# How conservation makes dairy farms more resilient, especially in a lean agricultural economy

Environmental Defense Fund | K·Coe Isom

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Report Prepared by Environmental Defense Fund and K·Coe Isom

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*About EDF*

Environmental Defense Fund (edf.org), a leading international nonprofit organization, creates transformational solutions to the most serious environmental problems. EDF links science, economics, law and innovative private-sector partnerships.

*About K·Coe Isom*

K·Coe Isom (kcoe.com) is a leading national firm of consultants and certified public accountants in the food and agriculture industry. AgKnowledge is a service that gives farmers and ranchers access to financial and farm management knowledge to inform decision-making.

*Acknowledgments*

Collaborators: TeamAg, Inc.

About TeamAg, Inc.

TeamAg Inc. (teamaginc.com) provides independent agricultural, engineering and consulting services throughout the Northeastern U.S. TeamAg offers a team of professional engineers, nutrient management planners, agronomists and precision ag specialists.

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Case study participants

We would like to thank the farmers who generously gave their time and expertise to this report.

Foreword

Chris Sigmund, president of TeamAg, Inc.

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# About this report

This report is the result of a collaboration between Environmental Defense Fund (EDF), the agriculture managerial accounting firm K·Coe Isom AgKnowledge, the ag consulting firm TeamAg, Inc. and four Pennsylvania dairy farmers. It builds on learnings from a 2018 report, *Farm finance and conservation: How stewardship generates value for farmers, lenders, insurers and landowners,* also conducted by EDF and AgKnowledge.

This report analyzes the impact of conservation on dairy farm budgets with four in-depth case studies that combine the farmers' own records with their experience adopting conservation practices. The cases show how dairy farms of various sizes and budgets have financed different sets of conservation practices with a variety of benefits — including economic benefits which many of the farmers did not realize until they participated in this study. The cases include lessons farmers learned in the process of adopting these practices, particularly when examining impacts at the farm enterprise scale. Due to the personal nature of the financial information shared, the farmers who participated chose to remain anonymous.

It is important to note that this analysis is based on farmer records and expertise and therefore does not prove a causal relationship between conservation adoption and the cost and yield impacts of crops for feed or dairy production. However, the farmers who participated in this analysis attribute their cost savings and yield impacts to conservation adoption. Their stories show how, even in a weak agricultural economy, conservation can be financed and incorporated successfully into more resilient farming enterprises.

In addition to analyzing the impact of conservation practice adoption on dairy farm budgets, the case studies address some of the challenges that farmers and their advisers face. We offer some recommendations for increasing educational, technical and financial resources for farmers to make conservation practice adoption more viable not only within Pennsylvania's dairy sector, but across the entire U.S. agricultural system.

Capturing the true financial value of conservation and incorporating it into the decision-making of farmers and their business partners presents opportunities to share the benefits, costs and risks of conservation adoption more equitably across the farm financial system, and to generate more financial and environmental value for all.

"This report provides valuable and timely information for dairy farms exploring how to invest in conservation practices. The farms featured in the report demonstrate the business case for conservation. The returns were not only limited to improved water quality and soil health – they had a positive impact on the operations' bottom lines. The data from this report will be used by my sustainability staff when they are working with farms to identify improvements that can be made on their farms. Using data from real farms will have a large impact on their decision-making process and help to sell the case for sustainability."

**— Lindsay Reames, director of sustainability and external relations at the Maryland & Virginia Milk Producers Cooperative**

# Foreword

The Chesapeake Bay is a 64,299-square-mile drainage basin spanning six states and supporting a vibrant regional economy. The biggest threat to the bay's long-term economic and environmental viability is pollution from rivers and streams, largely from nutrient and sediment runoff from farms.

Pennsylvania and other bay states are actively working to improve the quality of the water flowing into the Chesapeake Bay by reducing the loss of nitrogen and phosphorus from local farms. This work includes expanding the adoption of conservation practices to improve soil health, optimize nutrient use, restore forest and grass buffers near waterways, and improve manure storage.

As president of TeamAg, a firm that supports farmers in adopting these practices, I've seen the positive impact that conservation can have. That's why TeamAg has collaborated with Environmental Defense Fund and other local environmental and crop consulting businesses on numerous farm-level initiatives in the Chesapeake Bay watershed. These initiatives help farmers improve the economic and environmental performance of their farms, as well as reduce nutrient and sediment loss from those farms into surface and groundwater — and, ultimately, the bay.

One such initiative – the Bay Farms On-Farm Network, launched in 2004 – grew to 185 farms from Pennsylvania and Virginia by 2009. Participating farmers used an adaptive nitrogen management program that helped them reduce nitrogen use by 20% and increase farm profits by $13.50 per acre. The network reached more than 20,000 acres, preventing 540,000 pounds of nitrogen from entering the groundwater that flows into the bay. The effort increased combined profits by more than $270,000 for participating farmers.

Many of the farmers who participated in the project, together with their certified advisers, continue to use an adaptive approach and agronomic tests to guide nutrient applications. The long-term adoption of these conservation practices by farmers — even after initial subsidies offered by public and private parties expired — highlights the important connection between a farm's environmental and economic performance. Improved nutrient management has a positive economic impact on local farms.

This report shows the impact of conservation practice adoption on dairy farm budgets in Pennsylvania. It analyzes the financial benefits that farmers realized as they worked to implement best management practices on their farms. It also addresses the challenges faced — especially in a weak agricultural economy — by farmers, environmental consultants and conservationists in adopting strategies to improve water quality and promote a healthier environment. Despite the challenges, improved nutrient management had positive financial benefits for local farms.

Profitable farms can coexist with a healthy Chesapeake Bay watershed. This report gives us a roadmap for achieving both objectives.

**— Chris Sigmund, president of TeamAg, Inc.**

# Executive summary

This report analyzes the budgets of four representative Pennsylvania dairy farms of varying sizes that have each adopted a different suite of conservation practices including nutrient management, conservation till or no-till, cover crops, stream fencing and manure storage. The overriding lesson learned from this analysis is that conservation contributes to the economic well-being and resilience of dairy farms.

The economic value of an effective mix of conservation practices is clearest when viewed across the full farm enterprise budget, with a variety of positive outcomes including reduced costs, improved soil health, improved feed crop resilience and improved dairy herd health.

Equally clear to the economic value of conservation practices is our finding that most farmers need some form of technical or financial assistance to implement the practices that achieve the greatest economic return and environmental benefit. This is especially true in the context of a lean agricultural economy that pressures farmers to focus on short-term business planning, making it difficult to incorporate practices with longer payback times.

Finally, this report identifies current sources of educational, technical and financial assistance available to farmers for increasing conservation adoption and reducing nutrient losses while improving financial returns. Additional recommendations are offered for bringing economically viable conservation solutions to scale, both in Pennsylvania and beyond.


"Dairy farmers share a long-standing commitment to environmental stewardship and this report recognizes that we are doing our part to protect the planet's natural resources. It also demonstrates that no two dairy farms are the same, underscoring the importance of partnerships that identify new practices and technology solutions that come with economic incentives and a positive environmental outcome. We look forward to continuing to work with Environmental Defense Fund, K·Coe Isom and other partners to advance sustainable agriculture practices that offer financial and technological support."

**— Marilyn Hershey, chair of Dairy Management Inc. and Pennsylvania dairy farmer**

# Key findings

**Conservation practices can pay, often in unanticipated ways.** Dairy farmers who adopted conservation practices including manure storage, nutrient management, cover crops, conservation tillage and stream fencing realized a variety of financial benefits, some of which they did not recognize or quantify prior to participating in this study. These benefits included reduced labor hours, savings on external feed and bedding, and lower vet bills due to improved herd health. Farmers also reported conservation practices improved soil quality, enabled them to get more value from manure and improved the quality of their forage. This resulted in higher crop yields, increased milk production and improved herd health. In some cases, conservation increased initial costs, but overall benefits outweighed these additional costs.

Specifically:

- Cover crops were associated with improved yield on all four farms, with costs being offset by improved yield.
- Conservation tillage saved labor and fuel costs and improved soil health in all four cases, though it can take time to for farmers to realize yield benefits.
- Manure storage options have high capital costs and almost always require supplemental grants or other sources of funding, but the farmers that were able to improve manure management realized significant benefits beyond water quality improvements. Additional benefits included improved nutrient management, which was associated with increased yield, and a host of benefits from manure separators, which allowed farmers to use manure for bedding instead of wood shavings, resulting in significant savings on bedding costs, vet costs and reduced cow mortality.
- Stream fencing improved water quality, wildlife habitat and herd health for farmers that implemented the practice.

**Economic gains come at the farm level.** Farmers benefited from looking at the farm enterprise holistically to better understand the full financial impacts of conservation adoption. For example, a single conservation practice like planting cover crops had upfront costs or, in some cases, a short-term drag on yield, but delivered large returns on investment in all cases by year two or three. Similarly, the cost for a practice in one area of the budget was typically offset by the savings in one or more other budget categories.

**Accurate recordkeeping typically results in better management.** Accurate and frequent recordkeeping for both economic and conservation measures proved to be essential for dairy farmers to understand their farm's economic status – whether profitable or not – and to assess the return on investment for conservation practices. The recordkeeping systems utilized by farmers in this report had varying levels of sophistication, but the systems that allowed farmers to document and analyze key performance indicators like yield, milk production and overall costs on a per-acre and per-cow basis enabled farmers to better identify areas of inefficiency and ways to reduce loss.

**Investments in conservation have increasing returns.** Farmers that had access to additional financial assistance for conservation through cost share programs, grants and carbon credits were able to make larger investments in practices that achieved even greater economic and environmental benefits. This was especially true for the farmers that had access to sufficient resources to invest in improved manure management.

# Recommendations

This report focused on the conservation economics of dairy farms in Pennsylvania, but the learnings and recommendations can be applied more broadly to improve the economic and environmental resilience of farms in other agricultural sectors across the country.

**Improve financial and technical assistance for farmers to realize conservation benefits at the enterprise scale.** Conservation programs need to do more to encourage and help farmers see the economic benefits of conservation practices across farm budgets, which will encourage them to try new practices and maintain them for the long term. Through financial and technical assistance programs, conservation districts, state agencies and the Natural Resources Conservation Service (NRCS) should provide guidance to farmers and their advisers on how to track and assess the broader economic benefits of conservation practices on their own farms and provide examples, like those in this report, of how such practices have generated economic benefit on other farms. In addition, conservation programs should extend contract lengths to encourage and enable farmers to reach the point at which conservation practices deliver a return on investment.

**Support farmers' collection of actionable financial and environmental data.** Good recordkeeping is necessary to understand the environmental and financial impacts of conservation practice adoption, but not all farmers have access to robust and easy-to-use recordkeeping platforms. Federal and state agencies, conservation districts and business partners such as Farm Credit should increase support for farm recordkeeping platforms and educational opportunities that combine financial and conservation management. Increased access to these tools will help farmers better track and manage their data, gain valuable insights from the information collected and measure progress towards conservation goals. One valuable resource farmers can use to track and document their economic and environmental performance is N Balance, which quantifies environmental outcomes with a simple calculation and allows farmers to share their conservation stories.[2]

**Enhance and better leverage innovative financing programs for agricultural conservation.** Public grants and cost share programs are essential for many conservation investments, especially some of the more capital-intensive practices that can deliver some of the largest economic returns and environmental benefits. Many of these conservation financing programs are highlighted in the September 2019 report by EDF and the National Association of State Departments of Agriculture, *Innovative State-Led Efforts to Finance Agricultural Conservation*.[3] Federal and state agencies, conservation districts and agricultural lenders should increase support for conservation through cost share programs, tax credits and low-interest loans.

**Increase private sector support and incentives for conservation.** Conservation is important to farmers' economic viability and social license to operate, but they cannot do it alone. Action is needed across the value chain.

Specifically:

- Farm advisers should ensure they are providing quality sustainability expertise to their client farmers and ensure they are aware of the latest resources for recordkeeping, financing and cost share assistance. One resource available to farm advisers is the SPARC online platform.[4]
- Dairy cooperatives and processors should be proactive in implementing programs to support their farmers' sustainability progress. One resource available to help dairy cooperatives develop a sustainability program is the *Water Quality Guide for Dairy Coops and Processors*.[5]
- Agricultural lenders could analyze the business benefits and risks of conservation and share that information with their clients. Lenders should also create new funds or favorable financing terms to target the expansion of conservation practices that have a proven return on investment.
- Farmers' supply chain and business partners should provide meaningful financial incentives for environmental outcomes.

# Introduction

"On our farm, conservation practices just make sense. Our soil quality has been getting better year after year. We are constantly looking for ways to improve on what we are already doing. Receiving an economic return from simply doing the right thing is just an added bonus."

**— Brett Reinford, owner of Reinford Farms, a dairy located in Juniata County, Pennsylvania**

Dairy farming is deeply engrained into the heritage, landscape and cultural fabric of the Chesapeake Bay region. Many families trace dairy farming back multiple generations and feel a strong emotional connection to the business and way of life. Sustaining the local economy and local environment is essential to sustaining this way of life, which is why dairy farmers in Pennsylvania and across the U.S. are highly motivated to increase their resilience to unfavorable economic and environmental conditions, including highly variable prices, unpredictable farm policies and extreme weather – most notably increased flooding.

Dairy is in the fourth year of an economic downturn in which the majority of farmers have struggled to break even. While dairy prices have recently trended upward and PennState Extension's dairy outlook[6] predicts milk price could approach $20/cwt by the end of 2019, another PennState Extension analysis[7] found that the gross milk price breakeven point for most farmers in the state is $21.20/cwt.

The challenges of the dairy economy in Pennsylvania coincide with near-term deadlines on required milestones to improve water quality. In 2010, the U.S. Environmental Protection Agency (EPA) established a Total Maximum Daily Load (TMDL) for the Chesapeake Bay, setting maximums for the amounts of nitrogen, phosphorus and sediment that can flow into the bay while still meeting water quality standards. Under the TMDL, each bay state must meet mandated two-year milestones. Pennsylvania is behind in meeting its mandated reductions in nutrients and sediments under
the TMDL, and is counting on agriculture and other sectors to deliver significant reductions in nitrogen, phosphorus and sediment. Specifically, Pennsylvania missed its 2017 target for nitrogen reductions by more than 17 million pounds statewide, with 16 million pounds of that reduction to come from agriculture.

Given Pennsylvania's failure to date to reach the required regulatory milestones for achieving water quality goals, there is an urgent need to identify other non-regulatory incentives to increase the scale and pace of conservation practice adoption across dairy farms in the region, focusing on practices that have a strong return on investment. It is within this context that EDF and AgKnowledge embarked on this conservation economics assessment, digging into the books of four willing farmers who, due to the sensitive nature of farm financials, have asked to remain anonymous. The farmers' experiences provide valuable insights on the important role conservation can play in the overall health of a farm's budget, and which conservation practices can deliver the greatest return on investment.

To achieve these important insights, each farmer case study includes a comprehensive analysis of the full farm budget. Farmers frequently receive cost and benefit data for a single conservation practice and a single year. Presented that way, much of the economic value is hidden. The real value becomes apparent when farmers incorporate the economics of conservation within the context of their entire operation, tallied over multiple years, and therefore is the approach presented in the following analysis.

# Conservation practices assessed

This report focuses on five of the most common conservation practices for reducing soil erosion and nutrient loss from dairy farms in Pennsylvania: manure storage, stream fencing, cover crops, conservation tillage and nutrient management.

## Manure storage

Dairy manure is a valuable nutrient resource and can reduce a producer's commercial fertilizer costs. If mishandled, however, dairy manure can contaminate surface and groundwater. Proper storage, handling and application of manure from dairy operations can help to protect Pennsylvania and the Chesapeake Bay's water resources and increase profits for dairy and crop operations.[8]

## Stream fencing

Stream bank fencing is a simple, effective way for farmers to improve herd health and water quality by controlling livestock access and establishing a buffer zone of vegetation that supports water quality and wildlife habitat. Federal and state agencies encourage fencing and provide technical and financial assistance to cooperating farmers.[9]

## Improved nutrient management

Managing the timing, rate, source and placement of nutrients (both manure and commercial fertilizer) can optimize feed crop yield and reduce nutrient loss to water and air. Nutrient management planning, soil testing and management tools can help farmers get the most value out of nutrient applications and reduce losses that can negatively impact the environment. Agronomists can help farmers understand specific soil needs to optimize costs and yield from this practice.

## Cover crops

On many conventional farming operations, the fields are left bare after harvest. Cover crops are grasses, legumes or forbs planted to provide seasonal soil cover on cropland when the soil would otherwise be bare. Cover crops are generally not intended for harvest or sale, although some growers earn revenue by integrating livestock into their cover crop systems or planting an overwintering cash crop, such as winter wheat. Cover crops can prevent soil erosion, improve soil health, suppress weeds, disrupt pest cycles and scavenge excess nutrients.[10]

## Conservation tillage

In conventional tillage systems, the soil is turned to prepare the seedbed and control for weeds. No-till and reduced-till are management approaches in which the soil is not turned or only minimally turned, leaving plant material on the surface of the soil. The seed is then directly drilled for planting. Conservation tillage reduces soil erosion and improves the quality of the soil, for example, by increasing its water-holding capacity.[11]

# Farm enterprise case study methods

EDF, AgKnowledge and TeamAg identified a range of farming operations that had adopted conservation measures to be considered for analysis as a case study in this report. Based on the data and other required financial and conservation information needed to complete the analysis, four farms were selected that represent an accurate cross-section of dairy farms in Pennsylvania. The selected farm operations range from 40 to 750 cows, produce a variety of other crops, and include a mix of conservation practices and programs. The selected farmers provided complete access to financial records and conservation plans, in addition to personal experiences and observations offered through farmer interviews. The full list of data collected is available in the Appendix.

Each case study contains general information about the farm, the farmer's history of conservation adoption, a table of key financial variables and a farm budget compiled using 2017 data from each farmer's records. AgKnowledge standardized the budgets as much as possible, but different farm recordkeeping systems led to some variances in the budget categories. The budgets highlight the increased costs and savings that the farmers attributed to conservation adoption. Each case also includes a table of key financial variables, which summarizes the farmers' estimates of the magnitude of the cost and yield impacts from conservation adoption.

To enable comparison across the four budgets, AgKnowledge normalized the price of dairy milk and commodity grains, assuming a price of $9 per bushel for soybeans, $33 per ton for corn silage, $165 per ton for grass hay, $190 per ton for alfalfa and $16 per hundredweight (cwt) for milk.

The cost of land was excluded from the analysis. When farmers own their own land, renting it out can generate revenue or be used to pay land debt. If they farm on rented land, that adds to their production costs. The bottom line for each budget is therefore net return before land costs. The decision to exclude the cost of land from the analysis is a significant one and was not taken lightly.

Land ownership or rental rates vary considerably and can alter significantly the overall profitability of an operation. In addition, in many cases, land costs are fixed — tied to long term loans and equity — and do not shed light on conservation costs or benefits.

Conservation expenses, on the other hand, are typically tied to variable costs — costs that vary from year to year based on a farm's management and production plans. Typically, land costs do not affect these variable costs. As a result, AgKnowledge normalizes land costs to give a more accurate picture of the variables that drive conservation and profitability.

The following case studies are valuable to farmers interested in the financial impacts of conservation for several reasons:

- **The methods are accessible and understandable.** The crop budgets in this analysis will look familiar to any farmer. Good recordkeeping is the only requirement to replicate this analysis on any farm. Land Grant University Extension services can help farmers with this process.
- **The budgets show how everything connects across the whole farm enterprise.** The budgets show how relatively small savings in multiple cost categories across the budget add up. The holistic view of the farm enterprise and conservation practices allows farmers to see the overall impact on their finances.
- **The enterprise view places focus on profit over yield.** To understand the true financial health of their operations, farmers must consider crop yields, prices, production costs, and milk production and qualities. Instead of tracking yield and profitability separately from practices each year, a farmer should connect each individual practice and expense to the year's overall profitability to understand which areas are profitable and which are not.
- **The stories behind the budgets offer important context and insights.** The farmers' stories that accompany their budgets will allow other farmers to learn from their experiences and understand potential tradeoffs and management considerations that can be the difference between making a profit or not.

# Farm budget categories

### Revenue
Farm revenue was measured as a function of milk pounds multiplied by commodity price. The analysis uses the producer's milk yield but assumes a commodity price for milk. Actual revenue may vary depending on the producer's marketing plan. Additionally, income that is separate from milking revenue is denoted as such.

### Internal feed value
The value of internal feed was calculated as a function of crop yield multiplied by an assumed commodity price. This figure should be thought of as an opportunity cost to producers. The next best alternative to feeding the crops to the dairy herd would be to sell the crop into the grain market for profit.

### Internal feed cost
The internal feed cost was calculated as the cost to produce the feed that is fed internally. Included in those costs are input costs for each crop. Input costs included seed, chemical, fertilizer and other costs such as bailing that are directly related to the production of internal feed. This internal feed cost is then included in the dairy herd budget as an input cost to the overall herd budget.

### External feed costs
Includes the cost of purchasing supplementary feed that is not grown on the farm.

### Variable costs
Includes the costs that vary with production and number of head in the herd.

### Fixed costs
Includes the costs of running the operation, which do not vary with production or herd size.

# Abbreviations and explanations

| | |
|---|---|
| **BMP** | Best Management Practice. A BMP is defined as any program, process, design criteria, operating method or device which controls, prevents, removes or reduces pollution. Farmers implement BMPs, or conservation practices, to ensure they operate in a profitable and environmentally friendly manner. |
| **CAFO** | Concentrated Animal Feeding Operation. A CAFO is defined by the EPA as an intensive animal feeding operation with more than 1,000 animal units confined more than 45 days per year. |
| **NRCS** | Natural Resources Conservation Service. NRCS is the agency within the U.S. Department of Agriculture (USDA) that provides farmers, ranchers and forest managers with free technical assistance or advice for their land and manages a range of conservation programs that provide financial assistance to farmers for implementing conservation practices. |
| **EQIP** | Environmental Quality Incentives Program. Managed by USDA's NRCS, EQIP provides financial and technical assistance to agricultural and forestry producers to implement practices that address natural resource concerns and deliver environmental benefits, including improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation, and improved or created wildlife habitat. |
| **CRP** | Conservation Reserve Program. CRP, run by USDA's Farm Service Agency, is the nation's largest conservation program. Through CRP, farmers receive an annual payment for removing environmentally sensitive land from agricultural production and planting species that will improve environmental health and quality. |
| **CREP** | Conservation Reserve Enhancement Program. CREP, an offshoot of CRP, is a voluntary program that targets high-priority conservation issues identified by local, state or tribal governments, or non-governmental organizations. Through CREP, farmers and other landowners can receive an annual payment for removing environmentally sensitive land from production and implementing conservation practices. |
| **Cwt** | Cwt is the abbreviation for a hundredweight – a unit of measurement for weight used in milk commodities trading contracts. A hundredweight is equal to 100 pounds. |
| **DHIA** | Dairy Herd Improvement Association. DHIA is a national association that helps dairy producers create and manage records and data about their cows for management decision-making. |
| **N Balance** | N Balance measures how much of the nitrogen fertilizer applied to crops is lost to the environment. Improving N balance through practices such as cover crops and crop rotation reduces water pollution and greenhouse gas emissions, while improving fertilizer efficiency for crop yield. For more information on N Balance, contact sfriedman@edf.org. |
| **PA DEP** | Pennsylvania Department of Environmental Protection is the Pennsylvania agency responsible for protecting and preserving the land, air, water and public health through enforcement of the state's environmental laws. |
| **PennVEST** | Pennsylvania Infrastructure Investment Authority. PennVEST provides low-interest financing across the state for sewer, storm water and drinking water projects, often using federal Clean Water State Revolving Funds from the EPA. Some of loans are 100% principal forgiveness, essentially making it a grant, based on financial need. |
| **PFA FACCTS** | PFA FACCTS is a bookkeeping software specially designed for agriculture and small business needs by the Pennsylvania Farm Bureau. |
| **REAP** | Resource Enhancement and Protection. REAP offers Pennsylvania state tax credits to eligible applicants to help defray the costs associated with farm improvements that improve water quality, with $13 million available in FY20. |
| **SRF** | State Revolving Funds. SRF provides communities a permanent, independent source of low-cost financing for a wide range of water quality infrastructure projects. |

# Farmer A: Enterprise analysis and approach to conservation

Farmer A – Lebanon County, Pennsylvania

- Farm size: 600 acres
- Crops grown: Corn, soybeans, barley, grass hay, alfalfa
- Dairy herd: 355 milking cows, 56 dry cows
- Conservation practices: Conservation tillage, cover crops, stream fencing and riparian buffers, manure separator and roaster
- Conservation program and research participation: EQIP, Ducks Unlimited program

"Implementing better conservation strategies, especially manure management, has changed our farm for the better. Our manure separator has hugely impacted our herd health and reduced our costs, in addition to the other positive changes we've made over the past decade."

**- Farmer A**

## Approach to conservation

Farmer A is a second-generation family farmer in Lebanon County, Pennsylvania. Since 2000, he has grown the operation from 150 milking cows to more than 350. In 2012, the family completed construction on a new free-stall barn and milking parlor, and their son returned to the operation as a business partner. Farmer A has a partnership with his farming brother that enables them to share machinery and equipment and term debt payments across all their acres. In addition to the facility expansions in the past decade, Farmer A has engaged in several conservation initiatives to improve overall production and farm health.

Farmer A uses PFA FACCTS software provided by Pennsylvania Farm Bureau for financial recordkeeping. He keeps records based on bank reconciliations and maintains his books on a semi-accrual basis. Farmer A hires an accountant to prepare taxes and financial statements (income statement, balance sheet and statement of cash flows) at year-end. Farmer A receives comparative financial statements to understand profitability and year-over-year growth. Farmer A records production data in Excel and uses software from the DHIA to manage dairy data. Farmer A uses CAFO records to track manure management, and he uses handwritten records for fertilizer.

In 2012, Farmer A installed a manure separator with cost share support from NRCS's EQIP program. He also capitalized on a partnership with Schnupps Grain Roasting to install a roaster that uses heat to further process and sterilize the manure to use for bedding. After separation, the liquids are deposited into the operation's lagoon, with a capacity of 2.5 million gallons. Farmer A utilizes sterilized solids as bedding for cows, replacing wood shavings. This repurposing of manure has had substantial benefits. Farmer A has saved more than $1,000 per week in bedding costs and has reduced veterinary costs due to decreased mastitis. The increased operating cost for the roaster is $20 per day, or $7,300 per year. Farmer A estimated a decrease from 22 to five cases of mastitis per month, resulting in 204 fewer cases per year, translating to $51,000 in saved veterinary costs ($250 per case). Farmer A has also observed a decreased cow mortality rate since the switch to manure bedding. Farmer A estimated a reduction from 12 to 3-4 cow mortalities per year. Assuming an overall value of $850 per cow[12], this equates to an estimated savings of $7,225 per year from the reduced mortality loss. With the benefit of the cost share program, Farmer A was able to make a return on the manure separator within the first year, as the annual benefits of $112,000 outweighed his investment of $100,000.

## Manure Separator Economics

| | |
|---|---|
| Farmer Investment | $100,000 |
| Cost Share Program | $70,000 |

Total Cost: $170,000

### Annual economic benefit to farmer

| | |
|---|---|
| Bedding Savings | $52,000 |
| Savings from Selling Surplus Separated Solids | $2,000 |
| Additional Return from Reduced Cow Mortality | $7,225 |
| Veterinary Savings* | $51,000 |

Total Annual Benefits $112,225

*Estimate from bedding change and reduced cases of mastitis after Farmer A transitioned to conservation tillage in 2012.

Farmer A has also transitioned to conservation tillage, which has been a learning and growing process as he discovered which practices work the best for his operation. Previously, Farmer A performed three passes of chisel and disc tillage. He has continued to utilize those types of tillage, but reduced the frequency to one pass. In addition to recognizing soil health benefits on his property, Farmer A observed a two-thirds reduction in fuel expenses and an estimated 25 days of gained labor time to attend to other work on the operation.

Farmer A's nutrient management strategy incorporates both manure and synthetic fertilizers. Farmer A performs soil testing on an annual basis to ensure that he applies the correct type and amount of nutrients. Farmer A shared that rainy years can present a challenge, as his manure storage is not large enough to accommodate the added rainfall from wet fall and winter months, and still allow him to apply the manure at the preferred times. To avoid over-applying liquid manure, Farmer A is seeking financial assistance to expand his manure storage capacity, put a roof over his barnyard, cover over his current storage lagoon, and/or reduce the amount of clean stormwater captured by barnyards and added to the manure storage.

Over the past few years, Farmer A has added synthetic fertilizers to the rye forage, which has helped increase yields by between ½ and 1 ton per acre, decreasing the overall cost of external feed. Farmer A started planting cover crops in 2012. When asked about the effects of cover cropping, Farmer A shared that it had an "immediate impact on our nutrient management" by increasing soil quality and decreasing the quantity of applied nutrients. Since he began implementing cover crops, corn silage production has increased from approximately 6 tons per acre to 8-9 tons per acre. Since 2012, Farmer A has worked with his advisers to experiment with different cover crops on his land. Farmer A acknowledged the external cost of paying for cover crop seed, but said that the reduction in external feed purchases from higher yields outweighed the seed costs while also improving soil health. Farmer A observed that before the farm started conservation tillage and planting cover crops, wind on the property caused erosion, but the conservation measures have significantly reduced this problem.

Farmer A has several streams running through the property. The streams have natural trees and riparian buffers in some areas, but in 2000, Farmer A participated in a Ducks Unlimited project to install fencing 20 feet back from the streams, creating a more substantial riparian buffer throughout the property and preventing cattle from having direct access to the stream. The stream fencing delivered clear and substantial water quality benefits, in addition to co-benefits for fish and other wildlife.

Overall, Farmer A has seen substantial environmental and economic benefits on his operation from implementing conservation measures, and cost share programs made it much easier for him to finance a number of the conservation practices.

## Key takeaways

- Farmer A experienced several economic benefits from implementing conservation practices with assistance from EQIP and Ducks Unlimited.
- The manure separator delivered significant benefits, including reduced mastitis, reduced bedding costs and reduced mortality. Cost savings included $1,000 per week in bedding costs, $51,000 per year in veterinary costs and $7,225 per year in reduced mortality.
- Fencing animals out of the stream reduced mastitis and improved herd health and water quality.
- Conservation tillage delivered significant savings and conservation benefits, including a two-thirds reduction in fuel expenses, 25 days of gained labor time and reduced erosion.
- Cover cropping increased soil quality, decreased the quantity of applied nutrients, increased yields, reduced external feed purchases from higher yields and reduced erosion.

## Key financial variables

The table of key financial variables summarizes Farmer A's estimates of the magnitude of cost and yield impacts from the farm's conservation adoption. The table is based on the farm's current crop mix of corn, soybeans, barley, and alfalfa acres, in which cover crop is planted for fall/spring growth with minimal-till corn. Data is from 2017, and represents a full production and crop year. For comparative purposes all data is shown on per acre or per cow basis.

TABLE 1

### Farmer A, Key Financial Variables

| Crops ($/acre) | Corn | Soybeans | Soybeans and Barley | Grass Hay |
|---|---|---|---|---|
| Cover Crop Seed | (32) | (3) | (2) | (3) |
| Labor Savings | 4 | 0.3 | 0.3 | 0.4 |
| Fuel Savings | 4 | 0.4 | 0.2 | 0.4 |
| Yield Increase | 26 | 2.3 | 1.5 | 2.5 |
| Net Impact by Crop | 2 | 0 | (0.1) | 0.3 |
| Net Impact for Full Rotation | | | $2.2 per acre | |
| **Dairy ($/Cow)** | | | | |
| Bedding Savings | 127 | | | |
| Vet Bill Savings | 124 | | | |
| Net Impact for Dairy | $251 per cow | | | |

## Crop budget

Table 2 summarizes Farm A's 2017 crop budget. All figures shown are dollars per acre unless otherwise indicated. Rows in green are areas of reduced costs due to conservation practices, while rows in red are increased costs. The assessment of increased or decreased costs are based on the farmer's experience. The cost to produce feed represents the cost of all input, variable and overhead expenses that are attributed to producing crops and feed that will be fed internally to livestock.

TABLE 2

### Farmer A, 2017 Crop Budget

| Crop Values are per/tn | Corn Silage | Soybeans | Soybeans and Barley | Grass Hay | Total | Units |
|---|---|---|---|---|---|---|
| Acres | 516 | 46 | 30 | 50 | 642 | Acres |
| Yield (Tn/acre) | 27 | 75 | 80 | 9 | 190 | Ton/acre |
| Commodity Price $/Tn | 33 | 9 | 9 | 165 | | $/Ton |
| **Internal Feed Value** | **890** | **675** | **720** | **1,403** | **3,687** | $/Acre |
| **Internal Feed Value (Total $)** | **459,177** | **31,050** | **21,600** | **70,125** | **581,952** | **$ Total** |
| Seed | 146 | 146 | 146 | 146 | 146 | $/Acre |
| Fertilizer | 49 | 49 | 49 | 49 | 49 | $/Acre |
| Chemicals | 26 | 26 | 26 | 26 | 26 | $/Acre |
| **Total Crop Input Costs** | **221** | **221** | **221** | **221** | **221** | $/Acre |
| Farm Fuel | 33 | 33 | 33 | 33 | 33 | $/Acre |
| Other Variable Crop Costs | 225 | 225 | 225 | 225 | 225 | $/Acre |
| **Total Crop Input + Variable Costs** | **478** | **478** | **478** | **478** | **478** | $/Acre |
| **Cost to Produce Feed (Total $)** | **246,735** | **21,996** | **14,345** | **23,908** | **306,985** | **$ Total** |

Values are $/acre unless otherwise indicated. Rows in green are areas of reduced costs when using conservation practices. Rows in red are increased costs.

## Dairy herd budget

Table 3 summarizes Farm A's 2017 dairy herd budget. All figures shown are dollars per cow unless otherwise indicated. The number of cows includes all cows – milking, bred and dry. Rows in green are areas of reduced costs due to conservation practices, while rows in red are increased costs. The assessment of increased or decreased costs are based on the farmer's experience. Internal feed costs are the costs to produce internal feed as shown in the Crop Budget from above. Net return before debt, land or capital expenditures represents gross milk income minus total expenses, divided by total number of cows.

TABLE 3

### Farmer A, Dairy Herd Budget

| Dairy Herd* Values are per/head | Open Cows | Bred Cows | Milking Cows | Total | Units |
|---|---|---|---|---|---|
| Head # | - | 56 | 355 | 411 | |
| Expected Productions (CWT/Cow) | - | - | 262 | 227 | CWT/Cow |
| Commodity Price | 16 | 16 | 16 | 16 | $/CWT |
| **Gross Income** | **-** | **-** | **4,197** | **3,625** | $/Cow |
| **Gross Income (Total $)** | **-** | **-** | **1,489,864** | **1,489,864** | **$ Total** |
| External Feed | | | | 1,671 | $/Cow |
| Internal Feed Cost | | | | 747 | $/Cow |
| **Total Dairy Input Costs** | | | | **2,418** | **$/Cow** |
| Animal Health / Vet / Breeding | | | | 305 | $/Cow |
| Farm Repairs | | | | 121 | $/Cow |
| Farm Supplies | | | | 162 | $/Cow |
| | | | | **Total** | **Units** |
| Other Dairy Variable Costs | | | | 408 | $/Cow |
| **Total Dairy Input + Variable Costs** | | | | **3,415** | $/Cow |
| Machinery | | | | 529 | $/Cow |
| Taxes | | | | 60 | $/Cow |
| Interest | | | | 34 | $/Cow |
| Other Fixed Costs | | | | 211 | $/Cow |
| **Total Fixed Costs** | | | | **835** | $/Cow |
| **Total Expenses** | | | | **4,250** | $/Cow |
| **Total Expenses (Total $)** | | | | **1,746,835** | **$ Total** |
| **Net Return before Debt, Land or Capital Expenditures** | | | | **(625)** | **$/Cow** |

Values are $/cow unless otherwise indicated. Rows in green are areas of reduced costs when using conservation practices. Rows in red are increased costs.

# Farmer B: Enterprise analysis and approach to conservation

Farmer B – Lancaster County, Pennsylvania

- Farm size: 90 acres
- Crops grown: Corn, alfalfa, hay, triticale (cover crop), oats (cover crop)
- Dairy herd: 60 milking cows, 10 open cows
- Conservation practices: No-till, field terracing, improved nutrient management
- Conservation program and research participation: PennVest grant candidate, Center for Dairy Excellence Transformation team grant

"Before we started no-till, our run-off wasn't clear, but now you see water coming through the fields and onto our driveway, and it is completely clear. This change has improved our water and soil quality immensely."

**– Farmer B**

## Approach to conservation

Farmer B, a Mennonite farmer, operates on a steep area of 90 acres in Lancaster County, Pa. The operation is sloped with a creek running through the lowest area of elevation. The creek is fenced so that cattle do not have direct access to the water source. Implementing conservation is relatively new for Farmer B, and he has much more planned for the years ahead based on his experience so far. Farmer B uses QuickBooks desktop and does his recordkeeping and financial tracking based on bank reconciliations. Farmer B uses cash deposits and checks as a means of recording expenses and income on a cash basis. Farmer B hires a tax accountant to prepare his taxes at year-end, using the tax return information as an indicator of profitability and year-over-year growth. Farmer B uses Excel to track production data, such as crop inputs application data.

One of the first conservation challenges Farmer B has worked to tackle is manure management. Currently, Farmer B stores manure in small concrete manure storage behind the dairy barn and immediately adjacent to the creek. During storms, runoff from the manure storage can flow into the creek. Farmer B is actively working to fix this by pursuing financial assistance to help him upgrade his manure storage with sufficient capacity to manage his manure effectively for crop production and environmental protection. Working with his farm advisers, Farmer B has submitted a proposal to PennVest to install additional manure storage for solid manure, which would reduce manure entering the creek as stormwater runoff.

Farmer B transitioned to no-till farming in 2014 and was pleased that his yields did not drop off during the first year, as some other farmers have experienced. Farmer B also observed substantial improvements in the water quality of his runoff, which was much clearer after a hard rain than before he implemented no-till. Clearer runoff during storms indicates better soil retention, reduced soil erosion, and likely increased economic value and crop quality in the long-term. Farmer B observed that adopting no-till saved approximately one week of work per year for two men and saved on fuel. Based on Farmer B's estimated $15 per hour labor wage, this saved him approximately $300 per year.

Farmer B has enhanced his nutrient management practices over the past several years. With the help of an agronomist and soil testing, Farmer B discovered that he was not providing enough nutrients to his crops and thus was losing yield. By continuing to provide nutrients with mostly manure and some additional nutrients, he increased his overall hay and alfalfa yields by one ton per acre. He also observed increased feed quality and reduced the need to purchase between $1,000 and $3,000 dollars of feed per year. Farmer B also observed a reduction of $2,000-$3,000 in veterinary bills in 2017 due to fewer cases of 'twisted gut' syndrome[13], which can be also be linked to conservation practices due to higher quality forages.

Farmer B has planted cover crops for the past five years – primarily oats and triticale. These crops supplement feed sourcing for the dairy herd and reduce the need to purchase supplemental feed from external vendors, which saved the operation nearly $15,000 in 2017.

Farmer B's conservation practices have delivered both qualitative and quantitative improvements in both crop quality and milk quality. While Farmer B's operation has not been profitable for the past few years, the conservation practices he implemented have helped mitigate his overall profit loss, putting him ahead of where he would have been otherwise.

## Key takeaways

- Farmer B observed immediate water quality impacts from implementing low-cost conservation measures like no-till.
- Farmer B experienced a significant yield increase from implementing no-till, which eliminated his need to purchase nearly $15,000 in feed per year.
- Farmer B saw a reduction in veterinary visits and bills due to improved feed quality estimated at $2,000-3,000 per year.
- Farmer B saw an immediate yield benefit from working with an agronomist to improve nutrient management with soil testing and scouting.
- Farmer B found significant labor and time savings from implementing no-till.
- Acquiring improved manure storage is a top priority to enhance the economic and environmental performance of the farm.
- Farmer B experienced a slight decrease in milk production, but he noted that the milk quality improved, which he attributed to improved feed quality and herd health.

## Key financial variables

The table of key financial variables summarizes Farmer B's estimates of the magnitude of cost and yield impacts from the farm's conservation adoption. The table is based on the farm's current crop mix of corn and alfalfa acres, in which cover crop is planted for fall/spring growth with no-till corn. Data is from 2017, and represents a full production and crop year. For comparative purposes all data is shown on per acre or per cow basis.

TABLE 1

### Farmer B, Key Financial Variables

| Crops ($/acre) | Corn | Alfalfa |
|---|---|---|
| Cover Crop Seed | (42) | 0 |
| Increased Fertilizer | 0 | (53) |
| Labor Savings | 2 | 1 |
| Fuel Savings | 3 | 2 |
| Yield Increase | 17 | 285 |
| Net Impact by Crop | (20) | 235 |
| Net Impact for Full Rotation | $215 per acre | |
| **Dairy ($/Cow)** | | |
| Bedding Savings | 214 | |
| Vet Bill Savings | 36 | |
| Reduced Milk Production | (11) | |
| Net Impact for Dairy | $239 per cow | |

## Crop budget

Table 2 summarizes Farm B's 2017 crop budget. All figures shown are dollars per acre unless otherwise indicated. Rows in green are areas of reduced costs due to conservation practices, while rows in red are increased costs. The assessment of increased or decreased costs are based on the farmer's experience. The cost to produce feed represents the cost of all input, variable and overhead expenses that are attributed to producing crops and feed that will be fed internally to livestock.

TABLE 2

### Farmer B, 2017 Crop Budget

| Crop Values are per/tn | Corn | Alfalfa | Total | Units |
|---|---|---|---|---|
| Acres | 60 | 30 | 90 | Acres |
| Yield (Tn/acre) | 24 | 5 | 29 | Ton/acre |
| Commodity Price $/Tn | 33 | 190 | | $/Ton |
| **Internal Feed Value** | **779** | **950** | **1,729** | $/Acre |
| **Internal Feed Value (Total $)** | **46,719** | **28,500** | **75,219** | **$ Total** |
| Seed | 304 | - | 203 | $/Acre |
| Fertilizer | 155 | 60 | 124 | $/Acre |
| Chemicals | 53 | 53 | 53 | $/Acre |
| **Total Crop Input Costs** | **512** | **113** | **379** | $/Acre |
| Farm Fuel | 50 | 50 | 50 | $/Acre |
| Other Variable Crop Costs | 367 | 367 | 367 | $/Acre |
| **Total Crop Input + Variable Costs** | **930** | **530** | **797** | $/Acre |
| **Cost to Produce Feed (Total $)** | **55,790** | **15,906** | **71,696** | **$ Total** |

Values are $/acre unless otherwise indicated. Rows in green are areas of reduced costs when using conservation practices. Rows in red are increased costs.

## Dairy herd budget

Table 3 summarizes Farm B's 2017 crop budget. All figures shown are dollars per acre unless otherwise indicated. Rows in green are areas of reduced costs due to conservation practices, while rows in red are increased costs. The assessment of increased or decreased costs are based on the farmer's experience. The cost to produce feed represents the cost of all input, variable and overhead expenses that are attributed to producing crops and feed that will be fed internally to livestock.

TABLE 3

### Farmer B, Dairy Herd Budget

| Dairy Herd* Values are per/head | Open Cows | Milking Cows | Total | Units |
|---|---|---|---|---|
| Head # | 10 | 70 | 411 | |
| Expected Productions (CWT/Cow) | - | 190 | 163 | CWT/Cow |
| Commodity Price | 16 | 16 | 16 | $/CWT |
| **Gross Income** | **-** | **3,042** | **2,607** | $/Cow |
| **Gross Income (Total $)** | **-** | **182,525** | **182,525** | **$ Total** |
| External Feed | | | 1,654 | $/Cow |
| Internal Feed Cost | | | 1,024 | $/Cow |
| **Total Dairy Input Costs** | | | **2,679** | **$/Cow** |
| Animal Health / Vet / Breeding | | | 235 | $/Cow |
| Farm Repairs | | | 208 | $/Cow |
| Farm Supplies | | | 356 | $/Cow |
| Other Dairy Variable Costs | | | 356 | $/Cow |
| **Total Dairy Input + Variable Costs** | | | **3,477** | $/Cow |
| Taxes | | | 65 | $/Cow |
| Interest | | | 116 | $/Cow |
| Other Fixed Costs | | | 203 | $/Cow |
| **Total Fixed Costs** | | | **384** | $/Cow |
| **Total Expenses** | | | **3,861** | $/Cow |
| **Total Expenses (Total $)** | | | **270,237** | **$ Total** |
| **Net Return before Debt, Land or Capital Expenditures** | | | **(1,253)** | **$/Cow** |

Values are $/cow unless otherwise indicated. Rows in green are areas of reduced costs when using conservation practices. Rows in red are increased costs.

# Farmer C: Enterprise analysis and approach to conservation

Farmer C – Lancaster County, Pennsylvania

- Farm size: 51 acres (41 tillable acres)
- Crops grown: Corn, alfalfa, grass hay, rye (cover crop), oats (cover crop)
- Dairy herd: 45 cows, 30 replacement heifers
- Additional livestock: Seven draft horses, two driving horses
- Conservation practices: Improved manure storage facility, stream fencing and riparian buffers, cover crops, conservation tillage
- Conservation program and research participation: PennVest grants for conservation BMP implementation and financing, NRCS grants (EQIP and CREP programs), Stroud Water Research Center Farm Stewardship Program grants

"Our water and manure management upgrades have really made a difference to our crop production and quality, helping us be more successful overall."

**– Farmer C**

## Approach to conservation

Farmer C, a Plain sect farmer in Lancaster County, Pa., was a relatively early adopter of conservation practices including manure storage, stream fencing and riparian buffers, nutrient management and no-till. The benefits of these practices have spanned his farm budget and operation, improving the quality and quantity of feed produced on farm, thereby reducing the need to purchase additional feed for his dairy cattle; improving herd health, thereby reducing vet bills; and improving milk production. Farmer C primarily feeds his dairy cows from his own crops and purchases hay feed externally for his horses and replacement heifers. Farmer C relies on a handwritten recordkeeping system. The farm's receipts and cash records were used to develop the data in this report.

Farmer C has tapped into the available conservation programs offered by local and national government organizations to finance his conservation plans. The farm has received funding from PennVest and NRCS's EQIP program.

Through PennVest grants, Farmer C implemented an improved manure storage facility in 2014, including a 24' x 56' roofed manure stacking structure featuring concrete walls to aid stacking. Additionally, Farmer C's manure storage contains a partial, interior concrete divider wall to create a designated area for mortality composting. This 8' x 16' structure is typically used as manure storage, but can accommodate several animals as needed. Additionally, Farmer C utilizes an existing liquid manure storage structure that collects the waste and barnyard runoff from the existing dairy herd. This structure was installed in 2005 as part of an 80%/20% cost share program with NRCS's EQIP program. The structure holds at least six months of manure and liquid waste in summer and three months in winter. Farmer C said, "These structures have completely changed our manure storage and they definitely would not have been possible without the grant funding."

Farmer C said his manure stacking and storage structures have improved his options when it comes to manure and nutrient management. More storage capacity gives him more control over when and at what amounts he can spread his manure to get more nutrient value out of the manure for crop and forage production, and avoid applying at times when it is more likely to harm water quality. Although he still owes $70,000 on the 2005 installations and additional improvements made to the farm since then, it has been worthwhile. His improved manure storage infrastructure enhanced the cleanliness of his farm and gained environmental improvements from better manure retention.

"It was a big investment on our part, but I can't imagine going back to our old manure system. It does have its value," Farmer C said.

Farmer C utilizes his improved manure storage system to optimize nutrient management. In 2018, working with an agronomist, he performed nitrogen testing to identify specific soil needs and applied 30% liquid nitrogen to his crops. He has and keeps up to date his conservation and nutrient management plans for Lancaster County and will continue to perform soil testing to identify ideal crop needs. He said that his improved nutrient management has improved his overall yield by a marginal amount, reducing the need for purchasing feed externally.

Protecting water quality is important for Farmer C, as a stream runs directly through the property adjacent to the livestock pasture and cropland. Farmer C installed stream fencing in 2015 with a 35-foot buffer on each side of the stream to prevent livestock from having direct contact. He also planted trees to create a riparian buffer to prevent runoff from entering the stream and provide co-benefits for wildlife. Farmer C struggled with wet areas in one of his fields that resulted in poor crop production and, likely, high nutrient loss. In consultation with his agronomist and following NRCS standards, Farmer C installed a tile drain from the wet area to the stream, significantly increasing crop productivity and quality, and, as a result, milk quality. In order to reduce nutrients entering the tile, Farmer C follows his nutrient management plan and uses additional soil testing to fine tune his rate to his crop needs. He also ensures there is a crop growing on the field year-round to soak up excess nutrients. Farmer C is concerned that restricting cow access to the stream reduces cow comfort in extreme heat and decreases milk production. While current research does not support that impact, we have included the potential negative impact in the crop budget.[14]

Farmer C's operation has been practicing no-till for more than 20 years. Because of generational changes in farm management, Farmer C was not involved with the operation when no-till was first implemented, therefore he has not directly observed improved crop production or quality from the previous conventional tillage system. However, Farmer C acknowledges the reduced man-hours as an indirect cost savings from no-till. Using Farmer C's wage of $12.50 per hour, this translates to an overall savings of $1,650 per year. Farmer C has observed that his crops are of a higher quality since he started no-tilling, and the higher-quality feed has also helped to increase overall animal health. Farmer C attributes an annual $300-$500 reduction in veterinary bills to the higher quality forage. Additionally, Farmer C utilizes cover crops such as oats and rye to replenish soil nutrients.

## Key takeaways

- For many dairy farmers, sufficient manure storage is often the first step to other conservation measures, but covering the costs on their own can be a challenge. Farmer C's case provides an example of the significant value that grant and cost share programs like PennVest and NRCS's EQIP program can provide by enabling farmers to implement these key conservation infrastructure projects.
- Manure storage made a huge difference in Farmer C's ability to get value out of manure, apply it when needed and when environmentally appropriate, and save on purchased feed by boosting yield.
- Farmer C benefited significantly from time and labor savings from no-till.
- The combination of improved nutrient management, no-till and cover crops enabled Farmer C to benefit from improved yields, higher quality feed, reduced feed purchases and reduced vet bills due to improved herd health.

## Key financial variables

The table of key financial variables summarizes Farmer C's estimates of the magnitude of cost and yield impacts from the farm's conservation adoption. The table is based on the farm's current crop mix of corn and alfalfa acres, in which cover crop is planted for fall/spring growth with no-till corn. Data is from 2017 and represents a full production and crop year. For comparative purposes all data is shown on per acre or per cow basis.

TABLE 1

### Farmer C, Key Financial Variables

| Crops ($/acre) | Corn | Alfalfa | Grass Hay |
|---|---|---|---|
| Cover Crop Seed | 0 | (37) | (9) |
| Labor Savings | 25 | 13 | 3 |
| Yield Increase | 1 | 21 | 5 |
| Net Impact by Crop | 26 | (3) | (1) |
| Net Impact for Full Rotation | | $22 per acre | |
| **Dairy ($/Cow)** | | | |
| Vet Bill Savings | 9 | | |
| Net Impact for Dairy | $9 per cow | | |

## Crop budget

Table 2 summarizes Farm C's 2017 crop budget. All figures shown are dollars per acre unless otherwise indicated. Rows in green are areas of reduced costs due to conservation practices, while rows in red are increased costs. The assessment of increased or decreased costs are based on the farmer's experience. The cost to produce feed represents the cost of all input, variable and overhead expenses that are attributed to producing crops and feed that will be fed internally to livestock.

TABLE 2

### Farmer B, 2017 Crop Budget

| Crop Values are per/tn | Corn | Alfalfa | Grass Hay | Total | Units |
|---|---|---|---|---|---|
| Acres | 24 | 13 | 3 | 40 | Acres |
| Yield (Tn/acre) | 27 | 4 | 2 | 33 | Ton/acre |
| Commodity Price $/Tn | 33 | 190 | 165 | | $/Ton |
| **Internal Feed Value** | **890** | **683** | **371** | **1,944** | $/Acre |
| **Internal Feed Value (Total $)** | **21,357** | **8,883** | **1,114** | **31,354** | **$ Total** |
| Seed | 70 | 46 | 46 | 60 | $/Acre |
| Fertilizer | 10 | 5 | 5 | 8 | $/Acre |
| Chemicals | 56 | 27 | 30 | 44 | $/Acre |
| **Total Crop Input Costs** | **136** | **78** | **81** | **113** | $/Acre |
| Farm Fuel | 125 | 61 | 67 | 100 | $/Acre |
| Other Variable Crop Costs | 116 | 57 | 62 | 93 | $/Acre |
| **Total Crop Input + Variable Costs** | **376** | **197** | **209** | **305** | $/Acre |
| **Cost to Produce Feed (Total $)** | **9,030** | **2,558** | **628** | **12,216** | **$ Total** |

Values are $/acre unless otherwise indicated. Rows in green are areas of reduced costs when using conservation practices. Rows in red are increased costs.

## Dairy herd budget

Table 3 summarizes Farm C's 2017 dairy herd budget. All figures shown are dollars per cow unless otherwise indicated. The number of cows includes all cows – milking, bred and dry. Rows in green are areas of reduced costs due to conservation practices, while rows in red are increased costs. The assessment of increased or decreased costs are based on the farmer's experience. Internal feed costs are the costs to produce internal feed as shown in the Crop Budget from above. Net return before debt, land or capital expenditures represents gross milk income minus total expenses, divided by total number of cows.

TABLE 3

### Farmer C, Dairy Herd Budget

| Dairy Herd* Values are per/head | Open Cows | Bred Cows | Milking Cows | Total | Units |
|---|---|---|---|---|---|
| Head # | 1 | 11 | 31 | 43 | |
| Expected Productions (CWT/Cow) | - | 199 | 199 | 194 | CWT/Cow |
| Commodity Price | 16 | 16 | 16 | 16 | $/CWT |
| **Gross Income** | **-** | **3,177** | **3,177** | **3,104** | $/Cow |
| **Gross Income (Total $)** | **-** | **34,952** | **98,501** | **133,452** | **$ Total** |
| External Feed | | | | 1,427 | $/Cow |
| Internal Feed Cost | | | | 284 | $/Cow |
| **Total Dairy Input Costs** | | | | **1,711** | **$/Cow** |
| Animal Health / Vet / Breeding | | | | 169 | $/Cow |
| Farm Repairs | | | | 96 | $/Cow |
| Farm Supplies | | | | 209 | $/Cow |
| Other Dairy Variable Costs | | | | 58 | $/Cow |
| **Total Dairy Input + Variable Costs** | | | | **2,244** | $/Cow |
| Machinery | | | | 35 | $/Cow |
| Taxes | | | | 101 | $/Cow |
| Interest | | | | 12 | $/Cow |
| Other Fixed Costs | | | | 96 | $/Cow |
| **Total Fixed Costs** | | | | **244** | $/Cow |
| **Total Expenses** | | | | **2,488** | $/Cow |
| **Total Expenses (Total $)** | | | | **106,969** | **$ Total** |
| **Net Return before Debt, Land or Capital Expenditures** | | | | **616** | **$/Cow** |

Values are $/cow unless otherwise indicated. Rows in green are areas of reduced costs when using conservation practices. Rows in red are increased costs.

# Farmer D: Enterprise analysis and approach to conservation

Farmer D – Lancaster County, Pennsylvania

- Farm size: 700 acres (rented and owned)
- Crops grown: Corn, alfalfa, oats, rye, triticale
- Dairy herd: 750 milking cows, 50 dry mature cows, 310 heifers, 205 calves
- Conservation practices: No-till, cover crops, manure separator and anaerobic digester, soil testing and advanced agronomic practices
- Conservation program and research participation: Pennsylvania DEP grant, partnerships with Sustainable Energy Fund and Native Energy

"We've been doing conservation here for decades, but taking the plunge to install our digester took us to the next level. We have no regrets from installing technologies that provide these environmental and economic benefits to our farm."

**– Farmer D**

## Approach to conservation

Farmer D is a large dairy farmer in Lancaster County, Pa., with more than 700 acres of cropland, more than 750 milking cows and 9 full-time employees. Farmer D took over the operation from his father, who first implemented a conservation plan on the farm in the 1960s. The operation has made conservation a priority, implementing both standard conservation practices and advanced technologies like anaerobic digesters to create renewable energy. Farmer D feeds his cows utilizing his own crops in addition to crops purchased externally. Farmer D has participated in cost share programs to fund conservation innovations on his operation.

Farmer D uses QuickBooks desktop for financial recordkeeping. Farmer D keeps extensive records, basing his recordkeeping on bank reconciliations and accrual adjustments. He keeps his books on an accrual basis. Farmer D hires an accountant to prepare taxes and financial statements (income statement, balance sheet and statement of cash flows) at year-end. The accountant reviews the financial data and makes any necessary adjustments to the financial records to convert them fully on an accrual basis. The operation receives comparative financial statements to understand profitability and year-over-year growth. Farmer D uses DHIA to track dairy herd and production data, and uses Excel or handwritten records of field and conservation activities.

Farmer D uses a high-density polyethylene (plastic lined) manure storage system and digester for manure storage and treatment. He installed a digester in 2007 at a total cost of $1.1 million. Farmer D used a Pennsylvania DEP grant to cover $200,000 of the cost, and worked with the Sustainable Energy Fund and Native Energy to secure additional funding through carbon credits. Overall, Farmer D invested approximately $500,000 of his own money into the project, with the rest covered by grants and carbon credits. Despite some technical challenges with the digester, his operation has benefited from the technology, including providing a source of renewable energy and significantly reducing odors.

Farmer D utilizes automatic alley scrapers in the dairy barns. Manure from the dairy goes to the digester first, where it stays for 30 days. The methane gas produced from the digester produces enough energy to heat the operation's mechanic shop completely – more than 125 kilowatts per hour at maximum capacity. Though Farmer D has had intermittent periods of repair during which the digester is not functioning, the digester typically runs during work hours every day, providing more than 25,000 kW per month of energy, saving an estimated $1,542 in electricity costs per month. After the digester, the manure is separated and the liquid portion goes to two double-lined HDPE manure storage ponds. The lagoon works in two stages: stage 1 holds 1 million gallons and stage 2 holds 3 million gallons.

Farmer D applies the liquid manure to crops as fertilizer and uses the solid manure as bedding in the dairy barns, replacing the wood shavings used previously and providing

consistent, substantial cost savings. Farmer D noted that using the manure as bedding has resulted in an improvement in herd health, including a reduction in leg infections and a lower overall somatic cell count in the milk – a measure of milk quality. The separator required a $60,000 investment, but has generated more than $3,000 in savings per month from not buying wood shavings for bedding. The regular maintenance costs for the separator vary, but typically include such costs as replacing an outer filter ($2,200) annually, replacing an inner filter ($4,000) every three years, and replacing the auger ($15,000) every five years.

Farmer D's cattle are housed in confined housing and do not have access to the streams on the property. As a result, there has been no need to install stream fencing. Farmer D has installed a 50-foot buffer between crops and the stream to reduce the risk of fertilizer runoff in a weather event.

Farmer D has practiced no-till for corn crops since the mid-1990s and began no-tilling all of his crops in 2009. Upon the transition to no-till, Farmer D observed a modest decrease in production for about five years, which then moderated itself. Transitioning to no-till has led to numerous benefits, including reduced fuel use estimated at $2,625 per year and reduced labor costs estimated at $44,100 per year, calculated by using 3-4 man-hours per acre at a wage of $18 per hour. Farmer D has seen significant environmental benefits from no-till, including better soil stability, especially during weather events. Before implementing no-till, getting access to his fields during a rainstorm was almost impossible. Since implementing no-till, this is no longer a problem because the practice has increased soil absorption and reduced his mud problem.

Farmer D's father started planting cover crops during his childhood in the 1980s to increase forage and soil health. The operation's goal is to cover every acre of corn farmed each year in a cover crop to ensure the farm maintains a very high level of soil quality. In 2018, Farmer D used rye, triticale and oats as a cover crops, though he only used oats on alfalfa ground. Farmer D cited numerous benefits from cover cropping, including reduced erosion from wind and rainstorms, and reduced costs from purchasing feed externally with the additional feed from the cover crops.

Working with an agronomist, Farmer D does soil sampling on an annual basis. The soil sampling informs the timing and rate of his liquid manure application, as well how much and when to apply potash, lime and any supplemental commercial nitrogen to his crops. Farmer D has not applied commercial phosphorous to crop ground since the early 1990s. He has used stalk testing for nutrient profiles to have additional data and insights to make applications even more precise.

Overall, Farmer D has observed substantial benefits from conservation practices on his operation – some that are less capital-intensive such as no-till, and others that require a large amount of capital, like the anaerobic digester and manure separator. Though the financial ability to implement such large capital projects is unique for the area due to Farmer D's overall size, the combination of conservation practices has led to cost savings and environmental benefits that Farmer D says he "has no regrets in implementing."

## Key takeaways

- Farmer D gained substantial monthly savings from some of his larger conservation implementations such as the anaerobic digester and manure separator, including 25,000 kW energy per month from the digester and monthly savings of more than $3,000 from not buying wood shavings for bedding from the separator.
- Farmer D benefited from improved animal health and milk quality from the manure separator bedding due to reduced mastitis and leg infections.
- Transitioning to no-till led to numerous benefits, including estimated labor cost savings of $44,100 per year and fuel cost savings of $2,625 per year. No-till also improved soil stability, especially during weather events, increasing Farmer D's access to his farm during bad weather.
- The economic benefits of cover cropping included less erosion from wind and rainstorms, and reduced feed costs.

## Key financial variables

Farmer D is a large dairy farmer in Lancaster County, Pa., with more than 700 acres of cropland, more than 750 milking cows and 9 full-time employees. Farmer D took over the operation from his father, who first implemented a conservation plan on the farm in the 1960s. The operation has made conservation a priority, implementing both standard conservation practices and advanced technologies like anaerobic digesters to create renewable energy. Farmer D feeds his cows utilizing his own crops in addition to crops purchased externally. Farmer D has participated in cost share programs to fund conservation innovations on his operation.

TABLE 1

### Farmer D, Key Financial Variables

| Crops ($/acre) | Corn | Alfalfa | Grass Hay |
|---|---|---|---|
| Cover Crop Seed | (10) | (3) | 0 |
| Chemical Costs | (17) | (5) | (1) |
| Labor Savings | 47 | 14 | 2 |
| Yield Increase | 1 | 0 | 0 |
| Net Impact by Crop | 27 | 6 | 1 |
| Net Impact for Full Rotation | | $34 per acre | |
| **Dairy ($/Cow)** | | | |
| Vet Bill Savings | 29 | | |
| Net Impact for Dairy | $29 per cow | | |

## Crop budget

Table 2 summarizes Farm D's 2017 crop budget. All figures shown are dollars per acre unless otherwise indicated. Rows in green are areas of reduced costs due to conservation practices, while rows in red are increased costs. The assessment of increased or decreased costs are based on the farmer's experience. The cost to produce feed represents the cost of all input, variable and overhead expenses that are attributed to producing crops and feed that will be fed internally to livestock.

TABLE 2

### Farmer D, 2017 Crop Budget

| Crop Values are per/tn | Corn | Alfalfa | Grass Hay | Total | Units |
|---|---|---|---|---|---|
| Acres | 525 | 150 | 25 | 700 | Acres |
| Yield (Tn/acre) | 27 | 10 | 6 | 42 | Ton/acre |
| Commodity Price $/Tn | 33 | 190 | 165 | | $/Ton |
| **Internal Feed Value** | **890** | **1,805** | **990** | **3,685** | $/Acre |
| **Internal Feed Value (Total $)** | **467,186** | **270,750** | **24,750** | **762,686** | **$ Total** |
| Seed | 171 | 171 | 171 | 171 | $/Acre |
| Fertilizer | 19 | 19 | 19 | 19 | $/Acre |
| Chemicals | 78 | 78 | 78 | 78 | $/Acre |
| **Total Crop Input Costs** | **267** | **267** | **267** | **267** | $/Acre |
| Farm Fuel | 91 | 91 | 91 | 91 | $/Acre |
| Other Variable Crop Costs | 484 | 484 | 484 | 484 | $/Acre |
| **Total Crop Input + Variable Costs**** | **842** | **842** | **842** | **842** | $/Acre |
| **Cost to Produce Feed (Total $)** | **441,984** | **126,281** | **21,047** | **589,312** | **$ Total** |

Values are $/acre unless otherwise indicated. Rows in green are areas of reduced costs when using conservation practices. Rows in red are increased costs. **Crop Input and variable costs were not available on a per enterprise level, totals were allocated evenly per acre.

## Dairy Herd Budget

This table summarizes Farm D's 2017 dairy herd budget. All figures shown are dollars per cow unless otherwise indicated. The number of cows includes all cows – milking, bred and dry. Rows in green are areas of reduced costs due to conservation practices, while rows in red are increased costs. The assessment of increased or decreased costs are based on the farmer's experience. Internal feed costs are the costs to produce internal feed as shown in the Crop Budget from above. Net return before debt, land or capital expenditures represents gross milk income minus total expenses, divided by total number of cows.

TABLE 3

## Farmer D, Dairy Herd Budget

| Dairy Herd* Values are per/head | Open Cows | Bred Cows | Milking Cows | Total | Units |
|---|---|---|---|---|---|
| Head # | 37 | 38 | 750 | 825 | |
| Expected Productions (CWT/Cow) | - | 264 | 264 | 252 | CWT/Cow |
| Commodity Price | 16 | 16 | 16 | 16 | $/CWT |
| **Gross Income** | **-** | **4,224** | **4,224** | **4,035** | $/Cow |
| **Gross Income (Total $)** | **-** | **160,512** | **3,168,000** | **3,328,512** | **$ Total** |
| External Feed | | | | 2,222 | $/Cow |
| Internal Feed Cost | | | | 714 | $/Cow |
| **Total Dairy Input Costs** | | | | **2,937** | **$/Cow** |
| Animal Health / Vet / Breeding | | | | 181 | $/Cow |
| Farm Repairs | | | | 198 | $/Cow |
| Farm Supplies | | | | 154 | $/Cow |
| Other Dairy Variable Costs | | | | 37 | $/Cow |
| **Total Dairy Input + Variable Costs** | | | | **3,506** | $/Cow |
| Taxes | | | | 43 | $/Cow |
| Interest | | | | 83 | $/Cow |
| Other Fixed Costs | | | | 983 | $/Cow |
| **Total Fixed Costs** | | | | **1,112** | $/Cow |
| **Total Expenses** | | | | **4,618** | $/Cow |
| **Total Expenses (Total $)** | | | | **3,810,189** | **$ Total** |
| **Net Return before Debt, Land or Capital Expenditures** | | | | **(584)** | **$/Cow** |

Values are $/cow unless otherwise indicated. Rows in green are areas of reduced costs when using conservation practices. Rows in red are increased costs.

# Report findings

The overriding lesson learned from our analysis of four dairy farms in Pennsylvania is that conservation contributes in important ways to the economic well-being and resilience of farms. Here are the key findings from our analysis.

**Conservation practices can pay, often in unanticipated ways.** Dairy farmers who adopted conservation practices including manure storage, nutrient management, cover crops, conservation tillage and stream fencing realized a variety of financial benefits, some of which they did not recognize or quantify prior to participating in this study. These benefits included reduced labor hours, savings on external feed and bedding, and lower vet bills due to improved herd health. Farmers also reported conservation practices improved soil quality, enabled them to get more value from manure and improved the quality of their forage. This resulted in higher crop yields, increased milk production and improved herd health. In some cases, conservation increased initial costs, but overall benefits outweighed these additional costs.

Specifically:

- Cover crops were associated with improved yield on all four farms, with costs being offset by improved yield.
- Conservation tillage saved labor and fuel costs and improved soil health in all four cases, though it can take time to for farmers to realize yield benefits.
- Manure storage options have high capital costs and almost always require supplemental grants or other sources of funding, but the farmers that were able to improve manure management realized significant benefits beyond water quality improvements. Additional benefits included improved nutrient management, which was associated with increased yield, and a host of benefits from manure separators, which allowed farmers to use manure for bedding instead of wood shavings, resulting in significant savings on bedding costs, vet costs and reduced cow mortality.
- Stream fencing improved water quality, wildlife habitat and herd health for farmers that implemented the practice.

**Economic gains come at the farm level.** Farmers benefited from looking at the farm enterprise holistically to better understand the full financial impacts of conservation adoption. For example, a single conservation practice like planting cover crops had upfront costs or, in some cases, a short-term drag on yield, but delivered large returns on investment in all cases by year two or three. Similarly, the cost for a practice in one area of the budget was typically offset by the savings in one or more other budget categories.

**Accurate recordkeeping typically results in better management.** Accurate and frequent recordkeeping for both economic and conservation measures proved to be essential for dairy farmers to understand their farm's economic status – whether profitable or not – and to assess the return on investment for conservation practices. The recordkeeping systems utilized by farmers in this report had varying levels of sophistication, but the systems that allowed farmers to document and analyze key performance indicators like yield, milk production and overall costs on a per-acre and per-cow basis enabled farmers to better identify areas of inefficiency and ways to reduce loss.

**Investments in conservation have increasing returns.** Farmers that had access to additional financial assistance for conservation through cost share programs, grants and carbon credits were able to make larger investments in practices that achieved even greater economic and environmental benefits. This was especially true for the farmers that had access to sufficient resources to invest in improved manure management.

"I support the conclusion that recordkeeping is imperative for dairies. The small farmer is not a record keeper. They are better with cows. The dairy industry needs to provide simple tools and training for recordkeeping. Good records will show how different small things in conservation add up to affect overall profitability."

**— Chris Stoltzfus, president of White Horse Construction, a leader in the dairy construction industry building dairies since 1995**

# Conclusion and recommendations

In addition to showcasing the many opportunities for conservation to deliver economic benefits on the farm, this report demonstrated how a tough ag economy can make it difficult for farmers to weather the early years before some conservation practices have time to deliver a return on investment. Dairies in Pennsylvania and across the nation face record-low milk prices, and some of the operations examined in this report were unprofitable, despite the conservation benefits. These economic difficulties are not limited to the dairy sector, but are widespread as farmers across the nation face low prices, turbulent markets and unpredictable weather.

While conservation clearly contributes to both farm and community resilience, market challenges can eclipse these benefits, especially when farmers feel the pressure to focus on next year's profits instead of taking a multi-year view in which conservation practices are more likely to provide a return on investment.

Given the lean times in the agricultural economy, particularly in the dairy sector, achieving the dual goals of a viable dairy economy and improved water quality will require elevating the economic benefits of conservation demonstrated in this report. It will also require increased financial support and incentives for farmers through government programs, supply chain commitments, conservation finance and other innovative solutions.

We must work to increase the resilience of the ag economy, the natural environment and rural communities in the following ways:

**Improve financial and technical assistance for farmers to realize conservation benefits at the enterprise scale.** Conservation programs need to do more to encourage and help farmers see the economic benefits of conservation practices across farm budgets, which will encourage them to try new practices and maintain them for the long term. Through financial and technical assistance programs, conservation districts, state agencies and the NRCS should provide guidance to farmers and their advisers on how to track and assess the broader economic benefits of conservation practices on their own farms and provide examples, like those in this report, of how such practices have generated economic benefit on other farms. In addition, conservation programs should extend contract lengths to encourage and enable farmers to reach the point at which conservation practices deliver a return on investment. These two improvements will enable conservation programs to show farmers the return on investment for conservation practices, which will increase success in farmers adopting and maintaining conservation practices, ultimately increasing sustainability outcomes and return on investment for taxpayer dollars.

**Support farmers' collection of actionable financial and environmental data.** Good recordkeeping is necessary to understand the environmental and financial impacts of conservation practice adoption, but not all farmers have access to robust and easy-to-use recordkeeping platforms. Federal and state agencies, conservation districts and business partners such as Farm Credit should increase support for farm recordkeeping platforms and educational opportunities that combine financial and conservation management. Increased access to these tools will help farmers better track and manage their data, gain valuable insights from the information collected and measure progress towards conservation goals. One valuable resource farmers can use to track and document their economic and environmental performance is N Balance, which quantifies environmental outcomes with a simple calculation and allows farmers to share their conservation stories.[16]

The dairy industry prioritized the collection and analysis of environmental data in 2018 with the launch of the FARM Environmental Stewardship module, created by the Innovation Center for U.S. Dairy and the National Milk Producers Federation.[17] The tool is based on a life cycle assessment of fluid milk conducted by the University of Arkansas' Applied Sustainability Center and asks a set of questions to assess a farm's carbon and energy footprint. The tool does not currently gather data for or assess water quality impacts, which would be a valuable addition for dairies in the Chesapeake Bay watershed and beyond.

"Dairy cooperatives and processors are a linchpin for industry-wide sustainability progress. Dairy coops and processors can help dairy farmers by providing a roadmap for what downstream buyers expect on conservation."

**— Suzy Friedman, senior director of agricultural sustainability at Environmental Defense Fund**

**Enhance and better leverage innovative financing programs for agricultural conservation.** Public grants and cost share programs are essential for many conservation investments, especially some of the more capital-intensive practices that can deliver some of the largest economic returns and environmental benefits. Many of these conservation financing programs are highlighted in the September 2019 report by EDF and the National Association of State Departments of Agriculture, *Innovative State-Led Efforts to Finance Agricultural Conservation.*[18] Federal and state agencies, conservation districts and agricultural lenders should increase support for conservation through cost share programs, tax credits and low-interest loans. In addition, states should examine the learnings in *Innovative State-Led Efforts to Finance Agricultural Conservation* to learn from other states' experiences in order to improve existing programs and develop new programs that address agricultural conservation challenges in useful and cost-effective ways.

Farm advisers and conservation partners should help make farmers aware of the many resources already available to them via existing conservation grants and cost share programs offered through university extension services, soil and water conservation districts, and state and federal agriculture agencies.

**Increase private sector support and incentives for conservation.** Conservation is important to the economic viability and social license to operate not only of the farmers themselves, but of the broader agriculture system connected to those farmers. More profitable farmers are in a better position to afford inputs from local agribusinesses, pay back their loans, pay landowners for rented land, pay consultants for services provided, and deliver their crops or milk to downstream buyers. Some key value chain business partners with a vested interest in farmers' success are lenders, farm advisers and cooperatives. While lenders cannot directly prescribe practices to their clients, they can assess the materiality of sustainability issues to their business, make sustainable financing commitments, report on sustainability metrics and integrate sustainability into their governance.[19] Farm advisers – both in the public and private sector – are an integral part of farmer decision-making, including decisions about conservation. Cooperatives play a critical role connecting farmers, downstream companies and retailers – a growing number of which are making supply chain sustainability commitments. Farmers cannot shoulder what is needed for success on sustainability by themselves. Action is needed across the value chain.

Specifically:

- Farm advisers should ensure they are providing quality sustainability expertise to their client farmers and ensure they are aware of the latest resources for recordkeeping, financing and cost share assistance. One resource available to farm advisers is the SPARC online platform.[20]
- Dairy cooperatives and processors should be proactive in implementing programs to support their farmers' sustainability progress. Once resource available to help dairy cooperatives develop a sustainability program is the *Water Quality Guide for Dairy Coops and Processors*.[21]
- Agricultural lenders could analyze the business benefits and risks of conservation and share that information with their clients. Lenders should also create new funds or favorable financing terms to target the expansion of conservation practices that have a proven return on investment.
- Farmers' supply chain and business partners should provide meaningful financial incentives for environmental outcomes.

# Recommendations for Pennsylvania

Since this report focused on the conservation economics of dairy farms in Pennsylvania, we offer two additional recommendations for the state.

**Continue funding REAP at a level of at least $13 million per year and increase opportunities for farmers and sponsors to participate in the program.** One underutilized component of the REAP program allows businesses and individuals to apply for REAP tax credits by serving as a project sponsor. Businesses with state tax liability, especially those with a stake in the viability of the state's dairy sector and an interest in the state's progress on water quality goals, have the unique opportunity to sponsor REAP applications and generate business and environmental value. Businesses that participate in this program can direct some of their state tax liability towards farm conservation projects that will help the local economy, improve local water quality and support farmers in need of financial support to achieve water quality goals. The state can increase promotion and use of the REAP sponsorship option by developing a new program component that allows sponsors to apply for and reserve discrete blocks of REAP tax credits for specific high priority state and county BMPs before specific beneficiaries are known. One immediate step dairy value chain business partners such as cooperatives, processors, banks and others can take is to become REAP sponsors to help generate funding for conservation practices implementation by dairy farmers in their supply chain or in the region. In addition, cooperatives and processers can ask their downstream customers to be REAP sponsors if they themselves do not have tax liability.

**Explore ways to make PennVEST loans more attractive.** There are opportunities for Pennsylvania to use its Clean Water SRF more aggressively to reduce nutrient loss from farms. While SRF loans are available to farmers with interest rates below market, farmers are turning them down with a preference for grants. Given this feedback challenge, the state should evaluate the use of the program and identify ways to streamline the loan process. There are also opportunities to increase the amount of money overall going to ag conservation from PennVEST, such as looking to federal Clean Water Act Section 319 grants and using the state's purchasing power to advance conservation goals (such as procuring necessary materials for fencing, rather than paying for a specific project).

"We have long believed that for some dairy farms in Pennsylvania, the investment of limited funds for conservation is perceived as nothing more than an expense they cannot afford. Hopefully they can see from their peers and neighbors presented in this study that conservation practices may actually help their bottom line in the long term, and they will be more inclined to invest in them."

**— Alan Novak, executive director of Professional Dairy Managers of Pennsylvania**

# Appendix

Conservation can pay and ultimately make farms more resilient, but we must do more to help farmers capitalize on the economic and environmental benefits that conservation practices provide. We hope the learnings and recommendations in this report, and the discussions and collaborations that result, will help catalyze action at scale to improve sustainability outcomes and overall resilience, while also sustaining the unique livelihoods of farmers for generations to come.

## Section I: Pennsylvania programs

PennState University Extension resources:

- Information about seminars, webinars, and publications on conservation: https://cdn.sare.org/wp-content/uploads/20190426091223/FINAL-ONLINE-PORTFOLIO-collection-Business-and-Production-Guide-of-Dairy-Cattle-Operations.pdf.
- Online tools and apps for financial management: https://extension.psu.edu/animals-and-livestock/dairy/business-management/shopby/tools-and-apps

Pennsylvania assistance programs for meeting Act 38 regulations: https://extension.psu.edu/programs/nutrient-management/act-38-law-and-regulations/nutrient-management-legislation-in-pennsylvania-a-summary-of-the-2006-regulations

Farmers who develop a nutrient management plan under Act 38 regulations may be eligible for financial assistance for development and implementation of the plan, provided funds are available. The point of contact is the local county conservation district office or the State Conservation Commission.

- Plan Implementation Financial Assistance – Created by the SCC and PA State Treasury to help ag operations for implementation of a nutrient management plan, including alternative technology projects. These funds are available in the form of grants or low-interest loans for NMP implementation through the Agriculture Land Investment Program (AgriLink).
- Agricultural Plan Reimbursement Program – the program repays farmers for the cost of hiring a technical expert to develop plans after January 1, 2019, for manure management, nutrient management, or erosion and sediment control. You can submit more than one plan for reimbursement, up to a max of $6,000. Small farmers are especially encouraged to participate.

Pennsylvania Financial Assistance and Grant Programs:

- PA Growing Greener grant program: https://www.dep.pa.gov/Citizens/GrantsLoansRebates/Growing-Greener/Pages/default.aspx. The Growing Greener Watershed Grants provide funding to clean up non-point sources of pollution throughout Pennsylvania. Examples of projects include acid mine drainage abatement, mine cleanup efforts, abandoned oil and gas well plugging and local watershed-based conservation projects. Counties, authorities and other municipalities; county conservation districts; watershed organizations; and other organizations involved in the restoration and protection of Pennsylvania's environment are eligible to apply.
- Resource Enhancement and Protection (REAP) Program: https://www.agriculture.pa.gov/Plants_Land_Water/StateConservationCommission/REAP/Pages/default.aspx. Through REAP, farmers, landowner, and businesses earn tax credits for implementing

"Best Management Practices" (BMPs) that will enhance farm production and protect natural resources. REAP is a first-come, first-served program – no rankings. The SCC administers the program and the PA Department of Revenue awards the tax credits. Eligible applicants receive between 50% and 75% of project costs in the form of State tax credits for up to $150,000 per agricultural operation. Farmers can use the tax credits incrementally (as needed) for up to 15 years to pay PA state income tax. Farmers and landowners can elect to sell the tax credits after 1 year. Farmers can work with a sponsor that will help to finance the BMP project. The sponsor reimburses the farmer/landowner for the project installation costs and the sponsor receives the tax credits. Applicants can apply for proposed projects and/or completed projects.

Industry resources:

- An excellent resource for recordkeeping is the Center for Dairy Excellence (CDE), housed within the Pennsylvania Department of Agriculture. CDE has a network of consultants that can help dairies set up recordkeeping platforms. Each September, CDE hosts the Dairy Financial and Risk Management Conference[22], which provides training and educational opportunities for farmers.

## Section II: Information requested from farmers

Operational information, before and after BMP implementation:

What conservation practices have you implemented (specific to crop)?
Examples include:

- Enhanced manure management (structures and practices)
- Stream fencing/riparian buffers
- Enhanced nutrient management practices (synthetic and/or manure)
- Cover crops
- Conservation tillage

Crop production

- Number of production acres
- Crop production mix (corn, soybean, alfalfa)
- How many acres of each crop are planted yearly?
- What are your average crop yields for each crop?
- Using best management practices, what has been the effect on your yields?
- Increases? If so, on which crops? How long after implementation, and of which practices?
- Quantitative increases
- Qualitative increase observations
- Decreases? Why do you think production decreased, if so?
- Quantitative decreases
- Quantitative decrease observations
- Do you utilize crops all for internal feed or sell some externally?

Dairy Herd (Before and After BMP Implementation)

- Number of milking cows
- Number of times/day milked
- Average production per cow

- Quality of milk, has there been a change after BMP?
- Where is milk sold? Into co-op?
- Price typically received for milk?
- Explain overall herd rotation
- Average number of cull cows per year, average revenue received
- Bull calves, average price received?

Debt

- Do you have machinery loans or leases? Payments?
- Operating Loans (for cash flow purposes)?

Financial Information

- Preferably QuickBooks or financial software reports that can break down the following for 2-3 years (2016-2018?):
- Variable expenses
- Seed, chemicals, fertilizer, cattle feed, veterinary fees, breeding expenses
- Have these expenses changed overall since implementing conservation practices?
- If you are seeing any increased yields on your crops, have you noticed a decrease in externally purchased feed? If so, how much?
- Overhead expenses
- Fuel, insurance, labor, etc.
- How have these expenses changed since implementing BMPs? (labor hours, etc.)
- What were your estimated costs of implementing conservation BMPs?
- Did you use programs to fund these, or independently fund them?

# Notes

1 https://www.edf.org/ecosystems/how-farm-conservation-can-generate-financial-value

2 https://www.edf.org/media/study-nitrogen-balance-strong-indicator-sustainable-agriculture-progress

3 https://www.edf.org/media/report-innovative-state-led-financing-advances-agricultural-conservation

4 https://fieldtomarket.org/our-program/sparc/

5 https://www.edf.org/sites/default/files/documents/chesapeake-bay-water-quality-dairy-sustainability-guide.pdf

6 PennState Extension Dairy Update: April 2019, https://extension.psu.edu/dairy-outlook-april-2019.

7 PennState Extension Pennsylvania Dairy Farm Size and Profitability Summary: April 2016, https://extension.psu.edu/pennsylvania-dairy-farm-size-and-profitability

8 Pennsylvania Department of Environmental Protection. "Manure Management for Environmental Protection."

9 Pennsylvania State University Extension. Pennsylvania Nutrient Management Program. "Stream Bank Fencing: Green Banks, Clean Streams."

10 Wade, Tara et al. 2015. "Conservation-Practice Adoption Rates Vary Widely by Crop and Region." U.S. Department of Agriculture Economic Research Service.

11 U.S. Department of Agriculture Natural Resources Conservation Service. 2017. "CONSERVATION CHOICES: Soil Health Practices."

12 USDA National Dairy Comprehensive Report – Monthly. March 2019.

13 http://www.thecattlesite.com/diseaseinfo/211/displaced-abomasum-in-cattle/

14 https://am.gallagher.com/us/in-practice/fencing-out-streams-win-win-for-livestock-conservation

15 https://am.gallagher.com/us/in-practice/fencing-out-streams-win-win-for-livestock-conservation

16 https://www.edf.org/media/study-nitrogen-balance-strong-indicator-sustainable-agriculture-progress

17 https://nationaldairyfarm.com/dairy-farm-standards/environmental-stewardship/.

18 https://www.edf.org/media/report-innovative-state-led-financing-advances-agricultural-conservation

19 Eapen, Sandy, February 12, 2018. "Four sustainability opportunities in the banking sector," GreenBiz, available at https://www.greenbiz.com/article/4-sustainability-opportunities-banking-sector.

20 https://fieldtomarket.org/our-program/sparc/.

21 https://www.edf.org/sites/default/files/documents/chesapeake-bay-water-quality-dairy-sustainability-guide.pdf

22 https://www.centerfordairyexcellence.org/about-the-center/news-featured-article/2019/08/register-for-the-2019-dairy-financial-conference/

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