ADVANCING INNOVATIVE FINANCE OPTIONS FOR IMPROVED AGRICULTURAL WATER QUALITY

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SAND COUNTY FOUNDATION

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About the Sand County Foundation

Sand County Foundation inspires and empowers a growing number of private landowners to ethically manage natural resources in their care, so that future generations have clean and abundant water, healthy soil to support agriculture and forestry, plentiful habitat for wildlife and opportunities for outdoor recreation.

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Table of Contents

Executive Summary

U.S. farm incomes have been declining since 2013, while farm debt had reached levels comparable to the 1980s. At the same time, investment in precision agriculture, regenerative agriculture, and consumer-driven trends in farming that benefits the climate are accelerating. Recent declines in crop prices and broader concerns about farm program funding, coupled with farmer awareness of environmental issues, provides an impetus to advance on-farm conservation and the opportunity to diversify farm income through payments for water quality outcomes.

The purpose of this paper is to:

(a) survey the current state of conservation finance for water quality;

(b) explore some promising, replicable and scalable models of conservation finance for water quality improvements at a broad scale; and

(c) identify key drivers and obstacles to expanding conservation finance tools, all with the objective of scaling up water quality expenditures and overall progress toward improving water quality.

This report details the challenges and opportunities associated with conservation finance for water quality. The demand and solutions are rapidly changing. The U.S. EPA has provided guidance memos and offered regulatory changes meant to encourage states to do even more. This opens up space to explore creative new solutions that may get to clean water goals faster and at lower cost.

Within that context, this paper highlights five key themes:

1. The combined challenges of water quality and farmer income represent a unique opportunity to invest in agricultural conservation practices that improve water quality and support farm financial viability.

2. Government regulation of permanent impacts on urban stormwater is driving demand for offsets which could be met by investments in conservation practices on agricultural lands.

3. Voluntary conservation markets are growing as companies set environmental goals and invest in agricultural programs. To support these corporate pledges, there are a growing number of nonprofit organizations and for-profit intermediaries who develop sustainability standards and act as conveners for food companies, environmental nonprofits, and farmer organizations.

4. New advancements in conservation technology hold promise for scaling up investment in conservation practices, especially when that technology can help investors measure outcomes.

5. The enormous impact of extreme weather events on the insurance industry is spurring innovation in the development of tools, metrics and programs to reduce risk and the payouts associated with extreme weather events and other crop and livestock losses.

Photo by Angela Guentzel

Victor Ranch of Afton, Oklahoma

Introduction

This paper explores trends and challenges in conservation finance[1] that support farmer adoption of water quality practices. It builds on the research and recommendations in the *Prioritizing Resources to Meet Water Quality Goals* report published in June 2020.[2] The ultimate objective of both efforts is to scale up water quality expenditures and progress toward improving water quality.

The industry processes and past management that have shaped food and agricultural water policies continue to be challenged by the desire to meet water quality goals while increasing productivity. This creates tension that opens opportunities for new approaches to solve environmental issues across the agricultural landscape. Costly urban and suburban water infrastructure requirements are contributing to the debate about the need for environmental regulatory policy changes in rural watersheds to reduce agriculture-related pollutants, including manure, fertilizers and pesticides. Increasingly, NGOs, universities, and members of the general public who have not been traditionally involved in shaping food and agriculture policy are mobilizing. Moreover, food and beverage companies are becoming more engaged in state and federal policy discussions to meet their respective corporate environmental pledges to consumers to reduce impacts on climate, water quality and quantity, in the absence of federal, state or local goals. Furthermore, there continues to be pressure from state governments for regulation to meet nutrient reduction needs and from lawsuits brought by citizens for a variety of environmental practices.

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[1]The Conservation Finance Network explains that conservation finance is 'the practice of raising and managing capital to support...the stewardship, protection and restoration of nature and the environmental services on which people depend.' Martin, Chris. "Conservation Finance 101." Conservation Finance Network, 28 Dec, 2015, https://www.conservationfinancenetwork.org/conservation-finance-101

[2] Sand County Foundation (June 2020) Prioritizing Resources to Meet Water Quality Goals. [accessed October 5, 2020] http://www.sandcountyfoundation.org/WaterQualityGoalsReport

Current State of Agricultural Finances

Net farm income in 2020 is expected to reach its highest level since 2013. However, a closer look at the data underscores several systemic challenges. While net income is expected to increase 43.1 percent over 2019, this is largely a result of direct government payments that increased 107.1 percent. Cash receipts for commodities and animal products are expected to decrease by 0.9 and 5.5 percent, respectively.[3]

Nearly 90 percent of farms in the U.S. generate less than $250,000 of gross sales per year.[4] The median farm income of all farms for four of the last five years has been a net loss ranging from $765 in 2015 to $1,735 in 2019. This was offset by off-farm income that ranged from $67,500 to $68,750 between 2015 and 2019.[5] In 2018, between 46.4 and 83.7 percent of total household income came from off-farm sources, such as construction, transportation, sales and administrative jobs.[6] A significant portion of income for many farmers and ranchers includes public and private pensions, interest and dividend payments, asset sales, and Social Security,[7] which is not surprising considering the average age of farmers is 57.5 years old.[8] The number of farms generating between $50,000 and $249,999 of gross sales have decreased by 5 percent over the past 24 years and have been replaced by those generating more than $500,000 per year.[9] These data point to the need for creative new revenue sources, including programs that invest in water quality improvements on farms.

Another troubling, underlying problem is farmer debt, which has reached levels not seen since 1980. Total outstanding agricultural debt was $418.9 billion in 2019 and is expected to reach $434 billion in 2020. In 1980, total farm debt was $435 billion in real (2020) dollars.[10] Figure 1 shows the U.S. farm debt, including real estate and non-real estate debt from 1970 to the present. In 2020 farm equity is forecast to increase 1.1 percent and farm assets by 1.5 percent, but farm debt is forecast to increase by 4.0 percent, which is led by an expected 6.1 percent increase in real estate debt.[11] Agricultural real estate debt accounts for 61 percent of total outstanding debt and represents loans secured by farmland.

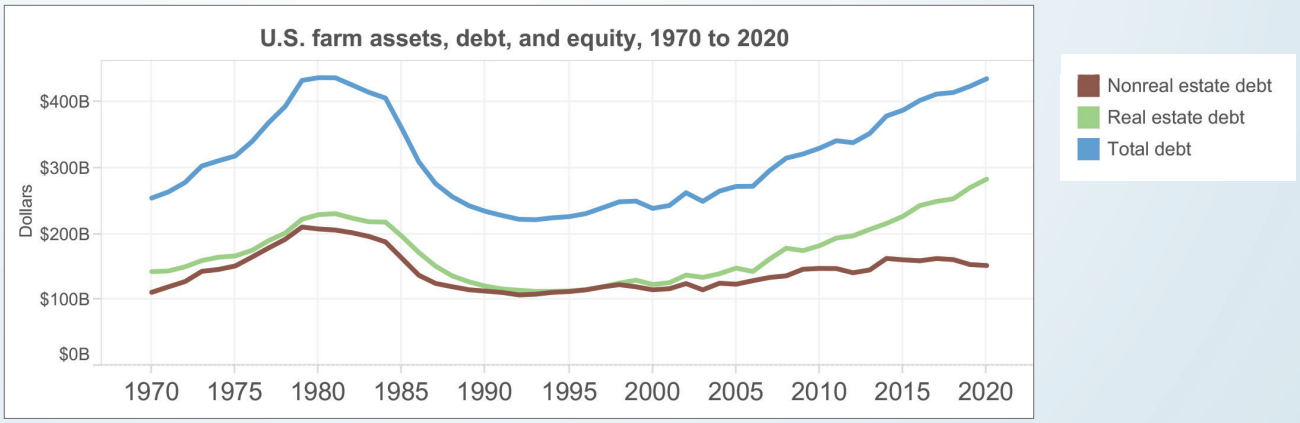

Figure 1 *- U.S. farm assets, debt and equity, 1970 to 2020, USDA ERS.*

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[3]USDA ERS (December 11, 2020) Highlights from the December 2020 Farm Income Forecast [accessed December 17, 2020] https://www.ers.usda.gov/topics/farm-economy/farm-sector-income-finances/highlights-from-the-farm-income-forecast/

[4]USDA ERS (December 2, 2020a) All farms and family farms, by farm size class (gross sales), 1996-2019 [accessed December 8, 2020] https://www.ers.usda.gov/webdocs/DataFiles/48870/table03.xlsx

[5]USDA ERS (December 2, 2020b) Principal farm operator household finances, 2015-20F [accessed December 8, 2020] https://www.ers.usda.gov/webdocs/DataFiles/48870/table01.xls

[6]Whitt, C. and Todd, J. (2020) Family Farm Households Reap Benefits in Working Off the Farm. USDA ERS. [Accessed September 17, 2020] https://www.ers.usda.gov/amber-waves/2020/march/family-farm-households-reap-benefits-in-working-off-the-farm/

[7]Whitt, C. Op. Cit.

[8]USDA NASS. (2019) Farm Producers. Revised census questions provide expanded demographic information. [Accessed September 17, 2020] https://www.nass.usda.gov/Publications/Highlights/2019/2017Census_Farm_Producers.pdf/

[9]USDA ERS (December 2, 2020a) Op. Cit.

[10]USDA ERS. Data Files: U.S. and State-Level Farm Income and Wealth Statistics. U.S. farm sector financial indicators, 2013-20F. [accessed September 16, 2020] https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/data-files-us-and-state-level-farm-income-and-wealth-statistics/

[11]USDA ERS (December 11, 2020) Op. Cit.[11]USDA ERS (December 11, 2020) Op. Cit.

The remaining 39 percent of agricultural debt represents short-term debt, typically used to finance operations.

The increase in real estate debt is being driven by two factors. First, low interest rates are encouraging the long-term financing of agricultural land.[12] Second, the value of farmland continues to increase. This is happening at the same time as the number of farms in the in U.S. continues to decrease. Between 2012 and 2019 the number of farms decreased 5 percent from 2.11 million to 2.02 million farms, while the average size of farms increased 2.5 percent, from 433 to 444 acres per farmer.[13] As the value of farmland increases and more consolidation occurs, as evidenced in the increase in the percentage of farms generating more than $500,000 per year, farmers are increasing their debt. This has resulted in an increase in the debt-to-equity ratio of farms from 12.9 in 2013 to a forecasted 16.2 in 2020.[14]

The overall trend in the increase of debt is concerning when taken in isolation, but it is particularly concerning when considering the impact of extreme weather events. After the severe flooding in the spring of 2019, a significant portion of farmers in the Midwest reported "major" or "severe" repayment problems, the highest level in 20 years.[15]

As of 2014, farmers owned 69 percent of farmland in the U.S. Non-farming individuals and partnerships own 21 percent, and the remaining 10 percent of all farmland was owned by corporations, trusts, and other ownership arrangements (see Figure 2).[16] Over the past five years there has been more interest from investment funds, such as pension funds and venture capital. Two examples of funds purchasing lands are the Teachers Insurance and Annuity Association (TIAA) and Ceres Farms LLC. In 2015, TIAA closed a $3 billion farmland partnership fund, which built upon its earlier $2 billion fund in 2012. Over the past decade, Ceres Farms has created a $500 million portfolio of farmland purchases across ten states totaling more than 100,000 acres.[17]

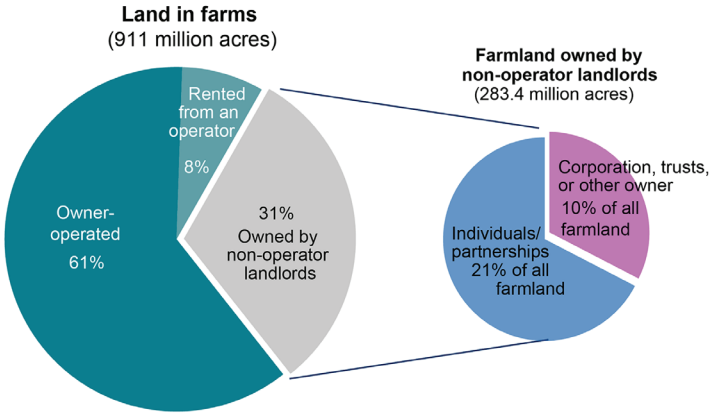

Figure 2 *- U.S. acres owned by farm operators, operator landlords, and non-operator landlords (2014).*

Drivers of Private Investment in Water Quality Improvements

Water quality markets offer a significant opportunity to generate additional on-farm revenue to address farmers' financial challenges while encouraging practices that provide on-farm and downstream environmental benefits. These on-farm and downstream benefits are critical to the future of water quality. Investing in traditional gray infrastructure will cost communities at least $1 trillion over the next 25 years to meet existing and growing demands of drinking water systems and another $271 billion for wastewater treatment plants. Implementing agricultural conservation practices to generate offset credits has the potential to meet these municipal infrastructure needs at similar or lower cost, while providing additional ecosystem services.

Historically there have been three drivers of private investment in water quality. The first, and most

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[12]Gloy, B. (September 17, 2018) US Farm Debt Continues Its Upward March. Agricultural Economic Insights. [accessed October 5, 2020] https://aei.ag/2018/09/17/us-farm-debt-continues-its-upward-march/

[13]USDA NASS. (February 2020) Farms and Land in Farms: 2019 Summary. [accessed October 5, 2020] https://downloads.usda.library.cornell.edu/usda-esmis/files/5712m6524/k0698r168/2b88qx13z/fnlo0220.pdf

[14]USDA ERS. Op. Cit.

[15]Oppedahl, D. (2019). AgLetter: August 2019. Chicago, Illinois: Federal Reserve Bank of Chicago. Retrieved September 17, 2020, from https://www.chicagofed.org/publications/agletter/2015-2019/august-2019.

[16]Bigelow, D., Borchers, A., Hubbs, T. (August 2016) U.S. Farmland Ownership, Tenure, and Transfer. USDA ERS. EIB 161. [accessed October 8, 2020] https://www.ers.usda.gov/publications/pub-details/?pubid=74675

[17]Maixner, E., Wyant, S. (February 5, 2019) Big changes ahead in land ownership and farm operators? Agripulse. [accessed October 2, 2020] https://www.agri-pulse.com/articles/11869-big-changes-ahead-in-land-ownership-and-farm-operators

persistent, is government regulations and policies. Second, there are emerging opportunities from some nonprofits and food and agriculture companies who see the need and are stepping up to improve water quality from the products they purchase. Finally, there is a growing interest from the insurance industry to develop tools, metrics and programs to reduce risk and the payouts associated with extreme weather events and other crop and livestock losses.

Regulatory Driven Water Quality Programs

The regulatory requirements for water quality were created by the Clean Water Act (CWA) and Safe Drinking Water Act (SDWA), and in some cases, state laws. The acts, passed almost 50 years ago, focused on reducing emissions from point sources, such as wastewater treatment plants, manufacturing facilities, and stormwater systems, and improving the quality of drinking water systems. They were never designed to address the significant challenges encountered by agriculture, such as erosion and nutrient run-off.

As our drinking water and water treatment infrastructure continues to age, the cost to repair this gray infrastructure continues to increase. This high cost presents opportunities for the agricultural sector to provide more cost-effective solutions from agricultural conservation practices. In the last decade, these requirements have led to massive growth in municipal green infrastructure investment in cities and modest growth in credit and trading approaches that use agricultural conservation offsets to meet the increasingly low discharge thresholds of point source and stormwater permit requirements.

Permitted facilities may be able to reduce their compliance costs by investing in non-point source agricultural conservation practices, especially if they can apply nutrient load reduction credits to current or future permit obligations. This section describes the key regulations that can be used to develop alternative water quality programs.

Clean Water Act

All waterways within the U.S. are regulated at some level – for swimming, drinking, or fishing. If a water body does not meet its water quality standards (WQS), it will be considered impaired and listed according to Section 303(d) of the CWA. With few exceptions, such as California's Irrigated Lands Regulatory Program, water quality impacts from agriculture are not directly regulated. States must develop limits, called Total Maximum Daily Loads or TMDLs, for every water body that does not meet its respective WQS. TMDLs are a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet its WQS. The regulations for National Pollution Discharge Elimination System (NPDES) permits are the primary opportunity for regulated entities to invest in agricultural practices that improve water quality.

In addition to NPDES permits, billions in public funding have been spent on various CWA programs, such as Section 319 grants and the Clean Water State Revolving Fund (CWSRF). It is possible for the CWSRF to provide funding for projects that generate water quality credits for compliance markets. Revolving fund grant recipients can develop projects eligible for water quality trading and then retain the revenues they earn from the sale of those credits.[18]

National Pollution Discharge Elimination System Permits

The CWA prohibits the release of "pollutants" through a point source into a water of the U.S. unless they have an NPDES permit. These permits contain limits on what the entity can discharge and sets monitoring and reporting requirements for the permitted facility. Examples of point sources regulated by the NPDES program include municipal and industrial wastewater treatment plants, concentrated animal feeding operations Concentrated Animal Feeding Operations (CAFOs), Municipal Separate Storm Sewer Systems (MS4s), stormwater associated with industrial activity, and various other potential sources of nutrient pollution.

[18]EPA. Draft: The Clean Water State Revolving Fund Program: Tapping its Untapped Potential. 3 [accessed December 17, 2020] https://www.epa.gov/sites/production/files/documents/SRF_TappingUntappedPotential.pdf

The American Society of Civil Engineers gives the 14,748 wastewater treatment plants across the country a D+ grade at protecting public health and the environment, and estimates that 56 million new users will be connected over the next two decades as people move from septic systems to centralized wastewater treatment plants. Meeting the needs of new users and meeting current demands will require at least $271 billion if traditional methods are used. There are about 772 communities where wastewater and stormwater systems drain into the same treatment system. During heavy rains these systems can overflow and impact water quality.[19]

Conservation finance represents a significant opportunity to invest in green infrastructure which can drastically reduce the scale and the cost of replacing or repairing systems in these communities. Regulated entities that contribute to permanent impacts on stormwater represent a growing source of demand for offsets to mitigate for those impacts. State and federal highway projects must also have stormwater permits, which trigger demand for mitigation of impacts through mechanisms like wetland and stream mitigation credits. Such offsets and credits can be developed through conservation practices on agricultural lands.

Section 319 Grants

Section 319 provides federal grants for nonpoint sources. States that develop nonpoint source pollution management programs can receive grants from EPA. Congressional appropriations for the Section 319 program peaked at $230 million in 2002 but more recently have averaged about $200 million per year. Grant recipients must provide a 40 percent match, either in dollars or in-kind services.

State Revolving Funds

The CWSRF program is a federal-state partnership operated by the EPA with each of the 50 states and Puerto Rico. It provides communities below-market loans, up to 20 years in length, for eleven types of qualified projects (see Table 1). These loans are increasingly being used as a tool to incentivize agricultural conservation on individual operations in addition to funding traditional municipal infrastructure. Through October 2017, the CWSRF has funded more than $700 million to agricultural water quality improvement projects, such as feedlot runoff, manure management, and conservation tillage.[20]

Table 1 - Eligible Clean Water State Revolving Fund (CWSRF) projects.

Eligible CWSRF Projects[21]
Constructing Publicly Owned Treatment Works (POTW)
Nonpoint Source Projects
National Estuary Program Projects
Decentralized Systems
Stormwater
Reducing the Demand for POTW Capacity through Water Conservation, Efficiency, and Reuse
Watershed Pilot Projects
Energy Efficiency
Reusing or Recycling Wastewater, Stormwater, or Subsurface Drainage Water
Security Measures at POTWs
Technical Assistance

Iowa's Local Water Protection Program (LWPP), for instance, harnesses CWSRF resources as a source of low-cost financing to support farmers working to improve their conservation practices. Surveys indicate LWPP has been well received by nearly all participants and has succeeded in increasing funding for conservation. This successful initiative could be expanded to other states. Another example is the Iowa State Revolving Fund (SRF) which is billed as 'two water improvement projects for the price of one.' The SRF allows municipal utilities undertaking facility upgrades to use a portion of the

[19]ASCE (2017b) Op. Cit.

[20]EPA (October 2017) Funding Agricultural Best Management Practices with the Clean Water State Revolving Fund, EPA 832F17004 [accessed December 17, 2020] https://www.epa.gov/sites/production/files/2018-01/documents/cwsrf_ag_bmp_fact_sheet_-_10.26.17.pdf

[21]EPA. CWSRF 101: An Introduction to EPA's Clean Water State Revolving Fund [accessed December 17, 2020] https://www.epa.gov/cwsrf/cwsrf-101-introduction-epas-clean-water-state-revolving-fund

interest they would have paid back to the SRF as a grant for a nonpoint source project in the watershed where the utility is located.

Like the CWSRF, EPA also operates a Drinking Water State Revolving Loan Fund (DWSRF) which was created under the 1996 amendments to the SDWA. In addition, it expanded the eligibilities for set-aside expenditures to focus on source water protection activities and "re-authorized states to establish source water protection (SWP) programs that can investigate the origins of pollution to reduce levels of contamination, establish partnerships for SWP, and develop recommendations for long-term SWP strategies."[22] The DWSRF also requires a 20 percent match by the states. Through the end of 2019, state DWSRFs have invested more than $41.1 billion in drinking water systems.[23]

Practices that can be supported by the set-aside include building fences to protect water sources, acquiring land, implementing conservation easements, and paying for cover crops.[24] Unlike the CWSRF, the DWSRF does not have data on the use of the fund to support agriculture projects. At $21.0 billion, the DWSRF is about half the size of the federal government's $45.2 billion cumulative funding for the CWSRF.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) applies to every public water system in the U.S. There are more than 170,000 public water systems which provide water to people across the country. USEPA sets national standards for drinking water, called National Primary Drinking Water Regulations, which set the maximum level for specific contaminants in drinking water.[25]

Voluntary Water Quality Programs

Voluntary water quality programs are driven by a combination of nonprofit organizations developing programs, corporations seeking to meet their Environmental, Social, and Governance (ESG) goals, and farmland corporations which, while still a small proportion of farm owners, are steadily increasing. Unfortunately, while 77 percent of the largest publicly traded food, beverage and agriculture companies mention water as a risk factor in their financial filings, 37 percent "still lack goals to source crops in ways which reduce impacts on water use and quality."[26] The organizations in this section of the report are trying to change that statistic.

Nonprofit Programs

Several nonprofits and trade organizations have developed voluntary programs which encourage farmers to implement and then track sustainability practices. Many of these programs were developed in response to the requests from corporate supply chain initiatives. Some of these programs provide certifications or benchmarking that allow farmers to differentiate themselves from other farmers. Other programs, such as the Environmental Services Market Consortium, are working to reduce the barriers to environmental markets. These programs have been designed by agriculture-centric organizations and focus more on developing the supply of practices than on stimulating the demand from food companies. While the food companies supporting these programs are under pressure from their customers and investors to reduce the impact of their supply chain, there have been few successful programs targeted at consumers, such as the USDA organic program and Fair Trade USA. Nonprofits have therefore focused on programs to help food companies meet their ESG goals and metrics.

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[22]USEPA. (October 2019) Protecting Source Water with the Drinking Water State Revolving Fund Set-Asides. EPA 816-F-19-003 [accessed September 30, 2020] https://www.epa.gov/sites/production/files/2019-10/documents/protecting_source_water_with_the_dwsrf_-_final.pdf

[23]USEPA. How the Drinking Water State Revolving Fund Works. [accessed September 30, 2020] https://www.epa.gov/dwsrf/how-drinking-water-state-revolving-fund-works

[24]Ibid.

[25]USEPA. Drinking Water Grants. [accessed September 30, 2020] https://www.epa.gov/ground-water-and-drinking-water/drinking-water-grants

[26]CERES. (2019) Feeding Ourselves Thirsty – Tracking Food Company Progress Toward a Water-Smart Future. [accessed September 30, 2020] https://www.ceres.org/sites/default/files/reports/2019-10/FOT2019_Executive_Summary.pdf

Field to Market

Field to Market was formed in 2006 and has expanded into a diverse collaboration of almost 150 companies across the food supply chain. Members include grower organizations; agribusinesses; food, beverage, apparel, restaurant and retail companies; conservation groups; universities; and public sector partners.[27] The cornerstone of the organization is their Fieldprint® Platform, which enables farmers and the supply chain to document sustainability outcomes and provide information on their sustainability practices to retailers and consumers, using research and science-based data. The Platform also allows growers to benchmark their sustainability practices, including water quality, against other farmers in the region.[28] Members have implemented 52 sustainability projects on 3.7 million acres and Field to Market's third-party data management partners, companies who can interface with the Fieldprint Platform, reach more than 33.1 million acres through their clients.[29]

4R Nutrient Stewardship Certification Program

The 4R Nutrient Stewardship Certification Program, developed by The Fertilizer Institute and Fertilizer Canada, is a voluntary program intended to significantly reduce and prevent fertilizer from running off fields into the water supply. It was launched in the Western Lake Erie Basin in 2014 as a partnership between The Fertilizer Institute, The Nature Conservancy, and the Ohio Agribusiness Association. Programs are currently available in Florida, New York, and Ohio in the U.S. and in Ontario and Prince Edward Island in Canada. Other geographies working to implement the program are Indiana, Minnesota, and Missouri.[30]

Ecosystem Services Market Consortium

The Ecosystem Services Market Consortium (ESMC) was formed in 2019 with a mission to "advance ecosystem markets that incentivize farmers and ranchers to improve soil health systems that benefit society."[31] Their goal is to launch a voluntary ecosystem services market focused on agriculture-based carbon and water quality and quantity credits by 2022. ESMC currently has 59 members including General Mills, Danone, Almond Board of California, The Campbell Foundation, Sand County Foundation, and the World Wildlife Fund (WWF).

Midwest Row Crop Collaborative

The Midwest Row Crop Collaborative (MRCC) is a partnership aligned to drive positive environmental change in the upper Mississippi River Basin. MRCC was founded in 2016 and is composed of 9 members, including Walmart, Kellogg's, World Wildlife Fund and Environmental Defense Fund. The members "design, fund, and implement cutting-edge programs and pilots that demonstrate the soil, water, and climate benefits of regenerative agricultural practices to unlock strategies for a more resilient system."[32] MRCC specifically identifies conservation finance as one of the top five catalysts for change. They intend to provide access to new lending and other financial products that support the transition to new farming practices.[33]

Corporate Supply Chain Programs

For almost half a century, corporations have faced intense scrutiny over their business practices originating with activists pushing for disinvestment in South Africa in response to apartheid. This has evolved to the present day where practically every multinational

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[27] Field to Market. The Alliance [accessed October 5, 2020] https://fieldtomarket.org/the-alliance/

[28] Field to Market. Fieldprint Platform. [accessed October 5, 2020] https://calculator.fieldtomarket.org/

[29] Field to Market (2019) Growing our Impact Together, 2019 Annual Report [accessed December 17, 2020] http://fieldtomarket.org/media/2020/06/FTM_2019_Annual-Report_HiR-2.pdf

[30] 4R Nutrient Stewardship Certification Program. [accessed September 30, 2020] https://4rcertified.org/

[31] ESMC. About Us [accessed December 17, 2020] https://ecosystemservicesmarket.org/about-us-2/

[32] MRCC. Our Approach [accessed December 17, 2020] https://midwestrowcrop.org/

[33] MRCC (April 2020) Progress Report. 7 [accessed December 18, 2020] https://midwestrowcrop.org/wp-content/uploads/2020/10/MRCC-Progress-Report-April-2020.pdf

corporation has an ESG program that responds to stakeholder and investor concerns. A growing focus for food, beverage, and agriculture companies is the availability and quality of the water where the company has facilities and within the company's supply chain. In response to these concerns, many of the largest food brands and retailers are implementing supply chain sustainability programs to reduce the environmental impact of their supply chain. These companies direct their buyers to encourage farmers and ranchers in their supply chain to implement farm-level conservation practices. There are a couple challenges with this approach. First, most of the ingredients food companies purchase are commodities, and therefore the food companies do not know the exact farm where the product originated. Food companies have dealt with this in a number of ways. The most common way is focusing on a "supply shed" where they source one or more of their ingredients and work with local farming organizations and multi-stakeholder initiatives to advocate for the implementation of conservation practices.

The second challenge with these programs is that the margins on food products is small. The gross profit margin for the food processing industry was 22.0 percent in 2019, which is less than half the overall food and beverage market average of 49.4 percent.[34] This means that food companies do not pay a premium for sustainably grown products. What they do offer is technical assistance for farmers and support for programs that develop and implement sustainability tools such as Field to Market. Some food companies recognize select farmers on their packaging, or highlight them in press releases or annual sustainability reports. The largest food companies and retailers can also threaten not to purchase products from a region if programs are not developed or implemented, creating a potential barrier to market entry. Four examples of corporate supply chain programs driving water quality improvements with agriculture are Cargill, Walmart, Danone and Coca-Cola.

Cargill

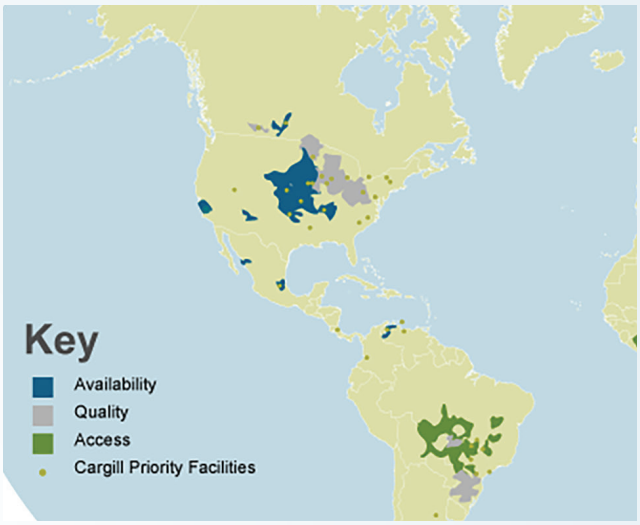

Figure 3 *- Cargill Priority Watersheds.*

Cargill is one of the largest food companies in the U.S.[35] Because of its size and impact on the market, it can drive changes in agricultural practices across millions of acres. In 2020, the company set a goal to reduce 5 million kg of water pollutants in priority watersheds by 2030.[36] The company has targeted the Great Plains states as a water quantity priority region, and the Midwest as a water quality priority area (see Figure 3).[37] In addition, to meet its climate change goal of reducing GHG emissions from its supply chain 30 percent by 2030, Cargill set an internal carbon price of $30 per ton for its operations.[38] This program could also improve water quality if it is focused on the reduction of fertilizer losses. This is because fertilizer is both a water quality and GHG concern, and any program focused on reducing fertilizer loss will reduce both nitrous oxide emissions and nitrates in waterways.

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[34]Segal, T. (June 15, 2020) Profit Margins for the Food and Beverage Sector, Investopedia [accessed December 18, 2020] https://www.investopedia.com/ask/answers/071015/what-profit-margin-usual-company-food-and-beverage-sector.asp

[35]Wikipedia.[accessed September 16, 2020] https://en.wikipedia.org/wiki/Cargill

[36]Cargill. Water Resources. [Accessed September 16, 2020] https://www.cargill.com/sustainability/priorities/water-resources

[37]Cargill. Priority Water Facilities and Watersheds. [accessed October 6, 2020] https://www.cargill.com/sustainability/water-resources-cargill-priority-water-facilities-watersheds-map

[38]CDP. (October 2017) Putting a price on carbon: Integrating climate risk into business planning, 26 [accessed October 5, 2020] https://www.actu-environnement.com/media/pdf/news-29828-prix-carbone-entreprises-cdp.pdf

Danone

Over the past three years, Danone has dramatically increased efforts to implement practices in its supply chain that will improve water quality. In November 2017, Danone announced a plan to increase its focus on regenerative agriculture. In 2018, Danone North America pledged $6 million over five years to develop a soil health initiative to identify regenerative agriculture practices that increase soil carbon sequestration.[39] In 2019, it launched the One Planet Business for Biodiversity coalition, which brings together nineteen companies committed to scaling up regenerative agriculture practices to protect soil health.[40] Through the Danone Ecosystem Fund, the company has invested nearly $240 million supporting 87 projects around the world.[41] One of their projects in the U.S. is to increase the amount of organic milk produced in the Northeast by encouraging young farmers to convert to organic farming. They have established a training center for research, demonstration and training in sustainable organic dairy farming and pasture management.[42]

Coca-Cola

Water quality is a core concern for Coca-Cola as its products are dependent on high quality water. The company has developed two sets of requirements that it expects its suppliers to comply with – Supplier Guiding Principles and Sustainable Agriculture Guiding Principles. One of the standards Coca-Cola supports is the Farm Sustainability Assessment (FSA) of the Sustainable Agriculture Initiative Platform. This standard includes numerous water management requirements, including water pollutant management and the implementation of run-off practices.[43] Part of its climate change governance program is managing and monitoring the "risks relating to climate change and its potential impacts on our business, such as those related to water scarcity and quality, and supply chain disruption."[44] In addition, Coca-Cola launched a new water strategy in 2020 based on input from external stakeholders, which includes more water and climate-smart agriculture actions.[45] In addition, the company has adopted two agriculture-based sustainability goals:

1. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.[46]

2. By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Farmland Corporations

As stated in the previous section, 10 percent of agricultural land in the U.S., or about 9.1 million acres are owned by corporations, trusts, and other ownership arrangements. Corporate ownership increases for the largest farms where almost a quarter of farms with more than $1 million in annual sales are corporate owned.[47] In addition, the number of farms generating between $50,000 and

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[39]Danone. Regenerative Agriculture [accessed December 18, 2020] https://www.danone.com/impact/planet/regenerative-agriculture.html

[40]Danone. Towards Carbon Neutrality [accessed December 18, 2020] https://www.danone.com/impact/planet/towards-carbon-neutrality.html

[41]Danone Écosystème. Danone Ecosystem Fund [accessed December 18, 2020] http://ecosysteme.danone.com/

[42]Danone Écosystème. Wolfe's Neck New Farmer Incubator [accessed December 18, 2020] http://ecosysteme.danone.com/projectslists/wolfes-neck/

[43]Coca-Cola (2020) 2020 CDP Water Response, 14 [accessed December 18, 2020] https://www.coca-colacompany.com/content/dam/journey/us/en/policies/pdf/sustainability/2020-cdp-water-response.pdf

[44]Coca-Cola (2019) 2019 Business and Sustainability Report, 23 [accessed December 18, 2020] https://www.coca-colacompany.com/content/dam/journey/us/en/reports/coca-cola-business-and-sustainability-report-2019.pdf

[45]Ibid, 33

[46]Ibid, 45

[47]MacDonald, J.M., Hoppe, R.A., Newton, D. (March 2018) Three Decades of Consolidation in U.S. Agriculture. USDA ERS. Economic Information Bulletin Number 189. [accessed October 2, 2020] https://www.ers.usda.gov/webdocs/publications/88057/eib-189.pdf

$249,999 of gross sales have decreased by five percent over the past 24 years, and have been replaced by those generating more than $500,000 per year.

Historically these companies have not set corporate water quality goals. However, in April 2020, ten of the leading farmland asset management companies[48] formed Leading Harvest and launched a Farmland Management Standard to "help family farmers and farm managers methodically increase agricultural sustainability and make verifiable claims to the market while simultaneously strengthening the credibility, reputation, and social license of businesses and investors across the value chain."[49] This new standard differentiates itself from other voluntary standards in two ways. First, it can be "universally applied across all crops and geographies and addresses the full spectrum of environmental, social, and economic concerns."[50] Second, it is "outcome-based," allowing farmers to apply the standard to their unique operations while generating sustainable outcomes. The standard is composed of 13 Principles, including Sustainable Agriculture (Principle 1) and Protection of Water Resources (Principle 3). The Protection of Water Resources includes the requirement of users to "properly manage the use of fertilizers and other soil amendments, crop protectants, and other inputs, and avoid release of sediment and nutrients from agricultural lands into groundwater and surface water."[51] As a new program, it is too early to determine its impact.

Financing Mechanisms, Markets and Incentives

A diverse array of mechanisms has been developed for encouraging farmers and ranchers to implement water quality improvements. This section will build on the demand described in the previous section and will discuss mechanisms which have been used to both finance and incentivize water quality improvements. It includes a summary of the opportunities with environmental markets, environmental impact bonds, tax incentives, and investment funds. Table 2 at the end of this section provides guidance on how to decide on the approach for a given market or opportunity.

Environmental Markets

The environmental benefits or ecosystem services generated during the production of consumer products that protect or enhance natural systems have not traditionally been priced into the goods purchased in our economy. We have not put a price on clean air, clean water, flood protection or healthy soils. That started changing about 30 years ago as the ability to quantify environmental benefits advanced and markets emerged where companies could purchase the environmental benefits associated with natural systems. According to a 2017 report by the Government Accountability Office (GAO), there were 19 voluntary programs trading water quality credits in 11 states as of 2014.[52]

One of the largest of these efforts is the Ohio River Basin Trading Project created by the Electric Power Research Institute (EPRI). In 2007, EPRI started working with power companies, wastewater utilities, farmers, state and federal agencies and environmental groups to develop a regional interstate water quality trading framework in the Ohio River Basin, focused on providing a supply of offsets for point-source phosphorus pollution in anticipation of stronger state phosphorus regulatory standards. The program focuses on facilitating collaborations to protect and improve the water quality of the Ohio River Basin at the lowest overall cost. Farmers generate water quality credits for nitrogen and phosphorus by implementing best management practices that reduce edge-of-field nutrient runoff.[53] In 2012, the environmental agencies in Ohio, Indiana and Kentucky accepted the program under their nutrient pollution regulation programs. The first

[48]Peoples Company, Hancock Natural Resource Group, UBS, Westchester, International Farming, Cottonwood AG Management, Ceres Partners, The Rohatyn Group, Agis Capital, and PGIM Real Estate.

[49]Whitman, A. (2020) A Primer for Understanding the Leading Harvest Farmland Management Standard. Leading Harvest. 2 [accessed October 2, 2020] https://static1.squarespace.com/static/5df405bb116ac7759bac2e37/t/5e98e9344102842ed9ee8905/1587079495633/LeadingHarvest_Primer.pdf

[50]Ibid.

[51]Leading Harvest. (2020) Leading Harvest Farmland Management Program 2020. 8. [accessed October 2, 2020] https://static1.squarespace.com/static/5df405bb116ac7759bac2e37/t/5f2b55886c92b204df866b3b/1596675491332/Leading+Harvest+Farmland+Management+Program+2020.pdf

[52]GAO (October 217) Water Pollution: Some States Have Trading Programs to Help Address Nutrient Pollution, but Use Has Been Limited, GAO-18-84 [accessed December 19, 2020] https://www.gao.gov/assets/690/687755.pdf

[53]EPRI. (2014) Ohio River Basin Water Quality Trading Project. [Accessed September 17, 2020] https://wqt.epri.com/pdf/3002001739_WQT-Program-Summary_2014-03.pdf

pilot trades for stewardship credits were executed in 2014.[54] As of May 2019, the program had generated 100,000 credits representing the prevention of 100,000 pounds of nitrogen or phosphorus from entering the environment.[55] Although the program was set up to facilitate regulatory-driven investment, the GAO found that the credits were not purchased by point sources to comply with discharge limits but rather by corporations to meet their ESG goals.[56]

Despite significant work by dedicated organizations and agencies, water quality trading markets have remained limited. Key agricultural states, including Indiana, Illinois, Kansas and Nebraska have not developed programs. Some states, such as Michigan, have rescinded their programs because they were overly complex and resulted in an ineffective and inefficient program.[57] According to the GAO, there are two challenges with nutrient credit trading. The first is that there need to be numeric water quality limits to create the demand for credits. For example, until a TMDL was established for the Chesapeake Bay, little trading took place.

The second challenge identified by the GAO was determining the environmental benefits of the practices implemented. The complexity of agricultural systems and the uncertainty inherent in the models makes many buyers concerned about the legal liability of the credits. Trading credits between regulated entities has more certainty, but more cost, than purchasing credits from nonregulated entities.[58]

Environmental Impact Bonds

Environmental impact bonds (EIB) are an emerging, and promising, type of bond used for conservation finance projects. They are designed to return to the investor a combination of principal, interest, and a performance payment. The performance payment portion of the bond is what makes them unique from traditional environmental bond instruments. The performance payment is dependent on one or more specific outcomes for which the project was financed and can be either fixed or variable. Fixed returns are based upon achieving a specific threshold of performance while variable returns are based on a sliding scale of the impact achieved by the project. Performance payments may also include bonus payments for higher than expected performance and reverse payments if projects fail. Risk payments are made by the fund to the buyer if the project underperforms desired outcomes by a previously identified level. Risk payments are also called "claw backs." [59]

There are two important parties engaged in the development of EIBs. Independent organizations often structure the bond, setting up the terms and metrics as well as the size of the performance payments and the outcomes that trigger the performance payments. The second party engaged in EIBs are independent verifiers. These organizations review the performance of the project and determine whether any performance payments should be made to the investors.[60] EIBs have significant overhead and are best suited for projects with high capital costs to cover the marketing and underwriting costs of developing and issuing the bonds. Finally, EIBs often require a strong credit rating by the issuer, such as a city or county would have.[61]

In December 2020, the City of Hampton, Virginia issued the first EIB in that state. It will finance $12 million in nature-based solutions to reduce the impacts to the city from floods. The bond will start by funding three projects

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[54]Ibid.

[55]EPRI and First Climate. (2019) Press release: EPRI and First Climate Bring Water Quality Credits to Environmental Stewardship Markets. [Accessed September 17, 2020] https://wqt.epri.com/pdf/EPRI_First-Climate_WQT_PressRelease.pdf

[56]GAO, Op. Cit., 29

[57]Office of Regulatory Reinvention. (December 23, 2011). Recommendations of the Office of Regulatory Reinvention Regarding Environmental Regulations. State of Michigan, 32. [accessed October 6, 2020] https://www.michigan.gov/documents/lara/ORR_-_Environmental_Recommendations_377252_7.pdf

[58]Ibid, 31

[59]Conservation for Private Investment in Conservation. (2019) Conservation Investment Blueprint: Environmental Impact Bond for Green Infrastructure. [Accessed September 17, 2020] http://cpicfinance.com/wp-content/uploads/2019/01/CPIC-Blueprint-Case-Study-Environmental-Impact-Bond-for-Watershed-Green-Infrastructure-by-Quantified-Ventures.pdf

[60]Ibid.

[61]Credit Suisse, IUCN, Gordon and Betty Moore Foundation, Rockefeller Foundation, McKinsey Center for Business and Environment. (2016) Conservation Finance From Niche to Mainstream: The Building of an Institutional Asset Class, 9.

that, among other practices, create swales to store and slow water flow and create a stormwater park to slow, store, and clean runoff. The projects are expected to add more than 8.6 million gallons of storage capacity for stormwater.[62] Although this is an example of an urban impact bond, the same structure can be applied in agricultural settings to pay for agricultural best management practices that have a water quality benefit.

Investment Funds

The scarcity of water around the world has attracted the attention of investment fund companies. Several mutual funds and exchange-traded funds, such as Calvert Global Water Fund and Allianz Global Investors, have developed funds that supply and repair water systems.[63] Many of these funds are focused on international projects. This is due, in part, to the significant need for water infrastructure investments in emerging economies, but also because some countries, such as the U.S., subsidize the price of water. The price of water in Switzerland, for example, is about four times that in the U.S.[64]

Investment in forest land and management is one of the most significant areas of conservation finance. These funds can be as large as $200 million and yield a return between 10 to 15 percent over ten to 15 years. They are successful in large part because of the 15 to 25 percent premium they can charge to customers for Forest Stewardship Council (FSC) certified wood.[65] These funds are expanding their services and are marketing water quantity and quality benefits to water utilities, who are investing in the funds.[66] Adaptation of this approach to commodity and animal agriculture presents a potential opportunity for farmers and ranchers.

In addition to traditional investment funds, some organizations act as green banks, collecting funds from investors and investing them in projects on their behalf. An example of such an arrangement is the Soil and Water Outcomes Fund, which is jointly administered by the Iowa Soybean Association and Quantified Ventures. The fund supports the implementation of in-field, edge-of-field, and structural practices that result in quantifiable environmental benefits. It is structured as a "revolving fund that manages a pool of capital on behalf of impact investors to pay farmers for implementation of agriculture best management practices." [67]

Tax Programs

Establishing state taxes that specifically set aside tax revenue for agricultural conservation or tax credits for the costs of adopting them are mechanism for enhancing natural resource management on working lands. Several states have implemented tax credit programs for implementing conservation practices. Programs from three states are highlighted in this section: Minnesota, Virginia, and Oregon.

Minnesota

In 2008, Minnesota voters passed the Clean Water, Land and Legacy Amendment to their state constitution. It raised the state sales tax by 3/8 of one percent, and dedicated those funds to clean water, environment and natural resources, outdoor heritage and parks and trails, and arts and cultural heritage projects. The Minnesota Clean Water Fund alone received $1.2 billion between fiscal years 2010 and 2021 to fund surface water, groundwater and drinking water. The Minnesota Agricultural Water Quality Certification Program is one initiative funded with $14.5 million from this Clean Water Fund. This program alone has encouraged almost 800 farms (with 500,000 acres) to meet agricultural water quality certification standards, while leveraging another $11.4 million in program support.[68]

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[62]Chesapeake Bay Foundation (December 3, 2020) City of Hampton Fights Flooding with Issuance of Virginia's First Environmental Impact Bond [accessed December 19, 2020] https://www.cbf.org/news-media/newsroom/2020/virginia/city-of-hampton-fights-flooding-with-issuance-of-vas-first-eib.html

[63]Gray, T. (July 11, 2019) As Fresh Water Grows Scarcer, It Could Become a Good Investment. New York Times.

[64]Saefong, M.P. (October 11, 2019) The Case for Investing in Water. Barron's [accessed December 22, 2020] https://www.barrons.com/articles/the-case-for-investing-in-water-51570791604

[65]Credit Suisse, Op. Cit. 21.

[66]Blue Forest Conservation (September 2017) Forest Resilience Bond: Fighting Fire with Finance – a Roadmap for Collective Action. 8 [accessed October 6, 2020] http://www.carpediemwest.org/wp-content/uploads/Forest-Resillience-Bond-Report.pdf

[67]Soil and Water Outcomes Fund. About the Soil and Water Outcomes Fund. [accessed September 30, 2020] https://static1.squarespace.com/static/5db70c3d3a013f252a36f1da/t/5f18567558182f1d752ebb6c/1595430535186/SWOF+Informational+One+Sheet

[68]Minnesota Clean Water Council. (2020) Clean Water Fund Performance Report. [Accessed September 17, 2020] https://www.legacy.mn.gov/2020-clean-water-fund-performance-report.

Virginia

Since 1998, Virginia has offered an income tax credit of 25 percent for the first $70,000 spent on implementing approved agricultural best management practices to encourage voluntary adoption. An update to increase this to the first $100,000, with a $2 million per year program limit, is currently under review. For example, a farmer qualifies for the credit if they purchase equipment designed to more precisely apply fertilizers and implement a nutrient management plan approved by the local soil and water conservation district.[69] Five different categories of equipment qualify for the credit, including:

- Sprayers for pesticides and liquid fertilizers;
- Pneumatic fertilizer applications;
- Manure applicators;
- Tramline applicators (Precision chemical application technology);
- Starter fertilizer banding attachments for planters.[70]

Table 2 - A comparison of financing approaches.

Market Opportunity	Financial Vehicle	Opportunities	Challenges
Markets	Environmental Markets	Very efficient when there are large numbers of buyers and sellers	Ensuring a balance of supply and demand is challenging
Debt and Equity	Environmental Impact Bonds	Good choice for large point sources who need cost-effective reductions which can be provided by agricultural land	• Good credit rating of issuer is important • Larger deals essential due to high transaction costs
	Investment Funds	Tool for a portfolio of project investments	Requires a financial benefit that can be returned to investors
	State Revolving Funds	Provides low interest loans for water quality projects As a revolving fund, the availability of funds is maintained over time	SRFs do not directly require private finance, but can be used as supplemental funding to support larger projects
Financial Incentives	Tax Incentives	Provides a stable income stream which can be invested in environmental reductions	Requires taxpayer support for an increase in taxes or a new tax incentive
	Reduction in Crop Insurance Premiums	Farmers and ranchers have flexibility in implementing Good Farming Practices, allowing them to tailor programs to their operations	• Flexible criteria also result in uncertain outcomes • NRCS practice codes are not included as GFPs
	Other Insurance Opportunities	Creative opportunity to fund infrastructure that can reduce in-surance payouts	Relatively new and untested tool
Non-Traditional Opportunities	Corporate Supply Chain	Large corporations are bringing attention and publicity to the need to implement agricultural practices that improve water quality	The market is not willing to pay a premium for these preferable agricultural practices

[69]Virginia Department of Taxation. Agriculture and Farming Credits [accessed December 21, 2020] https://www.tax.virginia.gov/agriculture-and-farming-credits#fertilizer-pesticide-equipment-credit

[70]Title 58.1 Taxation, Subtitle I, Chapter 3, Article 3, § 58.1-337. Tax credit for purchase of advanced technology pesticide and fertilizer application equipment. [accessed December 21, 2020] https://law.lis.virginia.gov/vacode/title58.1/chapter3/section58.1-337/

Oregon

Since 1981 Oregon has had a tax credit program for landowners who conserve and rehabilitate riparian zones. The program offers a property tax credit to property owners for improving or maintaining qualifying riparian land. To qualify for the credit, the landowner must work with state or federal conservation agencies to develop a management plan that specifies the conservation and management practices that will be implemented to protect and restore the riparian land. Allowed practices include installing livestock watering and crossing areas, fish habitat restoration, vegetation management, and the development of recreational facilities.[71]

One of the challenges in implementing tax programs is designing a program that is equitable, politically feasible, and raises sufficient funds for its purpose. The Minnesota sales tax (see above) is an example of a regressive tax–one that is the same no matter the income of the purchaser.

Insurance Programs

As extreme weather events continue to increase, the pressure for governments and the insurance industry to identify ways to reduce risk and payouts increases. Between 2012 and 2016, the payout for losses from the federal flood insurance program was 90 percent of the premiums paid and was 95 percent for crop insurance. Compare that to an average 41 percent payout for fire insurance.[72] USDA and the insurance industry have both developed programs and recommendations to reduce the risk and impact of extreme weather and natural disasters on agriculture.

Most lenders require farmers to get crop insurance to get a loan. When they do, farmers must implement Good Farming Practices (GFP) designated by USDA's Risk Management Agency (RMA).[73] The challenge is that these GFPs do not completely align with conservation programs; they are determined based on a combination of the agronomic situation of the farmer and the opinion of at least one agricultural expert, making compliance with the GFP very subjective.[74] In 2019, cover crops were added to the Handbook for the first time and is the only specific practice identified. Several organizations are lobbying for the inclusion of not just cover crops under GFPs for crop insurance, but for the inclusion of any Natural Resources Conservation Service (NRCS) conservation practice standard or conservation enhancement.[75] If these practices could be included, USDA's RMA would send a strong signal to incorporate these practices to both reduce the farmer's risk and their impact on local water quality.

USDA is also researching how cover crops and no-till practices affected the planting of fields in 2019. Extreme rain events and flooding in 2019 prevented planting on 19 million acres of farmland resulting in $4 billion in crop insurance claims. Some farmers who implemented conservation practices reported a reduced planting risk. Through a pilot in six midwestern states, the USDA, the Meridian Institute, and the University of Illinois are hoping to determine if there is a relationship between conservation practices and crop risk exposure and yield variability. These practices could increase farm resilience and help farmers improve their productivity, profitability, and sustainability.[76]

The global crop insurance market was valued at $34.05 billion in 2019 and is expected to grow to $53.02 billion by 2027.[77] Two developments impacting the insurance industry are particularly interesting for conservation finance – new insurance products and technological innovation.

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[71]Oregon Department of Fish and Wildlife (October 2019) Riparian Lands Tax incentive Program: Manual for Landowners, 5-7 [accessed December 21, 2020] https://www.dfw.state.or.us/lands/docs/RLTIP_Manual%20for%20Landowners.pdf

[72]National Association of Insurance Commissioners. (2017) 2016 Market Share Reports for Property/Casualty Groups and Companies By State and Countrywide [accessed October 2, 2020] https://www.naic.org/prod_serv/MSR-PB-17.pdf

[73]EDF, 20.

[74]USDA Risk Management Agency. (June 2019) Good Farming Practice Determination Standards Handbook. FCIC-14060 [accessed October 2, 2020] https://www.rma.usda.gov/-/media/RMA/Handbooks/Program-Administration--14000/Good-Farming-Practice/2020-14060-Good-Farming-Practice-Determination-Standards.pdf

[75]National Sustainable Agriculture Coalition. (2014, November 11). What Does "Good Farming Practices" Really Mean? Retrieved from https://sustainableagriculture.net/blog/good-farmingpractices-hndbok/

[76]Agree (Fall 2020) Frequently Asked Questions: Conservation and Crop Risk Management Research Pilot [accessed December 18, 2020] https://s31207.pcdn.co/wp-content/uploads/sites/4/2020/12/Frequently-Asked-Questions.pdf

[77]Allied Market Research. Crop Insurance Market Outlook – 2027 [accessed December 18, 2020] https://www.alliedmarketresearch.com/crop-insurance-market-A06791

Insurance companies are starting to create sustainable insurance products targeted at farmers and ranchers. One of the insurance companies developing new products is Allianz, which has created a portfolio of sustainable solutions for its customers. This includes environmental liability solutions, such as water contamination liability insurance. To qualify as a sustainable solution, Allianz products must meet a suite of environmental and social criteria. One of those criteria are products that conserve natural resources and encourage or reward environmentally responsible behavior.[78] In 2019, Allianz generated total revenue of 1.33 billion € ($1.63 billion) from 203 sustainable solutions, which is up from 874 million € in 2017.[79] Unfortunately, its annual sustainability report did not break out solutions for agriculture.

The private insurance market is being rapidly impacted by technology. Most administrative tasks are being automated, such as underwriting and claims. Determining risks to price insurance is also being impacted by technology – remote sensing (satellite and drones), sensors, machine learning, and mobile applications.[80] At the same time, risks and claims are increasing in response to more extreme weather events. Increases in data collection and analysis provide the opportunity for farmers and ranchers to document the practices they implement, reduce the risk of crop failure, and decrease their premiums. More discussion about the role technology can play in conservation finance is found in the next section.

Technology Drivers of Conservation Finance

In early 2019, there were more than 1,600 agricultural technology startups.[81] These include companies that: examine weather, soil and field data to aid in farmer decision making; help farmers recruit, retain and manage their bilingual farm labor; and reduce food waste by selling imperfect produce. As stated in the Financing Mechanisms section above, one of the challenges with conservation finance for water quality practices is the measurement of the practices in relation to the outcomes generated. However, the ability to monitor practices across vast landscapes is rapidly improving with new technologies. Moreover, these tools can complement and enhance the planning and evaluation stages, thereby reducing barriers to implement and scale up conservation outcomes. This section will provide an overview of tools and technologies available to increase both the geographic scale and scope of water markets, how automation will expedite these processes, and how that gives way to reimagining water quality programs going forward. While this section is not an exhaustive list of appropriate technologies, it will provide an overview of tools available and summarize how technologies can be utilized together at different stages to quickly and efficiently implement and monitor water quality practices.

Scaling Up

Historically, we could only monitor and observe landscapes as far as our feet, horse or car would take us. This limited the ability to efficiently evaluate landscapes and monitor programs at scale to determine where projects could have the highest impact. Following project implementation, it was hard to gauge whether practices were yielding the expected outcomes. In the last ten years, remotely-sensed data and new management systems have taken this process to new heights, literally and figuratively. This section will cover the type, resolution, frequency and cost of information captured from satellites, drones, aerial technologies and in-situ sensors.

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[78]Allianz. Sustainable Solutions. [accessed October 2, 2020] https://www.allianz.com/en/sustainability/business-integration/sustainable-insurance/sustainable-solutions.html

[79]Allianz (2019) Collaborating for a Sustainable Future, Allianz Group Sustainability Report 2019, 42 [accessed December 18, 2020] https://www.allianz.com/content/dam/onemarketing/azcom/Allianz_com/sustainability/documents/Allianz_Group_Sustainability_Report_2019-web.pdf#page=43

[80]Ernst & Young. (2020) 2020 Global Insurance Outlook: The drive for transformation and growth. [accessed October 2, 2020] https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/insurance/insurance-outlook-pdfs/ey-global-insurance-outlook.pdf

[81]Day, S. (June 4, 2019) AgTech Landscape 2019: 1,600+ Startups Innovating on the Farm and in the 'Messy Middle'. Ag Funder News. [accessed October 6, 2020] https://agfundernews.com/2019-06-04-agtech-landscape-2019-1600-startups.html

Yoder Farms of Missouri

Satellite

Public domain organizations and private companies have been capturing data from satellites since the 1950s; however, in the last ten years the quality and frequency of that data has improved substantially.[82] There is some variation, but generally speaking, most satellites capture the data necessary to evaluate ecosystem conditions like plant health, presence of cover crops, tillage, or simply an up-to-date true-color image such as those available from Google Earth.

The choice between public domain or private imagery becomes relevant depending on the resolution, timing, and budget for the project.

Resolution

Public domain sources, like the European Space Agency and NASA, capture data in lower spatial resolution between 10 meters and 30 meters respectively, which is sufficient to monitor and evaluate watersheds and in-field practices like cover cropping or riparian buffers. Public domain sources, like the European Space Agency and NASA, capture data in lower spatial resolution between 10 meters and 30 meters respectively, which is sufficient to monitor and evaluate watersheds and in-field practices like cover cropping or riparian buffers (Figure 4). Private sources, such as Planet, Airbus or Maxar, collect data between 0.3 meters and 3 meters. At this resolution, smaller details such as cattle exclusion fencing, individual trees planted, or where certain parts of a field prone to gully formation could be easily identifiable.

[82]The Space Review. How space technology benefits the Earth. [accessed January 26, 2021] https://www.thespacereview.com/article/3768/1

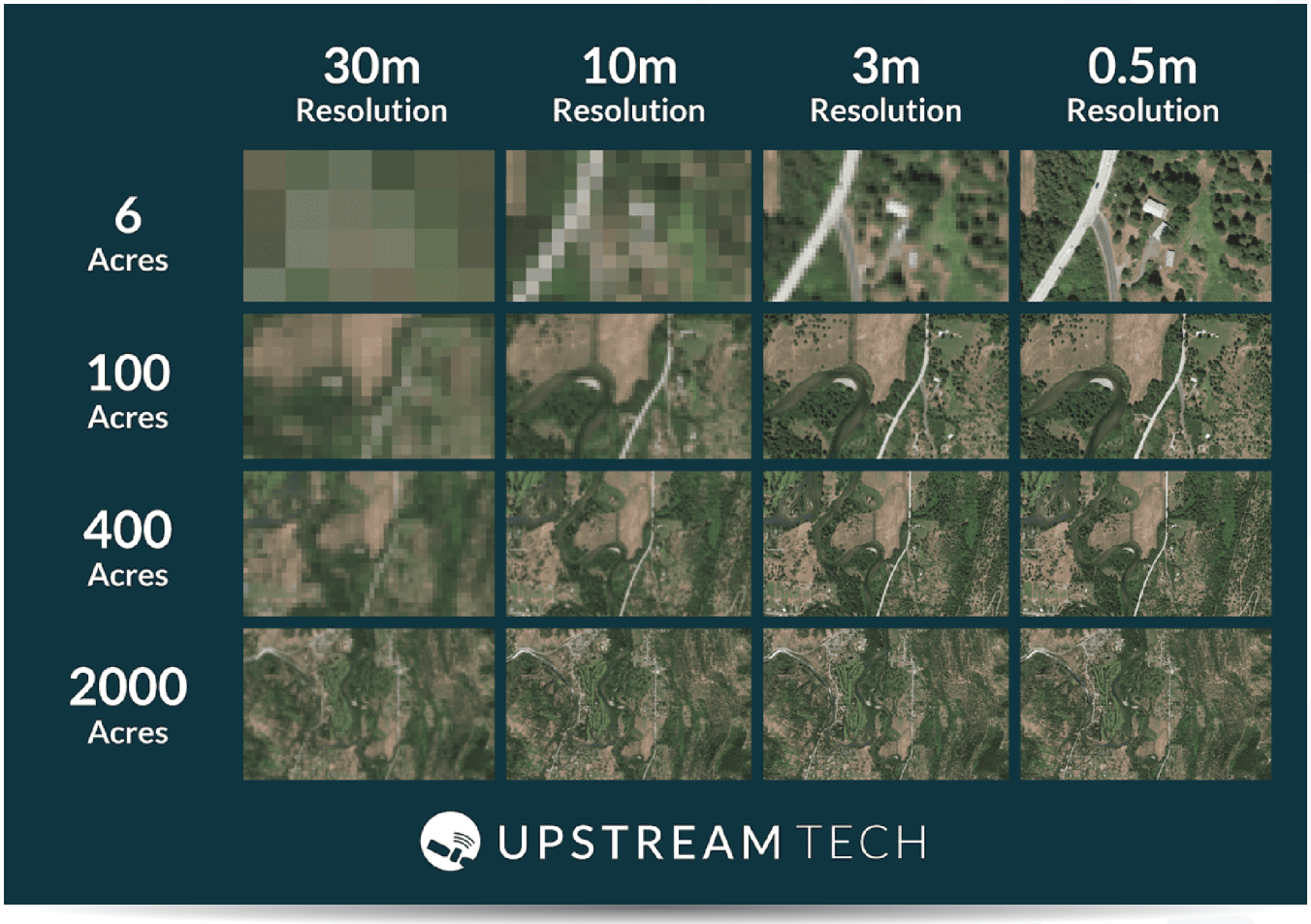

Figure 4 *- A comparison of satellite imagery resolution.*

Timing

Public domain sources have been collecting data on a weekly basis since 2000. Through historic imagery archives one can see how landscapes evolved over time, as well as consistently monitor programs into the future. Private companies started gaining traction in the mid-2010s, and only capture imagery when contracted by another entity. Though less frequent, this historic data is then available for other organizations to purchase and analyze. Private company contracts can help parties that have an interest in specific dates, such as milestones throughout project implementation or evaluation, and wish to assign a satellite to capture an image at that time.

Budget

The cost of satellite technology and its imagery is rapidly decreasing. For public domain imagery, open-source services exist today[83] where organizations can view and evaluate their regions of interest for free. For private imagery, prices range from $15 per square km for 0.3 to 1 m resolution to between $1 and $1.5 per square km for 5 to 10 m resolution.[84]

[83]Examples include Sentinel Hub Browser, Public Lab, US National Map or GIS Geography

[84]Landinfo. Buying Satellite Imagery: Pricing Information for High Resolution Satellite Imagery. [accessed October 6, 2020] http://www.landinfo.com/satellite-imagery-pricing.html

Drones

Over the past several years, agriculture has been one of the major industries to incorporate drones. It is estimated that the agriculture drone market is worth $32.4 billion.[85] Similar to satellites, drones are being used to monitor crop health, determine irrigation needs, and target fertilizer and pesticide application. The main benefit of drones is that they can be deployed at a finer scale and generate higher spatial resolution data than satellites (0.5 cm spatial resolution). Furthermore, certified pilots have the opportunity to deploy drones as frequently as necessary for projects.

The primary drawback with drones is that they must be flown within line of sight to the pilot and they take much longer to capture images over larger landscapes. For example, in mountainous or rugged terrain there is a smaller range for data capture. It can take several days to fly over a 1000-acre property. As a result, the optimal application for deploying drones is on flat terrain like agricultural fields or wetlands, and on properties that are smaller than 500-acres.

Prices for complete, ready-to-fly ag drone systems range from $1,500 to well over $25,000. The difference in cost includes the sensors dictating the type of data captured, flight control software, and analysis software to process and evaluate the data. At the low end, drones have a four spectral band sensor (green, red, red edge, and near infrared) that is necessary for true color imagery and data to evaluate vegetation vigor. The price increases when adding LiDAR, hyperspectral or radar sensors that can enhance the analysis to monitor aspects such as tillage, differentiate plant species or water application.[86]

LiDAR

Light Detection and Ranging (LiDAR) is a type of sensor that uses a pulsed laser to illuminate an area and determine distances based on the reflection of the light. This generates precise, three-dimensional images of a geography. These LiDAR data can be used to generate maps of elevation, soil type, detect soil erosion, determine land use patterns, and forecast yield. Between satellites and drones, LiDAR is the highest spatial resolution data source and gives way to many diverse applications.

The J.R. Simplot Company uses LiDAR to help farmers develop application plans for seed, fertilizer, pesticides, and water. Their approach leads to increased farm yields, improved resource efficiency, and reduced chemical use.[87] The Freshwater Trust uses LiDAR data to determine field drainage patterns and determine where irrigation systems should be modified.[88] The Chesapeake Foundation has a long history of using LiDAR for water quality management. The Foundation has used LiDAR since at least 2010 to develop maps of flooding and surface-water flow and recording changes over long time periods.[89]

LiDAR sensors can be attached to planes to capture large geographies in one flight, or drones for highly precise local data. State and federal agencies have flown LiDAR in different regions of the U.S. over the last decade, often annually or tri-annually, and made that data publicly available. Historically LiDAR was cost-prohibitive, as sensors and flights to capture data cost about $75,000, but recently the cost for LiDAR has plummeted because it is a core technology for autonomous vehicles. In July 2019, the company Luminar announced a production-ready LiDAR system which costs as little as $500.[90]

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[85]Pinguet, B. (April 22, 2020) The Role of Drone Technology in Sustainable Agriculture, PrecisionAg [accessed December 19, 2020] https://www.precisionag.com/in-field-technologies/drones-uavs/the-role-of-drone-technology-in-sustainable-agriculture/

[86]Nixon, A. (January 10, 2020) Best Drones For Agriculture 2020: The Ultimate Buyer's Guide. [accessed October 6, 2020] https://bestdroneforthejob.com/drone-buying-guides/agriculture-drone-buyers-guide/

[87]USGS (December 2016) The 3D Elevation Program—Precision Agriculture and Other Farm Practices. [accessed September 29, 2020] https://pubs.usgs.gov/fs/2016/3088/fs20163088.pdf

[88]The Freshwater Trust (December 21, 2018) SB-88 Measurement Method for Measuring and Reporting on the Diversion of Water in the Sacramento-San Joaquin Delta, 18 [accessed December 19, 2020] https://www.thefreshwatertrust.org/wp-content/uploads/2019/01/SB-88-TFT-MM-ACP-Draft-v2_0_20181220-Final.pdf

[89]USAD ARS (August 2010) Helping Save the Chesapeake Bay, Agricultural Research, 14 [accessed December 19, 2020] https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_013643.pdf

In-situ Sensors

In-situ sensors have the potential to decrease the cost and increase the frequency and accuracy of data from agricultural operations. Currently available sensors can measure air and soil moisture, pH and temperature of farm fields and waterways. Pairing these in-field sensors with Internet of Things (IoT) technology enables the data to automatically be synced to a central database or software for analysis. Such systems are rapidly decreasing in cost and are starting to be deployed broadly by farmers facilitating continuous monitoring and more responsive management.

Sensors can be utilized for environmental markets to document specific water quality metrics in real time, to set a baseline of the metric and to monitor throughout the project. This is relevant, for instance, if measurable nitrogen reduction triggers pay-outs. To that end, nitrate sensors are not currently cost effective for widespread use. Current technologies cost between $7,500 to $35,000 for a high-frequency nitrate sensor capable of measuring concentrations of >1 mg/L. However, research is underway to develop IoT in-situ nitrate sensors that cost $100.[91]

Automation

Once a framework and monitoring protocol has been established, the same or similar tasks often need to be repeated over and over again. Automation through machine learning can reduce the time, effort and human error involved in water market administration for tasks such as quantifying environmental benefits based on farm practices or streamlining processes through farm management systems.

Machine Learning

The intersection of IoT, remotely captured data, and high-performance computing has generated enormous sets of data. Machine learning has emerged as a critical tool to analyze this data by learning patterns and classifying the data which can then be turned into action by the farmer. An example of the power of machine learning is in the estimation of evapotranspiration (ET) on croplands. Monitoring and maximizing ET is important to maximize yields and is used in the design and operation of irrigation systems. Multiple studies have been conducted to estimate ET based on temperature or climate data. Accurate estimates allow farmers to provide the right amount of water to crops at the right time.[92] In September 2020, EDF, NASA, the Desert Research Institute (DRI) and Google announced plans to develop a web application called OpenET which will enable farmers to accurately track water consumption by crops using data from satellites and weather stations.[93]

Machine learning can also be used in a soil health context to estimate the temperature and moisture content of soils. Prior to machine learning applications, the soil measurement was time-consuming and expensive. Scientists have successfully combined visible and near infrared spectroscopy with machine learning to estimate soil total nitrogen, organic carbon and moisture content.[94] Machine learning has also been used to estimate the precise amount of nitrogen required by a crop.[95]

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[90]Davies, A. (July 11, 2019) This Lidar Is So Cheap It Could Make Self-Driving a Reality. Wired [accessed September 29, 2020] https://www.wired.com/story/lidar-cheap-make-self-driving-reality/

[91]Alahi, M.E.E., Xie, L., Mukhopadhyay, S., Burkitt, L., 2017. A temperature compensated smart nitrate-sensor for agricultural industry. IEEE Trans. Industr. Electron. 64 (9), 7333–7341. https://doi.org/10.1109/TIE.2017.2696508.

[92]Liakos, K.G., Busato, P. Moshou, D., Pearson, S., Bochtis, D. (2018) Machine Learning in Agriculture: A Review, Sensors, 18 (2674) https://www.mdpi.com/1424-8220/18/8/2674

[93]EDF (September 15, 2020) EDF, NASA, DRI and Google Announce Web Application to Transform Water Management in the Western United States, [accessed September 30, 2020] https://www.edf.org/media/edf-nasa-dri-and-google-announce-web-application-transform-water-management-western-united

[94]Morellos, A., Pantazi, X.-E., Moshou, D., Alexandridis, T., Whetton, R., Tziotzios, G., Wiebensohn, J., Bill, R., Mouazen, A.M. (2016) Machine learning based prediction of soil total nitrogen, organic carbon and moisture content by using VIS-NIR spectroscopy, Biosyst. Eng., 104–116. https://doi.org/10.1016/j.biosystemseng.2016.04.018

[95]Chlingaryana, A., Sukkarieha, S., Whelanb, B. (2018) Machine learning approaches for crop yield prediction and nitrogen status estimation in precision agriculture: A review, Computers and Electronics in Agriculture, 151, 61-69. https://doi.org/10.1016/j.compag.2018.05.012

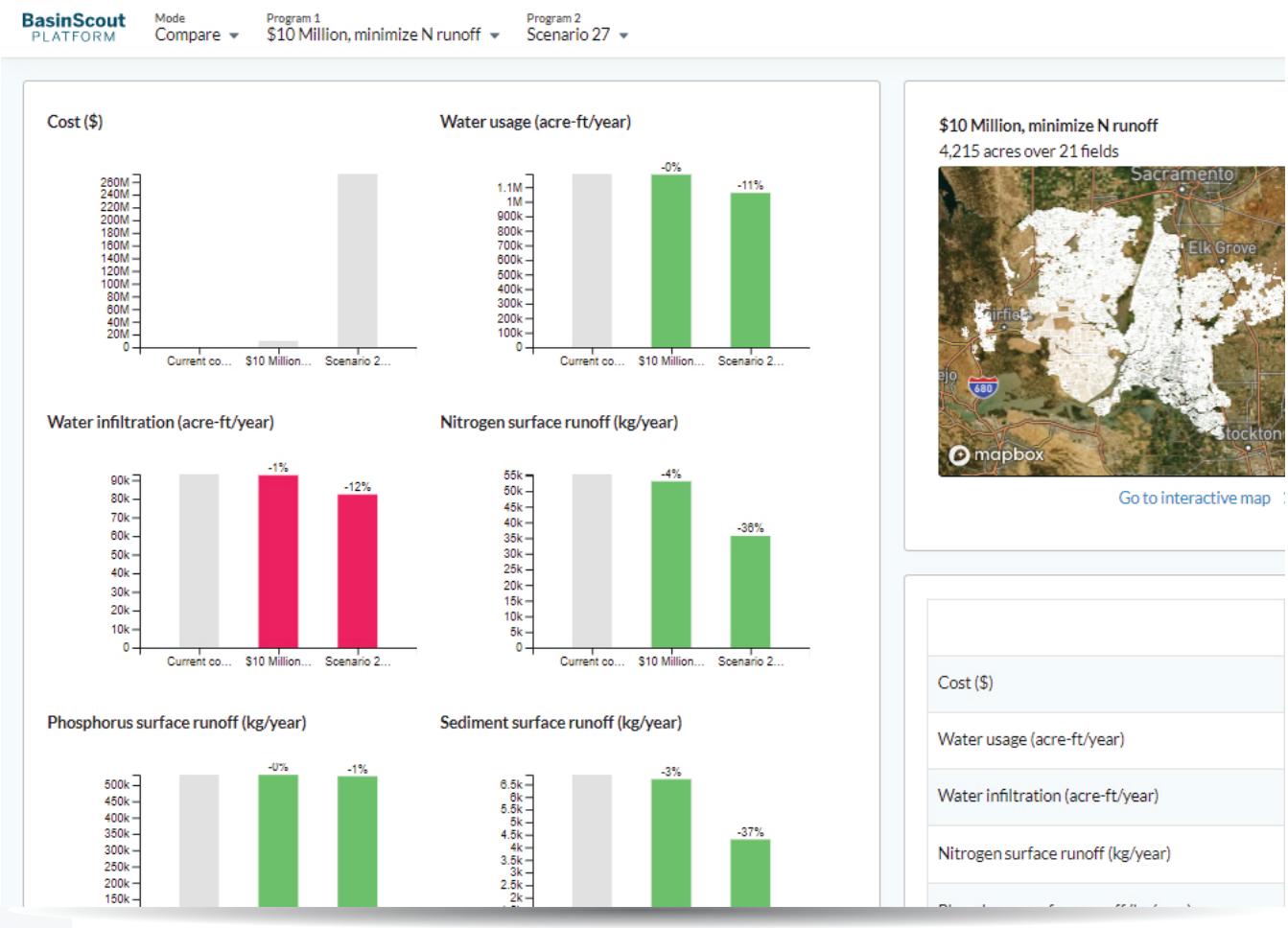

Figure 5 *- Interface of the BasinScout tool to evaluate scenarios of costs and benefits for minimizing nitrogen runoff.*

However, a fundamental challenge remains with machine learning: ground truth or training data[96] is necessary to develop, validate and calibrate the models. A plethora of training data exists to classify a forest or water or farm field that a machine learning model could then automate in new geographies. However, there is much less training data available that labels details such as specific crop types or management practices occurring in a region. Furthermore, depending on the classification the machine learning model may not translate well to a new geography. For example, the types of crops or rate of evapotranspiration for fields that were labeled in California may not have the same types in Iowa or may look different through satellite imagery in that geography.

Quantifying Benefits

USDA plays a central role in collecting data and supporting quantification tools critical to environmental markets and supply chain sustainability initiatives. These models are used to quantify costs and benefits from program implementation and input data can be derived from GIS data, remote sensing or manual entry. GIS mapping tools USDA provides, like Web Soil Survey and SSURGO shapefiles, are critical foundations of multiple quantification standards. The robust USDA data and tools facilitate greater automation in several areas of environmental markets, particularly for quantification, development of emission factors and in calibrating and validating models.

Several organizations are developing open datasets and customized tools that can be used in environmental markets. Models developed by USDA provide a scientifically rigorous foundation for subsequent organizations

[96]The process of manually assigning labels to data, for example verifying that at a specific time, on a particular field, a certain crop or management practice had occurred.

to build upon. An example is OpenTEAM which "offers field-level carbon measurement, digital management records, remote sensing, predictive analytics, and input and economic management decision support in a connected platform that reduces the need for farmer data entry while improving access to a wide array of tools." Robust and reliable datasets are often critical for building standards for environmental markets (in particular any standardized approaches to additionality, as well as eligibility screens, and baseline setting requirements). The Freshwater Trust and Upstream Tech have developed a proprietary platform, BasinScout, that "uses satellite data and machine learning to allow users to rapidly assess field-level agricultural management practices and their impact on water resources" (Figure 5). This automates many of the USDA tools and allows users to customize scenarios in their watersheds of interest to yield specific outcomes. This is primarily being deployed in California for groundwater management as well as nitrogen and phosphorus runoff reductions.

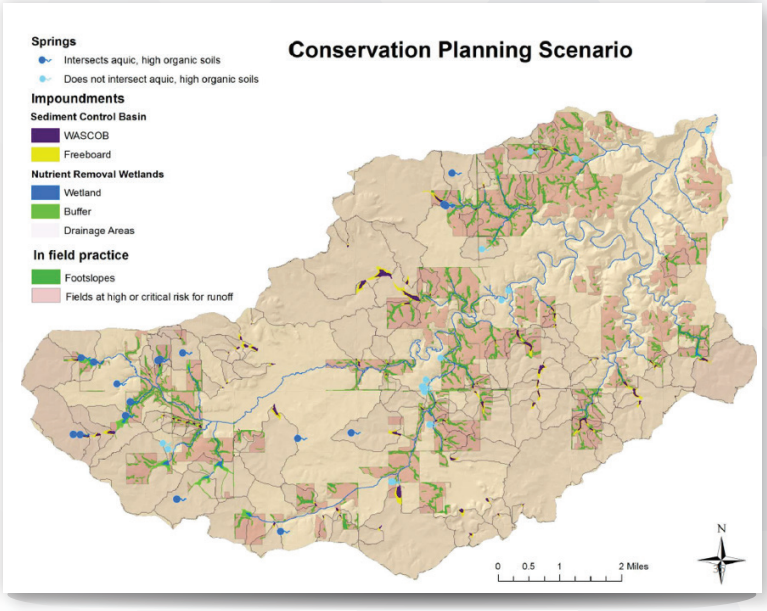

Figure 6 *- An example of an Agricultural Conservation Planning Framework (ACPF) output map leveraging LiDAR data to help local farm communities better address soil and water conservation needs.*

Making it easier to use biogeochemical models will allow farmers to demonstrate improvements from the implementation of agricultural practices, which is critical to the success of conservation finance. Looking ahead, greater availability of data and improved computing power will facilitate the development of emission factors, and broader applicability and more efficient performance of biogeochemical models.

Farm Management Systems

For farmers and portfolio managers, several new technologies exist to greatly increase the scale and efficiency of management from data analysis such as yields and soil type to the environmental impacts of farms. These tools can be used to automate or streamline various environmental market requirements, including meeting operational data requirements, and demonstrating eligibility. They also can greatly simplify the demonstration of compliance with requirements that historically used manual maps, manual data collection, or collection of map data from disparate sources (Figure 6). The increased availability and ease of use of such tools is likely to drive down the cost to develop projects for environmental markets.

Almost 50 companies are developing systems to capture, integrate and analyze data from farm operations.[97] These companies include Agrivi, The Climate Corporation, Farm^{IQ}, Farm Logic, Farmers Edge, Conservis, SWIIM, Sustainable Environmental Consultants, and Granular. FMS companies are increasingly including sustainability metrics, such as water quality, in their products. Field to Market currently has seven Qualified Data Management Partners that have integrated the Field to Market sustainability metrics into their tools to support farmers and supply chain companies in measuring and reporting on environmental outcomes. In addition, companies like Land O'Lakes and Nutrien are specifically marketing their roles in sustainability measurement and reporting.

Table 3 contains a list of example FMS and, where available, the estimated cost for farmers to use them.[98]

[97]Day, S. Op. Cit.

[98]Pricing data in Table 1 was obtained from the websites of each of the companies listed.

Table 3 - Example Farm Management System (FMS) companies and the cost for associated precision agriculture tool use.

Company	Cost for farmers
Agrivi	$19/month/user
Climate Corp FieldView	$1,300
Farm Logic	$1,999
Farm Logs	prices range from free to $1,428 plus add-ons which can cost as much as $288 each
Farmers Edge	prices range from $1.50 to $6.00/acre
Granular	priced as an annual subscription based on crop mix and farm size

Reimagining Siting, Screening and Monitoring Water Quality Programs

New technology makes it possible for farm operators and managers, agricultural associations, and conservation and restoration organizations to reimagine how they can more efficiently site, screen, and monitor water quality programs. An important advancement will be making this technology and data accessible to stakeholders who can benefit from its use but who lack specialized technology training in GIS, remote sensing or machine learning. Deploying the appropriate technology will also depend on the level of decision-making. Remote monitoring and in-situ sensors enable consistent and real-time monitoring to evaluate if practices have changed or are yielding expected outcomes. These tools can automatically detect where cover crops have been planted and record the water quality changes downstream. Applying machine learning to data collected from in-situ sensors, drones, satellites, and farm management systems allows the creation of artificial intelligence systems, which will be able to provide detailed recommendations and insights to guide management decisions that minimize the environmental impacts of agricultural practices while maximizing yield.

Precision Agriculture

Precision agriculture technologies allow farm operators to fine-tune their production practices and provide valuable information for water quality markets. Historically, there was uniform application of fertilizers and water, making it hard to determine precise sources of nitrogen or phosphorus runoff. Variable rate technologies (VRT) allow farmers to specify how much fertilizer they have applied, and where, and to target water application to regions of the field that need it. According to USDA ERS, "The capital cost of farm implements equipped with VRT capabilities is fairly high, especially when specialized machinery with integrated sprayer or seeding equipment must be scrapped." [99] However, these capital costs provide benefits beyond environmental markets – adopters have reduced input costs between $22 (for yield mapping) to $2 an acre.[100] Going forward, it will be important to environmental markets for the precision agriculture software to integrate with other Farm Management Systems to streamline use.

[99] Ibid.

[100] Ibid.

Data Privacy

Concern about privacy in data collection is an issue that could constrain the utility of technology to farmers. Some of the technologies described here are capable of collecting data about field-level practices without a farmer's express consent. Government agencies are required to maintain privacy of farmer data and those requirements may limit the ability of the USDA to collate, manage and share data. On the other hand, data captured remotely and automatically analyzed by private or nonprofit organizations do not have the same privacy restrictions. They can link parcel data to identify landowners who are implementing conservation practices to inform where programs, outreach, or education within a watershed should be targeted. Some ways to address these concerns include presenting information at an aggregate level so specific farmer data can be obscured; adhering to rigorous data encryption such that individuals' information cannot be found or breached; and working with trusted partners or USDA extension agents who have context in the region and whose mission is to advocate for farmers rather than sell them something.

Photo by Patrick O'Connor

Examples of Public-Private Conservation Finance

In 2016, Ecosystem Marketplace conducted a survey of 128 banks, companies, fund managers, family offices, foundations, and non-governmental organizations directly investing in conservation and expecting a financial return. They found that private capital investment in conservation increased 62 percent between 2004 and 2015 to $8.2 billion. Unfortunately, there were few financial commitments identified for water credit trading, water rights trading, or stormwater management programs.[101]

This section presents two case studies where public funding is driving successful conservation finance for water quality: anaerobic digesters and a payments-for-outcomes compliance strategy being implemented by a municipality in Wisconsin.

California Anaerobic Digesters

California is the largest dairy producing state in the country. The management of manure from the state's dairies is a significant challenge for the state, specifically related to its air and water quality. In 2001, the California legislature passed Senate Bill 5X, which allocated $10 million for dairy biogas projects. By August 2006, ten digester projects had been funded.[102] Unfortunately, by 2012, there were only nine digesters in operation. While seven new digesters had been built, ten had been shut down.[103] Three challenges existed with the development of these projects. The first was, with only 17 digesters built by 2012, there was not enough experience building digesters to achieve economies of scale. Even today, when they have achieved economies of scale, the cost to build a digester in California ranges from $3.1 to almost $17 million.[104]

The second challenge was developing the business model and meeting regulatory requirements. For example, Maas Energy Works, which operates 12 digesters serving 20 farms, encountered significant challenges in the permitting, operating and financing of digesters.[105] To help work through the startup and regulatory challenges, the California legislature, beginning in 2015, provided annual funding for the development of projects – starting at $11.09 million in 2015 and increasing to $72.41 million in 2018. This funding was critical for digester companies to work through the operational challenges and to work with regulators on the air and water permitting processes. The state's funding resulted in a significant outcome. By the end of 2018, 108 digesters had been funded. Due to the dramatic increase in digester construction and availability of private capital to finance it, the legislature reduced funding to $69.14 million in 2019 and planned to reduce it to approximately $25 million in 2020.[106]

The final challenge was the need for a stable revenue stream for the projects. Initially, digester projects contracted with gas utilities for the sale of renewable natural gas. Unfortunately, the price of natural gas has remained low and natural gas buyers are not interested in long-term contracts. Developers then turned to electricity generation as a revenue stream. Biogas-generated electricity meets the Renewable Portfolio Standard requirements in California and electricity companies are willing to sign ten-year or longer contracts which provide price certainty for these projects. Unfortunately, dairy biogas does not generate large volumes of electricity. To meet their Renewable Portfolio Standard procurement requirements, utilities turned to other projects, such as utility-scale solar projects, which could generate more electricity at lower prices.

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[101]Hamrick, K. (December 2016) State of Private Investment in Conservation 2016: A Landscape Assessment of an Emerging Market, vii, 26 [accessed December 19, 2020] https://www.forest-trends.org/publications/state-of-private-investment-in-conservation-2016/

[102]California Energy Commission (February 2009) Dairy Methane Digester System Program Evaluation Report, PIER Consultant Report, CEC-500-2009-009

[103]Lee, H., Sumner, D. (October – December 2018). Dependence on policy revenue poses risks for investments in dairy digesters. California Agriculture 72 (4), 226-235.

[104]California Department of Food and Agriculture (CDFA). (2020) Dairy Digester Research and Development Program: Report of Funded Projects (2015 – 2019). [accessed September 29, 2020] https://www.cdfa.ca.gov/oefi/ddrdp/docs/DDRDP_Report_April2020.pdf

[105]Simet, A., Fletcher, K. (January 27, 2017) Biogas Advances in the US, Biomass Magazine [accessed December 21, 2020] http://www.biomassmagazine.com/articles/14135/biogas-advances-in-the-us

[106]CDFA (2020) Op. Cit.

Coordinating performance-based conservation in the Village of Grafton, Wisconsin

To replace the renewable energy funding that became less available for digester projects, dairies turned to renewable fuel markets for environmental commodity revenue. The opportunity they identified was injecting biomethane into natural gas pipelines and selling the biogas into renewable fuel markets, specifically California's Low Carbon Fuel Standard (LCFS) and the EPA's Renewable Fuel Standard (RFS). While multi-year contracts are uncommon in these programs, there is significant and increasing demand for renewable fuels. Prices for the renewable fuel credits generated by these projects have increased over time, and the Institute of Transportation Studies at the University of California at Davis estimates that "gasoline and diesel will generate between 320 and 410 million metric tons (MMT) of deficits" between 2019 and 2030.[107] Finally, digesters can generate a large number of LCFS credits because the carbon intensity of the fuel is as low as -400 gCO_2e/MJ, lower than any other alternative transportation fuel.[108] This low carbon intensity enables farms to generate more than $2 million a year through a combination of fuel sales, LCFS credits, and RINs (RFS credits).[109]

The multi-year financial support from the state allowed digester developers to work through the permitting and operational challenges to their business model. The renewable fuels markets provided digesters with a stable and long-term revenue stream which enabled digesters to provide an attractive return on investment to banks and other investors.

Municipal-Agricultural Partnerships

The State of Wisconsin has developed a number of pathways for municipalities and sewer and storm water utilities to comply with their water quality discharge permits. The Wisconsin Department of Natural Resources (WiDNR) allows point-source phosphorus dischargers to utilize Adaptive Management or Nutrient Trading options to obtain Wisconsin Pollutant Discharge Elimination System (WPDES) permit compliance as an alternative to expensive utility infrastructure upgrade requirements. To date, 45 permittees are using these options, often targeting streambank stabilization or retiring one or two farm fields from production. Few incentivize conservation practices on annual cropland, due to complexity in documenting phosphorus reductions dispersed across multiple farms.

With a 2018 Fund for Lake Michigan grant, Sand County Foundation piloted a novel performance-based conservation approach with the Village of Grafton, Wisconsin wastewater utility department. The project focused on paying farmers for outcomes, bridging urban and rural communities,

[107]Bushnell, J. et. al. 2020. Uncertainty, Innovation, and Infrastructure Credits: Outlook for the Low Carbon Fuel Standard Through 2030. UC Office of the President, Institute of Transportation Studies reports. 24.

[108]CARB. LCFS Pathway Certified Carbon Intensities [accessed September 29, 2020] https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities.

[109]Lee, Op. Cit.

and sharing outcomes with local and state agency representatives. The Village of Grafton pursued a WiDNR Adaptive Management Plan to meet its Wastewater Treatment Plant Water Quality Permit needs. Under the pilot program, the Village adopted a performance-based approach (as opposed to a pay-for-practice approach) to meet municipal WPDES permit compliance needs by facilitating cash incentive contracts to farmers implementing practices for nutrient and sediment reduction. The farmer incentive approach pays farmers according to the modeled reduction in pounds of phosphorus lost through surface runoff resulting from the implementation of new conservation practices on their fields.

The project will expand each year as farmers implement additional conservation practices, with a goal of achieving a reduction of at least 62,000 pounds of phosphorus to the Milwaukee River system, and ultimately Lake Michigan, over ten years. There is also a broader goal to empower other regulated facilities within the Lake Michigan basin to apply an Adaptive Management approach for permit compliance. This program is an example of how municipal rate payers can finance on-farm conservation practice outcomes to achieve compliance and benefit overall water quality.

Roles of Intermediaries Aggregators, Bankers, Brokers

In successful environmental markets, third parties, such as entrepreneurs, conservation or agriculture commodity associations, and land trusts, have served as aggregators, bankers, or brokers of credits by serving as an intermediary between farmers or ranchers and market buyers. These third parties bring together multiple nonpoint sources who benefit from the experience of the third party with the markets and credit generation process. The third parties also reduce the transaction cost of developing the credits or participating in agency programs. In addition to their legal and technical expertise, these brokers ensure legitimacy in the market with respect to the certification, monitoring, and modeling required for a well-functioning environmental market.[110]

Brokers

Brokers bring together buyers and sellers in environmental markets. Brokers match buyers and sellers based on pollutant type, amount, and timing. The broker acts primarily as the matchmaker and typically does not take possession of the credits generated by the seller. Most brokers are independent parties, but some trading markets employ brokers to facilitate transactions. For example, in 2016, the Great Lakes Commission and NRCS brought together the Green Bay Metropolitan Sewerage District and Bob Van De Loo and Sons, Inc. of Kaukauna, Wisconsin for a phosphorus water quality trade.[111]

Aggregators

Aggregators bring together multiple parties into either a single transaction or single project. They differ from brokers because they typically oversee the generation of the credits and may receive a percentage of the credits as their payment. Aggregators enter into two separate contracts. The first is with the farmer who generate the credits and second is with the entities who purchase the credits to meet their compliance or voluntary obligations. By bringing together multiple farmers into a single project or transaction, aggregators can dramatically reduce the transaction costs of projects. This includes centralizing the collection of data, overseeing a consolidated verification, and developing a reporting and monitoring program for the project. Examples of aggregators include state Farm Bureaus and soil and water conservation districts.

Central Exchanges

Central exchanges act as a hub between buyers and sellers. Exchanges purchase environmental credits from multiple farmers and then sell them to multiple buyers. Buyers and sellers negotiate the transaction with the central exchange. When sellers agree to the terms on the sale of their credits, they do not know who will purchase them. Typically, there will be only one

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[110]Conservation Technology Information Center (July 2006) Getting Paid for Stewardship: An Agricultural Community Water Quality Trading Guide, Element 5: Finding a trading partner, 27-30 [accessed September 30, 2020] https://epa.ohio.gov/portals/35/WQ_trading/wqt%20getting%20paid%20for%20stewardship%20ag%20guide.pdf

[111]Gough, T. (October 15, 2016) GLC brokers Fox River water quality trade. Wisconsin State Farmer. [Accessed September 30, 2020] https://www.wisfarmer.com/story/news/2016/10/19/glc-brokers-fox-river-water-quality-trade/92398154/

central exchange in a trading program that oversees all the trades within the program. Central exchanges develop the entire ecosystem of a program including the standards, eligibility requirements and contracts. They often charge a fee to have an account or to generate or trade credits. An example of a central exchange is EPRI for the Ohio River Basin Trading Project.

Factors that Encourage Conservation Finance

When investing in agriculture practice adoption programs and markets, there are at least three criteria investors consider: 1) the maturity of the technology or practice being implemented, 2) whether the policy signal will support the market for the long-term, and 3) whether there is a strong price signal.

Mature Technology or Accepted Practice

The first consideration for conservation investing is whether the practice or technology being financed has a proven environmental benefit. The less scientific support or the newer the technology, the higher the risk. Practices without the support of peer reviewed research can be criticized by environmental stakeholders and may not be supported by governments for use in regulated markets. They may also not yield benefits in all crops or geographies or they may be variable over time, reducing the positive environmental impact.

As discussed in the *Technology Drivers of Conservation Finance* section, technology has transformed markets and farmers, especially those who are younger, are increasing their use of new technology. Technology can speed the adoption of agricultural conservation practices by reducing transaction costs, bringing buyers and sellers together, targeting locations with largest opportunity for water quality improvements, and much more. However, early stage technology may have challenges raising sufficient capital to pilot, revise and scale their product. They may not be adequately tested in agricultural systems which are exposed to dirt, high/low temperature swings, and significant moisture.

Regulatory Certainty

Most environmental markets are driven or created in response to regulations. Clear direction from government agencies is critical to the success of these markets. A non-agriculture related example of the impact to changes in market signals is the frequent expiration of the renewable energy Production Tax Credit. In years following the expiration of the tax credit, renewable energy development dropped between 76 and 93 percent.[112] Lack of a clear and long-term policy signals increased risk. Part of the certainty of water quality markets is driven by the demand. For example, one of the reasons why the Michigan water quality program was rescinded was because the companies discharging to the Kalamazoo River went out of business or moved out of state.[113] Building programs where there is stable demand, such as watersheds that include urban and rural dischargers, is critical.

Strong Price Signal

Even markets with regulatory certainty require an adequate price signal to drive investment. Between 2015 and 2018, there was a 475 percent increase in the consumption of renewable natural gas in California.[114] This increase in demand came as a result of the strong price signal from the LCFS. Not only is there a stable and increasing price for LCFS credits, dairy digesters can generate large number of credits because their fuel has a very low carbon intensity.

Designing markets that have a strong and increasing price has, unfortunately, proved challenging for water quality markets. Water markets are not as fungible as carbon markets because the demand is limited to the watershed in which the reductions occur. Identifying markets where there is a strong demand from a regulated entity, such as an aging wastewater treatment plant that is required to improve the quality of its effluent, is critical to the success of water quality markets.

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[112]Clemmer, S. (March 29, 2017) Testimony to the Committee on Energy and Commerce, U.S. House of Representatives, Hearing on "Federal Energy Related Tax Policy and its Effects on Markets, Prices and Consumers". [accessed October 7, 2020] https://docs.house.gov/meetings/IF/IF03/20170329/105798/HHRG-115-IF03-Wstate-ClemmerS-20170329.pdf

[113]Zimmerman, M.D. (December 14, 2014) Water Quality Trading: A Program Whose Time Has Come (Again). Varnum Attorneys at Law [accessed October 7, 2020] https://www.varnumlaw.com/newsroom-publications-water-quality-trading-a-program-whose-time-has-come-again

[114]Fehrenbacher, K. (August 12, 2020) Sustainable fleets are at an inflection point. GreenBiz. [accessed October 7, 2020] https://www.greenbiz.com/article/sustainable-fleets-are-inflection-point

Financing at the Tipping Point

Conservation finance has dramatically increased to address the challenges encountered by the agricultural sector. As highlighted in the *Examples of Public-Private Conservation Finance* section, private investment in natural capital projects reached $8.2 billion in 2015, a 4,000 percent increase since 2003.[115] Based on this review of water quality financing, three mechanisms are poised to scale rapidly in the next several years. The first two are water investment funds and new insurance products. A third, but more indirect, mechanism is the leveraging of GHG goals and markets for fertilizer optimization.

Water Investment Funds

Governments around the world are dramatically increasing funding for water infrastructure. In some countries, this provides water to people who have not traditionally had access to clean water. In others, governments are focused on the critical need to repair infrastructure that is a hundred or more years old. This government investment has attracted companies looking to take advantage of government spending. Institutional investors also recognize this potential and are developing water focused funds to invest in those companies. Even the mainstream media has taken notice of the potential. On December 16, 2020, *USA Today* ran an article on "7 Ways to Invest In Water" featuring seven stocks and exchange traded funds.[116] An example of one of these funds is the Invesco S&P Global Water Index ETF, which is composed of 50 companies including utilities, infrastructure, equipment, instruments and materials companies providing water to customers. More than half of the companies in this global fund operate in the U.S. While these funds are primarily focused on water quantity, rather than water quality, the emergence and growth of investment funds has the potential to bring significant capital to conservation. At this time there are only a few funds focused on water quality projects. However, there are some companies, in particular Allianz Global Investors, that are evaluating water quality markets. Because Allianz is also developing sustainable insurance products, they are poised to become a market leader in this space. Companies that can build on the success of forestry investment funds which can yield 10 to 15 percent in returns over ten to 15 years will provide a very compelling option for investors.

Sustainable Insurance

The increasing losses experienced by insurance companies over the past decade pose an existential threat to their business. Insurance companies are starting to identify infrastructure investment opportunities that can reduce risks of adverse weather events. For example, there are more than 30,000 miles of levees in need of repair which is expected to cost an estimated $80 billion over the next ten years.[117] Designing insurance products that can reduce flooding impacts to croplands and marketing them to farmers represents a tremendous potential to reduce both risks and costs. Companies, such as Allianz, are developing conservation related insurance products.

GHG Goals and Markets

There has been a four-fold increase in the number of Fortune 500 companies who have made public climate change commitments since 2015. Many of these goals are to become carbon neutral in the next ten to 20 years.[118] In order for these companies to become carbon neutral, they will need to drive GHG reductions in the agricultural sector. Since agricultural soil management accounts for 78 percent of all nitrous oxide emissions in the U.S., initiatives to reduce nitrous oxide emissions are expected to increase in the future. The opportunities to reduce nitrous oxide include increasing the precision in fertilizer application, using nitrification inhibitors, planting cover crops, and reducing tillage. All of these practices not only reduce nitrous oxide emissions, they also reduce nitrate runoff. Identifying ways to partner with and leverage climate change programs that target the reduction in nitrous oxide emissions is an opportunity to strategically invest in conservation outcomes.

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Photo by Angela Guentzel

Advancing Innovation: Next Steps

Farmers are getting financially squeezed from multiple angles. Commodity prices are at an all-time low,[119] debt is near record highs, and downstream communities are pointing-fingers at agricultural land for polluting their water. Innovative approaches to conservation financing can provide a scalable opportunity to address these challenges through agricultural practices that improve water quality, while providing diversified income to farmers and ranchers.

Several conservation funding and finance approaches for water quality improvements have developed in recent years, including:

- public funding to pay farmers for compliance outcomes and to overcome early hurdles in developing new water quality programs.
- voluntary pledges by corporations and nonprofits.
- raising tax revenues for conservation and applying tax incentives to scale up water quality outcomes.
- creative structures such as environmental impact bonds and revolving loan funds.

New opportunities that hold the greatest near-term potential for scaling up conservation finance for water quality include:

- expansion of water quality focused investment funds that can increase returns by focusing on companies that generate conservation practices on farms.
- reduction in premium costs for insurance products that increase resiliency and decrease risks for both farmers and downstream communities.
- linking of water quality projects to corporate GHG reduction goals. Improving fertilizer use efficiency reduces GHG emissions while improving water quality.
- advancements in conservation technology, especially when that technology can help investors measure outcomes.

Financing the implementation of conservation is not a one-sized-fits-all prescription. A combination of these approaches integrated regionally at the right time and engaging the appropriate collaborators can help solve the nation's water quality crisis one watershed at a time, while supporting a financially viable agricultural production system.

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