edu/. • This material is based on work supported by 2018 USDA NRCS grants: NR183A750008G008 & NR182C31XXXXC001.

For more information about this study or to discuss soil health practices, please contact

- Aaron Ristow, American Farmland Trust, New York Agricultural Stewardship Program Manager, aristow@farmland.org, 315-748-5029
- USDA NRCS Genesee County Office, 29 Liberty Street, Suite 1, Batavia, NY 14020, 585-343-2362

To read more case studies, visit farmland.org/soilhealthcasestudies

UNLOCK YOUR FARM'S POTENTIAL
Do Not Disturb

unlock the SECRETS IN THE SOIL

If soil health is your goal, till as little as possible.

Tillage can destroy soil organic matter and structure along with the habitat that soil organisms need. Tillage, especially during warmer months, reduces water infiltration, increases runoff and can make the soil less productive. Tillage disrupts the soil's natural biological cycles, damages the structure of the soil, and makes soil more susceptible to erosion. Transitioning to tillage systems that increase soil surface cover and limit soil disturbance and loosening is an effective approach to building a healthy soil.

Benefits of Reduced-Till/No-Till

- **Aiding in Plant Growth** – Soils managed with conservation tillage or no-till for several years contain more organic matter and moisture for plant use. Healthy soils cycle crop nutrients, support root growth, absorb water and sequester carbon more efficiently.
- **Reducing Soil Erosion** – Soil that is covered year-round with crops, crop residue, grass or cover crops is much less susceptible to erosion from wind and water. For cropping systems, practices like no-till keep soil undisturbed throughout the entire cropping season.
- **Saving Money** – Farmers can save money on fuel and labor by decreasing tillage operations. Improving nutrient cycling allows farmers to potentially reduce the amount of supplemental nutrients required to maintain yields, further reducing input costs.
- **Providing Wildlife Habitat** – Crop residue, grass and cover crops provide food and escape for wildlife.

Production Inputs

Soils can be disturbed if inputs are not applied properly, potentially disrupting the delicate relationship between plants and soil organisms. Soil Health Management Systems help minimize that potential disturbance, while maximizing nutrient cycling, which can lead to greater profitability for producers.

Livestock Grazing

Improperly managed grazing can disturb the soil. There are several ways to graze livestock to reduce environmental impacts. For example, implementing a rotational grazing system instead of allowing livestock to continuously graze pasture allows pasture plants to rest and regrow.

Soil Health Management Systems

Implementing Soil Health Management Systems can lead to increased organic matter, more soil organisms, reduced soil compaction and improved nutrient storage and cycling. As an added bonus, fully functioning, healthy soils absorb and retain more water, making them less susceptible to runoff and erosion. This means more water will be available for crops when they need it. Soil Health Management Systems can allow farmers to enjoy cost savings from reduced inputs as well as more consistent yields, increased crop quality, and increased resilience resulting from improved soil conditions.

More Information

To learn more about Soil Health Management Systems and the technical and financial assistance available visit **farmers.gov/conserve/soil-health** or contact your local NRCS office. To find your local NRCS office, visit **farmers.gov/service-center-locator**.

FARMERS.GOV

USDA United States Department of Agriculture

NATURAL RESOURCES CONSERVATION SERVICE

UNLOCK YOUR FARM'S POTENTIAL
Discover the Cover

unlock the SECRETS IN THE SOIL

Diverse cover crop mixes increase the success of most agricultural systems.

Plant biodiversity helps to prevent disease and pest problems associated with monocultures. Using cover crops and increasing diversity within crop rotations improves soil health and soil function, reduces costs, and increases profitability. Diversity above ground improves diversity below ground, which helps create healthy productive soils.

Cover Crops

Cover crops are grasses, legumes, and forbs planted for seasonal vegetative cover. Well-managed cover crops can be an integral part of a cropping system. Cover crops can be managed to improve soil health, as they help to develop an environment that sustains and nourishes plants, soil life and beneficial insects.

- Cover crops can be planted any time of the year, typically following cash crops. Examples of cover crops include rye, wheat, triticale, oats, clovers and other legumes, turnips, radishes, sunflowers, buckwheat, etc. Planting several cover crop species together in a mixture can increase their impact on soil health. Each cover crop provides its own set of benefits, so it's important to choose the right cover crop mixture to meet management goals.

Cover Crop Benefits

- **Restoring Soil Health** – Cover crops help increase organic matter in the soil and improve overall soil health by adding living roots to the soil during more months of the year. Cover crops can improve water infiltration; for example, planting deep-tap rooted crops like forage radishes can create natural water passages. Also, fibrous rooted grass plants help break up compaction layers at the surface and allow water to percolate deeper in the soil. Legume cover crops serve as natural fertilizers while grasses scavenge nutrients that are often lost after harvest or during winter.

- **Natural Resource Protection** – Along with crop residue above ground, cover crops protect the soil against erosive heavy rains and strong winds. Cover crops trap excess nitrogen, keeping it from leaching into groundwater or running off into surface water – releasing it later to feed growing crops.
- **Livestock Feed** – Cover crops can provide livestock producers with additional forage opportunities.
- **Wildlife Habitat** – Cover crops provide winter food, cover, and nesting sites for birds and other wildlife. During the growing season,flowering cover crops can provide food and habitat for pollinator and other beneficial insects.

Soil Health Management Systems

Implementing Soil Health Management Systems consisting of a group of practices like no-till or reduced till, cover crops, prescribed grazing, nutrient management, and pest management can lead to increased organic matter, reduced greenhouse gases, more soil organisms, reduced soil compaction, and improved nutrient storage and cycling. Healthy soils have greater aggregate stability and therefore absorb and retain more water, making them less susceptible to runoff and erosion. This means more water will be available for crops when they need it. Soil Health Management Systems can allow farmers to enjoy cost savings from reduced inputs as well as more consistent yields, increased crop quality, and increased resilience to weather extremes resulting from improved soil conditions.

More Information

To learn more about Soil Health Management Systems and the technical and financial assistance available visit **farmers.gov/conserve/soil-health** or contact your local NRCS office. To find your local NRCS office, visit **farmers.gov/service-center-locator**.

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USDA United States Department of Agriculture

NATURAL RESOURCES CONSERVATION SERVICE

UNLOCK THE SECRETS IN THE SOIL
Basics & Benefits

Healthy, fully functioning soil is balanced to provide an environment that sustains and nourishes plants, soil microbes, and beneficial insects.

Managing for soil health is one of the most effective ways for farmers to increase crop productivity and profitability while improving the environment. Positive results are often realized within the first year, and last well into the future.

Soil Health

Soil is made up of air, water, decayed plant residue, organic matter from living and dead organisms, and minerals, such as sand, silt and clay. Increasing soil organic matter typically improves soil health since organic matter affects several critical soil functions. Healthy soils are also porous, which allows air and water to move freely through them. This balance ensures a suitable habitat for the myriad of soil organisms that support growing plants.

It's not difficult to improve soil health when utilizing the 4 soil health management principles. Here's how: **minimize disturbance** – for example, till the soil as little as possible; **maximize biodiversity** – for example, integrate livestock and grow as many different species of plants as possible through rotations and a diverse mixture of cover crops; **maximize living roots** – for example, by keeping living crops and cover crops in the soil as long as possible; and **maximize soil cover** – for example, by keeping the soil surface covered with residue year round.

Soil Health Benefits

Farmers who manage their land in ways that improve and sustain soil health benefit from optimized inputs, sustainable outputs and increased resiliency. Healthy soils benefit all producers regardless of the size or type of their operations. Healthy soils provide financial benefits for farmers, ranchers and gardeners, and environmental benefits that affect everyone.

Healthy soils lead to:

- **Increased Productivity** – Healthy soils typically have more organic matter and soil organisms which improve soil structure, aeration, water retention, drainage and nutrient availability. Organic matter provides and holds more nutrients in the soil until the plants need them.
- **Increased Profits** – Healthy soils may require fewer passes over fields because they are only minimally tilled and they aren't over-reliant upon excessive inputs to grow crops. Healthy soils can increase farmers' profit margins by reducing labor and expenses for fuel and optimizing inputs.
- **Natural Resource Protection** – Healthy soils hold more available water. The soil's water-holding capacity reduces runoff that can cause flooding, and increases the availability of water to plants during periods of stress. Good infiltration and less need for fertilizers and pesticides keep nutrients, sediment, and agrichemicals from loading into lakes, rivers, and streams. Groundwater is also protected because there is less leaching from healthy soils. Additionally, fewer trips across fields with farm machinery mean fewer emissions and better air quality.

Soil Health Management Systems

Implementing Soil Health Management Systems can lead to increased organic matter, more soil organisms, reduced soil compaction and improved nutrient storage and cycling. As an added bonus, fully functioning, healthy soils absorb and retain more water, making them less susceptible to runoff and erosion. This means more water will be available for crops when they need it. Soil Health Management Systems allow farmers to improve profitability because they spend less on fuel and energy while benefiting from the higher crop yields resulting from improved soil conditions.

More Information

To learn more about Soil Health Management Systems and the technical and financial assistance available visit **farmers.gov/conserve/soil-health** or contact your local NRCS office. To find your local NRCS office, visit **farmers.gov/service-center-locator**.

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