Pasa SUSTAINABLE AGRICULTURE | Policy

2021 Report

Policy Pathways to Healthy Soils

Recommendations for improving Pennsylvania's agricultural soils through existing & new programs

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Introduction

Pasa Sustainable Agriculture, a Pennsylvania-based sustainable farming research and education nonprofit founded in 1992, and its partners have developed a set of policy recommendations to support the widespread adoption of farming practices that improve the health of the Commonwealth's vitally important agricultural soils. This policy paper assesses where we are and where we need to be in terms of soil health in Pennsylvania; reviews existing state and federal programs that have the potential to more effectively support the adoption of soil health practices on farms; and ultimately offers a set of recommendations for optimizing existing programs as well as developing innovative new soil health initiatives **(find a summary of these recommendations on pages 20–21)**.

This document is not an exhaustive treatment of the scientific benefits of soil health, but rather a practical guide to finding the best policy channels for encouraging evidence-based practices that build and maintain healthy soils on farms while using the most cost-effective and efficient processes possible. The information and recommendations here are aimed at farmers, those in the agricultural business more broadly, food consumers (all of us), and policy makers at the state, local, and regional levels whose decisions can help make better soil health a reality in Pennsylvania.

Pasa staff and our partners have spent decades working with farmers—many of us are farmers—and understand the vital importance of healthy soils. There is scientific consensus that soil health is one of the most important elements of sustaining long-term food security. Increasingly, federal and state agencies are also recognizing this importance, and are developing programs, funding sources, and education and outreach programs to promote healthy soils.

With leadership by the Stroud Water Research Center, Pasa and partners have organized a state Soil Health Coalition, many of whom have contributed to this analysis of where Pennsylvania stands in terms of need, progress, and steps yet to take toward improving soil health on farmland. Coalition members have many years of experience testing and promoting soil health, and represent a spectrum of renowned nonprofit, academic, government, and research groups working in the state (see sidebar). Pasa also had the opportunity to share and gather input on its recommendations from members of the National Healthy Soils Policy Network, a group of state-level advocates across the country working to advance soil health. We also received feedback on our recommendations from farmers, food system professionals, and community members during our annual Sustainable Agriculture Conference—one of the largest gatherings of farmers, food system professionals, and sustainable agriculture supporters in the nation.

Much of this work has been funded through the William Penn Foundation as part of its initiative to improve soil health and regenerative agriculture practices. Pasa and its expanding group of partners will periodically revisit and update these recommendations as state and federal initiatives evolve over time, and as new research emerges.

Pennsylvania Soil Health Coalition

Numerous organizations in Pennsylvania have worked for decades to promote best management practices for improving soil health. In 2020, these pioneering organizations formed the **Pennsylvania Soil Health Coalition** under the direction of Stroud Water Research Center to foster collaboration and improve the efficacy of their educational and research initiatives. This policy paper was developed with input from the Pennsylvania Soil Health Coalition, which includes the following partners: Capital RC&D, Chesapeake Bay Foundation, The Nature Conservancy, Pasa Sustainable Agriculture, Penn State Extension, Pennsylvania Association of Conservation Districts, Inc., Pennsylvania Grazing Lands Coalition, Pennsylvania Department of Agriculture, Pennsylvania No-Till Alliance, Pennsylvania NRCS, Rodale Institute, Soil & Water Conservation Society, State Conservation Commission, Steve Groff Cover Crop Coaching, Stroud Water Resource Center, 4R Alliance.

Soil health practices: Where Pennsylvania stands

Pennsylvania farmers understand the importance of healthy soils. They know, for example, that healthier soils produce higher yields and often reduce the need for costly soil amendments. Healthy soils rich in organic matter absorb more rainfall—mitigating floods and also periods of drought—an important hedge against an increasingly volatile climate. Soils are the foundation on which farming exists, and taking care of our rich legacy of soils is essential for the long-term food security of our nation. Practices that increase the long-term viability of our agricultural soils are not only a good investment, but essential for life.

State interest in soil health did not begin in 2021, although it has gained rapid momentum in recent years. Our federal partner in advancing soil health, the Pennsylvania agency of the Natural Resources Conservation Service (NRCS), has been providing technical assistance and funding for practices that promote soil health through a variety of federal Farm Bill conservation programs, including the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP). NRCS developed a set of five core soil health principles, as well as issued a State Soil Health Strategic Plan in June 2020. These five core principles mirror what state, local, and nonprofit groups have come to a consensus view over recent years that represent the most important functions of any soil-improving conservation practices: keep the soil covered; minimize soil disturbance; grow a living root all year long; add diversity to crop rotations; and, where practical, integrate livestock grazing into farm operations. NRCS also issued a State Soil Health Strategic Plan in June 2020 that explores different ways to expand soil health practices in Pennsylvania.

Pennsylvania is about in the middle of the pack as far as what states have accomplished to date to promote and ensure healthy agricultural soils. We have strong federal partners, the nation's first state-level Farm Bill with new funding and programs, and many committed nonprofit groups working hard on this issue. However, we don't have a state-level soil health program or dedicated state funding for farmland soil health practices.

There are a number of distinct, well-documented practices shown to improve soil health. Below, we review several of the most effective practices and where Pennsylvania farms stand in adopting them.

Cover crops

Cover crops are critical for keeping soil covered in vegetation year-round. Cover crops also provide additional soil health qualities—for example, legume cover crops can add nitrogen to soils; deep-rooted radishes can help aerate soils and reduce compaction; rye can add substantial amounts of organic matter to soil; cereal grains can provide forage for livestock. Cover crops are typically planted immediately after vegetable or commodity crops like corn and soybeans have been harvested to prevent fields ever being left bare. This both prevents

valuable, nutrient-rich topsoil from being washed away after rains or snowmelt, and protects nearby waterways from runoff pollution. Cover crops are not typically grown for harvest and sale, but they can provide financial value for farms in terms of soil-building benefits or for forage for livestock as live feed or winter hay. Generally, row crop farmers are burning off the cover crop with herbicides or rolling it to become mulch for the next cycle of crops.

Fallow fields are highly prone to topsoil erosion and flooding, and leave soil more susceptible to structural damage from strong winds and heavy rains. Without plants and roots serving as a natural barrier and filter, fallow fields also easily leach applied fertilizers and pesticides into waterways.

Pennsylvania ranks 10th among all U.S. states for the number of cover crop acres planted—behind large midwestern states and Texas—with 595,309 acres, which is a 33.4% increase from the last USDA census taken (2012). As a percentage of available farmland acres that could be planted in cover crops, Pennsylvania rises to third overall, with 37.2%.[1] Pennsylvania has made good progress, but this level of increase has tapered off in recent years.

USDA's 2019–20 Cover Crop Survey reflects a similar pattern of improvement with occasional backsliding across states. The survey found that a majority of farmers who used cover crops saw increases in profits, yields, and reduced inputs and other costs.The survey got responses from 1,172 farmers representing all 50 states. Ninety-three percent of respondents reported having used cover crops before, with 11.5% having shifted from no cover crop acres to some between 2015 and 2019. Other findings include:

- Farmers who planted cover crops saw small increased yields for soybeans, corn, and spring wheat.
- Farmers saved significantly (32–71% by crop) on herbicide costs.
- Farmers also saved significant dollars on fertilizer costs (41–53% by crop).
- Cover crop users reported spending less in 2019 and 2020 than previous years on cover crop seed purchased, with a median cost of $16 to $20 per acre compared to a median cost of $25 per acre in earlier surveys from 2012 and 2013. As cover crop seed has become more widely available, some costs have gone down.

[1] USDA National Agricultural Statistics Service, 2017 Census of Agriculture

In addition to keeping soil covered, planting a radish cover crop helps loosen compacted soil, while planting a winter rye cover crop helps suppress weeds and contributes significant organic matter to soil. Cover crops can also provide forage for livestock. ***Left to right:*** *Radish cover crop (credit: USDA-NRCS); rye cover crop; forage cover crop*

Reduced tillage & no till

Pennsylvania has also done relatively well in terms of farmers who adopt conservation tillage, a category including no-till, strip-till, and mulch-till practices. Since 2002, Pennsylvania has gone from 20% of acres in no-till, to more than 60% of acres planted, ranking the state sixth in conservation tillage behind Tennessee, Virginia, Maryland, Kentucky, and Montana.[2]

Yet, according to the USDA National Agricultural Statistics Service (NASS) 2017 survey, 13–25% of those acres don't meet minimum residue standards for erosion control, and half had less than 50% residue—so there's room for improvement in adoption and effectiveness. The number of farms using no-till in Pennsylvania increased 3% from 2012 to 2017, but the acreage under no-till in the state increased 17%, to a total of 1.6 million acres.

It's important to note that eliminating tillage entirely may not always be necessary for achieving optimal soil health. Pasa's ongoing soil health research involving 100+ farms has demonstrated that farms that rely on tillage to some degree were also capable of achieving optimal soil health. These farms likely accomplished this by balancing minimal tillage with a holistic soil health management strategy.

Most no-till farmers are able to avoid tillage by relying, to some degree, on herbicides to control weeds and terminate cover crops. However, because of the escalating prevalence of herbicide-resistant weeds and growing public health and environmental problems associated with herbicide use, continuous no-till may not always be a sustainable soil health management method.

[2] USDA National Agricultural Statistics Service, 2017 Census of Agriculture

Two significant obstacles to wider adoption of conservation tillage practices among farmers are lack of technical assistance and lack of capital to purchase specialized equipment.

Tilling excessively damages soil structure, breaking up soil aggregates that are resistant to erosion and disrupting soil life like microorganisms, fungi networks, and earthworms. Minimizing tillage is vital for building and preserving soil health.

Livestock grazing

NRCS and many other partners emphasize the importance of promoting soil health practices on pasture land in Pennsylvania. Pasture lands are often adjacent to streams and can sequester carbon, improve water quality, and build soil health. Animals that graze on pasture more evenly distribute nutrients back to the ground, especially with rotational grazing practices, and don't require concentrated manure storage, which can be costly. Grazing naturally recycles nutrients back to the soil, and reduces soil and animal waste runoff that can contaminate streams.

While there are trade-offs—animal volumes and efficiencies can be higher with confinement operations, while environmental and lower input benefits are higher with pastured livestock operations—the soil health benefits are clearly much higher with pastured grazing. In Pasa Sustainable Agriculture's *Soil Health Benchmarks 2021 Report*, researchers found that well-managed pastured livestock farms achieved optimal soil health ratings for every indicator measured, on nearly all fields measured.

Converting an operation from confined to pasture-based can require significantly more land. It also frequently requires technical assistance and other transitional costs, such as pasture development. Improving grazing practices on existing pastured livestock farms can also require technical assistance and paying for fencing, planting trees, and new equipment.

Nationwide, it's estimated that less than 5% of the 32 million beef cattle, 5% of the 121 million hogs, and 0.01% of the 9 billion broiler (meat) chickens produced in the U.S. in 2017 were raised and finished on pasture.[3] In Pennsylvania, nearly all beef cattle are raised on pasture, but many are not finished on pasture.

Despite downward trends in Pennsylvania's dairy industry, there is still great potential for dairy farmers to improve soil health through practices like pasturing livestock. Also, while national fluid milk consumption has decreased as a whole, there is growing consumer demand for grassfed milk and value-added dairy products. Dairy is still Pennsylvania's largest agricultural sector, with 5,430 dairy farms and 482,000 cows, although Pennsylvania lost 5.2% of its dairy farms between 2019 and 2020, and over the past decade, the herd has shrunk by 11%.[4]

Pastured livestock resources

Case Studies: Transitioning to Pasture-Based Systems
Capital RC&D, a Pennsylvania Soil Health Coalition partner, has compiled a series of case studies documenting a number of Pennsylvania farms that have transitioned successfully to pasture-based systems, and the economic impact on those operations. In each case, there were learning curves and different transition rates, but all were able to make the switch to pasture and to lower their farm costs overall, including manure storage and hauling, feed, veterinary bills, and other costs.

Pasture Condition Scoring Workbook
The national NRCS office issued a revised Pasture Condition Scoring Workbook in 2020. This tool serves as a required benchmark assessment tool for technical assistance providers and farmers for measuring the health of pastureland, including the condition of the soil.

Scaling Up Pastured Livestock Production: Benchmarks for Getting the Most Out of Feed & Land
In partnership with 10 diversified pastured livestock farms in Pennsylvania, Pasa Sustainable Agriculture developed feed and land efficiency benchmarks for the most common meat animals. It's research brief both documents those benchmarks and uses them to consider implications for land use scenarios and the future of sustainable meat farming in our region.

[3] *Scaling Up Pastured Livestock Production: Benchmarks for Getting the Most out of Feed & Land*, Pasa Sustainable Agriculture, 2020

[4] Pennsylvania Dairy Overview, Pennsylvania Center for Dairy Excellence, 2020

Whole-farm approaches

Organic farming

Organic farming methods prohibit the use of synthetic pesticides, fertilizers, and other chemicals in crop and livestock production systems. In place of chemical controls, organic production methods promote an integrated approach to pest, weed, and soil health management that relies on a number of sustainable practices. Organic farms are required to demonstrate to certifying agencies that they are taking steps to build and maintain soil health, such as by minimizing tillage and planting cover crops. While most organic farms rely on tillage to some degree to control weeds, some farmers and organizations have found success in implementing organic no-till methods.

Pennsylvania has long been a leader in the nation's organic sector, currently ranking third in the country in organic sales with $742 million, trailing only California and Washington state.[5] Despite this impressive standing, only 2% of Pennsylvania farms were certified organic in 2017 according to the most recent NASS Agricultural Census data. This represents a major opportunity for growing the Commonwealth's organic industry while improving its soils.

The organic sector in Pennsylvania continues to experience growth. The number of certified organic farms in the state rose by 82% between 2012 and 2017, compared to 39% nationally. Organic farm sales in Pennsylvania rose 800% in just five years—from $78.5 million to $707.6 million—compared to 133% growth nationally. The number of farms in the state transitioning to organic has increased by 17%.[6]

Notably, 72% of organic farmers in Pennsylvania report that farming is their primary income source in contrast with 46% of farmers in the state overall.[7] Organic farmers are also younger—the majority are under 45 years old, compared to the majority of farmers overall in the state being 45 or older.[8] As the average age of principal farm operators continues to rise across the country—in Pennsylvania, it's 56.5 years

[5] USDA National Agricultural Statistical Service, 2019 Organic Survey

[6] USDA National Agricultural Statistical Service, 2019 Organic Survey

[7] USDA National Agricultural Statistics Service, 2017 Census of Agriculture

[8] USDA National Agricultural Statistics Service, 2017 Census of Agriculture

old—supporting the organic industry additionally means supporting the success of young and beginning farmers.

A major obstacle to the adoption of organic production methods is the initial cost of transitioning to organic practices and the annual cost of maintaining organic certification. Pasa, Pennsylvania Certified Organic (PCO), and the Rodale Institute have been in discussion on ways to help financially support the transition to certified organic for willing farms. While costs for the required three-year transition period for farms to become certified organic include many variables, from acres in production to type of production, USDA's Organic Certification Cost-Share Program reimburses farmers for 50% of their transition costs up to a maximum of $500 in each of five production categories, assuming an average transition cost of $1000/year/category.[9] In 2020, Pennsylvania's Department of Agriculture partnered with Rodale Institute to offer organic transition assistance to Pennsylvania farmers for free for a limited period of time. This kind of technical support for farmers transitioning to organic methods should be extended through the Pennsylvania Farm Bill and be conditioned on documented improvements to soil health.

Agroforestry

Agroforestry practices combine agricultural practices with trees and shrubs, harkening back to when most farms had woodlots, windbreaks, hedgerows, and other woody species that were removed with the onset of intensive industrial agriculture. Trees provide heat relief and shade for livestock and farmers/farmworkers, enrich soil with leaf litter and other organic materials, sequester carbon, and protect streams from soil and nutrient runoff. *Alley cropping* combines rows of fruit trees, nut trees, or bushes with lanes of vegetables or grains. *Silvopasture* integrates trees into livestock pastures, providing fodder, shade, and supplemental nutrients, also providing the opportunity to diversify farm income streams.

Agroforestry practices are increasingly taking root among Pennsylvania farms today. NRCS promotes many agroforestry practices, including *riparian forest buffers*. Because of a change in the 2018 Farm Bill, buffers are allowed to generate additional farm income. Riparian forest buffers have been planted across the state for the past 20 years, supported robustly by DEP, DCNR and Pennvest funding. A recent focus on income-producing buffers—fruit and nut trees that take 7–10 years to mature but eventually contribute to farm income and diversity—are multiplying across south-central Pennsylvania farms, in particular. Outside investors, such as Propagate Ventures, are also funding multi-functional buffers as a conservation investment

[9] 2021 USDA Organic Certification Cost Share Program (OCCSP) announcement

practice. Riparian buffers are a central part of the Chesapeake Bay Phase 3 Watershed Implementation Plan (Phase 3 WIP) to address Pennsylvania's nutrient and sediment obligations to improve Chesapeake Bay water quality. The plan calls for an additional 95,000 acres of riparian buffers by 2025.[10]

Pennsylvania Soil Health Coalition partners including Chesapeake Bay Foundation, Stroud Water Resource Center, the No-Till Alliance, and others promote other agroforestry practices including alley cropping and silvopasture. While these practices are eligible for NRCS funding, the key to long-term adoption will be the ability for them to pay for themselves. Silvopasture, for example, can provide supplemental feed stocks on pasture lands through honey locust tree pods and other plant products, reducing animal feed costs while enriching pasture soils.

Other states' approaches to soil health

Many states are racing to pass soil health legislation to better support and fund soil health practices—18 had passed legislation as of September 2021[11]—while others are adopting programs by agency regulation, implementing voluntary measures, or both. As Pennsylvania seeks to expand soil health practices across the Commonwealth, it can be instructive to look at what other states have been doing and how these efforts are working.

Providing incentive payments to farmers

- **Maryland** currently has 500,000+ acres planted in cover crops, according to state data, representing approximately a quarter of the state's farmland. One reason for this is Maryland's achievement in passing state legislation offering farmers a $45 per acre payment for planting cover crops. Maryland also adopted a Million Acre Challenge campaign to have one million acres planted in cover crops by 2030. Since Maryland has almost two million acres total in farmland production, its cover crop goal represents slightly more than 50% of all state farm acres. In addition, in spring 2021 Maryland adopted legislation to lower the farmer cost-share percentage from 12.5% to 0% for a range of water quality improvement practices to help clean up the Chesapeake Bay.

- **Iowa** and **Illinois** passed legislation offering farmers a financial incentive to plant cover crops in return for a state subsidy on crop insurance payments. Iowa's program, implemented in 2017 as a three-year pilot, offers $5 per acre as a cover crop insurance subsidy. The program has been successful in increasing cover crops—over the first two years of the program, 1,200 farmers applied and enrolled 300,000 acres in cover crops. Illinois approved a similar program in 2019, modeled on Iowa's as a three-year pilot and

[10] *Pennsylvania's Chesapeake Bay Phase 3 Watershed Implementation Plan*, Pennsylvania Department of Environmental Protection, 2019

[11] Stephen Keleti, Massachusetts-based soil health consultant, personal communication, May 2021

$5 per acre. They capped the program at $300,000 and hope to enroll 50,000 acres in year one; 100,000 acres in year two; and 200,000 acres in year three.

- **Minnesota** introduced a bill that would pay farmers for implementing and maintaining soil health practices, as well as for the transition costs they incur. Covered costs include transitioning cropland to managed rotational grazing and transitioning conventional land to certified organic land. The bill caps lifetime payments at $15,000 per farm. If adopted, Minnesota would join 18 states that currently have soil health programs.

Using carbon-offset funds

There are a number of states and private companies working to develop carbon-offset markets, which pay farmers for carbon-sequestering or emission-reduction practices, but to date do not pay for soil health projects. However, measuring soil carbon has proven difficult to standardize and has generated skepticism, including within the National Sustainable Agriculture Coalition.

- **California** passed a cap-and-trade program to reduce greenhouse gases in 2012. Offsets can be awarded to projects that reduce greenhouse gas emissions from livestock operations, forestry improvements, mine methane reduction, and urban forest expansion, but to date its uses do not include building soil health.

- The Regional Greenhouse Gas Initiative (RGGI) was the first mandatory market-based program in the U.S. to reduce greenhouse gas emissions. It formed a decade ago with 10 East Coast states. **Pennsylvania** is now developing regulations to join the initiative. None of the original states participating in RGGI use offsets for soil health improvement, but Pennsylvania's DEP is considering this, and may become the first state to do so if they join RGGI.

Peer-motivation & recognition for good practices

- **Illinois** adopted the S.T.A.R. (Saving Tomorrow's Agriculture Resources) program, which gives farmers ratings of 1–5 (low to high) for adopting soil health practices as a peer-based incentive. The ratings are measured and verified by university agriculture researchers. The program has been marketed as a way to head off more rigorous regulations, and has grown from one county in 2017 to 102 counties today, with 180 participants and 27,418 acres as of 2018.

Discouraging soil-damaging practices

- Several states have imposed or are seeking to impose chemical fertilizer fees to create a funding pool for soil health practices while disincentivizing fertilizer inputs. This 2019 report from the Izaak Walton League documents ongoing efforts in multiple states, as well as varying approaches. **Wisconsin** has gone the farthest in this effort, passing a

62-cents-per-ton fee on commercial fertilizers, which funds agrichemical management, fertilizer research, outreach, nutrient and pest management, and agricultural chemical cleanup. **Nebraska** has a state buffer-strip program funded by proceeds from fees assessed on registered pesticides.

Comprehensive approaches to sustainability that include soil health

- **Vermont's** comprehensive approach to sustainability includes everything from a minimum wage hike, to universal health care, to a soil health fund—part of a Vermont "new green deal." Vermont's focus on soil health is one of many areas identified for improvement. The Stimulus Plan for an Agriculturally Resilient, Emergency Ready Vermont was developed as a roadmap to economic and environmental improvements statewide to be addressed through specific pieces of legislation, policy, and regulation.

- **New York State's** Department of Agriculture and Markets commissioned a report, *New York Agriculture and Climate Change*, that promotes incentives to reduce greenhouse gas emissions along with efforts to protect family farms. It focuses on what farms can do to lower emissions of the worst gases—nitrous oxide and methane—through practices like covering manure storage containers and flaring off (burning) methane; adjusting livestock feed to reduce methane; managing nitrogen fertilizer to limit runoff; promoting reforestation; and reusing "underused" lands such as mined lands and fallow fields to expand regenerative farming and increase carbon storage. The report directly promotes planting cover crops and alley cropping as practices with strong soil health benefits.

Cooperatives

- Embracing the cooperative model, **Montana** created a Cooperative Development Center to help launch a diverse array of local and state cooperatives, including agricultural cooperatives. Agricultural cooperatives let farmers share equipment, marketing, and distribution to reduce their individual business costs. The Montana Organic Producers Cooperative, created in 2007, helps farmers collectively negotiate a fair price for their products and mitigates against the "commodification" of organic produce, giving farmers more authority in decisions that affect their businesses.

State governor councils & committees

- Several states have adopted Governor-level soil health committees or councils to develop plans, educate policymakers, and advocate for resources to expand soil health practices. For example, **Nebraska** passed legislation in 2019 to create a Governor's Advisory Task Force on Soil Health. This 15-member board has met seven times since August 2019 and delivered a final report of recommendations to the governor in December 2020, when it was scheduled to dissolve.

Improving agricultural soil health in Pennsylvania

State-level efforts

While various programs to help farmers improve their soil health exist today in the Commonwealth, they are currently limited by funding, lack of farmer awareness, or other eligibility requirements such as matching funds or secure tenure to the land. Below is a brief overview of existing programs in Pennsylvania that could incorporate soil health elements if amended or better funded.

In 2019, the Commonwealth completed a two-year planning effort known as the Chesapeake Bay Phase 3 Watershed Implementation Plan (Phase 3 WIP) to map out how to reduce our total maximum daily loading of nitrogen, phosphorus, and sediment into the Chesapeake Bay. The planning effort concluded that to meet Chesapeake Bay water quality standards, Pennsylvania needs to spend $330 million each year more than it does currently.[12] Many of the practices recommended in the plan would address soil health, including establishing riparian forest buffers, planting cover crops, minimizing tillage, and effectively managing soil amendments. There is currently no dedicated state funding to address soil health practices in the Bay watershed beyond general funding to conservation districts and competitive grants awarded by DEP, DCNR, Pennvest, and from private philanthropies.

There are no state-funded programs for soil health practices equivalent to the NRCS federal programs, but a state-level tax credit program—the Resource Enhancement and Protection (REAP) Program—has been expanded in recent years to allocate more funding to soil health practices. In 2020, REAP was expanded from $10 million to $13 million in the state budget, and renewed at that level in 2021. Still, the program's new emphasis on paying for soil health testing and up to 90% of soil health practices on the ground is a very positive direction. For REAP to become more widespread and effective, it would need to be doubled in size to $20 million per year. Because it is popular with farmers, the funding would likely get fully used.

A recent effort to address the funding gap for soil health and related on-farm practices in Pennsylvania was introduced in 2020 and again in 2021. The Agricultural Conservation Assistance Program (ACAP) would establish a program at the state level through county conservation districts modeled on the state's successful Dirt and Gravel Roads Program to work with farmers to adopt more conservation practices in the Chesapeake Bay region of the state. Current iterations of the bill look to federal sources for funding. Another measure being pursued in the Commonwealth is to include Pennsylvania in the Regional Greenhouse Gas Initiative (RGGI), and potentially use some portion of the carbon offset funding it generates to pay for soil health practices that not only reduce carbon emissions but provide multiple co-benefits to air,

[12] *Pennsylvania's Chesapeake Bay Phase 3 Watershed Implementation Plan*, Pennsylvania Department of Environmental Protection, 2019

water, and food production. In September 2021, RGGI was approved by members of the Independent Regulatory Review Commission, but may face additional legislative hurdles to final approval.

Two long-standing state programs that are not expressly dedicated to improving soil health still have the potential to make a significant difference if a soil health incentive component were added to each. Pennsylvania leads the nation in the number of active agricultural acres preserved through its Pennsylvania Farmland Preservation Program, which purchases qualified farms' development rights in return for a permanent easement that allows continued farming but restricts any further development. To date, more than 5,300 farms have been approved for easement purchases totaling more than 552,700 acres. And yet, this program does not currently require that farmers managing preserved farmland take additional steps to conserve or improve soil health. Future farm enrollments could be conditioned on an agreement to adopt specific soil health practices, in conjunction with completion of a soil health conservation plan, which would require a minor modification of the program.

Similarly, the Pennsylvania Clean & Green program, which allows counties to lower property tax assessments for farms and forested properties of 10 acres or more—at a considerable cost to the state budget—has no requirements to adopt soil improvement or conservation measures.

Clean & Green was initially adopted in 1974 to encourage land preservation, particularly forestland and agricultural land, and to stem sprawl development. By 2016–17, 22 years after the program was authorized, landowner assessment discounts had grown to $16.7 billion on 9 million acres across 59 Pennsylvania counties, according to an analysis of state Tax Equalization Board records reviewed by the Morning Call. There are currently 9.3 million acres in Pennsylvania enrolled in Clean & Green. Here again, future enrollees could be required, or incentivized, to adopt soil health practices and complete a soil health conservation plan, with a minor modification of this popular program. Renewals into the program could also be conditioned on developing and adopting soil health practices, although politically this would be harder to apply retroactively to those already in the program.

Transition costs for current Clean & Green enrollees to adopt new soil health practices could either be paid for through a set-aside fund of state dollars, or reimbursed to farmers who adopt them through modest adjustments in county assessments to compensate for these costs. Amendments to Clean & Green to incentivize soil health practice adoption would make sense only in the Agricultural Reserve and Agricultural Use portions of the program; the Forest Reserve acres would not be applicable.

An increasing number of states across the country have created new programs within their departments of agriculture to deliver funding and technical assistance for soil health practices at the state level. Pennsylvania would be wise to follow suit, particularly as momentum builds for national legislation, such as the Agriculture Resilience Act, that would pass federal funding to states. Pennsylvania should create a Soil Health Program under the State Conservation Commission or Pennsylvania Department of Agriculture that can accept federal funding for soil

health practices.[13] Alternatively, the state could amend the existing 1994 Sustainable Agriculture Act of Pennsylvania to do this.[14]

Pennsylvania has the distinction of passing the nation's first state-level Farm Bill. Initially passed in 2019, this focused effort to improve agricultural investment across a broad set of initiatives has proven both popular and effective. Several new amendments to the PA Farm Bill could augment this effort and support soil health. Additional funding in the PA Farm Bill budget for 2022–23 and beyond could augment the Urban Agriculture Infrastructure Grant Program to improve urban farm soils. Urban farming is a growing segment of the Pennsylvania agricultural community. The existing program at the state level focuses on micro-grants for single operators and collaboration grants for partnerships, but a pool of urban soil health funding would enable all applicants to get specific help in testing and improving soils on urban farms and community gardens. Funds at the federal level for urban agriculture have grown quickly in recent years and could also be a source of funding to support this work at the state level. A new office of Urban Agriculture was created in the 2018 Farm Bill and has a range of grant, loan, and other types of assistance.

Currently 60% of applicable Pennsylvania farm acreage uses conservation tillage, but this could be increased to 75% by 2030 through greater education, demonstration, and training.[15] A 2016 study by USDA called the Conservation Effects Assessment Project found that switching to no-till saves farmers money on fuel and labor costs, and reduces greenhouse gas emissions.[16] Funds to promote conservation tillage should support demonstration events, educational materials, and research, and can be funded through an increase in the state's PA Farm Bill budget.

Education and demonstration have been shown to be highly effective recruitment approaches for adopting soil health practices. The recent USDA/SARE 2019–2020 cover crop survey listed four primary incentives mentioned by farmers that might get them to adopt cover crops: cost share or incentives to offset the cost of planting (72%); tax credits for planting (70%); demonstrations such as local farm tours (65%); and carbon storage payments (63%).[17] While three of these are financial benefits, recognizing that farmer-to-farmer demonstrations had clout as a non-financial path is well worth further pursuit. More funds for education, research, and demonstration efforts added to the PA Farm Bill budget or with pass-through federal funding would help support these efforts.

[13] H.R. 5861, Agricultural Resilience Act

[14] 1994 Act 129, Pennsylvania General Assembly

[15] USDA National Agricultural Statistics Service, 2017 Census of Agriculture

[16] Reduction in Annual Fuel Use from Conservation Tillage

[17] USDA Sustainable Agriculture Research and Education (SARE), 2019-2020 National Cover Crop Survey

Many partners across the state, including most members of the Pennsylvania Soil Health Coalition, engage in education and demonstration efforts to advance soil health. These efforts in Pennsylvania are supported through private philanthropy as well as public funding. Having more dedicated federal and state funding to support these efforts would accelerate the rate of farmer adoption of soil health practices quickly and relatively efficiently. One way to address this gap would be to amend the PA Farm Bill in 2022–23 to include funding for a new program to promote soil health through grants to universities and nonprofits that provide soil health education for farmers. Funds could be used to disseminate farm-based research data on soil health, conduct demonstrations on soil health practices, and promote the benefits of improving soil health. The leveraging effect of this additional funding would also help universities and nonprofits meet matching requirements to bring even more federal and other funding into Pennsylvania.

One program already in the works is the concept of "soil health hubs." Building on the successful peer-to-peer education model established by the Pennsylvania No-Till Alliance, Pennsylvania Soil Health Coalition partners are supporting efforts to create regional soil health hubs. Through small group meetings and field days, growers will have the opportunity to learn soil health management strategies, network, share experiences, and garner feedback and support for new ideas and past challenges. These groups will also serve as local contacts and be able to advise growers that are new to soil health management. The ultimate goal is to increase local adoption rates of regenerative agricultural practices.

Federal efforts

USDA's Natural Resources Conservation Service (NRCS) currently provides the lion's share of funding in Pennsylvania that goes to improve soil health through several federal Farm Bill programs: Conservation Stewardship Program (CSP), which emphasizes regenerative practices; Environmental Quality Improvement Program (EQIP), which often pays for equipment or structures; and Conservation Reserve Enhancement Program (CREP), which supports the installation of riparian buffers designed to help control erosion and runoff into streams.

A recent report by USDA's research staff found that while the EQIP program was originally designed to help promote soil health practices, these are often outcompeted by other practices such as manure storage—soil health activities received only 2–27% of all EQIP funding between 2009 and 2018.[18] Giving soil health practices higher priority under CSP and EQIP would help them compete favorably with other practices and become more widespread in Pennsylvania.

[18] *Evaluating the Untapped Potential of U.S. Conservation Investments to Improve Soil and Environmental Health. Frontiers in Sustainable Food Systems*, November 2020

While NRCS provides significant funding (EQIP funding alone is currently authorized at $1.81 billion), there are barriers to accessing these funds.[19] There are waiting lists for many of their programs; eligibility can be an issue for new farmers or those who lease the land they work; most have cost-share requirements that can limit participation; and some farmers—particularly those in Plain sect communities—can be leery of receiving government assistance.

Shifting more EQIP and CSP funding to support implementing soil health practices would begin to address this lack of soil-health funding in Pennsylvania, at least for farmers who qualify. Since EQIP and CSP already pay for practices like cover cropping and conservation tillage, encouraging state and regional decision makers within NRCS to give these higher priority for Farm Bill program funding would accelerate their adoption. Pennsylvania has 37.2% of eligible farm acreage in cover crops. Boosting this figure to 50% would cost $23.7 million (based on a SARE median cost estimate of $37 per acre), and boosting it to 75% would cost $46.2 million.

Federal funding for climate disaster relief or preemptive protections should also be made available for soil health improvements. Pennsylvania is expected to experience increasingly frequent and severe rain events, as well as other volatile weather, as a result of a changing climate. The 2018 farm season brought record rainfall, deluging farm fields and towns across the state and leading to 61 Pennsylvania counties declaring disaster. In 2020, farmers in 25 Pennsylvania counties experienced prolonged drought, again leading to emergency declarations and relief funding.

Healthy soils absorb and retain significantly more rain water, helping to reduce downstream flooding. Credit: Tim Furlong, NBC Philadelphia

A 2015 study by the Natural Resources Defense Council found that even a 1% increase in soil organic matter would reduce flooding and droughts on farmland, including capturing and holding

[19] USDA FY2021 Budget Summary

an additional 10,000 gallons of rainwater per acre. Healthy soil can help lessen the impact of severe weather for farmers, as well as for towns and cities located downstream.[20]

The Federal Emergency Management Agency's (FEMA) current Community Rating System Program (CRSP) provides incentives through reduced flood insurance costs to communities who take proactive measures to reduce flood damage. The program should be amended to provide funding or incentives to farmers to implement healthy soil practices that can absorb far more water than poor soils, as well as mitigate crop losses due to severe rain and drought.

We should also explore the potential for Federal Homeland Security funding to be another source of federal funds to improve soil health since food security is in our national interest.

The federal Farm Bill is reauthorized every five years. New ideas and amendments in anticipation of a 2023 federal Farm Bill are already underway. The federal Farm Bill is the single largest source of agricultural practice funding, and may be the likeliest source as well since state budgets have been weakened by the coronavirus pandemic and economic recession.

NRCS Farm Bill funding should help farmers complete and implement more soil health plans. Soil health plans are a relatively new practice for NRCS (practice #116), and focus more specifically on implementing soil health practices than the more general conservation plans. These plan costs will likely compare to the cost of conservation plans in Pennsylvania, which start at about $1,500 for a 200-acre farm and can go higher, and are done through private planning consultants. Completing plans for 53,000 farms in Pennsylvania would require a major addition of technical assistance providers, which should be supported through the 2023 federal Farm Bill under technical assistance to states. A requirement that these subsidized soil health plans convey when a farm is divided or sold would ensure that future farm operators benefit from the soil health planning (and investment) involved.

Three research priorities for new federal Farm Bill funding should include: funding to assess how healthy soils can reduce the need for chemical fertilizer use, including on-farm economic cost-benefit analyses; more research on the connection between healthy soils and nutrient density in foods (Pasa Sustainable Agriculture, Rodale Institute, and Penn State University are all already conducting early studies in this field); and links between healthy soils and adapting to and mitigating climate change.

Another important priority for the 2023 Farm Bill should be to add transition funding and technical assistance to shift confined livestock operations to pasture-based systems, with dedicated technical assistance funding. The most cost-effective way to achieve this shift is to convert cropland to pasture on an existing livestock operation since purchasing additional pastureland is often cost-prohibitive. Most costs are in technical assistance to set up sustainable grazing systems and establish good forage. Augmenting the number of livestock-to-pasture technical assistance staff at the state level through additional federal funding would be the

[20] *Organic Matter Can Improve Your Soils Water Holding Capacity*, Natural Resources Defense Council, 2015

fastest route to expand this practice, and additional funds to support education and demonstration efforts are critical.

Legislation such as the recently reintroduced Agriculture Resilience Act (ARA), sponsored by U.S. Rep. Chellie Pingree of Maine, herself a long-time farmer, offers a comprehensive approach to addressing conservation and climate needs and would fund soil health practices, address pandemic-related stresses to our food supply chain, promote carbon-sequestering practices, and more. The legislation, as currently drafted, includes funding for states to develop their own state-level soil health programs and to fund these practices.

New approaches

While amending existing programs can often be easier than creating new ones, new ideas and new approaches can sometimes appeal to landowners who have not participated in existing programs.

Commonwealth grant programs have for many years provided additional points for applicants who have adopted practices that offer social and environmental benefits. Pennsylvania's Department of Agriculture (PDA), Department of Environmental Protection (DEP), Department of Conservation and Natural Resources (DCNR), Department of Community and Economic Development (DCED), and Pennvest could award soil health bonus points to landowners who can demonstrate investments and successes in improving soil health.

This would be a no-cost solution that addresses one of the most common complaints from farmers and conservationists when it comes to conservation programs at both federal and state levels: The worst actors in terms of farms that pollute heavily are often prioritized first for grant funding.

Pennsylvania's DCNR, Game Commission, Department of Corrections, and Department of General Services all manage Commonwealth lands, some of which are currently under lease agreement or cooperative agreements with farmers. Creating a Soil Health Council similar to the GreenGov Council—which encourages the incorporation of environmentally sustainable practices into the Commonwealth's policy, planning, operations, procurement, and regulatory functions—with representatives from these four agencies and representatives from the Pennsylvania Soil Health Coalition would ensure that farmers implement soil health practices on lands owned or managed by the Commonwealth.

While state and federal action is required for many needed soil health services, including additional financial and technical support, there are actions non-governmental entities can take to promote soil health practices, including universities, nonprofits and even the business community. We heard ideas from our discussions with farmers and agricultural professionals as well. A few of these are profiled below.

For decades, and continuing into the present day, soil health testing labs have primarily focused on measuring a soil's chemical attributes—its pH level and nutrient levels. While this provides farmers with some basic information about soil fertility, this approach does not take into account a wealth of other attributes, such as whether a soil is resistant to erosion, or to what extent beneficial living organisms are present in soil. Comprehensive soil tests that offer farmers a more complete understanding of soil health are an important tool for supporting farmers' efforts to improve their soils. In addition to the standard chemical analyses, comprehensive soil health tests include analyses of physical and biological attributes of soil.

Today, some testing facilities like Cornell University's Soil Health Laboratory are capable of offering farmers this more complete analysis—though the $330 cost for three tests plus technician time can be expensive for some farms, and larger farms will need to test more than one field. Pennsylvania should work with Penn State University (PSU) to build its own soil testing facility capable of offering the Commonwealth's farmers affordable, comprehensive soil health tests. These funds should be prioritized in PSU's annual state budget allocation.

Comprehensively testing soils on 10% of Pennsylvania's 53,000 farms each year would cost an estimated $1.7 million, based on Cornell's comprehensive soil health testing costs for three soil samples. Pennsylvania Resource and Enhancement Protection Program (REAP) dollars are now eligible to pay 75–90% of these testing costs, and USDA NRCS dollars can be used to match or fund these practices as well. Basic soil health fertility tests, which only cost $20 each, should be done annually while comprehensive tests can be done less regularly.

The private sector also has a critical role to play in encouraging healthy soil practices. Turkey Hill Dairy, based in Lancaster, Pennsylvania, has partnered with The Alliance for the Chesapeake Bay and Maryland & Virginia Milk Producers Cooperative Association to form the Turkey Hill Clean Water Partnership. This partnership has raised $1.5 million to support dairy producers planning and implementing conservation practices to improve the water quality of local rivers and streams, and ultimately the Chesapeake Bay. Turkey Hill requires the dairy farmers it buys milk from to complete an updated conservation plan and to implement conservation practices on those farms. Once the practices are in place, producers receive a premium from Turkey Hill for all the milk supplied to its dairy.

Pasa Sustainable Agriculture itself was recently awarded a National Fish and Wildlife Foundation grant to promote organic dairy grazing in the Lancaster area, partnering with a private organic dairy supplier. The project has a goal of converting 10,000 acres to pasture and reducing annual runoff by 400,000 pounds of nitrogen, 9,000 pounds of phosphorus, and 23 million pounds of sediment.

Pennsylvania nonprofits, academic institutions, and agencies should work with the private sector to encourage these kinds of partnerships and approaches.

Summary of recommendations

State policy actions

1. Increase funding for soil health testing and practices under Pennsylvania's Resource Enhancement & Protection (REAP) tax credit by increasing its budget from $13 million to $20 million per year.

2. Pass the Agriculture Conservation Assistance Program (ACAP) bill through Pennsylvania's General Assembly to create a state program for delivering on-farm conservation practices, including practices that build and preserve soil health.

3. Amend the 1988 Pennsylvania Farmland Preservation Act and the 1974 Clean & Green Law to encourage future awardees to adopt soil health practices and to provide transition funds for current enrollees to adopt soil health practices.

4. Pass legislation to create a Soil Health Program under the State Conservation Commission or Pennsylvania Department of Agriculture that can accept federal funding for soil health practices, or amend the 1994 Sustainable Agriculture Act of Pennsylvania to create a new soil health program.

5. Increase soil health testing to 30% of Pennsylvania farms by 2030, and 50% by 2040, through Pennsylvania's Resource Enhancement & Protection (REAP) program or other state or federal funding sources.

6. Add $500,000 to the Pennsylvania Farm Bill budget for 2022–23 and beyond to augment the Urban Agriculture Infrastructure Grant Program to improve soils on urban farms.

7. Amend the PA Farm Bill in 2022–23 to include $1 million annually to promote soil health education and demonstrations through grants to universities, nonprofits, and farm-based organizations.

8. Extend technical support for conventional farms transitioning to organic methods through the PA Farm Bill in 2022–23.

Federal policy actions

1. Increase federal funding for state soil health programs through the federal 2023 Farm Bill or other federal legislation, such as the Agriculture Resilience Act.

2. Increase the acreage of Pennsylvania farms planting cover crops—currently at 37.2% of applicable acreage—to 50% by 2030 and 75% by 2040 by prioritizing USDA's Natural

Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP) funding for cover crops.

3. Amend the federal 2023 Farm Bill to include additional funding and technical assistance for Pennsylvania farms to complete soil health plans. Complete and implement soil health plans on 30% of Pennsylvania farms by 2030 and 50% of farms by 2040.

4. Develop a cooperative agreement with the Federal Emergency Management Agency (FEMA), in coordination with the Pennsylvania Emergency Management Agency (PEMA), to award federal emergency prevention funding for soil health practices on Pennsylvania farms to mitigate crop loss and downstream flooding.

5. Increase federal funding for food and agriculture research, particularly the soil health implications for food nutrient density and reduced fertilizer use, through the federal 2023 Farm Bill.

6. Provide transition funding and technical assistance to shift confined livestock operations to pasture-based, rotational grazing with dedicated federal Farm Bill technical assistance and education funding.

7. Promote conservation tillage. Currently at 60% of applicable Pennsylvania farm acreage (2017). Increase to 75% by 2030 through more education, demonstrations, and training.

New approaches

1. Reward landowners for state and federal grant funding that demonstrate a high level of healthy soil practice adoption through soil health bonus points on grant applications.

2. Create a Governor's Commission on Soil Health, similar to the GreenGov Council, where state agencies that own and/or manage Commonwealth agricultural land lead by example in implementing soil health practices.

3. Work with Penn State University to develop a streamlined version of Cornell University's Comprehensive Assessment of Soil Health test to lower comprehensive soil health testing costs and expand testing capacity.

4. Encourage agricultural businesses to require soil health planning and practices from the farms they buy from. Turkey Hill Farms' Clean Water Partnership is one such model.

Conclusion

Pennsylvania has an exciting opportunity to improve its agricultural soil health and, in doing so, help protect the long-term security of our food system. As state and federal governments recognize that healthy soils are essential for life and livelihoods, as a changing climate brings increasingly severe weather events, and as a pandemic shows us how vulnerable our food production system really is, there has never been a better time to invest in soil health.

Fortunately, there are many pathways toward improving the adoption of practices that build and maintain soil health. Some will require investments of federal and state dollars, while others require vision, imagination, and the will to improve—but not new financial resources. The initiatives launched by other states may offer some guidance for Pennsylvania, or they may inspire us to develop our own path. We hope that the discussion included in this report and its recommendations will inspire some of our policymakers, our businesses, and our communities to take up the challenge and help promote and pass some of these different pathways to soil health.

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