AGree

Transforming
Food & Ag Policy

Collaborative Management of Agricultural Landscapes: Achieving Measurable Conservation Improvements

Workshop Report

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Disclaimer

This paper is intended to catalyze discussion about policy and action strategies to address critical challenges in the food and agriculture system. It is intended to stimulate the development of ideas as input into AGree deliberations on these issues and does not represent consensus views of AGree.

Foreword

The ability of agriculture to maintain and improve productivity, provide ecosystem services, and return profits to producers depends on building healthy soils, managing nutrients wisely, improving water quality and quantity, and supporting biodiversity in agricultural ecosystems. Not surprisingly, many of the most promising examples of how to achieve these multiple outcomes simultaneously are collaborative efforts among diverse stakeholders to address outcomes at the watershed or landscape scale.

AGree convened leaders of a sampling of best-in-class watershed projects from across the US for a day-long workshop in Washington, D.C. on March 21, 2013. Farmers, ranchers, and conservation professionals who lead successful watershed collaborations, along with members of AGree's Workgroup on Production and Environmental Outcomes, discussed what they think are the most significant factors driving/catalyzing the emergence of collaborative watershed and landscape management; the most important enabling conditions to the successful execution of such initiatives; and, the obstacles to achieving intended watershed objectives. At the end of the workshop, participants identified potential policy and action strategies to advance the emergence of collaborative watershed and landscape management. Discussion was informed by four panels of presentations as well as project descriptions submitted and circulated in advance that addressed a set of questions about objectives, origins, engagement strategies, measurable accomplishments, obstacles, and lessons learned.

This report includes a thematic summary of the discussion, abstracts of the presentations, and the project descriptions. It is intended to convey key insights gained, share information gathered, and catalyze discussion about policy and action strategies to advance collaborative management of agricultural landscapes for both high productivity and improved environmental outcomes.

Over the course of 2013, AGree will continue to convene stakeholders, consult with experts, and deliberate in order to develop goals for conserving and enhancing soil, water, and habitat in agricultural landscapes in the United States, along with approaches to achieve those goals that integrate public policy, government programs, private sector investments and supply chain initiatives, and civil society action. With respect to public policy, AGree is seeking to find a productive middle ground between the extremes of rigid command-and-control regulation on the one hand and ad-hoc voluntary conservation without clear goals and accountability on the other. AGree welcomes reactions to this report and the implications for policy and action identified herein.

Deb Atwood
Executive Director

Contents

About AGree

AGree seeks to drive positive change in the food and agriculture system by connecting and challenging leaders from diverse communities to catalyze action and elevate food and agriculture as a national priority.

Through its work, AGree will support policy innovation that addresses four critical challenges in a comprehensive and integrated way to overcome the barriers that have traditionally inhibited transformative change. AGree anticipates constructive roles for the private sector and civil society as well as for policymakers. Increasing agricultural productivity by conserving and enhancing soil, water, and habitat is among the priority strategies AGree has identified.

Priority Strategy: Increase Agricultural Productivity by Conserving and Enhancing Soil, Water, and Habitat

Farmers and ranchers across the U.S. recognize that healthy soils and watersheds are critical to the productivity and profitability of agricultural systems, as well as to rural communities and wildlife. Innovative producers are demonstrating the potential of a diversity of high-performance agricultural ecosystems to produce food, return profits, and conserve and enhance natural resources. Working with partners, they also are pioneering and refining solutions that cut across farm boundaries to address environmental challenges across the landscape. Yet, in too many areas, despite these efforts, loss of nutrients to air and water, depletion of organic matter, mining of groundwater, and production on sensitive lands threaten to undermine the natural systems on which agricultural productivity, communities, and wildlife all depend over the long term.

A growing population, increased demand for agriculturally-based fuel and other products, changing climate, increasing water scarcity in many areas, and loss of agriculturally productive lands to development will only increase pressure on natural resources in coming decades.[2] In order to secure future agricultural productivity, the nation needs both to conserve and enhance soil, water supplies, and other natural resources and to adapt to changing conditions. Addressing these challenges at home also will contribute to agricultural development and resource conservation abroad through knowledge and technology transfer.

Achieving Transformative Change over the Long Term

AGree believes that the ability of agriculture to maintain and improve productivity, provide ecosystem services, and return profits to producers depends on building healthy soils, managing nutrients wisely, improving water quality and quantity, and supporting biodiversity in agricultural ecosystems.

AGree is developing a framework and specific recommendations to achieve these results through actions, policies, programs, and investments by government, the food and agriculture supply chain, and civil society. These recommendations will take an integrated approach to production, risk management, conservation, and environmental outcomes. Key components include:

- Developing an integrated national agricultural policy that recognizes the value of and provides comparable opportunities and benefits to all sectors of U.S. agriculture.
- Moving away from "one size fits all" approaches focused on individual operations to collaborative and adaptive management of natural resources on multiple scales, including watersheds across the landscape.
- Establishing goals tailored to each growing region to focus and mobilize action and investing federal and other resources in capacity and infrastructure to assess progress over time.
- Providing support and incentives to ensure all producers adopt basic soil and water conservation practices to address natural resource concerns in their areas.
- Using best available science to better understand and reduce adverse human and environmental health and safety impacts of agricultural inputs and practices.
- Moving towards a "whole farm approach" in which productivity, environmental, and social concerns are addressed in a holistic and integrated manner.
- Investing in research and development to increase resilience and adaptive capacity of agricultural systems to increasing weather variability and a changing climate.

- Focusing attention and resources on soil health and the benefits it provides for productivity, resilience, land value, and water quality.
- Scaling up successful models of collaborative efforts to reduce release of nutrients into surface and groundwater and to improve water management to address both flooding and scarcity, including groundwater depletion.
- Leveraging markets to drive alignment of productivity and environmental outcomes.
- Considering the effects of U.S. agricultural and environmental policy on vulnerable import-dependent populations and sensitive ecosystems abroad.
- Strengthening and focusing agricultural research, extension, and education on a diversity of high-performance agricultural ecosystems.

Thematic Summary and Potential Implications for Policy and Action

The "key implications for policy and action" included below are ideas emerging through AGree's broader deliberations on policy and action around management of agricultural landscapes. These ideas were not necessarily discussed at the workshop but are included here to stimulate discussion and reaction among stakeholders and policymakers.

Catalysts and Drivers

As most conservation policies and programs are focused on individual ownerships and operations, the emergence of efforts to collaboratively manage agricultural landscapes for environmental outcomes across ownerships and jurisdictions usually requires some kind of catalyzing event. Such events can include new opportunities for funding, application of regulations, scientific findings that demonstrate a problem that needs to be addressed or an effective solution that requires application at landscape scale. For example:

- Targeting of government or NGO program funds to address specific landscape-scale problems can catalyze conservation efforts by focusing both human and financial resources and creating new awareness among and opportunities for producers/landowners.
- The Endangered Species Act and the Clean Water Act are significant catalysts, including through listing of species; designation of waterways as impaired; and, in some states (e.g., Ohio), designation of watersheds as "stressed."
- Scientific findings that demonstrate that a new kind or scale of action is needed to achieve clean water, clean air, or other standards in agricultural landscapes can catalyze activities to develop new approaches to landscape management that provide environmental quality while supporting productive and profitable land use. For example, increasing recognition that in many large watersheds in which there is considerable agricultural production (e.g., Mississippi River Basin, Chesapeake Bay watershed, etc.), off-field practices, in addition to in-field and edge-of-field practices, will be required to address water quality concerns[1] may drive voluntary efforts to find least-cost approaches that are well-suited for productive agricultural landscapes and/or to forestall the imposition of regulation.

Though all of these factors may play significant roles, it seems that in most cases an external "igniter" is necessary to stimulate producer/landowner-led watershed efforts. Successful watershed collaborations have been ignited, for example, by EPA listing of waterways as impaired; establishment of Total Maximum Daily Loads for waterways; and, likelihood of a species being listed as threatened or endangered without action to prevent it.

Whatever the catalyst for action might be, effective local leadership and trusted relationships with the producer/landowner community is necessary for a successful response. Local leaders must educate, engage, and build trust among diverse stakeholders and focus attention and resources on a positive and productive response. While leadership can initially come from landowners, producers, extension staff, conservation organizations, and/or local regulatory agency staff, leadership among producers/landowners is vital to grow and sustain participation in the agricultural community. Conservation organizations and agencies are most effective when serving in the background as facilitators. Engaging local leaders in decision making and planning builds trust and mutual respect between different groups. By integrating local leaders from the outset, not only will communities feel more engaged in the process and have "skin in the game," the solution strategies that are developed will be more likely to be practical and effective. Factors that contribute to leadership include strong stewardship values and commitment.

There is a lack of infrastructure to develop and support local watershed leaders. The possibility of recognition for leadership (e.g., conservation awards) can spur farmers, ranchers, and landowners to make investments

[1] See for example, the national and regional assessments of USDA's Conservation Effects Assessment Project: www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/ceap/, Iowa Nutrient Management Strategy www.nutrientstrategy.iastate.edu/.

in conservation. Conversely, peer pressure can result in laggards joining conservation efforts. Given the norms and assumptions that prevail in many communities, the emergence of leadership can be catalyzed by creating safe places for farmers and other stakeholders to step outside of their day-to-day social interactions and discover that others share similar points of view about changes that may be needed/issues that need to be addressed – and this can spark collaborative action. Frequently the locus for local leadership seeking to catalyze action or respond to an igniter is a conservation district.

Key implications for policy and action:

- *National standards, local implementation:* While specific national environmental standards may be necessary to catalyze action of the scope and in the timeframe necessary to address current challenges, enabling locally-driven approaches to meeting those standards is critical to achieve solutions that are effective, practical, economical, and adaptive.
- *Leadership development:* Policymakers, agency staff, producer groups, and conservation and private sector organizations seeking to improve environmental outcomes while maintaining productive and profitable agricultural landscapes may increase their effectiveness and efficiency by actively seeking to develop professional and volunteer leaders with the skills necessary to provide trusted leadership to diverse multi-stakeholder, science-driven collaboration.

Enabling Conditions

In addition to the presence/emergence of local leaders, there are some other necessary conditions that enable a community to respond to a catalyzing event with a collaborative and productive approach.

Trust provides a necessary foundation for collaborative watershed management. While trust takes time to establish, it can be lost very quickly and be very difficult to rebuild. Building trusted relationships requires skilled personnel. As people and communities foster and support what they help create, success requires a *sense of ownership among stakeholders* of the health of their landscape/watershed and the collective effort to maintain and enhance it. Incorporating local leaders into decision-making and goal-setting for the landscape, in addition to their individual operations, builds ownership and trust.

A common base of knowledge and common goals among stakeholders are also necessary for successful efforts to isolate problems and implement solutions. Engaging landowners/producers alongside other stakeholders in designing and implementing data collection and analysis of practices and conditions in their watershed builds trust among stakeholders, instills confidence in and builds a sense of ownership of findings, and leads to a sense of responsibility to take action to address problems they reveal. Setting clear outcome-based goals at the landscape scale that are based on good baseline data, achievable, easily quantifiable, clearly linked to management practices, and aligned with high productivity can support action to achieve the goals.

Highly skilled staff at a landscape-scale organization also seems to be a necessary condition, at least in most communities. A paid professional is needed to reach out to diverse stakeholders, connect community-members with technical resources, search out and secure public and private funds, serve as a liaison to various levels of government, and provide an organizational and administrative hub for landscape-scale initiatives. Staff serving these functions seem to be most often found at conservation districts.

The economics must work for producers. Farmers are business people, and participation in conservation will fail if it undermines productivity and profitability. Some are of the view that conservation must be economically advantageous for widespread adoption, and that conservation can – and must - pay for itself over time and that producers will implement new practices that are demonstrated to contribute to higher margins. Others suggest that not all conservation will in fact pay for itself and that non-economic incentives and disincentives are needed to achieve desired outcomes and that a better understanding of what the costs and benefits of conservation are to enable focusing of cost-share resources and other (dis)incentives on activities that have a net cost to producers.

Other conditions that may not be necessary, but increase participation and the likelihood of success:

- *Regulatory certainty/safe harbor:* Providing some form of protection from future regulation and/or third party litigation for participants in voluntary action, particularly for early adopters, facilitates experimentation with new methods and practices and may increase participation.
- *Community:* "The more community you create around a watershed effort, the more local buy-in, impact, and success you can achieve."
- *Peer pressure:* Both passive peer pressure (farmers comparing their operations to those of their neighbors) and active peer pressure (persistent outreach from neighbors) can lead to engagement of farmers and landowners.
- *Participation and voluntary action:* Creating opportunities for concerned members of the public and conservation organizations to participate with farmers in setting watershed goals can also help relieve pressure for regulation. Regulatory approaches generate resistance; a focus on outcomes – rather than on prescribing rules for how farmers should farm – encourages involvement.
- *Proven and visible success:* Monitoring of progress against a clear baseline enables successful projects to demonstrate how agriculture can be part of the solution rather than part of the problem. In addition, farmers will respond to efforts that can demonstrate sustained or higher productivity and margins through participation in conservation efforts.
- *Partnerships:* Investing the time and effort to form partnerships can leverage resources and magnify impact.
- *Stewardship ethics:* Successful efforts frequently connect watershed collaboration to producer/landowner ethics as well as their self-interest.
- *Technology:* New technologies, such as precision agriculture tools, can make change technically possible and economically attractive.

Key implications for policy and action:

Training and professional development: Significantly greater capacity is needed to provide extension agents and conservation district staff professional training and ongoing development to conduct outreach to and engage landowners/producers in developing and implementing landscape/watershed scale conservation plans. Training, development, and mentorship are also needed for conservation district board members to provide effective leadership as well as for producers/landowners to engage in peer-to-peer outreach to educate and influence practices over time.

Governance mechanisms for landscape-scale/watershed management: Possible options include aligning conservation districts with watersheds (as Nebraska has), establishing watershed districts to complement conservation districts (as Minnesota and Ohio have), and/or forging strategic and programmatic collaboration among counties within a watershed for activities designed to address watershed-scale issues. More information is needed to better understand what enables conservation districts to succeed and to develop strategies and programs to strengthen the system.

Conservation district authorities: In some states, the elected or appointed boards of conservation districts have the capacity to levy assessments to address collective scientific, technical and infrastructural needs and to regulate agricultural activities and land use to achieve district-scale natural resource outcomes. These authorities might be extended to conservation districts in all states and their responsibilities expanded to include taking action as necessary to meet state and federal water quality and other relevant standards.

Economics of conservation: Precise knowledge is needed about what practices have a monetary return under what conditions, and the timeframe for that payoff. Such an inventory would lessen uncertainty amongst producers. Aligning marketplace signals with desired outcomes could help drive progress, such as standardized metrics that link landscape goals with management and business decisions. Ecosystem services markets (including but not limited to water utilities paying farmers for water quality and quantity credits) may be developed more broadly.

Obstacles

Data limitations: The data and scientific analysis necessary to fully and successfully advance landscape scale management is not yet available, both in terms of practices on the land and outcomes from the field to large landscape scale. Good data is expensive to collect and because conditions are highly variable, data must be collected frequently. Good baseline data is lacking in most places. In some cases emerging technology may reduce the cost of data collection; in other cases, it may increase the cost. There is insufficient analytical capacity to monetize the economic benefits of improved water quality and ecosystem services as well as a lack of knowledge about what the monetary benefits are for engaging in particular projects and the timeframe for returns. Complicating matters is the significant temporal delay between changes in agricultural practices and improved downstream environmental outcomes at the large landscape scale.

Limited institutional capacity: The institutional capacity for fully integrated watershed governance at multiple scales is not in place and will require significant realignment and integration of authorities and capacities. There is insufficient technical assistance available through land grant extension services and NRCS, where a significant portion of staff time is consumed with administration of contracts rather than providing technical support.

Fear of regulation and litigation: There is widespread distrust between farmers and regulatory agencies, in part as a result of regulation imposed from the outside without adequate consultation and understanding of the variability of contexts to which it applies. Regulations often impose over-simplified solutions that do not make sense in many particular situations as effective solutions usually must be site specific, commodity specific, and resource specific. Fear of regulation, in some cases based on past experience and other cases based on often incorrect anecdotes that circulate in the rural and agricultural media, limits many producers' willingness to participate in efforts to address environmental outcomes at the landscape scale. Farmers fear that both data collection and successful voluntary action may lead to more regulation. There is also fear among landowners that if they take a risk to do something innovative to achieve a conservation objective they might face litigation if the objectives are not achieved or some group does not like the project or the outcomes.

Lack of agency flexibility and coordination: Regulatory agencies tend to work in silos and often do not adequately communicate or share information. They almost always lack the flexibility to coordinate effectively with each other when this requires some change in standard protocols. Furthermore, permitting and transaction costs can be prohibitively expensive for projects that require engagement of multiple agencies.

Additional obstacles include the following:

- *Declining federal and state funding:* Stitching together different funding sources is labor intensive and requires interagency coordination and cooperation.
- *Lack of trust and skilled leadership:* Lack of trust among land owners, land-users, government agency staff, and various stakeholder groups remains, in some cases after decades of effort, a critical limiting factor. The skilled volunteer and professional leadership necessary to effectively engage landowners/producers at the grassroots has yet to emerge or be developed in most communities.
- *Changing land ownership:* Owners are more likely than tenant operators to invest in the long-term health of land. The long term engagement and investment necessary for land and watershed health is complicated by the fact that more than half of land under production is being rented, and growing numbers of landowners are holding land purely as an asset through which to earn an annual return.
- *Lack of integrated systems approach to farming:* Successful farmers over the past 40 years have largely been trained to think about their farms in mechanical and chemical terms, with a focus on input management, rather than as biological systems requiring adaptive management of complex

interconnected biological, geological, and chemical systems. There is increasing recognition that soil health, nutrient management, water quality, and greenhouse gas emissions are deeply intertwined and have a dynamic relationship. Soil must be managed as a system, rather than as a machine requiring simply nutrient inputs. Farmers need more and better information in order to improve soil management. Methods to quantify and value soil health are needed to more easily convey its importance to farmers, and potentially to integrate soil health into crop insurance premiums (i.e., healthy soils are more resilient to drought).

- *Opposition to targeting:* There is a resistance to targeting among some producers and agency staff who prefer the current approach of broadly distributing conservation dollars. Some are concerned that targeting may limit the involvement of producers in areas that are not targeted. There also are technical and political challenges in determining in which areas to target funding.

- *Limited replicability:* Though institutional, program, and infrastructure design developed by pilot projects may be adapted to other locations, building relationships and trust, which requires significant human and financial resources, requires local investment in each and every watershed. Establishing baselines, identifying problems, and monitoring progress also must be done in each new location and require additional/new resources. Also, projects require a strong sense of local ownership to be successful and therefore often need to be developed from the ground up in each community.

Key implications for policy and action:

- *Science infrastructure and data collection:* Significant investments are needed to create the monitoring and modeling infrastructure and tools to establish baselines and assess progress over time. Greater capacity is needed to isolate problems and their geographic source over time as baseline measurements and ongoing monitoring yield sufficient data. Landowners/producers and other stakeholders should be regularly engaged in the collection of data about practices and outcomes. As much of the data that needs to be collected to demonstrate water quality or habitat improvements has potential value to producers, it should be available to them. Where data is of value, farmers may help pay for its collection. A shared dataset where descriptions of watershed projects and their outcomes are stored and can easily be accessed would enable producers and other stakeholders to learn from successes across the country.

- *Regulatory certainty:* Regulatory certainty/safe harbor might be provided to those who voluntarily and fully participate in landscape-scale conservation efforts for a period of time long enough to serve as an incentive to fully participate but not so long as to disincentivize timely adaptive management. Given that outcomes must be achieved at a landscape scale, regulatory certainty/safe harbor might be granted collectively to those members of a community who are taking actions considered sufficient (based on available evidence) to achieve outcome targets. Periods of certainty could be calibrated to coincide with the period of time required for changes in practice to result in changes in outcomes at the watershed scale.

- *Integrating performance- and practice-based approaches:* While a performance-based approach based on measurement is needed to achieve outcomes at the watershed scale, a practice-based approach, sensitive to variation in fields and operations, may be practical at the farm scale.

- *Intergovernmental coordination:* Some kind of ombudsman or command structure may be needed to coordinate agencies to reduce confusion and cost for producers and to allow for (and when necessary require) the flexibility necessary to ensure that less important requirements of some rules/agencies do not prevent achievement of more important outcomes.

- *Technical and financial assistance:* The balance between technical and financial assistance may need to be altered moving forward to ensure that adequate technical resources are available for all producers.

Presentation Abstracts

Panel I: Complex Partnerships to Maintain and Enhance Bio-diverse Working Landscapes

The first panel was intended to explore key aspects of collaboration: trust, leadership, catalysts, and the roles of various kinds of partners. Both examples presented by panelists involve biodiverse landscapes in which a wide range of stakeholders are needed to successfully address multiple outcomes, including productivity, water quality, water quantity, and biodiversity.

Muddy Creek, 1989

Muddy Creek, 2002

Muddy Creek, 2011

The long-term impact of conservation projects in the Little Snake River Conservation District.

Larry Hicks, Wyoming State Senator | Little Snake River Conservation District (Wyoming)

The Little Snake River Conservation District has completed an array of watershed restoration projects in a highly variable and complex landscape where agriculture, livestock grazing, and recreation are the primary uses, and ownership is split between private and federal entities. A wide range of projects to improve water quality and restore and conserve habitat have been undertaken to address the needs of listed and candidate endangered species and to remove streams from EPA's 303(d) list of impaired waterways. Given the lands involved, the District must engage with 32 government entities to carry out these projects, and streamlining of processes is needed. Having a staff person, paid for through the taxing authority of the conservation district (as provided by Wyoming law), has proven essential to conducting outreach, building trust with and a sense of ownership among landowners, engaging agencies, and securing project funds – all of which are critical ingredients in successful collaborative watershed projects.

Fred Yoder, former President, National Corn Growers Association | Big Darby Creek Watershed (Ohio)

In the early 1990s, the Natural Resource Conservation Service (NRCS), Farm Service Agency (FSA), and Ohio State University Extension Service joined with leaders in the farming community and conservation

organizations to engage agriculture in helping to protect Big Darby Creek, which is amongst the most ecologically healthy stream systems in the Midwestern Corn Belt. Together they formed Operation for Future Association (OFA) and focused initial efforts on building relationships and trust among farmers, scientists, and environmentalists, including through canoe trips in the on the Darby. Once these groups were able to meet face to face they developed an understanding of their mutual values and interests in protecting the watershed. During these trips farmers were able to identify the farms that had better conservation practices. Through word of mouth and peer pressure, eventually 150 farmers joined the effort. The Nature Conservancy and USDA, through programs such as the Conservation Reserve Enhancement Program, were important and trusted partners. However, when U.S. Fish and Wildlife Service (USFWS) sought to establish a wildlife refuge within the watershed, divisions emerged between the farming and conservation communities. Many farmers lost trust and stopped participating in OFA as they believed that it was the success of OFA that led to USFWS's attempt to establish a refuge, which would have permanently taken lands out of production and reduced the tax base of the community.

Sean McMahon, North American Agriculture Program Director, The Nature Conservancy

The Nature Conservancy (TNC) has developed a "Sustainable Intensification Strategy" which aims to increase crop production on existing farm land. While recognizing the need for some level of land expansion to meet the pressure of a growing population, TNC is working to redirect that expansion to areas that have been previously degraded. Additional efforts include high-level strategies such as engaging with the Farm Bill and partnering with the private sector as well as local outreach to individual farmers and landowners. TNC is practicing "precision conservation" through which it targets specific areas and applies the best restoration practices to meet the needs of that location. TNC partners with others on a range of agricultural projects, including: pilot projects to address nutrient loading in agricultural landscapes by building wetlands (such as with the City of Bloomington); tools to help farmers improve both productivity and environmental performance of their fields (such as Field to Market's FieldPrint calculator); and, integrating best management practices for improving soil health into supply chain management (with National Corn Growers Association and Monsanto).

Ernie Shea, President, Natural Resource Solutions, LLC | Solutions from the Land

Solutions from the Land (SfL) engaged several hundred thought leaders to develop a new vision for land managers and for the land itself – valuing the full range of services land and land managers provide (food, fuel, ecosystem services, etc.). Five pathways to achieving the vision were identified: employ landscape-scale solutions and partnerships, harmonize policy frameworks, reward stewardship of ecosystem services, energize and coordinate research, and transform and modernize information networks. SfL also developed a set of "lessons learned" which can help inform other watershed efforts: start with and remain focused on your vision; don't be government-centric; underpin with diverse multi-stakeholder partnerships; relationships before issues builds trust; and, what you are in on you are not down on.

Panel II: Watershed-Scale Nutrient Reduction Strategies

The second panel addressed the role of various approaches and practices in a comprehensive strategy to reduce nutrient loading within a watershed. Panelists discussed effective strategies for engaging farmers in taking action as well as resources and strategies to build sufficient engagement to achieve watershed-scale outcomes.

Richard Sloan, Farmer | Lime Creek Watershed Improvement Association (Iowa)

Located in Northeast Iowa, the Lime Creek Watershed Improvement Association used a community-based approach to engage local land owners to achieve a set of agreed-upon nutrient reduction goals. 45 percent of watershed residents engaged in the program with 23 percent using the Iowa Phosphorus Index, Corn Stalk Nitrate test, and Soil Conditioning Index to better understand soil health on their land and compare management scenarios. Participants were then paid incentives for sustainable land stewardship as measured by improved index scores and reduced corn stalk nitrate. Payments were made to producers based on farm participation rather than per acre. This approach dissuaded larger farms from participating and the recommendation to use a per-acre rate was adopted by recent performance-based watershed groups in Northeast Iowa. Different fields on the same farm may need different treatment; it is important to respect that each farmer knows his own fields best.

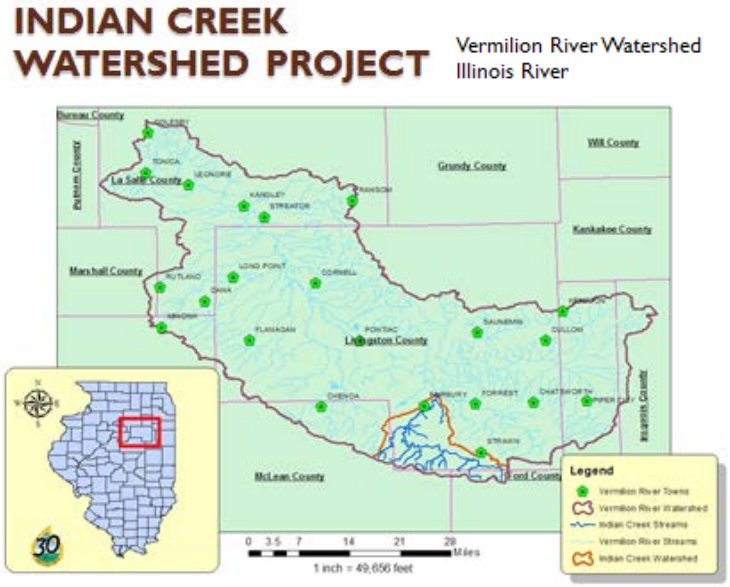
Matt Helmers, Associate Professor – Agriculture and Biosystems Engineering, Iowa State University | Iowa Nutrient Reduction Strategy

In partnership with the Iowa Department of Agriculture and Land Stewardship, Iowa State University conducted a technical assessment needed for the development of a state-wide strategy to meet the goals of the 2008 Gulf Hypoxia Action Plan for reducing nutrient runoff into the Gulf of Mexico. A collaboration of 23 scientists met to determine the effectiveness and cost of various practices to reduce nitrogen and phosphorus loading of the riverine environment.

The group found that implementing a suite of on-farm practices including, but not limited to, the use of cover crops, extending crop rotations, and prairie and wetland construction would likely be most efficient at effectively reducing nutrient loads into waterways. Many of the studies conducted were on a plot-sized scale and while studies at this level provide critical data, the group has suggested that future efforts must expand the area of practice implementation to further understand water quality impacts across the landscape. There is also a need to better monetize the economic benefits of improved water quality and ecosystem services as well as a need for better tracking and understanding of current practices.

Karen Scanlon, Executive Director, Conservation Technology Information Center | Indian Creek Watershed Project (Illinois)

Located within the greater Vermillion River watershed, the Indian Creek Watershed Project was established in 2009 to support increased nutrient use efficiency and to



reduce nutrient loading of waterways. The Conservation Technology Information Center (CTIC), in partnership with Illinois EPA, NRCS, and the Livingston County Soil and Water Conservation District, set a goal of determining the water quality impacts that result when 50% of farms and acres in a watershed adopt conservation systems. The partners offer producers technical, informational, and financial assistance while also providing on-farm education and demonstration projects. A steering committee led by local producers has garnered strong community support. To date, 100 percent of farmers have been contacted and 55 percent of farms have enrolled. The more community you create around a watershed effort, the more local buy-in, impact, and success you can achieve.

Suzy Friedman, Director, Agricultural Sustainability, Environmental Defense Fund | Adapt Network

Growing out of collaborations with land grant universities and other partners, the Adapt Network is an informal partnership working to improve nutrient management while meeting both production and environmental goals. Emphasizing the high demands and concurrent productivity needs of agricultural lands today, the Adapt Network aspires to optimize on-farm efficiency. To do this, farmers, farm advisors, and/or other partners create a coordinated learning community to gather farm-specific data which is then compared with results across other farms within the region. By having a better means for data collection and sharing, farmers will have the best information available to make informed on-farm decisions. This data has been particularly useful in informing farmer's application of fertilizer. While a few farmers learned that they were not applying enough nitrogen to optimize outcomes, participants in the program have reduced N application by an average of 25 lbs. per acre, which correlates to a direct financial benefit to farms and healthier waterways.

Alex Echols, Consultant, Sandy County Foundation | Agricultural Incentives Program

Sand County Foundation's Agricultural Incentives Program was founded to address the degradation of surface waters by nutrient runoff in the Upper Midwest. By providing incentives to advance market-based strategies to conservation, the Foundation works to develop and demonstrate new nutrient reduction strategies. Working closely with NRCS and landowners, Sand County Foundation has developed different strategies for conservation investment. These strategies include: ecosystem service delivery, targeting agency conservation investment, developing local commerce, and creating incentives for producers to deliver off-site benefits such as incentivizing landowners to produce clean water. The Foundation stresses the importance of having the financial systems in place to support local farmers and to focus conservation efforts where there is the greatest potential for a high return on investments.

Panel III: Agriculture/Water Utility Collaborations

The third panel provided four examples of collaboration between agriculture and water utilities to achieve water quality and/or quantity goals. Panelists addressed the role measurement and monitoring play in creating financial value for producers and landowners. Panelists were asked about challenges they experienced moving projects from pilot states to full-scale efforts and to discuss the role intermediaries play in establishing partnerships between producers and water utilities.

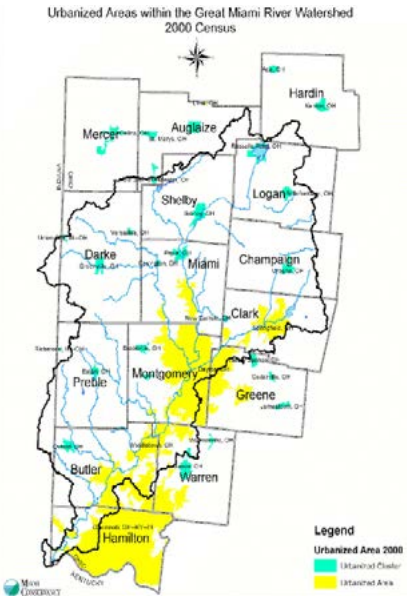
Water monitoring station on 77 Ranch.

Gary Price, Owner, 77 Ranch | Water as Crop™ (Texas)

Located 50 miles outside of Dallas in the Blackland Prairie Ecoregion, 77 Ranch is a working commercial cow-calf operation. 77 Ranch participates in the Water As A Crop™ program, a joint effort with Sandy County Foundation, NRCS, and other entities, to show the relationships between good conservation practices (including use of native grasses for pasture and water retention structures), improving water quality downstream, biodiversity, and sustainable production. The 2011 drought clearly demonstrated the value of conservation as 77 Ranch did not have to cull any of its cattle (most neighbors did). To better understand and help demonstrate the relationship between conservation practices and both production and environmental outcomes, 77 Ranch has recently installed water monitoring devices in three different locations (tall grass, mid-grass, and short grass) to show the importance of grass in improving both water quality and soil health. The monitoring devices capture data on runoff, soil temperature, and evaporation rates, and are shared with other landowners to demonstrate the importance of on-site water management.

Sarah Hippensteel Hall, Manager, Watershed Partnerships, The Miami Conservancy District | Water Quality Credit Trading Program (Ohio)

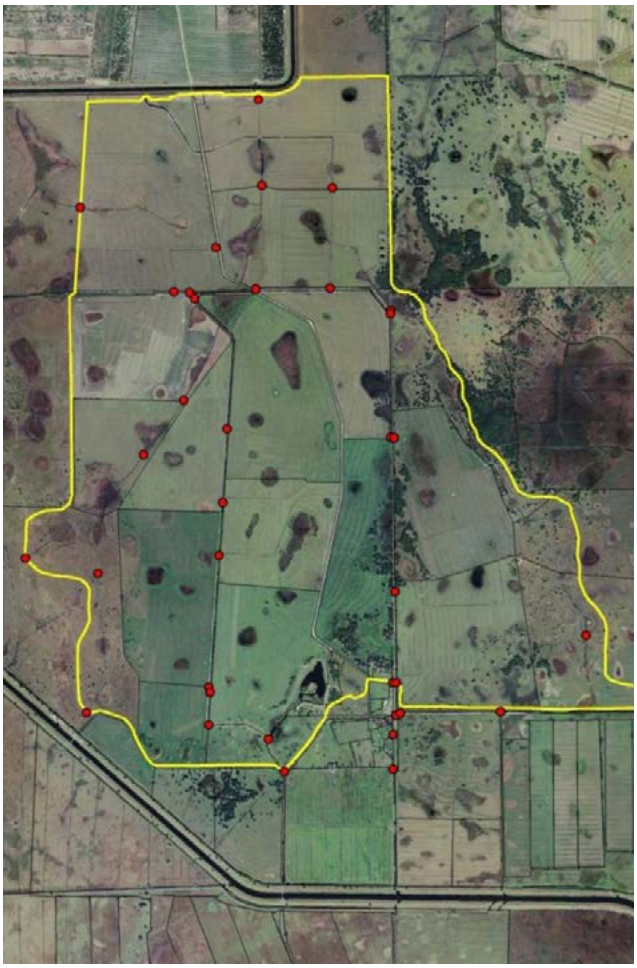
Recognizing that on-farm nutrient management practices are more cost-effective and yield greater water quality benefits than upgrading wastewater treatment plants, the Miami Conservancy District, in partnership with the local agricultural community, created a water quality credit trading program in which farmers receive a "credit" for every pound of nitrogen and phosphorus they prevent from entering local waterways. Creating the program required rebuilding trust with agricultural producers that had been lost as a result of prior programs that were not well managed by utilities. This required many one-on-one meetings and other methods to gather and incorporate the input of farmers during program development. The program was created in anticipation of a regulatory driver (a numeric nutrient standard), and will remain a pilot until that regulation is in place. Using a reverse auction format managed by a stakeholder advisory group, the program has generated more than 1.14 million credits – resulting in more than $1.6 million dollars being paid to agricultural producers. By creating an incentive to promote the use of practices such as no-till, cover crops, prescribed grazing, and crop rotation, the program has been successful in reducing nutrient runoff into rivers and streams by 572 tons. To accurately monitor and understand such changes within the watershed, the Miami Conservancy District collects 20 different water quality samples around the clock. Though measureable improvements in water quality benefits have not yet been achieved, there is a much greater understanding of the behavior and fate of nutrients.



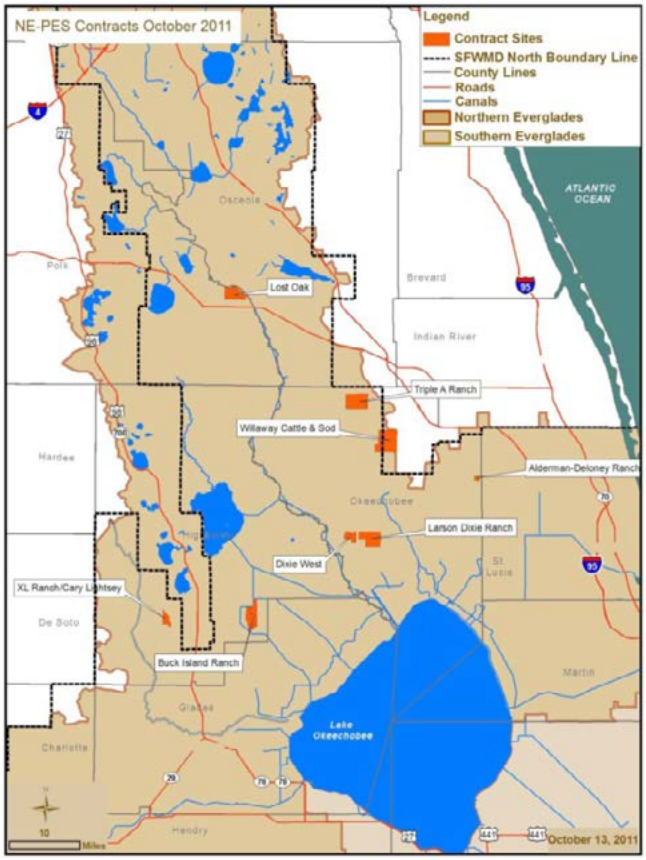
Great Miami Watershed

Gene Lollis, Ranch Manager, Buck Island Ranch, MacArthur Agro-ecology Research Center | Northern Everglades Payment for Environmental Services (Florida)

The Northern Everglades are the headwaters of Florida's Everglades and are highly susceptible to nutrient loading and the impacts of altered water flows to Lake Okeechobee. As the Everglades are naturally limited in phosphorus, increased runoff can be highly detrimental to this fragile and important ecosystem. The South Florida Water Management District (SFWMD) has called for a reduction of phosphorus inputs from 400 MT to 140 MT per year as well as an increase in water retention by one million acre-feet. To help reach these goals, a coalition of cattle ranchers, environmental organizations, state agencies, conservationists, and scientists created the Northern Everglades Payment for Environmental Services program. With technical support from program partners, ranchers design ranch-specific Water Management Alternatives to reduce nutrient loading and provide water retention and other environmental services. The program also uses a reverse auction bid based on cost/acre-foot stored or pounds of phosphorus removed. Successful bidders enter into a 10 year contract with SFWMD to provide these services. By engaging landowners and ranchers early, the program has been successful in its outreach to the community and in reducing phosphorus runoff from ranch lands.



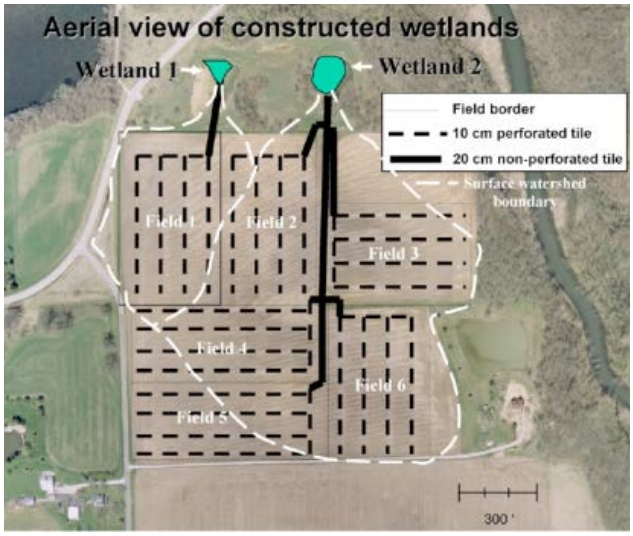
Buck Island Ranch, Florida



Northern Everglades Payment for Environmental Services contracts in 2011.

Rick Twait, Superintendent of Water Purification, City of Bloomington (Illinois)

The City of Bloomington relies on two reservoirs, Lake Bloomington and Evergreen Lake, to supply safe drinking water for more than 80,000 residents. Due to drainage from row crop agriculture, in the early 1990's Bloomington's drinking water exceeded the 10 Mg/L nitrate standard. Instead of installing water treatment plants, which are both costly and provide only limited benefits, city staff decided to explore other methods for limiting the delivery of nitrates into the two reservoirs. Through sampling programs, the city determined that the primary source of nitrates was agricultural drainage tiles. Working with a variety of partners, including local leaders, soil and water conservation districts, Illinois EPA, Illinois State University, USDA, Environmental Defense Fund, The Nature Conservancy, and Sand County Foundation, the City of Bloomington installed six experimental tile systems to measure nitrate delivery and constructed two experimental wetlands to accept tile drainage and surface runoff. The complex hydrology and cost of land have made identifying and securing sites for wetlands a significant challenge. Engaging soil and water conservation districts has been crucial to success. The City has also engaged in numerous other activities to reduce nutrient loading, including a clean lakes program, diagnostics/feasibility studies, nutrient management programs (including EDF's Adapt Network), and buffer strip planting.



Constructed wetlands, City of Bloomington watershed project.

Engaging farmers in the City of Bloomington watershed.

Panel IV: Lessons Learned and Looking Ahead: Collaborative Watershed Management

The fourth panel was intended to address some of the key lessons learned through NRCS's watershed initiatives while examining critical gaps in knowledge and technical capacities and how these gaps might best be addressed. Panelists identified potential drivers of future watershed initiatives as well as key obstacles to engagement and collaboration.

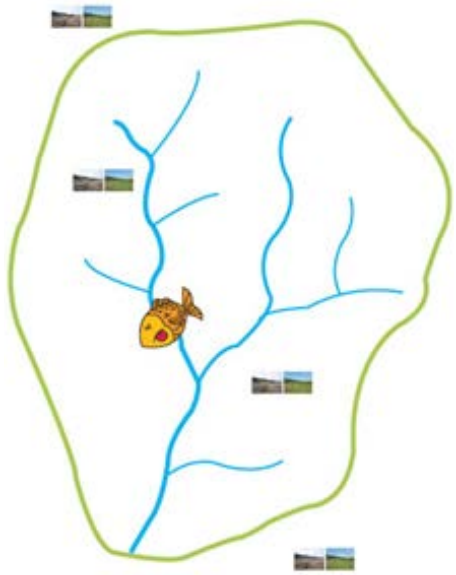
Michelle Perez, Senior Associate, Water Quality Team, World Resource Institute

The World Resource Institute (WRI) has numerous projects currently underway to address nutrient reduction and watershed conservation targeting throughout the United States. The Institute has two projects in the Mississippi River Basin – one to assess the use of point-nonpoint source nutrient trading to accelerate adoption of on-farm conservation practices and the other to develop field-scale and watershed-scale nutrient reduction estimation tools. Currently three efforts are underway to help NRCS prioritize watersheds for targeted nutrient reduction. Through these projects, as well as their work in the Chesapeake Bay, WRI has gleaned the following lessons:

- Gain stakeholder and producer buy-in early in the process.

"Business as usual" conservation project are important; however, a targeting of projects is needed to improve water quality at the landscape level.
World Resources Institute.

- Set clear outcome-based environmental goals based on good baseline data.
- Set goals that are targeted, achievable, and easily quantifiable.
- Tailor geographic targeting to get the "biggest bang for the buck."
- Build ownership and buy-in among farmers related to landscape scale goals, not only to conservation goals for individual operations.



Eileen McClellan, Chesapeake Bay Project Coordinator, Environmental Defense Fund

Environmental Defense Fund (EDF) has conducted research to understand which suites of environmental conservation practice(s) would be most effective at reducing nutrient exports by 45 percent in the Midwest. Nutrient export is driven by four characteristics: increased application of nutrients, loss of perennial cover, altered hydrology, and loss of local wetlands. A watershed-based approach – treating the watershed as a system – employed through a suite of practices to address all four characteristics of nutrient export would be most beneficial. Through specific targeting and by using multiple practices such as bioreactors, saturated buffers, and tile drainage treatment wetlands, it is possible to achieve a 45 percent reduction while taking very little land (one to two percent) out of production across the whole region. The physical science is the easier part; the social science – understanding what motivates producers to participate and how the economics work – is harder and has been neglected and underfunded. Throughout its work, EDF has identified key factors of success including, but not limited, to:

- Connecting local knowledge and leadership to outside expertise.
- Targeting regions, with particular attention to geology.

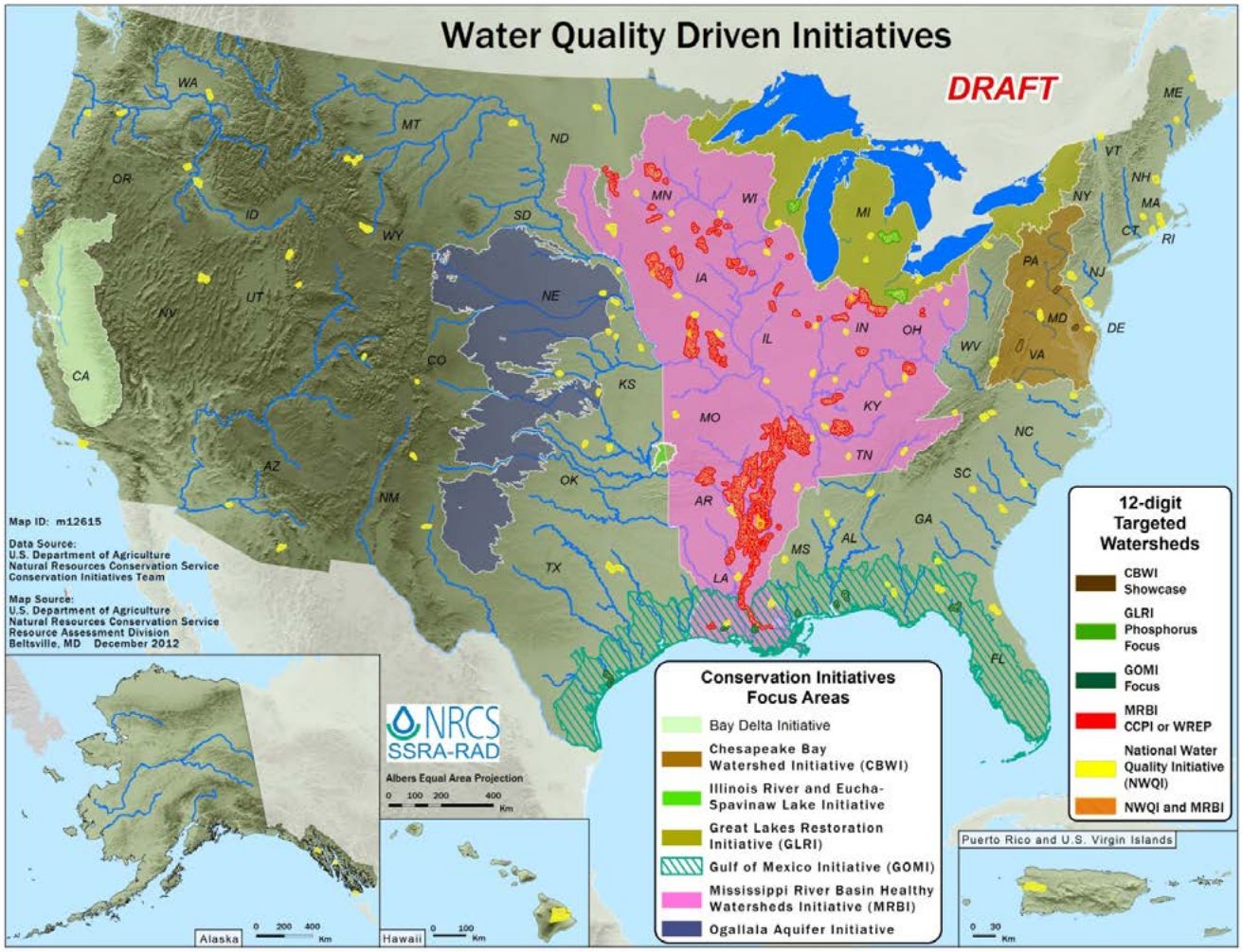
Better models are needed to integrate both social and biophysical science into decision-making. Some of the critical obstacles to collaboration are the lack of a system for watershed planning and the lack of investment in the human resources necessary to reach out to landowners.

Tom Christensen, Regional Conservationist, USDA Natural Resource Conservation Service

USDA's Natural Resource Conservation Service (NRCS) has multiple initiatives targeting high priority watersheds in North America. Among the key things learned through these initiatives, as well as through evaluations such as the Conservation Effects Assessment Project (CEAP), are:

- Voluntary conservation does work, but there is more work to do to achieve desired environmental results.
- Targeting the most vulnerable acres in a watershed can increase program effectiveness 3 to 5 times.
- Nutrient management and land treatment for nutrient reduction cannot solve the problem alone; downstream practices (buffers, wetlands, two-stage ditches, etc.) are often necessary.
- Conservation planning is needed to guide the decision-making process for producers in order to implement conservation systems that are effective, practical, and sustainable overtime.

Since 2010, NRCS has targeted up to $300 million annually toward contracts with individual producers to implement a system-based approach and is currently evaluating these projects. Moving forward, new partnerships will be needed to make the necessary progress, certainty/certification will be an important component of a voluntary approach, more attention needs to be given to soil health, and models need to be improved. NRCS is investing in edge of field water quality monitoring to help improve models.



NRCS Water Quality Initiatives

Pat O'Toole, Rancher, Ladder Livestock Company LLC (Wyoming)

Pat O'Toole, who is a leader in landscape-scale conservation efforts, including those in the Little Snake River Conservation District described by Larry Hicks, offered the following thoughts and observations:

- There is a lot of energy in trying to implement conservation practices, but it will take time and will be an evolutionary process for farmers and ranchers for whom it is not their primary occupation. The primary goal of those in agriculture/livestock is to stay in business – and that requires adaptability.
- Trust among land owners, land-users, government agency staff, and various stakeholder groups remains, after decades of activity, the number one challenge.
- In order to have a healthy watershed, farmers and ranchers must form coalitions so that their ideas and voices can be heard.
- Farmers and ranchers appreciate positive recognition and efforts that recognize leaders spur investments in conservation.

Participant List

Invited Guests

- Tom Christensen, Regional Conservationist, Central Region, USDA Natural Resources Conservation Service, Washington, DC
- Alex Echols, Program Director, Special Programs, Sand County Foundation, Wisconsin
- Suzy Friedman, Director for Agricultural Sustainability, Environmental Defense Fund, Washington, DC
- Sarah Hippensteel Hall, Manager, Watershed Partnerships, The Miami Conservancy District, Ohio
- Matt Helmers, Associate Professor – Agriculture and Biosystems Engineering, Iowa State University, Iowa
- Larry Hicks, State Senator, Wyoming
- Gene Lollis, Ranch Manager, MacArthur Agro-ecology Research Center, Florida (Northern Everglades Payment for Environmental Services Program)
- Sean McMahon, North American Agriculture Program Director, The Nature Conservancy, Iowa
- Eileen McClellan, Chesapeake Bay Project Coordinator, Environmental Defense Fund, Washington, DC
- Michelle Perez, Senior Associate, World Resources Institute, Washington, DC
- Gary Price, Owner, 77 Ranch, Texas
- Karen Scanlon, Executive Director, Conservation Technology Information Center, Indiana (Indian Creek Watershed Project, Illinois)
- Ernie Shea, Project Coordinator, Solutions from the Land, Maryland
- Richard Sloan, Farmer and Member, Lime Creek Watershed Improvement Association, Iowa
- Rick Twait, Superintendent of Water Purification, City of Bloomington, Illinois

AGree Production and Environmental Outcomes Workgroup Members

- Jeff Dlott, President, SureHarvest, California
- Steve Flick, Chairman of the Board, Show Me Energy Cooperative, Missouri
- Hal Hamilton, Co-Director, Sustainable Food Lab, Vermont
- Susan Heathcote, Water Program Director, Iowa Environment Council, Iowa
- A.G. Kawamura, Co-chair, Solutions from the Land; Farmer, California
- Britt Lundgren, Director of Organic and Sustainable Agriculture, Stonyfield Farm, Inc., New Hampshire
- Jim Moseley, Co-Chair, AGree; Farmer, Indiana
- Pat O'Toole, Rancher, Ladder Livestock, Wyoming
- Kitty Smith, Executive Director, Council of Professional Associations on Federal Statistics, Virginia
- Fred Yoder, Past President, National Corn Growers Association; Farmer, Ohio

Staff

- John Ehrmann, Senior Partner, Meridian Institute
- Mark Jacobs, Senior Mediator, Meridian Institute
- Tim Mullin, Project Assistant, Meridian Institute

Project Descriptions

The following project descriptions were submitted by participants in advance of the workshop. Each was asked to address the questions below. In some cases, pre-existing materials or articles were submitted.

- What are the aims of the project(s) in your watershed? What are the issues you are trying to address?
- When, why, and how did it get started? Who provided leadership?
- Who is involved (e.g., producers, landowners, partner organizations, agencies, businesses, etc.) and how do they participate/what do they contribute (e.g., changes in agricultural practices, information, technical assistance, funds, etc.)?
- What motivates producers/landowners to participate? What have been the challenges of engaging producers/landowners and how have you overcome them?
- How is the project financed?
- How do you measure success?
- To what extent have you been able to measure changes in environmental outcomes (e.g., improved water quality, increasing populations of species of concern, etc.), soil quality (e.g., increased soil organic matter), yield, and/or production costs?
    - If you have measured change, please provide a snapshot of your findings.
    - What have been the challenges associated with monitoring and measuring change?
- What are the most significant impediments to achieving intended objectives, particularly measurable improvements in environmental outcomes, and how might they be addressed (consider policy at multiple levels, private sector, civil society)?
- What are some of the key lessons you have learned about what it takes to engage producers and landowners in participating in and taking ownership of efforts to improve environmental outcomes in their watershed?

Little Snake River Watershed

Larry Hicks, State Senator, Wyoming

What are the aims of the project(s) in your watershed? What are the issues you are trying to address? Maintain socio-economic opportunity and stability through the restoration and enhancement of the Little Snake River Watershed.

When, why, and how did it get started? Who provided leadership? Started in the 1950's and has progressively gained momentum for the last half century.

It started to insure a livelihood off the land in a sustainable fashion in order pass a way of life on from one generation to the next. It started in order to leave the land in a better condition for the next generation than that found in the current.

How did it start? One rancher at a time!

Who is involved (e.g., producers, landowners, partner organizations, agencies, businesses, etc.) and how do they participate / what do they contribute (e.g., changes in ag practices, information, technical assistance, funds, etc.)? Anybody or entity that wants to be involved in a meaningful productive outcome based approach has an opportunity to participate. To date hundreds of landowners and a multitude of government agencies, NGO's, educational institutes, and private sector business entities have been involved.

Participation can be at any level from concept to completion. Contributions include intellectual capital, creative thinking, sweat equity, funding, appreciation, understanding, respect, commitment, and ownership. Friendship, a cold beer, and a meal are always welcome contribution.

What motivates producers/landowners to participate? What have been the challenges of engaging producers/landowners and how have you overcome them? Motivating factors are varied and diverse as the landowners themselves. Some of the major factors include economic opportunity & sustainability, conservation ethic & moral obligation to leave the land better than they found it, elimination or reduced regulatory threat, and sometimes it is just down right fun!

How is it financed? Landowner contributions, local conservation tax, state, federal, and NGO grants, mitigation fees, and sales of goods and services.

How do you measure success?

1. Economically viable ranches/ agribusinesses.
2. Perpetuation of local customs and culture (A sense of place).
3. Preservation of open space.
4. Resilient people and ecosystem.

5. Improved Water Quality and watershed function.
6. Protection of ancestral wildlife migration corridors.
7. Restoration and enhancements of aquatic habitats.
8. Enriched species diversity across all ecotypes.
9. Faith and belief in collaborative process.
10. TRUST

To what extent have you been able to measure changes in environmental outcomes (e.g., improved water quality, increasing numbers of species of concern, etc.), soil quality (e.g. increased soil organic matter), yield, and/or production costs?

- Majority of private lands still in multi-generational family operations.
- Six streams removed from the EPA's 303(d) list due to improved water quality.
- Physical, chemical, and biological water quality improved on over 200 miles of streams and rivers.
- Improved watershed function on over one million acres.
    - Including increased ground cover and desirable vegetation.
    - Over 1,000 acres of wetlands enhanced or created.
    - 85,000 acres of vegetation treatments to improve species age class & composition.
    - Improved riparian habitat on over 300 miles of intermittent & perennial streams.
    - Increase water infiltration, and improved hydrograph attributes.
- Eliminated 14 fish barriers opening up and reconnecting over 120 miles of river and stream habitat.
- Two listed Important Bird Area's (IBA's) over 125 avian species
- Restored native fishes to over 27 miles of streams.
- Stable to increasing population of sage grouse and Columbian sharptailed grouse.
- Increasing population of elk (4,200 – 10,000).
- Stable to increasing population of mule deer (19,000) and antelope (25,000).
- 50 miles of big game migration corridors improved through obstacle removal.

If you have measured change, please provide a snapshot of your findings.

- Three times highlighted in EPA's 319 success stories 1996 -2012.
- Six streams removed from the EPA's 303(d) list due to improved water quality.
- Peer reviewed published results in the Journal of Soil and Water Conservation, Journal of Rangeland Ecology, and University of Wyoming technical bulletins.
- Six master thesis and one PhD dissertation on water quality, hydrology, riparian management, and fisheries.
- Numerous Land management and collaborative partnership awards with state and federal agencies, trade organization, and NGO's.

- Publication in popular magazines like Bugle Magazine - Rocky Mountain Elk Foundation, Wyoming Wildlife, Rangelands, Range Magazine, Beef Today, and Farm Journal.

What have been the challenges associated with monitoring and measuring change?
Cost, changing technology, and increased regulatory burden.

What are the most significant impediments to achieving intended objectives, particularly measurable improvements in environmental outcomes – and how might they be addressed (consider policy at multiple levels, private sector, civil society)?

1. Increased regulatory impediments. (CWA, NEPA, & ESA)
2. Increased centralized decision making and bureaucratic process. (NRCS, COE, & BLM).
3. Litigation and threats of litigation. (USFS).

What are some of the key lessons you have learned about what it takes to engage producers and landowners in participating in and taking ownership of efforts to improve environmental outcomes in their watershed?

First this question should not be constrained to just landowners! It should include government agencies and nongovernmental organizations.

Fundamentally there are three "axioms" that should be adhered to engage ANY PARTICIPANTING ENTITY in taking ownership of efforts to improve environmental outcomes in their watershed.

I. People mistrust what they do not understand!

II. People resist what is forced upon them!

III. People Support What They Help Create!

Big Darby Creek

Fred Yoder, Farmer, Ohio

Big Darby Creek: A Cautionary Tale

Drawn in large part from "Big Darby Creek Case Study: A Profile of Watershed Threats and Protection in a Midwest Landscape," US Environmental Protection Agency, December 2000. EPA 841-B-00-004. http://water.epa.gov/learn/training/wacademy/upload/2008_09_12_watershed_wacademy_darby13-2.pdf

During most of the 20th century the impacts on the Darby system by farming activities was relatively benign and a large percentage of the main channel and tributaries remained in good health. Big Darby Creek is among the most ecologically healthy stream systems in Ohio and the midwestern Corn Belt. Big Darby and Little Darby Creeks are not pristine, but (unlike most midwestern Corn Belt streams) most stretches have remained in fine condition despite conversion of the watershed to agricultural use, maintaining much of their original character. The watershed supports a rich aquatic life (almost 100 fish species and 40 mussel species). Many species are rare. Among them, one fish and two mussel species have been listed as endangered under the Endangered Species Act. The stream and the watershed are highly valued by watershed inhabitants and others for their aesthetic and recreational qualities as well.

In the mid-to late 1980s those working for USDA Natural Resources Conservation Service (NRCS), USDA Farm Service Agency (FSA), and the Ohio State University Extension Service (OSUE) became increasingly concerned about the impacts of farming on water quality within the Big Darby Watershed. In 1991, USDA personnel succeeded in getting Big Darby approved as a federally recognized Hydrologic Unit Area (HUA), which resulted in extra funding to increase staffing of USDA agencies operating in the watershed while also providing additional cost-share funding to farmers to implement best practices. Another important effect of the HUA designation was to focus efforts on a watershed, rather than county, basis.

Also in 1991 OSUE agents and farmers began to form a task force to address environmental and economic issues facing famers in the watershed. During this time there was an increasing concern amongst farmers that an increased attention on Big Darby Creek, coupled with criticism of agricultural nonpoint source pollution, would eventually lead to a regulation of agriculture. OSUE agents selected 20-30 farmers in the watershed who they considered to be "opinion leaders" – meaning farmers whom could influence other farmers. This group of farmers coupled with OSUE personnel evolved into a nonprofit organization called Operation for Future Association (OFA).

OFA sponsored many kinds of activities, including:

- Canoe trips in the Darby for farmers, scientist, environmentalist and others to display the Darby's resources and protect the streams.
- Field days attended by local farmers to address both environmental and agricultural topics, including conservation tillage and nutrient pesticide management.
- Seasonal newsletters with information on OFA, available cost-share programs, and related watershed activities.

Of all the activities listed above the canoe trips were widely-regarded to be the most effective practice. These trips provided an array of different groups including farmers, environmentalists, scientists, and officials a chance to meet and share ideas and concerns regarding protection of the Big Darby. They also provided an opportunity for groups to learn about the unique biological character of the area. Raising an awareness and an appreciation for the ecological condition of the Darby among farmers led to better working relationships between stakeholders within the watershed, including better communication, mutual understanding, increased trust, and eventually collaboration between farmers and environmentalists. OFA eventually came to list 150 farmers as members.

Designation of the Darby as an HAU, programs and resources regularly available from USDA, and the efforts of other groups had significant impacts in the region:

- Between 1991 and 1996 conservation tillage in the watershed increased from an estimated 45,000 acres to 111,000 acres.
- In 1996, sediment entering the streams from farms was estimated to have been reduced by 25,000 tons from a historical average 125,000 tons/years.
- Nutrient and pest management plans were applied on 14,650 acres.
- 136 acres of filter strips were installed.
- 191 acres of grassed waterways were planted.
- 17,783 feet of fencing were installed along the Darby and its tributaries.
- 321 acres of trees were planted.
- 14 water and sediment control basins (WASCOBs) were installed.

These accomplishments reflect the work of OFA, agencies and conservation organizations, which succeeded in producing an awareness amongst those in the farm community of the ecological importance of the watershed – and potential threats posed to it by farming. This awareness contributed to implementation of better farming practices. The changes in agricultural practices have relied almost entirely on voluntary actions of individual farmers – no regulatory controls existed for this activity. Farmers were instead motivated by personal concerns for the watershed, examples set by farmer "leaders," peer pressure, economic interest, and the threat of regulatory control. Significant changes in practices resulted in the measurable

changes on the land identified above; however, no direct scientific evidence was found at the time of the 1996 study to link these changes in agricultural practices to conditions in the aquatic resources of the streams.

Factors that were significant in achieving a robust response to threats to the watershed were the social and cultural values of those who live in the watershed, economic factors of the area itself, and a variety of other factors including that most of the land was privately –and not federally—owned.

Importantly, there has been since the early 1990s an increase in suburban and residential development within the watershed which has threatened to modify the flow regime of the stream, increase sediment and nutrients loads, and has concurrently threatened the stream with habitat destruction. These threats are especially serious, and efforts to address them have not been as successful as efforts to address threats from agriculture. [This ends the portion drawn from the EPA case study.]

In the late 1990s, the US Fish and Wildlife Service (USFWS) proposed a 50,000 acre wildlife refuge along the Darby to ensure it stay pristine and able to support the rare fish and mussels that live in it. The USFWS plan would have taken some of the best farm land in the state out of production and led to the loss of commerce and tax revenue to the local townships. Conservation organizations that had been successfully partnered with farmers to plant riparian and grass buffers along the river supported the USFWS plan, which they saw as a permanent fix to sediment and nutrient runoff. Farmers involved in OFA were blamed by their neighbors for having called attention to the watershed; and some of the farmers in OFA started blaming conservation organizations for alerting USFWS to proposing a refuge. Relationships unraveled. There likely would still be a watershed club today, continuing to get farmers to voluntarily enhance their conservation efforts on their farms, if the USFWS had not proposed a wildlife refuge along the Darby. It damaged the trust that had been built up between conservation groups and farmers. Though the 20 or so farmers who were involved in OFA are still doing a great job of conservation because they care about protecting the watershed, many more likely would be involved today had the farm community not been threatened with establishment of a wildlife refuge (the proposal for the refuge was defeated).

The Nature Conservancy's Global Agriculture Strategy

Sean McMahon, North American Agriculture Program Director, Iowa

Excerpted for AGree Workshop

Global Opportunity: Sustainable Intensification of Agriculture

Global population will stabilize at around 9.7 billion people in 2050. There is consensus that world food supply will need to increase by between 70 and 100 per cent by then, not just to feed three billion extra mouths but also to support the lifestyles of expanding middle classes in countries like China, India and Brazil, which will reach developed country levels of per capita income a generation from now.

This poses major challenges for conservation. The total area of cropland in the world is approximately equal to South America. The total area of land being grazed is approximately equal to Africa. Large areas of the world are unsuitable for agriculture and will remain so. Doubling food production by doubling area devoted to cropland and pasture would be difficult. Water presents a similar picture: with 70 per cent of global water consumption coming from agriculture, water scarcity and water quality are major challenges as we project demand a generation into the future.

Agriculture is also a key driver of climate change. Approximately a third of global greenhouse gas emissions are directly related to agriculture: around 18 per cent of global GHG emissions is from habitat conversion, especially deforestation, with another 12-14 per cent coming from other direct sources such as fertilizers and methane emissions from livestock[1]. An important part of the global response to climate change must be agricultural systems that are resilient to climate change: more tolerant of drought, flooding and higher salinity, more resistant to pests and more capable of maintaining and improving organic content in soils. Habitat conversion for agriculture should be minimized everywhere and eliminated altogether where possible.

From this four points flow, in logical sequence:

▪ Production systems must intensify. This has to be at the centre of *conservation* thinking about agriculture, a radical departure from tradition

▪ Intensification has to be sustainable. This is hard. An increase in return per unit area means market mechanisms can stimulate agricultural expansion. Increasing inputs can have environmental costs.

▪ Some expansion of agricultural area is necessary: "freezing the footprint" of agriculture may be possible in the US or western Europe but is not a realistic option at the global level. We must expect significant agricultural expansion in the tropics, eastern Europe and central Asia. Channeling that expansion where it will do least harm is imperative.

▪ Agriculture needs to intensify *while maintaining the environmental services on which producers and society depend*.

We therefore argue for sustainable intensification as the basis of the Conservancy's agriculture strategy.

[1] Beddington J, Asaduzzaman M, Clark M, Fernández A, Guillou M, Jahn M, Erda L, Mamo T, Van Bo N, Nobre CA, Scholes R, Sharma R, Wakhungu J. 2012. Achieving food security in the face of climate change: Final report from the Commission on Sustainable Agriculture and Climate Change. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark.

We need to get beyond a simple vision of agriculture based around a dichotomy between agribusiness and industrial farming on the one hand, and organic, small-scale farming on the other. Genetically modified crops and certified organic farms together account for less than five per cent of the world food system. Sustainable intensification has to happen across the board, in all forms of agriculture and on all types of farm, big and small. Agriculture in 2050 will in many ways be similar to agriculture today. Large-scale commodity production will still dominate agriculture in most of the US, while small-scale farming and rural peasantries will still dominate agricultural landscapes in sub-Saharan Africa, China and India. The farming the world needs going forwards is a pragmatic mix of technologies and management practices adjusted for local context, where relevant ideas can come from anywhere and no agricultural system has a monopoly on best practice. There is no silver bullet, but there may be silver buckshot[2].

THEORY OF CHANGE

Situation Analysis The global agricultural economy has two drivers: expanding population and increasing affluence. In order to meet demand, two patterns have emerged: expanding area and increasing inputs. Each poses distinct challenges. Expansion often occurs at the cost of biodiversity and also has negative carbon impacts, since habitat conversion occurs mainly through burning. Increasing inputs has historically comes at an environmental cost, as the link between nutrient run-off and hypoxia in the Gulf of Mexico shows. While productivity gains in some places over the last generation have been impressive – US agriculture increased productivity almost 50 per cent between 1982 and 2007, while land devoted to agriculture fell from 54 to 51 per cent[3] - there are doubts this can be maintained at the global level, especially with greater climate instability.

Agriculture's visibility as an issue is rising. Policymakers have paid more attention to agriculture since a spike in world food prices in 2008. Companies often perceive and manage supply chains with potential environmental constraints, such as climate change and water scarcity, in mind. The importance of agriculture as a driver of climate change is increasingly recognized by policymakers, as is the need to adapt to climate change by making agricultural systems more resilient. In some very relevant areas, such as water issues and addressing agricultural drivers of habitat conversion, the Conservancy's leadership and expertise is widely recognized.

However, a major challenge is the way the "food security" issue plays out for the Conservancy. Our position is that the foundation of food security is environmental: the conservation and effective management of the soils, water and other ecological processes, such as pollination, upon which agricultural productivity depends. This is relevant at the farm level but goes beyond it, addressing the place of agriculture in a broader landscape where agriculture has an important role but is not the only presence on the land. This is not the way "food security" is currently defined in the public arena. Driven by a narrower focus on poverty and malnutrition, which concentrates on distribution and equity and excludes environmental services, key institutional actors in the public sector and the foundation world, currently view agriculture in terms of its contribution to "food security" defined as the nutritional status of the rural poor[4]. This is an important concern, but it cannot be addressed without taking environmental services into account. A single-minded focus on increasing output by increasing access to key inputs like fertilizer and seed, which tends to accompany this perspective, can have negative social and economic consequences without factoring in the environmental implications.

[2] I thank Jon Foley of the University of Minnesota's institute of the Environment for this phrase
[3] USDA, "Changing Organization of US Farming", Economic Service Information Bulletin no.88 (Washington, December 2011).
[4] One problem in the "food security" debate is the privileging of rural over urban populations when it comes to hunger and nutritional status.

Changing the terms of the food security debate will be beyond our capacity, given its complexity and the number of actors involved. But there is a considerable body of evidence to support our position on the importance of environmental services. Several targeted institutions, such as USAID and the Gates Foundation, respond to evidence-based arguments. A targeted approach to shift thinking within a key subset of participants in the food security debate is feasible.

Our vision of sustainable agriculture Nobody objects to sustainability: most accept the need for agricultural intensification. Yet when we descend to what sustainable intensification means in practice, there is intense and very polarized debate. When we use the phrase "sustainable intensification", how does that translate into the type of agriculture we seek?

First is *soil health*. A healthy soil has a balanced biological community, with high organic matter and the capacity to retain and cycle nutrients and water through a living and functioning soil ecosystem. Healthy soil retains and absorbs moisture better, an important step towards making the best use of water available in water-scarce environments. Better absorption also reduces nutrient run-off, and along with management of water draining from fields is central to reducing agriculture's contribution to eutrophication in freshwater and coastal ecosystems. Healthy soil is less liable to erosion and loss of topsoil, and contributes to making agricultural systems more resilient in the face of climate change. Since healthy soils are also central to increasing yields, a focus on good soil management is key to a sustainable intensification approach.

Second is *resource efficiency*. All agriculture requires inputs, but a sustainable intensification approach implies precision in how those inputs, especially water and fertilizers, are applied. Yields are maximized and environmental impacts minimized when inputs are applied as sparingly and efficiently as possible: the minimum amount necessary in the most effective place, at the most appropriate time. Biotechnology and precision agriculture are important here: they have the potential to increase nutrient take-up, reduce pesticide use and target inputs, such as fertilizer and micronutrients, more effectively. A key challenge is spreading their potential beyond the high production/high intensity production systems where they are currently most utilized.

Third is *integration of natural habitat.* This operates at both farm and landscape level. At individual farm level, integrating areas of natural habitat into farm management helps to maintain a range of environmental services important to farmers, but which also have broader benefits for biodiversity, water quality and climate resilience. Agriculture is always part of a broader landscape upon which every society places multiple demands. Where agricultural expansion happens it should be efficient: as little expansion as possible into native habitat, as much expansion as possible into land already cleared. This has obvious benefits for biodiversity and climate change but is also more efficient in terms of productivity: concentration promotes higher intensity in production systems, geographical dispersal does the reverse.

Fourth is *resilience*. Agricultural systems need to be increasingly resilient to climate change. Resilience means hedging of bets, which requires a larger portfolio of crops, at both farm and landscape levels. Farms also need to be managed more intensively: effective climate adaptation involves crop rotation, cover cropping, tillage systems, erosion control, water management, soil improvement and more precise input management. Many farming systems do some or most of this already, but not necessarily, and rarely all at the same time. Thus there are pressing needs for agricultural extension, combined with political and financial support. Adapting agriculture to climate change will pose hard institutional, cultural and technical challenges which will become pressing in a shorter timeframe than has been generally anticipated.

Solutions from the Land

Ernie Shea, Project Coordinator

Solutions Overview

Solutions from the Land (SfL) is a national dialogue led by agriculture, forestry and conservation thought leaders. Started in 2009, SfL is working to help landowners and those who manage the land--farmers, ranchers and foresters--to make the most of the land's potential.

We believe agricultural and forestry systems should be recognized and valued for all that they provide society: food and energy security; clean water and air; wildlife habitat and a healthy environment. Inspired by this vision, SfL invites landowners and managers to join in a conversation about how we can meet society's appetite for food, fiber, energy and environmental quality.

Sponsors

Farm Foundation NFP and The Nature Conservancy

VISION STATEMENT

In 2050, U.S. farmers, ranchers, and foresters manage land to produce the food, fiber and energy needed to support a growing population and economy, while simultaneously protecting and improving biodiversity and the health of the environment.

PATH FORWARD

- Complete and release a "pathways report" in early 2013 outlining how the SFL vision can be achieved:
  - Implement landscape scale solutions and partnerships;
  - Harmonize policy frameworks;
  - Reward stewardship of ecosystem services by strengthening and adopting output objectives for each landscape;
  - Strengthen research, extension, education and public-private partnerships; and
  - Transform and modernize information networks.

- Engage U.S. agriculture, forestry and conservation thought leaders in an extended conversation about solutions they can deliver from the land and secure their buy in and support for the SFL vision and outcomes.

- Participate in global forums where sustainable land management strategies are being explored sharing ideas and listening and learning from others who share the SFL vision.

- Build a coalition to advance the SFL vision

Desired Outcomes

We envision a future that is significantly different from the past:

- Productivity is increasing in ways that allow landscapes to provide the full range of needed ecosystem services.

- Landowners and managers are making more efficient use of inputs, reducing waste and overall consumption of natural resources.

- Farmers, ranchers, foresters and other land managers are supported and compensated for their stewardship of ecosystems and the ecosystem services the land provides, such as clean water and air, wildlife habitat, biodiversity and carbon sequestration.

- Communities are engaged constructively at the policy level to participate with land owners and managers in resolving competing priorities in their own home landscape.

- Policy decisions about land use and land management at all levels reflect the results of multi-stakeholder assessment and negotiation so that regulatory frameworks support, rather than inhibit, sustainable land management.

- Integrated land use approaches are the major framework for planning and are incorporated into policy statements and initiatives.

- There is increased public sector funding for an integrated land use agenda.

- Cross-agency collaboration, resource-sharing and regulation alignment are widespread.

- The U.S. is playing a key role in promoting integrated land use policy internationally.

- Research institutions are re-organized to serve integrated solutions from the land.

- Market mechanisms are in place that encourage and incentivize farmers and the private sector to manage ecosystems sustainably.

- The SFL vision is realized.

Lime Creek Watershed Project

Richard Sloan

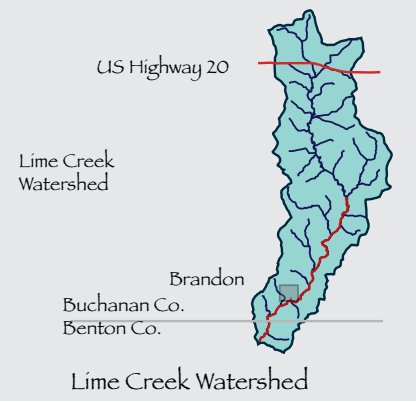
About Lime Creek

Lime Creek is a 27,039 acre sub-watershed of the Cedar River in western Buchanan County with its outflow in northwest Benton County approximately 25 miles from Cedar Rapids.

The lower one-half of the 16 mile stream is on the final 2004 Iowa list of Section 303(d) Impaired Waters. The cause/stressor is identified as biological, potentially flow alteration, habitat modification, nutrients and/or siltation.

A TMDL has not been completed for Lime Creek; however, a completed TMDL for the Cedar River includes a goal of 35 percent reduction of nitrate to 9.5 mg/L due to the classification as a drinking water supply resource for the people of Cedar Rapids.

Recognizing Lime Creek as a contributor of nitrate to the Cedar River, the Lime Creek watershed council adopted a goal of reducing both nitrate and phosphorus by 35 percent.



History, mission and Targeted activities

Beginnings

Lime Creek is one of two subwatershed projects in the larger Cedar River watershed in eastern Iowa where producers have used a community-based approach, computer modeling and science to help them improve their farm management.

Along with Coldwater-Palmer watershed, located to the northwest in Butler and Floyd counties, Lime Creek project used the Hewitt Creek model to involve watershed residents in a long list of management practices aimed at improving water quality.

One impetus to local action came from Iowa Department of Natural Resources listing of Section 303(d) of impaired waterways.

The lower one-half of Lime Creek was on the final 2004 list of 303(d) impaired waters and when the Lime Creek watershed council, composed of residents and landowners in the watershed, organized in 2006 it adopted a goal of reducing both nitrate and phosphorus by 35 percent. The council held meetings about six times a year to review budgets, set goals, evaluate progress and establish incentives for cooperators.

Richard Sloan of Rowley was among the first landowners to become involved.

"I received a letter from the Buchanan County Extension inviting me to attend an organzational meeting for a new watershed group."

Lime Creek's watershed improvement project was initiated with a $90,000 three-year grant from the Iowa Corn Growers Association.

The early meetings informed landowners the purpose of the formation of a watershed group as well as the purpose of the ICGA funding.

"I learned some of the fundamentals of the performance-based incentives model which would be tried," said Sloan.

When the group was formed, Sloan, who has had a "long-term interest in farming while protecting the environment," was elected president.

Watershed council leaders used a performance-based approach to achieve nutrient reduction goals and promote broad participation and increased implementation of nonpoint source management strategies in Lime Creek. The program also included a short list of best management practice incentives such as grassed waterways, spring nitrogen application and soil testing.

In this program, cooperators are paid incentives for sustainable stewardship and bonus rewards for improving environmental performance. The goal was to accomplish improved performance while improving net farm income.

The Lime Creek council, organized as an Iowa non-profit corporation, applied for an Iowa Watershed Improvement Board (WIRB) grant in 2006.

Program participation

The three-year grant (2007-2009) allowed the council to expand watershed participation by 12 new cooperators in 2007. In all, cooperators have enrolled 10,653 crop acres in the program.

Forty-five percent of watershed residents took part in the program, with 23 cooperators completing Phosphorus Index (PI) and Soil Conditioning Index (SCI) calculations for 12,068 acres. The two

Bioreactor demonstration

In a specialized area of nutrient management, a denitrifying bioreactor demonstration was installed in the north end of the watershed, on the farm of Kenneth Pint, in November 2006. The bioreactor site receives tile-line water from about 100 acres of corn-bean rotation, mostly flat land that is characteristic of the area. Explained simply, the bioreactor filters nitrates from the water using hardwood chips in a subsurface mass. Starting in 2007, water samples were monitored regularly and initial 2007 results were promising with 90 percent nitrate removal; however, drainage problems affected bioreactor efficiency in subsequent years. Monitoring continued through 2010.

indices along with the cornstalk nitrate test (CNT) are tools used by cooperators to evaluate conservation and nutrient management performance. The average Phosphorus Index, 0.88 (very low) and Soil Conditioning Index, 0.56 (on a scale of –1 to +1.1), along with the water monitoring data were used to set project priorities. Performance is high because 48 percent of participating farms use no-till planting for at least one crop in their rotation.

Project cooperators improved SCI scores 200 percent when no-till planting soybeans on environmentally sensitive fields. During the course of the project, participants reduced sediment delivery to Lime Creek by 959 tons per year and P delivery by 1,246 pounds per year through installing and improving waterways, planting vegetative filters and reducing tillage.

Three-quarters of the cooperators enrolled in the cornstalk nitrate testing program. Jesup High School FFA members collected samples, estimated yield and reported results to cooperators. Annual cornstalk nitrate test results and corn yields were variable but the process allowed cooperators to evaluate their nitrogen applications for the first time. In 2008, the average N nitrate of 24 samples (7 farms) was 2,876 ppm.

"What I learned from the indexes," said Sloan, "was a field by field analysis of how my crop rotations, fertilizations and tillage plans affect my farm's surface water pollution potential and how I could farm to build up organic matter in my soil to improve my farm's long term productivity."

"After a year or two, I sat down and mapped out a three-year rotation plan on one farm and a five-year plan on the other to help me in applying fertilizer and tillage at the opportune times...."

What was learned, what next?

WIRB funding for Lime Creek watershed ran out at the end of 2009, but the watershed council continues its efforts as well as the incentive program, using remaining Corn Growers funding. Currently, the project is conducting cornstalk nitrate testing for participating cooperators, again with Jesup FFA members gathering the samples.

What was accomplished during the three-year project? In addition to his personal experience, described above, Richard Sloan believes one lesson was that "...farmers shared experiences with no-till, waterways, contours, buffer strips and berms to control erosion on our soils and nitrogen application practices to increase efficiency, reduce costs and reduce nitrogen leaching out of the root zone."

"This discussion among farm neighbors in the watershed may have been the most valuable long-term outcome of our group forming."

Other efforts are also underway in the Cedar River watershed. Richard Sloan is involved in the Cedar River coalition, a group of residents and agency personnel looking at future activities in the watershed. There is also a group conducting an overview of Iowa/Cedar River basin, and Lime Creek may become one of the focal watersheds.

Water monitoring

Prior to the formation of the watershed council, from 2000 through 2005, Coe College conducted water monitoring of Lime Creek revealed total nitrogen and phosphorus levels above average for Cedar River tributaries. A goal of the Lime Creek water quality improvement project was to actively address nitrogen and phosphorus management in the watershed. A portion of the Iowa Corn Growers funding was used to monitor stream segments within the watershed.

Long-term monitoring of Lime Creek and six other tributaries of the Cedar River shows a promising trend in water quality improvement. Since 2006, average nitrate concentration is 19 percent lower in Lime Creek when compared to the four years prior to organization of the Lime Creek watershed council. Water monitoring by Coe College since 2000 consistently showed Lime Creek to be the highest contributor of nitrate with concentrations greater than 14 ppm NO_3-N in two of six years prior to council formation. However, during the most recent two years nitrate concentrations have fallen to less than 10 ppm NO_3-N. Dr. Martin St. Clair wrote in a 2008 report to Iowa DNR, "In a somewhat encouraging development the average concentration of nitrate in Lime dropped below 10 mg NO_3-N/L and it remains third [among the seven tributaries] after having the highest average for five of the previous six summers."

Lime Creek season average nitrate concentrations:

Year	Nitrate (ppm)
2000	13.14
2001	14.59
2002	11.99
2003	11.14
2004	14.18
2005	12.26
2006	10.21
2007	10.15
2008	9.87
2009	9.89
2010	12.10

Coe College students Zachary Hayes, Alyssa Qualls and Adam Becker take water samples from Finley Creek, a tributary of Lime Creek, near Brandon. (2010)

Summary – Iowa Science Assessment of Nonpoint Source Practices to Reduce Nitrogen and Phosphorus Transport in the Mississippi River Basin

For the full report — Iowa Nutrient Reduction Strategy — go to www.nutrientstrategy.iastate.edu

Introduction

The 2008 Hypoxia Action Plan calls for states along the Mississippi River to develop nutrient reduction strategies to reduce, mitigate, and control hypoxia in the Gulf of Mexico and improve overall water quality. In October 2010, the Iowa Department of Agriculture and Land Stewardship and the College of Agriculture and Life Sciences at Iowa State University partnered to conduct a technical assessment needed for the development of a statewide strategy to reduce nutrient to streams and the Gulf of Mexico. The team working on this effort consisted of 23 individuals representing five agencies or organizations. Within the overall team, sub-group science teams were formed to focus on nitrogen, phosphorus and hydrology.

The goals of the process were to assess nutrient loading from Iowa to the Mississippi River and the potential practices needed to achieve desired environmental goals. As per the 2008 Gulf Hypoxia Action Plan, these goals are a 45% reduction in riverine N and P load. In conjunction with this non-point source assessment, the Iowa Department of Natural Resources (IDNR) has been conducting an assessment of nutrient loads from point sources.

Based on IDNR estimates, nonpoint source load reductions for nitrate-N would need to achieve 41% load reduction in nitrate-N with the remaining 4% coming from point sources. For phosphorus, the nonpoint source load reductions would need to achieve 29%, with the remaining 16% coming from point sources.

Process

The assessment was conducted in the following steps:

1. *Establish baseline conditions*
   Available information was used to estimate existing conditions relative to nutrient application, timing of nutrient application, existing soil test phosphorus conditions, land use, crop rotations, extent of current tillage practices, estimated extent of land benefitting from tile drainage, and estimated extent of existing conservation practices. These conditions were aggregated by Major Land Resource Area (MLRA). Based on this review, it is clear there is a lack of information on existing conditions, and a need for greater on-going documentation and reporting of this information.
2. *Review scientific literature to assess potential performance of practices*
   A comprehensive list of practices potentially reducing nitrate-N or phosphorus export was assembled and refined based on practices expected to have the greatest potential impact and for which there was research data on the impact to water quality. An extensive review of scientific literature was conducted to assess the potential impact on nitrate-N and phosphorus reductions. Studies included were limited to those conducted in Iowa or surrounding states so climatic conditions would be similar to Iowa conditions. Initial documents on baseline conditions and practice performance were subjected to outside blind peer review.
3. *Estimate potential load reductions of implementing nutrient reduction practices (scenarios)*
   The potential for nitrate-N and phosphorus load reduction with implementation of individual practices or a combination of practices was assessed using the baseline data and information on practice performance. Example scenarios of practice combinations where the water quality goals could potentially be achieved were identified.
4. *Estimate cost of implementation and cost per pound of nitrogen and phosphorus reduction*

Economic costs of combination scenarios were computed considering the cost for implementing the practice and any potential impact on crop yield, specifically corn grain yield. An equal annualized cost (EAC) was computed so those practices with annualized costs and those with large initial capital costs could be appropriately compared.

Nutrient Reduction Practices

Nitrogen

Nitrogen reduction practices ranging from in-field nitrogen management practices to edge-of-field practices to land use change were reviewed to assess the potential for nitrate-N reduction and impacts on corn yield (Table 1). Based on this review, practices related to the timing of nitrogen application resulted in less than a 10% reduction in nitrate-N, no matter the timing of nitrogen application. In addition, all of these timing practices had high standard deviations (20% or greater), indicating that certain years there could be a fairly dramatic increase in nitrate-N.

For example, moving from fall to spring pre-plant nitrogen application, the percentage of nitrate reduction plus or minus one standard deviation is -19% to 31%. Inclusion of a nitrification inhibitor with fall-applied nitrogen had slightly higher nitrate-N reduction than the timing practices (9% reduction) but the standard deviation was still 19%. For the nitrogen management practices that consider nitrogen rate, timing, or source, the rate of nitrogen application and, specifically, reducing the average nitrogen application rate to the Maximum Return to Nitrogen Rate (MRTN) shows greatest potential for nitrate-N reduction. It should be noted some of the nitrogen timing or inhibitor practices show potential to increase corn yield. Overall, for the practices categorized as a nitrogen management practice, cover crops and living mulches show the greatest potential for nitrate-N reduction. However, both a rye cover crop and kura clover living mulch have the potential for reduced corn yield. Reducing potential negative corn yield impacts when utilizing a cover crop or living mulch is an area where future research is needed.

Land use change through conversion of corn-soybean systems to perennial vegetation or extended rotations show potential to dramatically reduce nitrate-N, but conversion to these perennial-based systems would reduce the acreage of corn-soybean. Edge-of-field practices also show potential for substantial reduction in nitrate-N and require little land to be taken out of row crop production.

Phosphorus

Phosphorus reduction practices ranging from in-field phosphorus management practices to erosion control to edge-of-field practices to land use change were reviewed to assess the potential for phosphorus reduction and impacts on corn yield (Table 2). Based on this review, phosphorus management practices have the potential to reduce phosphorus loss, but in all cases the standard deviations associated with these reductions were fairly large - greater than 27%. Reducing tillage intensity has the potential to significantly reduce phosphorus loss, especially when no-till is compared to a chisel plow system (90% reduction in phosphorus load).

Land use change through conversion of row crop systems to perennial vegetation shows potential to dramatically reduce phosphorus but conversion to these perennial-based systems would reduce the acreage of corn-soybean. Edge-of-field practices through buffers or sedimentation basins/ponds show potential for dramatic reductions in phosphorus load, 58% and 85% respectively.

Estimated Potential for Nutrient Load Reduction

Nitrogen

To estimate the baseline nitrate-N load, estimates of existing land use, literature estimates of nitrate-N concentrations in tile and subsurface water, and estimates of water yield to streams were used to compute a baseline nitrate-N load. The loads were calculated for each MLRA in Iowa and loads were accumulated for

a statewide load. To assess the impact of the nitrogen practice implementation, the baseline nitrate-N concentrations were adjusted based on literature estimates for each practice. These concentrations were used to compute a scenario load of nitrate-N, which was compared to the baseline load. From this comparison, the estimate of potential nitrate-N load reduction for each standalone practice was developed (Table 3). It is important to note the computed reductions for standalone practices are not additive. In other words, it's not possible to add together reductions from multiple practices.

From Table 3, the nitrogen management practices with the greatest potential for nitrate-N reduction are a reduction in nitrogen application rate or planting cover crops. Currently, the estimated average nitrogen application (commercial fertilizer and manure) to corn in a corn-soybean rotation is 151 lb-N/acre and 201 lb-N/acre to corn in continuous corn rotation. The MRTN for corn following soybean is 133 lb-N/acre and 190 lb-N/acre for corn following corn ($5.00/bushel corn and $0.50/lb nitrogen). In addition, sidedressing nitrogen rather than just a spring pre-plant application has some potential for nitrate-N reduction (4%). Moving nitrogen that is currently fall applied (estimated to be about 25% of the total fertilizer nitrogen for corn) to spring application shows little potential for overall nitrate-N reduction (less than 1%).

The edge-of-field practices of wetlands targeted for water quality benefits and subsurface drainage bioreactors show the greatest potential for nitrate-N reduction, 22% and 18% reductions, respectively. The potential for nitrate-N reductions for controlled drainage are limited by land area applicable for this practice (slopes less than 1%). Also, while nitrate-N concentration in water moving through the shallow groundwater below a buffer has been shown to be dramatically reduced (approximately 91%), the overall potential for nitrate-N load reduction by buffering all agricultural streams is limited (approximately 7%). This load reduction is limited by water interception and shallow groundwater movement below the buffer. Land use change also shows potential for nitrate-N reductions but the level of reduction will be dependent on the overall amount of land converted to a perennial based system or extended rotation.

A review of Table 3 shows no single practice would achieve nutrient reduction goals other than major land use changes. Instead, a combination of practices will be needed. There are endless combinations, but a few combined scenarios are highlighted in Table 4 that would reach goals for both nitrate-N and phosphorus. These represent a range of initial investments and annualized cost and benfits. Economic costs of these combination scenarios were computed considering the cost for implementing the practice and any potential impact on crop yield, specifically corn grain yield. An equal annualized cost (EAC) was computed so those practices with annualized costs and those with large initial capital costs could be appropriately compared. For the capital costs, a design life of 50 years and a discount rate of 4% was used. The price of corn was assumed to be $5/bushel and the cost of nitrogen was assumed to be $0.50/lb N. It is evident a range of scenarios are possible to achieve the nitrate-N and phosphorus reduction goals and that combinations of practices would be needed, with potential costs varying dramatically depending on which practices are implemented.

Phosphorus

The Iowa P Index is a quantitative assessment tool intended to assess risk of P loss from individual agricultural fields, allow for comparisons of conservation and P management practices in relation to potential P loss, and estimate P delivered to the nearest stream or water body. This model is comprehensive and estimates P loss, taking into account location in the state, soil type, soil test phosphorus, P application rate, tillage practices, source, timing and incorporation practices, runoff, erosion, and distance to the nearest stream or water body. To achieve the objectives of this effort, the science team adapted this tool to estimate P loads from MLRAs. To assess the impact of phosphorus reduction practice implementation, scenarios were developed within the P Index representing the number of acres being implemented with each practice or combination of practices. From this comparison, the estimate of potential P load reduction for each standalone practice or combination of practices was computed. It is

important to note the computed reductions for standalone practices are not additive. In other words, it's not possible to add together reductions from multiple practices.

Alternatives for reducing P loading to receiving waters fall into three main groups: P management practices, edge-of-field and erosion control practices, and land use change. Phosphorus management practices focus on the most effective or efficient use of P, or those that otherwise reduce its availability for transport to receiving waters. As shown in Table 5, the P management strategies of cover crops (50% reduction) and conversion of all tillage to no-till (39% reduction) have the potential to substantially reduce P loss. Converting all acres of intensive tillage (<20% residue) to conservation tillage (>30% residue) would potentially reduce P loss by 11%. Injecting or banding of P within current no-till acres has little potential impact on P loss (<1%).

Edge-of-field technologies are designed primarily to settle sediment, or, in some cases, to retain dissolved P. These provide opportunities to remove P either in combination with the above practices or as stand-alone P reduction strategies. While the potential reduction of many erosion control practices could not be estimated due to lack of data, streamside buffers were estimated to have the potential to reduce P loss by 18%.

A third option is changing land use, with major focus on cropping systems that involve perennial vegetation cover or rotations of row crops with perennial forage crops for hay, pasture, or bioenergy production. As shown in Table 5, scenarios were developed that would change land use to perennial crops (energy crops), or pasture and land retirement equal to the acreage of pasture, hay, and Conservation Reserve Program land in 1987. Of these two scenarios, conversion to perennial energy crops would have the greatest potential to reduce P loss (29%). Doubling the amount of current extended rotation acres would have little potential impact on P loss (3%).

A review of Table 5 shows that only a few single practices would achieve P reduction goals without significant land use change. Instead, a combination of practices, likely in conjunction with N reduction practices, will be needed. As discussed above, these combinations are highlighted in Table 3.

Future Needs

While significant research has been conducted on the potential performance of various nutrient reduction practices, there is a need for development of additional practices, testing of new practices, further testing of existing practices, and verifying practice performance at implementation scales. Many of the studies used in this evaluation were conducted at the plot scale. While these provide critical information and studies of this kind should continue, there also is a need for studies that scale up the area of practice implementation to better assess water quality impacts across landscapes and with multiple practices. Additional research also likely would improve the predictability of practice performance and improve the understanding of practice uncertainty.

There is a need for monetizing economic benefits that might be derived from improved water quality or other ecosystems services. Also, there is a need to examine the level of acceptance of the various nutrient reduction practices.

In addition, to assess potential landscape-scale changes, there is a need for better tracking of practices currently in place, including but not limited to land use, crop rotations, nutrient applications, tillage, and conservation practices. In this analysis, the practices and existing conditions were aggregated on a MLRA scale, but actual implementation would be at a much finer scale. This highlights the need for actual practice information at the field level in order to better inform future assessments on potential gains or actual gains being made in achieving nitrogen and phosphorus nutrient reductions to surface waters.

Table 1. Nitrogen reduction practices – potential impact on nitrate-N reduction and corn yield based on literature review.

	Practice	Comments	% Nitrate-N Reduction+	% Corn Yield Change++
			Average (SD*)	Average (SD*)
Nitrogen Management	Timing	Moving from Fall to Spring Pre-plant Application	6 (25)	4 (16)
		Spring pre-plant/sidedress 40-60 split Compared to Fall Applied	5 (28)	10 (7)
		Sidedress - Compared to Pre-plant Application	7 (37)	0 (3)
		Sidedress – Soil Test Based Compared to Pre-plant	4 (20)	13 (22)
	Source	Liquid Swine Manure Compared to Spring Applied Fertilizer	4 (11)	0 (13)
		Poultry Manure Compared to Spring Applied Fertilizer	-3 (20)	-2 (14)
	Nitrogen Application Rate	Reduce to Maximum Return to Nitrogen value 149 kg N/ha (133 lb N/ac) for CS and 213 kg N/ha (190 lb N/ac) for CC	10‡	-1‡‡
	Nitrification Inhibitor	Nitrapyrin – Fall - Compared to Fall-Applied without Nitrapyrin	9 (19)	6 (22)
	Cover Crops	Rye	31 (29)	-6 (7)
		Oat	28 (2)**	-5 (1)
	Living Mulches	e.g. Kura clover - Nitrate-N reduction from one site	41 (16)	-9 (32)
Land Use	Perennial	Energy Crops Compared to Spring- Applied Fertilizer	72 (23)	-100ɣ
		Land Retirement (CRP) Compared to Spring- Applied Fertilizer	85 (9)	-100ɣ
	Extended Rotations	At least 2 years of alfalfa in a 4 or 5 year rotation	42 (12)	7 (7)
	Grazed Pastures	No pertinent information from Iowa - Assume similar to CRP	85***	NA
Edge-of-Field	Drainage Water Mgmt.	No impact on concentration	33 (32)^	
	Shallow Drainage	No impact on concentration	32 (15)^	
	Wetlands	Targeted Water Quality	52†	
	Bioreactors		43 (21)	
	Buffers	Only for water that interacts with active zone below the buffer - a small fraction of all water that makes it to a stream.	91 (20)	

+ A positive number is nitrate concentration or load reduction and a negative number is increased nitrate.
++ A positive corn yield change is increased yield and a negative number is decreased yield. Soybean yield is not included as the practices are not expected to affect soybean yield.
* SD = standard deviation.
‡ Reduction calculated based on initial application rate for each Major Land Resource Area (MLRA).
‡‡ Calculated based on the Maximum Return to Nitrogen (MRTN) relative yield at the given rates.
** Based on 1 study with 3 years of corn and 2 years of soybean.
*** This number is based on the Land Retirement number – there are no observations to develop a SD.
^ These numbers are based on load reduction since there is no impact on concentration with these practices
† Based on one report looking at multiple wetlands in Iowa (Helmers et al., 2008a).

Table 2. Practices with the largest potential impact on phosphorus load reduction.
Notes: Corn yield impacts associated with each practice also are shown as some practices may be increase or decrease corn production. See text for information on value calculations.

	Practice	Comments	% Phosphorus Load Reduction[a]	% Corn Yield Change[b]
			Average (SD[c])	Average (SD[c])
Phosphorus Management Practices	Phosphorus Application	Applying P based on crop removal - Assuming optimal soil-test P level and P incorporation	0.6[d] [70[e]]	0[f]
		Soil-Test P – Producer does not apply P until soil-test P drops to the optimal level	17[g] [40[h]]	0[f]
		Site-specific P management		0[f]
	Source of Phosphorus	Liquid swine, dairy, and poultry manure compared to commercial fertilizer – Runoff shortly after application	46 (45)	-1 (13)
		Beef manure compared to commercial fertilizer – Runoff shortly after application	46 (96)	
	Placement of Phosphorus	Broadcast incorporated within one week compared to no incorporation – Same tillage	36 (27)	0[f]
		With Seed or knifed bands compared to surface application without incorporation	24 (46) [35[i]]	0[f]
Erosion Control and Land Use Change Practices	Tillage	Conservation till – chisel plowing compared to moldboard plowing	33 (49)	0 (6)
		No till compared to chisel plowing	90 (17)	-6 (8)
	Crop Choice	Extended rotation	[j]	7 (7)[k]
	Perennial	Energy crops	34 (34)	NA
		Land retirement (CRP)	75[l]	NA
		Grazed pastures	59 (42)	NA
	Terraces		77 (19)	
Edge-of-Field Practices	Wetlands	Targeted water quality	[m]	
	Buffers		58 (32)	
	Sediment Control	Sedimentation basins or ponds	85	

a - A positive number is phosphorus reduction and a negative number is increased phosphorus.
b - A positive corn yield change is increased yield and a negative number is decreased yield. Practices are not expected to affect soybean yield.
c - SD = standard deviation.
d - Maximum and average estimated by comparing application of 200 and 125 kg P_2O_5/ha, respectively, to 58 kg P_2O_5/ha (corn-soybean rotation requirements) (Mallarino et al., 2002).
e - This represents the worst case scenario as data is based on runoff events 24 hours after P application. Maximum and average were estimated as application of 200 and 125 kg P_2O_5/ha, respectively, compared to 58 kg P_2O_5/ha (corn-soybean rotation requirements), considering results of two Iowa P rate studies (Allen and Mallarino, 2008; Tabbara, 2003).
f - Indicates no impact on yield should be observed.
g - Maximum and average estimates based on reducing the average STP (Bray-1) of the two highest counties in Iowa and the statewide average STP (Mallarino et al., 2011a), respectively to an optimum level of 20 ppm (Mallarino et al., 2002). Minimum value assumes soil is at the optimum level.
h - Estimates made from unpublished work by Mallarino (2011) in conjunction with the Iowa P Index and Mallarino and Prater (2007). These studies were conducted at several locations and over several years but may, or may not, represent conditions in all Iowa fields.
i - Numbers are from a report by (Dinnes, 2004) and are the author's professional judgment.
j - There is scarce water quality data for P loss on extended rotations in Iowa compared to a corn-soybean rotation.
k - This increase is only seen in the corn year of the rotation – one of five years.
l - From a presentation in Illinois by McKenna (2009).
m - Specific conditions are important in wetlands with regards to P as with changing inflow loads.

Table 3. Example Statewide Results for Individual Practices Relative to Estimated Nitrate-N Reduction.
Notes: Research indicates large variation in reductions not reflected in this table and some practices interact such that the reductions are not additive.

	Name	Practice/Scenario*	Nitrate-N Reduction % (from baseline)	Total Load (1,000 short ton)	N Reduced from baseline (1,000 short ton)
	BS	Baseline		307	
Nitrogen Management	CCb	Cover crops (rye) on ALL CS and CC acres	28	221	79
	RR	Reducing nitrogen application rate from background to the MRTN 133 lb N/ac on CB and to 190 lb N/ac on CC (in MLRAs where rates are higher than this)	9	279	28
	CCa	Cover crops (rye) on all no-till acres	6	288	18
	SN	Sidedress all spring applied N	4	295	12
	NI	Using a nitrification inhibitor with all fall applied fertilizer	1	305	2
	FNb	Move all liquid swine manure and anhydrous to spring preplant	0.3	306	1
	FNa	Moving fall anhydrous fertilizer application to spring preplant	0.1	307	0
Edge-of-Field*	W	Installing wetlands to treat 45% of the rowcrop acres	22	238	69
	BR	Installing denitrification bioreactors on all tile drained acres	18	252	55
	CD	Installing Controlled Drainage on all applicable acres	2	300	7
	BF	Installing Buffers on all applicable lands	7	284	23
Land Use Changes	EC	Perennial crops (Energy crops) equal to pasture/hay acreage from 1987. Take acres proportionally from all row crop. This is in addition to current pasture.	18	253	54
	P/LR	Pasture and Land Retirement to equal acreage of Pasture/Hay and CRP from 1987 (in MLRAs where 1987 was higher than now). Take acres from row crops proportionally	7	287	20
	EXT	Doubling the amount of extended rotation acreage (removing from CS and CC proportionally)	3	297	10

* These practices include substantial initial investment costs.

Table 4. Example Statewide Combination Scenarios that Achieve Both the Targeted Nitrate-N and Phosphorous Reductions, Initial Investment and Estimated Equal Annualized Costs based on 21.009 Million Acres of Corn-Corn and Corn-Soybean Rotation.

Note: Research indicates large variation in reductions from practices that is not reflected in this table. Additional costs could be incurred for some of these scenarios due to industry costs or market impacts.

		Nitrate-N	Phosphorus	Cost of N Reduction from baseline ($/lb)	Initial Investment (million $)	Total EAC* Cost (million $/year)	Statewide Average EAC Costs ($/acre)
Name	**Practice/Scenario****	**% Reduction from baseline [xx]**					
NCS1	Combined Scenario (MRTN Rate, 60% Acreage with Cover Crop, 27% of ag land treated with wetland and 60% of drained land has bioreactor)	42	30	2.95	3,218	756	36
NCS3	Combined Scenario (MRTN Rate, 95% of acreage in all MLRAs with Cover Crops, 34% of ag land in MLRA 103 and 104 treated with wetland, and 5% land retirement in all MLRAs)	42	50	4.67	1,222	1,214	58
NCS8	Combined Scenario (MRTN Rate, Inhibitor with all Fall Commercial N, Sidedress All Spring N, 70% of all tile drained acres treated with bioreactor, 70% of all applicable land has controlled drainage, 31.5% of ag land treated with a wetland, and 70% of all agricultural streams have a buffer) - Phosphorus reduction practices (phosphorus rate reduction on all ag land, Convert 90% of Conventional Tillage CS & CC acres to Conservation Till and Convert 10% of Non-No-till CS & CC ground to No-Till)	42	29	***	4,041	77	4

* EAC stands for Equal Annualized Cost (50 year life and 4% discount rate) and factors in the cost of any corn yield impact as well as the cost of physically implementing the practice. Average cost based on 21.009 million acres, costs will differ by region, farm and field.

** Scenarios that include wetlands, bioreactors, controlled drainage and buffers have substantial initial investment costs.

*** N practices and cost of N reduction are the same as NCS7 (Section 2.2). Reducing P application meets the P reduction goal and lowers the cost of the scenario.

xx Baseline load includes both point and nonpoint sources.

Table 5. Example Statewide Results for Individual Practices Relative to Estimated Phosphorous Reduction.
Notes: Research indicates large variation in reductions not reflected in this table and some practices interact such that the reductions are not additive.

	Name	Practice/Scenario	Phosphorus Reduction (% from baseline)	Total Load (1,000 short ton)	P Reduced from baseline (1000 Short ton)
	BS	Baseline		16.8	
Phosphorus Management	CCa	Cover crops (rye) on all CS and CC acres	50	8.3	8.5
	Tnt	Convert all tillage to no-till	39	10.3	6.5
	Tct	Convert all intensive tillage to conservation tillage	11	14.9	1.9
	RR	P rate reduction in those MLRAs that have high to very high soil test P	7	15.6	1.2
	CCnt	Cover crops (rye) on all no-till acres	4	16.1	0.7
	IN	Injection within no-till acres	0.3	16.8	0.05
Edge-of-Field*	BF	Buffers (35 ft) on all crop land	18	13.7	3.1
Land Use Changes	EC	Perennial crops (Energy crops) equal to pasture/hay acreage from 1987. Take acres proportionally from all rowcrop. This is in addition to current pasture.	29	11.9	4.9
	P/LR	Pasture and Land Retirement to equal acreage of Pasture/Hay and CRP from 1987 (in MLRAs where 1987 was higher than now). Take acres from rowcrops proportionally	9	15.3	1.5
	EXT	Doubling the amount of extended rotation acreage (removing from CS and CC proportionally)	3	16.3	0.5

* These practices include substantial initial investment costs.

Indian Creek Watershed Project, Conservation Technology Information Center

Karen Scanlon

Project Goal

The Indian Creek Watershed Project aims to document water quality improvements that result when at least 50 percent of cropland and farmers in a small watershed implement conservation cropping systems. We selected Indian Creek watershed because it's a small watershed (52,480 acres) within the Vermilion River watershed (HUC 07130002), which is listed on the impaired waters list for nitrogen and nitrate impairment to public water supply as well as for sedimentation, fecal coliform and other pollutants. The USDA selected the Vermilion River watershed as a target area for its Mississippi River Basin Initiative.

When, why, and how did it get started? Who provided leadership?

CTIC approached Illinois Environmental Protection Agency (IEPA) in fall 2009 with a proposal to work with partners in a small watershed to concentrate public and private support to increase nutrient use efficiency and reduce nutrient input to waterways. IEPA accepted our proposal and invited other state partners to discuss where to target the effort. The group selected Livingston County because of its location in the Vermilion watershed and the strong, active soil and water conservation district.

Who is involved?

- Producers serve on the steering committee, lead demonstrations and Nutrient Use Efficiency trials on their land, assist with outreach, give presentations, participate in meetings and field tours, and spread the word to neighbors and others
- IEPA provides funding through section 319 of the Clean Water Act, conducts in-stream water quality monitoring and assists with events and project team leadership
- Livingston County SWCD provides local leadership, one-on-one technical assistance to producers, manages $1 million in MRBI funding for watershed and organizes events
- Natural Resources Conservation Service provides team leadership, technical assistance to producers and financial assistance through EQIP and CSP
- CTIC members sponsor the project to support technology and practice demonstrations, Nutrient Use Efficiency trials and outreach (see list of sponsors on other sheet)
- The Steering Committee includes: area farmers, the mayor of Fairbury, a local ag lender, Farm Bureau, retailers, equipment dealers, a local high school teacher and an area conservation group. Local, state and federal agency partners and many others serve on the project's advisory committee.

What motivates producers/landowners to participate? Challenges met and how?

We offer producers technical, informational and financial assistance to help improve their productivity and profitability.

Challenges include:

- Being an unknown entity. We found a local champion in the Livingston County SWCD resource conservationist. He became the local face of the project; he established trust with the local producers and community.
- Reaching all 104 producers in the watershed. The resource conservationist at the Livingston County SWCD met with all producers over the course of 2 years.

- Providing information in a timely manner. Collecting data for, analyzing and interpreting results of the demonstrations and NUEs takes time. Producers are eager for results, so we've had to find ways to move our technical consultants faster to produce results in a more acceptable timeframe.

How is it financed?

IEPA provides 52 percent of total project funds through Section 319 of the Clean Water Act. CTIC members and other agribusiness companies provide 48 percent of total project funds through cash and in-kind sponsorship

How do you measure success?

- Producer and community participation in the project and its events
- Results of the demonstrations and NUEs
- Adoption of conservation technologies and practices
- Participation in cost-shared conservation programs
- Water quality monitoring
- Growing awareness of the project
- Resident survey about water quality perceptions
- See other sheet for more

Measure changes in environmental outcomes?

Our Nutrient Use Efficiency trials give the most economical rate of N (MERN value). We compare the MERN value to the farmer's current rate to determine if the demo plot can be the basis for recommending a better rate. We then use GIS to project how many acres this potential change can apply to and the total N loss that can be saved if the improved rate were applied to those acres. Comparing NUE values for different practices (source, rate, timing and placement of nutrients) can tell us how much N can be saved in the watershed.

Because the demonstrations and NUE trials occur on selected areas of individual fields, any measurements of change in the water in Indian Creek has very little to do with the practices we are demonstrating. To effectively use edge-of-field monitoring of water quality---and changes from nutrient management---would require the ability to control practices in the entire field and to monitor confined drainage systems (surface and tile) for each management area. This is not possible in the Indian Creek watershed because we have no information on the tile systems in the individual fields, nor do we have isolated, paired tile drainage systems where different management practices can be compared.

Through a Conservation Innovation Grant, CTIC installed a tile outlet monitoring demonstration on a farm just outside the Indian Creek watershed. We expect to monitor water flow from this field site, however no water flowed the entire 2012 season. We hope for more rain in 2013.

Our partners at Livingston County SWCD and NRCS have met with every producer in the watershed and offered assistance in conservation planning. As a result, 55 percent of producers enrolled in cost-share conservation programs. And, 41 percent of the watershed's acres are enrolled in the Conservation Stewardship Program (CSP) and $101,644 in USDA Environmental Quality Incentives Program (EQIP) funds have been spent in the watershed.

IEPA monitoring data from Indian Creek helps us to understand water quality in the entire watershed. Our small-scale demonstrations do not directly influence water quality changes. We continue to monitor and analyze data for impact of the CSP and EQIP practices added to the watershed.

What are the most significant impediments to achieving intended objectives?

Significant impediments include: time lag between implementation of practices and improvements in water quality; extent of impact of an intentionally small-scale project; conservation plans and participation in voluntary conservation programs are a start – we need to continue to do more.

We need:

- more practical and applied research to demonstrate technologies that improve efficiency and protect resources
- greater access to these technologies – in terms of cost and availability
- more local technical assistance to help producers understand how to integrate new technologies and practices into their management systems and how to adapt over time for maximum productivity
- to continue recognizing producers who have successfully built sustainable operations and who encourage their neighbors to make similar changes
- targeted conservation funding that would allow local groups to set priorities for funding that would improve water quality.

What are some of the key lessons learned?

- Good things don't just happen overnight. Be patient.
- A strong local champion will build key relationships and trust.
- Give producers a real voice… and listen to that voice!
- Leverage partnerships and resources
- Encourage producers to test practices, technologies on their own land in their normal operations. Share their story, give them recognition. Put them in the spotlight to tell about the project.
- Be inclusive.
- Be up-front with your motives.
- Recognize people's desire to protect their own backyard.
- Respect and engage the community.

Conservation Technology Information Center
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Adapt Network

Suzy Friedman, Director for Agricultural Sustainability, Environmental Defense Fund

The Adapt Network is an informal partnership working to improve how nutrients are managed to meet both production and environmental goals. There are two main areas of work:

- A collaboration of land grant university experts and other partners working to further develop and advance improvements to how nutrient recommendations are made – the concepts, processes, and tools for more fine-tuned management at the field and farm scale, and
- Geographically-based projects in which farmers, farm advisors, and other partners are collaborating to use adaptive management to fine tune management on their own farms to use nutrients more efficiently to generate both economic and environmental benefits.

These two branches of the Adapt Network are united around the goal of using data to help farmers and their advisors make better decisions – decisions that improve efficiency, increase profit, and reduce the amount of nutrients lost to the environment.

NUTRIENT MANAGEMENT CHALLENGE -- VARIABILITY: There is a fundamental challenge agronomists have long tried to overcome when it comes to managing nitrogen: the optimum rate of nitrogen for a given field can vary from year to year by more than 60 lbs/acre due to weather and other factors. Many factors significantly affect nitrogen uptake, including time of application, source of nitrogen, method of application or rainfall, and soil condition. Farmers often do not have a structured process to evaluate the economic impacts of different practices.

Through the Adapt Network, farmers work in collaboration with their peers and advisors to evaluate recommendations and make field-specific improvements – adaptive management in real time with documentable benefits. This approach is grounded not only in using field specific data to give individual farmers more information with which to improve efficiency, but also by aggregating field data across multiple farms. This analysis at the individual field and aggregate levels enables farmers to benefit from a wider data pool and benefit from the results of evaluations played out across many more trials and many more fields in their region.

PROJECTS: Through the Adapt Network's on-the-ground projects, farmers are working with their advisors, scientists and others to use cost-effective tools to evaluate the effectiveness of their nutrient management practices. Visit www.adaptnetwork.org to learn more.

RESEARCH AND EXTENSION: Through the Adapt Network's research collaboration, land grant university experts and others are working together to develop the new approach to nutrient management needed if we are to meet both production and environmental goals. There is still much to learn, develop and define in terms of adaptive management, in particular the concepts of the approach and procedures to implement it. Collaborators are working together on these challenges so that adaptive management can be incorporated into nutrient management planning recommendations, standards and processes.

Visit www.adaptnetwork.org to learn more.

AGree Workshop Questions

Farmer motivation: Opportunity for using nutrients more efficiently and reducing guess work involved in managing nitrogen.
Challenges to participation: Perception that evaluation tools are too expensive, complicated, or out of reach for their own use.
Overcoming participation challenges: Leverage grant resources to provide access to evaluation tools (strip trials, guided stalk sampling, optical sensors, Adapt-N decision support tool, and more) at no cost to the farmers, advocate for USDA conservation program support for these tools, and increase educational opportunities for crop advisors working with farmers.

Measures of success:

- Number of farmers involved, number of networks created, documented improvements in nutrient use efficiency, support and involvement from more agricultural partners, support and involvement from more USDA staff and programs.
- We have measured and documented average improvements in nitrogen use efficiency of 20-30%. Farmer surveys have shown that 80% of farmers participating in the programs have made management changes based on their involvement.

Challenges in monitoring and measuring change: Resources for farmer surveys of behavior change, resources for improving data capacity and capabilities, resources for level of analysis needed to publish results.

Challenges to larger scale success: Difficulty of measuring environmental outcomes (water quality, greenhouse gas reductions); difficulty reaching all the players involved in nutrient management decisions to take improved methods to scale; difficulty overcoming strong hold of traditional ways of managing nutrients; need for a driver beyond economic benefits of efficiency.

Possible solutions: Increasing emphasis within USDA conservation programs; increasing collaboration with industry; increasing ability to monitor and document environmental outcomes; increasing ability to measure and document change in order to translate those improvements into economic rewards (ecosystem service payments, supply chain rewards, conservation program priority, etc).

Lessons learned: Importance of engaging within trusted infrastructure; importance of documenting economic considerations and outcomes; importance of involving key players/influencers at multiple levels (extension/LGU, crop advisors, ag groups, agribusiness, agencies at local/state/federal levels); importance of sticking with it for a very long time; importance of reducing the time/cost/complexity of involvement and improvement.

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Agricultural Incentives Program of Sand County Foundation

Alex Echols, Program Director, Special Programs

The Agricultural Incentives Program of Sand County Foundation and farming partners was established in 2003 to find creative ways to address the degradation of surface waters by nutrients running off agricultural land. The program emphasizes how farmers can lessen nitrogen and phosphorus runoff at the watershed scale. It does this through projects Sand County Foundation operates or supports directly, and also through efforts to bring together other conservation and farm groups throughout the Upper Midwest. We continue efforts to develop and demonstrate individual nitrogen runoff reduction practices by working with local and regional partners. A central focus of the program is to seek answers to "how do we invest scarce conservation resources to maximize environmental return on investment?" Performance based conservation.

Watershed-scale nutrient management projects:

Concentrating planning and practices in individual watersheds was an approach to agricultural conservation that gained momentum following the North Central Leadership Summit on Nutrient Management and Water Quality in 2006. Out of that grew the Mississippi River Basin Initiative (MRBI), a USDA-NRCS effort to create watershed-scale nutrient management projects throughout the Midwest and efforts to advance more cost effective practices and investment strategies to reduce nutrient loss to waterways.

Ag Incentives also seeks to advance "market" based strategies to advance conservation implementation. These strategies include ecosystem service delivery, targeting agency conservation investments, developing commerce such as trading for water, and creation of incentives for producers to deliver off site benefits. Beginning in 2011, the Agricultural Incentives Program provided early financial support to one of the most promising watershed projects in the entire country: the **Watershed Adaptive Management Pilot Project** north of Lake Mendota, in Dane County, Wis. The Madison Metropolitan Sewerage District, Dane County, local governments and the business community have joined together to support this first-in-the-nation attempt to use tools provided by the Clean Water Act to address non-point sources of pollution the Act does not regulate. If successful, this approach will provide larger-scale and more ecologically sound phosphorus reduction as well as large savings to Madison area ratepayers.

Leadership for Midwestern Watersheds:

In 2011, Sand County Foundation began **Leadership for Midwestern Watersheds**, a series of meetings intended to provide a forum for watershed project directors and key stakeholders throughout the Upper Midwest to compare notes and share lessons learned about project design and implementation. Leadership for Midwestern Watersheds meetings allow projects in the Upper Midwest region to communicate with one another, provide other environmental groups and stakeholders with information on how projects are meeting key challenges, and advise federal and state agencies on how to adjust program procedures.

Nitrogen (N) Sink Creation: Agricultural Incentives funded pioneering research on subsurface bioreactors in Illinois. We also developed demonstration projects with farmers in Illinois and Iowa that helped lead to establishment of bioreactors as an N trapping practice approved by NRCS. The Program funds oxbow restoration projects as an N sink practice in the Boone River in Iowa, and a monitored trial constructed wetland for nitrogen reduction at the Leopold Memorial Reserve in Sauk County, Wis. We have played a leading role in advancing the NRCS strategy on broadening the implementation of the full suite of drainage management practices including: drainage management, active management, bio reactors, wetlands, two state ditches and innovative practices such as wet buffers and phosphorous filters.

Water Monitoring on 77 Ranch

Gary Price, Owner

77 Ranch is a working commercial cow-calf operation located 50 miles south of Dallas in the Blackland Prairie Ecoregion in the Trinity River Basin of Texas. We have recently installed three water monitoring devices on three areas of the ranch to show the importance of grass in improving water quality by reducing runoff, improving soil health, being part of a diverse plant community and being part of a sustainable ranching operation that can play a vital role in water quality and the cost of water to urban water consumers downstream. This program has been in place for about 6 months and is a cooperative effort between Sand County Foundation, Trinity Waters, NRCS, Texas A&M AgriLife Extension and Texas Soil & Water Conservation Districts. Sand County Foundation proposed the original pilot project of Water As A Crop™ in 2010 in the Mill Creek watershed of which 77 Ranch is located. The intent of the project is to show the relationship of good conservation practices by landowners to improving water quality down-stream to urban areas.The demonstration of this importance has value downstream by reducing eroding sediment load in reservoirs and therefore reducing water cleanup cost. These savings to the Dallas/Fort Worth Metroplex and the greater Houston area would be dollars that could be used as incentives to install more conservation practices by landowners in the watershed.

The three monitors are installed in a tall grass area, a mid-grass area and a short grass slightly eroded area. We will monitor precipitation, rate of flow, sediment load, ambient temperature, ground temperature and moisture levels at various soil depths. By comparing the three sets of data we should be able to demonstrate the importance of a diverse plant community to overall soil health. More thatch equals more carbon in the soil which increases water holding capacity which means better grass and forb production which means cooler soil temperatures therefore reducing evaporation rates through more shading of bare ground. This all equates to more total forage production which when managed properly through proper rotational grazing and proper stocking rates should improve total production for the landowner. We will use the data and ranch tours of the monitoring sites to demonstrate to landowners the importance of managing rainfall on the land. “We can never control how much rain we get but we can control how much we keep.” Managing rainfall and water is possibly the most important thing we do in ranching to manage our most important resource, the land and grass.

Sand County Foundation has implemented incentive agreements with landowners to encourage them to implement conservation practices on their land that both improve water quality and also demonstrates more productive and sustainable land management. Many landowners are now involved in the program by implementing management practices such as planting native grasses, installing riparian buffers, replacing monocultures of Bermuda grass with native grasses and installing cross

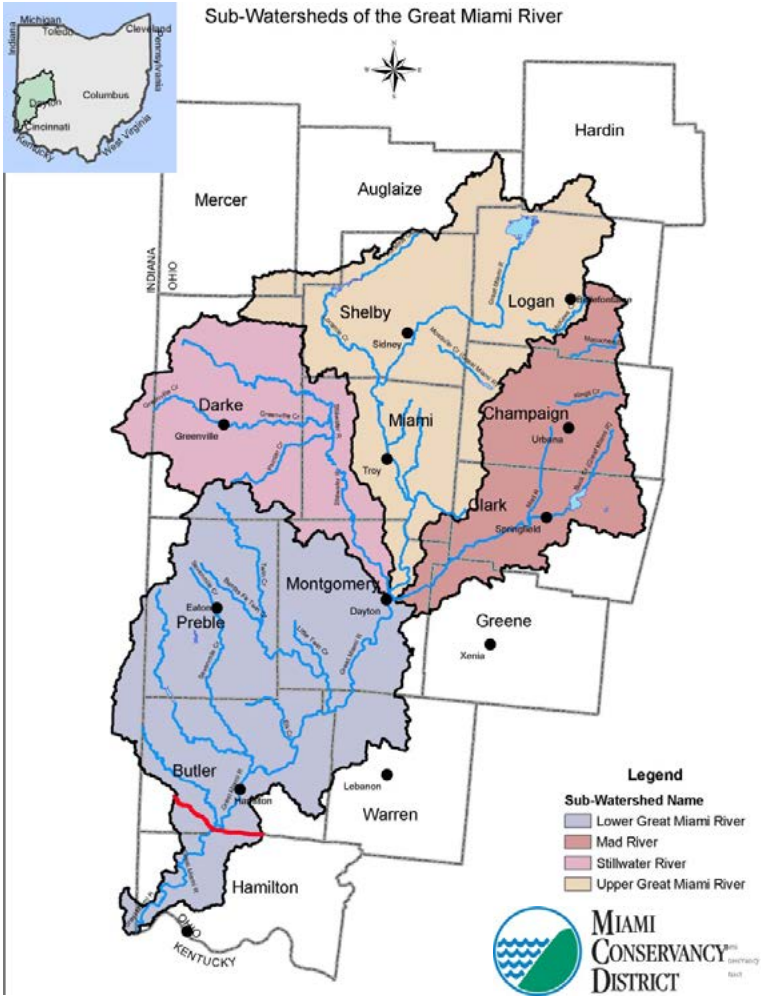
fences for rotational grazing. NRCS recently became involved in the project area by introducing the National Water Quality Initiative which gives incentive cost shares to landowners to implement similar practices through their EQIP Program. This program also includes the planting of cover crops in rangeland, pasture and row crops to encourage plant diversity, improve soil health and improve water holding capacity while promoting minimal tillage. NRCS also provides continual technical assistance to landowners.

There are many challenges in trying to encourage landowners to participate in our area. Many older landowners are locked into traditional management methods while many new landowners are open to new ideas of managing the whole resource but lack education and experience in agriculture. The value of this program can be tremendous in demonstrating a more productive and sustainable way for landowners to manage their resources to potentially add additional revenue while delivering an increasingly needed product to the urban areas…clean water.

Water Quality Trading Program, Greater Miami River Watershed

Sarah Hippensteel Hall, Manager, Watershed Partnerships, The Miami Conservancy District, Ohio

The Great Miami River Watershed, located in southwest Ohio, has experienced marked improvements in surface water quality over the last three decades. Despite these improvements, about 40 percent of the watershed's rivers and streams – primarily in the headwaters areas - still fail to meet water quality standards. The failure to fully attain water quality standards will trigger additional regulations focused on wastewater treatment plants (WWTPs). As an alternative to traditional regulatory strategies, the Water Conservation Subdistrict of The Miami Conservancy District, along with many partners, has created and implemented a water quality credit trading program. Water quality credit trading is an innovative, market-driven approach to improving water quality by investing dollars in voluntary agricultural practices that are more cost-effective and provide broader environmental benefits to the watershed than could be achieved by technology upgrades at WWTPs.



Because more than 70% of the land in the Great Miami River Watershed is used for agriculture, the majority of nonpoint source water quality challenges relate to agricultural land uses. Agricultural producers in the watershed have worked diligently for years to implement conservation farming practices. However, available federal, state and local funding to implement these practices does not match the demand.

Furthermore, agricultural practices such as no-till, cover crops, conservation crop rotation, prescribed grazing, and improved manure management can be very cost-effective at reducing the runoff of nutrients. These practices can also provide additional environmental benefits and improve the sustainability of farming operations. For example, conversion from conventional tillage to no-till not only reduces the runoff of phosphorus and nitrogen but also prevents soil erosion, stores carbon on the land, and reduces diesel consumption in the farm operation.

WWTPs in Ohio will soon face additional nutrient discharge limits. Upgrading the treatment plants to meet these new limits will be expensive and yield limited benefits. Nutrient management practices installed on farmland reduce the target pollutants more cost-effectively across more of the watershed and produce a broader array of benefits than upgrading WWTPs to meet the new limits.

To assist with these challenges, the Miami Conservancy District worked with federal, state, and local partners to create a program that reduces nutrients in streams and rivers. The Great Miami River

Watershed Water Quality Credit Trading Program was started in 2004 as a pilot and provides funds to agricultural producers who install practices that reduce nutrients, and provides an alternative method for WWTPs to comply with additional nutrient discharge limits.

To design the program and establish trusting relationships with the partner organizations, more than 100 meetings were held in the first two years. The Trading Program was not designed solely by the Miami Conservancy District; it was created using the knowledge and viewpoints of the primary stakeholders: the agricultural community.

How the Trading Program works

The Trading Program is administered by the Water Conservation Subdistrict of The Miami Conservancy District and "brokers" the credits for acquisition by participating WWTPs. Each pound of phosphorus and nitrogen that is prevented from running into rivers or streams generates a "credit."

When funds are available, a Request for Proposal that includes a submission deadline is announced by the Water Conservation Subdistrict. To submit applications for funding, county Soil and Water Conservation Districts work with agricultural producers who volunteer to implement additional nutrient management practices on their land. To model the number of pounds of nutrients a practice can reduce the Soil and Water Conservation Districts use the Region V Load Reduction Spreadsheet. In each application, the producer requests the amount of funds they are willing to take to reduce each pound of nutrients, regardless of actual cost to install and maintain the practice.

The Water Conservation Subdistrict reviews the applications for completeness and accuracy. The Ohio Department of Natural Resources reviews the use of the Load Reduction Spreadsheet for accuracy. An advisory group, with broad-based stakeholder representation, reviews the applications and recommends projects for funding. Project selection is competitive and based primarily on the cost per credit proposed by the agricultural producer. This method is also called a Reverse Auction.

The Trading Program includes an insurance strategy that credits will be adequate to meet the regulatory compliance needs of participating WWTPs. All trades must occur upstream of the participating WWTP. The strategy includes the annual inspection of all agricultural projects and an insurance pool of credits. Agricultural producers who participate do not assume regulatory liability on behalf of the participating WWTPs.

Funding for the pilot phase of the Trading Program has come from the Water Conservation Subdistrict of the Miami Conservancy District, wastewater treatment plants, a USDA Conservation Innovation Grant, and a USEPA Targeted Watershed Grant. During the Pilot Phase the WWTPs are voluntary participants in the Trading Program and earn a permanent discount on the number of pounds of nutrients they will be required to reduce once regulations are in place.

Evaluation

The Trading Program's progress is evaluated in several ways. Changes to water quality are measured through a continuous water quality monitoring program at a subwatershed scale. A water quality report, Nitrogen and Phosphorus Concentrations and Loads in the Great Miami River Watershed, Ohio 2005 – 2011, was published in 2012. The effectiveness of agricultural practices is verified through field inspections by Soil and Water Conservation District staff. The economic performance of the Trading Program is measured by comparison of credit costs to treatment costs. The Texas A&M University conducted an evaluation of the economics of the Trading Program that has been used to adjust aspects of the program.

Adaptive Implementation

The Trading Program utilizes an adaptive implementation approach. As opportunities arise to improve the program, adjustments are made to the program design. For example:

- Adjustment to the size of annual payments to agricultural producers for credits involving capital construction with a 15-20 year life expectancy.
- Modification of the Load Reduction Spreadsheet to include new agricultural practices.
- Established a partnership with the newly formed Great Miami River Watershed Joint Board to transfer the management of the program.
- The program has operated in Pilot Phase much longer than expected because the expected new nutrient regulations are still not in place ten years after they were originally announced.

Current Status

As of March 2013, eleven rounds of project submittals resulted in funding for 397 agricultural projects generating more than 1.14 million credits over the life of the projects. More than 1.6 million dollars will be paid to agricultural producers for these credits. This translates to a 572 ton reduction in nutrient discharges to rivers and streams and other benefits including more sustainable farming operations and an array of ancillary environmental benefits.

Partners

- Water Conservation Subdistrict of the Miami Conservancy District
- Cities of Dayton, Englewood, and Union
- Butler County Department of Environmental Services
- Tri-Cities North Regional Wastewater Authority
- Joint Board of county Soil and Water Conservation Districts
- Ohio Farm Bureau Federation, Inc.
- Ohio EPA - Division of Surface Water
- ODNR - Division of Soil and Water Conservation
- USDA Natural Resources Conservation Service
- U.S. EPA

For more information please contact

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Northern Everglades Payment for Environmental Services

Gene Lollis, Ranch Manager, Buck Island Ranch - MacArthur Agro-ecology Research Center

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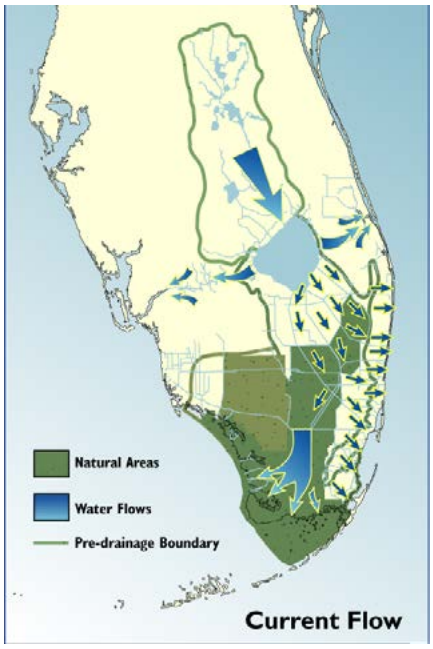
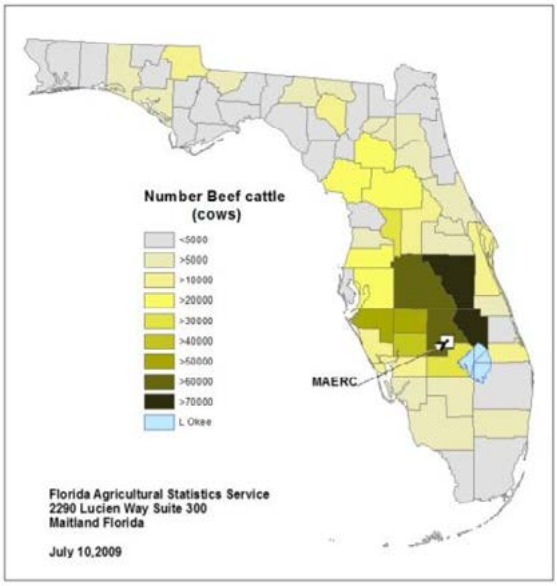
Hilary Swain, Executive Director, Archbold Biological Station
Benita Whalen, South Florida Water Management District and
Sarah Lynch, World Wildlife Fund

What are the aims of the project(s) in your watershed? What are the issues you are trying to address?
The Northern Everglades NE, specifically the lands draining south into Lake Okeechobee are the headwaters of Florida's Everglades one of the most important regions in the world for water and wildlife.



Two major issues in the NE watershed are: (i) elevated nutrient loading, primarily phosphorus P–which is detrimental to freshwaters in Florida and the Everglades because this is a P-limited ecosystem; and (ii) altered water flow to Lake Okeechobee (higher peak flows during wet season, reduced flows during the dry season). South Florida Water Management District (~state agency) has set targets are to reduce P inputs to the lake from current levels of more than 400 metric tons MT per year to 140 MT per year, and to increase water retention by one million acre-

feet in the NE to improve the timing and amount of water delivered to lake Okeechobee. There are a multitude of approaches to these targets, including large public works projects and regulations; this PES program is one of many solutions and approaches underway.



Cattle ranches (beef cow-calf operations) are a significant component of land use in the NE region. This PES program was initiated by early discussions with cattle ranchers about how they could contribute further towards meeting these environmental targets while maintaining economically viable cattle ranching. The approach adopted was to work with ranchers to design on ranch Water Management Alternatives that would provide measurable public benefits (more water retention and/or nutrient reduction) and generate a new payment/revenue source for ranchers. This was not a cost share program or regulatory but a true payment for environmental services.

When, why, and how did it get started? Who provided leadership?
The timeline of the development of this program was a pilot program called Florida Ranchlands Environmental Services Program FRESP which transitioned to the Northern Everglades Environmental Services NEPES program:

The key players in the development of FRESP, and what they brought to the table:

Ranchers–environmental pioneers: Jim Alderman, Joe Collins, Cary Lightsey, John Payne, Chuck Syfrett, Wes Williamson, Jimmy Wohl, Gene Lollis

- Environmental ethic in land stewardship
- Acknowledge environmental regulations as a reality. This program was "above and beyond" regulations.
- Looking for new profit opportunities in an evolving regulatory environment

Agencies staff–policy pioneers- State Agencies: Rich Budell, FDACS, Frank Nearhoff, FL DEP, Benita Whalen, SFWMD Federal Agencies: Greg Hendricks, Rosalind Moore, USDA NRCS; Paul Souza, US FWS

- Think outside agency mission, regulatory framework and budgeting principles
- Ability to conceptualize how the program benefits other agency's agenda
- Willingness to expend political capital inside their agencies

Civil Society– social pioneers. Conservation organizations Sarah Lynch, WWF, Len Shabman, RFF **Scientists**: Patrick Bohlen and Betsey Boughton, MAERC, Mark Clark, UF-IFAS, Sanjay Shukla, UF-IFAS, Hilary Swain, Archbold Biological Station

- Ability to work with non-traditional partners
- Openness to alternative paths to organizational goal

The FRESP partnership was essential but took a lot of time, money ($ 7 million including two USDA-CIG grants, SFWMD, additional legislative appropriation, Kellogg Foundation) and dedicated resources. Different institutions made different contributions providing many voices with the same message. Public interest organizations brought a measure of credibility. The group approach expanded sources of funding and support and provide political cover for agency innovation and increase buy-in from key players. The stakeholder approach provided diverse facets on the issue and multiple ways to pitch the program for funding and support. It brought needed expertise and credibility and expanded the variety and type of WMA.

Who is involved (e.g., producers, landowners, partner organizations, agencies, businesses, etc.) and how do they participate / what do they contribute (e.g., changes in ag practices, information, technical assistance, funds, etc.)?

In the NEPES program the ranchers design and implement the water management alternatives. These are ranch specific and range from wetland restoration by ditch riser culverts, to small STAs in wetlands to holding water back within original ditch and drainage structures. There is a reverse auction bid based on cost/acre foot stored or pounds P removed; the successful bidders (cost and design criteria) enter into a 10 year contract with the SFWMD to provide these services. FDACs provides technical assistance to landowners in developing their bids. USDA and USFWS in conjunction with SFWMD oversee the general permit for Endangered Species Act and wetlands. Payments from the SFWMD are monthly. 10 projects are currently contracted with a new bid due soon in 2013. Public benefits and payments (net acre feet retained/pounds P removed) are based on standard hydrological modeling (developed under FRESP) assuming average rainfall years. Compliance monitoring is conducted by an independent science group.

What motivates producers/landowners to participate? What have been the challenges of engaging producers/landowners and how have you overcome them?
Payments that make a financial difference. Ethic of environmental stewardship. Potential avoidance of future regulations.

How is it financed?
SFWMD – which has independent taxing authority for south Florida for water management.

How do you measure success?
Participation – acres enrolled. Acre feet stored. Pounds of P removed.

To what extent have you been able to measure changes in environmental outcomes (e.g., improved water quality, increasing numbers of species of concern, etc.), soil quality (e.g. increased soil organic matter), yield, and/or production costs?
Documented reduction in P loading e.g. from Lykes west waterhole project.

If you have measured change, please provide a snapshot of your findings.
Will present during the conference. Not enough space here.

What have been the challenges associated with monitoring and measuring change?
FRESP conducted extensive monitoring, it proved highly expensive and data intensive. We used these pilot data to design a greatly scaled back system of compliance monitoring (upstream pressure transducers and rain gauges to ensure the structures are operating as designed). For cost effectiveness we only monitor nutrient removal for WMAs with simple in and out pump systems similar to STAs.

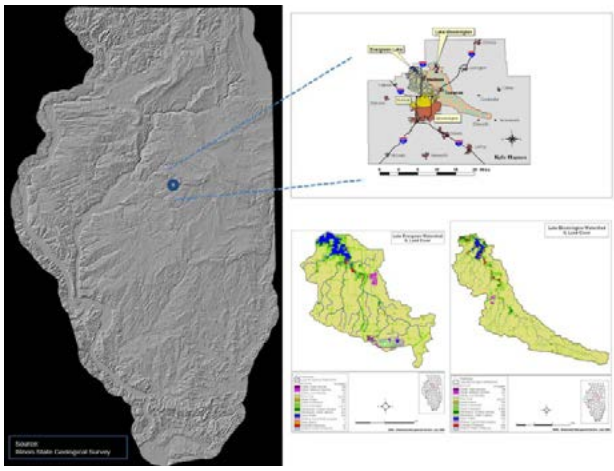
What are the most significant impediments to achieving intended objectives, particularly measurable improvements in environmental outcomes – and how might they be addressed
Because of our stakeholder approach and long design period we probably avoided most pitfalls during the development of the program objectives. Challenging issues to deal with included federal permitting for endangered species and wetlands. In the medium-term the transition from FRESP to NEPES and the evolution of NEPES within SFWMD will be interesting as there is no defined role for the original stakeholder group in that agency implemented program.

What are some of the key lessons you have learned about what it takes to engage producers and landowners in participating in and taking ownership of efforts to improve environmental outcomes in their watershed?

Early landowner participation in design and implementation was key, as well as input on the design of the process and the contract. Extensive stakeholder participation from the outset built trust. Pioneering ranchers lead the community into acceptance. Early adopting ranchers receiving checks in the mail certainly helped spread the word. Payments that represent a significant income stream for a given period of time with certainty were essential for ranchers.

Source Water Protection, Lake and Watershed Management Program for the City of Bloomington, Illinois Water Supply Reservoirs

Rick Twait, Superintendent of Water Purification, Illinois



The City of Bloomington relies upon two reservoirs, Lake Bloomington and Evergreen Lake, for supplying water to the more than 80,000 people we serve. Since the mid 1980's, the City Water Department has been actively developing and implementing a lake and watershed program to improve source water quality, to extend the longevity of the reservoirs and to meet drinking water quality standards. The McLean County Soil and Water Conservation District (SWCD) has been a partner in the watershed program from its inception. The City funded the SWCD Watershed Conservation program since the early 1990's.

The predominant land use in the 110 square miles that drain into the two lakes is row crop agriculture. One of the first concerns for the effect of watershed activities on the water supply was the loss of water storage in the lakes to sedimentation. Nutrients delivered to the lakes by the tributary streams resulted in taste and odor issues in the finished water from algal blooms.

In the early 1990's, Bloomington's drinking water exceeded the 10 mg/l nitrate nitrogen standard. The City entered into a consent agreement with the Illinois Environmental Protection Agency to reliably and consistently provide water to our customers that did not exceed that standard. At the time, the cost to install nitrate removal treatment at the water plant was estimated to cost 3 million dollars. Operating costs and disposal of treatment residuals were not included in the initial estimate.

Installing treatment facilities at the water plant was not an attractive option to department staff. During the exceedance, nitrate concentrations were only slightly above the standard, and concentrations above the standard were only expected to occur infrequently. Nitrate removal at the water plant would only treat the small fraction of water going through the plant, with no benefit to the water quality of the lake. City staff decided to research methods of limiting the delivery of nitrates to the reservoir at their sources, instead of removing them at the treatment plant.

One of the first tasks was to determine the source of the nitrates. The McLean County Soil and Water Conservation District and water department staff started a sampling program to measure nitrate concentrations in streams, storm runoff, ponds and tile drainage. After the primary source of nitrate was demonstrated to be agricultural drainage tiles, researchers from Illinois State University joined us in the effort to limit nitrogen losses through changes in application practices. An advisory group of producers in the watershed was formed to guide our work. We installed an experimental tile system that measured nitrate delivery from six individual 5 acre plots, each with a different nitrogen application regime. Two experimental wetlands were built to accept the tile drainage and surface runoff from the research farm. Dr. David Kovacic from the University of Illinois evaluated the effectiveness of nitrate removal by the wetlands.

Many lake and watershed activities with a variety of partners occurred over the past few decades. The SWCD sends out newsletters to keep landowners and producers informed of our activities and to solicit participation. SWCD staff also serve as trusted liaisons between landowners/producers and the partner organizations. Some of the projects that were implemented in the watersheds include clean lakes program diagnostic/feasibility studies, nutrient management programs, buffer strip plantings, and other conservation practices. Partners included Pheasants Forever, Illinois EPA, USDA, the Sand County Foundation, Illinois Department of Agriculture, Illinois State University, the University of Illinois and Extension, and local technical service providers.

The Nature Conservancy and the Environmental Defense Fund have partnered with the City of Bloomington in a project to reduce nutrients delivered to the streams. The project builds upon lessons learned from previous work in the Lakes Bloomington and Evergreen watersheds and from TNC and EDF projects in other watersheds. The Drinking Watersheds Project uses a targeted approach to locate sites for constructed wetlands to treat tile drainage water. Adaptive nutrient management, using stalk nitrate sampling and soil testing, address the input side of the issue. A Conservation Innovation Grant supports the work.

Landowners and producers in our watersheds have long demonstrated a strong stewardship ethic. Most operators and landowners are very aware of the nitrate issue and are willing to investigate and adopt techniques to improve their efficiency. High land prices and delays in cost reimbursement for installation of conservation practices can be impediments to participation. We are investigating the possibility of a revolving fund to decrease or eliminate out of pocket expenses for installing certain practices. A publicly accessible demonstration site should help promote adoption of practices on private lands.

Funding for projects comes from a variety of sources. Water Department funds, federal and state agricultural and clean water programs, private foundation, sportsmen and other groups support our watershed efforts.

Some of the key lessons we have learned about successfully achieving our goals is the need to work on a very local level. The SWCD and the volunteers working on our watershed oversight committees are experienced in working with limited budgets. Promoting new techniques like stalk sampling and other adaptive nutrient management practices should be done with the goal of them becoming a standard agronomic practice that is part of the producer's cost of doing business.

Web links for Bloomington, Illinois watershed activities and associations.

2005 and 2011 Governor's Conference on the Illinois River presentations:
http://ilrdss.sws.uiuc.edu/pubs/govconf2005/session2c/Jim%20Rutherford.pdf
http://ilrdss.isws.illinois.edu/pubs/govconf2011/session3b/LemkeandTwait.pdf

Lake Bloomington/Evergreen Lake locally written watershed plans:
http://web.extension.illinois.edu/lmw/cat83_3062.html

IEPA Lake Bloomington TMDL reports:
http://www.epa.state.il.us/water/tmdl/report/bloomington/lake-bloomington.pdf

IEPA Evergreen Lake TMDL reports: http://www.epa.state.il.us/water/tmdl/report/evergreen/approved-report.pdf

McLean County Soil and Water Conservation District website: http://mcleancountyswcd.com/

The Nature Conservancy press release describing the Mackinaw River Drinking Watersheds project:
http://www.nature.org/newsfeatures/pressreleases/the-nature-conservancy-city-of-bloomington-and-environmental-defense-fund-si.xml

Environmental Defense Fund Adapt network: http://adaptnetwork.org/

Sand County Foundation Agricultural Incentives program:
http://sandcounty.net/initiatives/agincentives/

Article on Friends of EverBloom lake and watershed group:
http://www.pantagraph.com/sports/recreation/fishing/below-the-waterline-good-start-for-friends-of-everbloom/article_c6df4d6e-6036-11e2-bba7-001a4bcf887a.html

City of Bloomington's Interim Water Supply Plan:
http://www.cityblm.org/modules/showdocument.aspx?documentid=4192

"Keep it for the Crop by 2025" Enhanced Nutrient Stewardship Program website:
http://www.ifca.com/resourcedisplay/681/

Water Quality Team, World Resources Institute

Michelle Perez, Senior Associate

Overview of Projects for AGree Meeting

MRB-GOM Nutrient Reduction Projects

WRI has two projects in the Mississippi River Basin. One project assessed the use of **point-nonpoint source nutrient trading** as a cost-effective mechanism to accelerate adoption of farm conservation practices and help achieve nutrient reduction goals. WRI evaluated two wastewater utilities located in Chicago, IL and in Fort Worth, KY for their potential willingness to pay for nutrient credits and their cost savings to comply, through trading, with a future hypothetical permit that achieves a 45% delivered nutrient load reduction goal to the Gulf of Mexico. In partnership with USDA's **Conservation Effects Assessment Project (CEAP)** APEX modelers, our study also evaluated the profit-making opportunities for crop farmers in six HUC8 "delta" watersheds in Arkansas and Mississippi from adoption of conservation practices alone and from selling credits in a trading market. A report will be available in April.

The second project is developing field-scale and a watershed-scale nutrient reduction estimation tools for use in the State of Mississippi to aid in a variety of policy applications. WRI is partnering with Tarleton State University TIAER modelers to calibrate USDA's field-scale **Nutrient Tracking Tool (NTT)** and the watershed-scale **Comprehensive Economic Environmental Optimization Tool (CCEOT)** to Mississippi delta conditions. WRI is facilitating stakeholder involvement from Mississippi's federal and state agricultural and environmental agencies, farm trade associations, environmental groups, farm conservation districts, and university extension practitioners to calibrate the tool and to deliberate use of the tool in Mississippi's **MRBI projects, State Nutrient Reduction Strategies, their USDA conservation programs, and their EPA 319 projects**.

Watershed Conservation Targeting Projects

WRI has three projects that aim to help USDA's NRCS conservation programs and initiatives prioritize watersheds for targeted nutrient load reductions in order to achieve measurable improvements in water quality indicators. First, WRI has evaluated the design of FY2010 and FY2011 targeted watershed projects in the new 13 state **Mississippi River Basin Healthy Watersheds Initiative (MRBI)** and the new four state Chesapeake Bay – Cooperative Conservation Partnerships Initiative (CB-CCPI). **Seven targeting factors** were assessed: stakeholder and producer buy-in; type of goal; SMART-Q goals; geographic targeting; measurement and evaluation; cost-effectiveness; and adaptive management. WRI is collaborating with NRCS staff to incorporate findings and recommendations into the MRBI and CB-CCPI Initiatives.

Second, WRI is conducting a **national conservation targeting modeling** project. Through partnership with APEX modelers at USDA's Conservation Effects Assessment Project **(CEAP)** and WRI's own GIS Specialist, WRI is identifying watersheds at various scales (HUC2, 4, and 8) that account for a disproportionate amount of nutrient loads and are the most cost-effective for achieving nitrogen, phosphorus, and sediment reductions and carbon sequestrations in order to **improve the effectiveness of farm conservation funding.**

Finally, WRI is categorizing the various **barriers to better targeting of conservation funds** and identifying ways to overcome the barriers. Targeting barriers include: political and statutory, institutional, and scientific and technical factors as well as barriers to cost-effectiveness.

Chesapeake Bay Nutrient Reduction Project work

WRI has been involved with **Chesapeake Bay states' nutrient trading programs** from their inception, serving in an advisory role to help develop program guidance and serving in a technical capacity to develop nutrient load assessment and credit calculation tools. WRI developed **NutrientNet, an online nutrient credit calculation tool, registry, and trading marketplace** for Pennsylvania, Maryland (including Delaware), and West Virginia. Currently, WRI is merging the individual state tools onto a common interstate platform, run in part by USDA's Nutrient Tracking Tool (**NTT**). This project involves designing a user-friendly calculation tool interface that agricultural producers and aggregators can use, calibrating NTT to the Chesapeake Bay watershed and EPA's Chesapeake Bay Program Watershed Model, developing a credit registry and marketplace, and working with the agricultural community to test the accuracy, functionality, and user-friendliness of the tool.

For this project, and other work, WRI closely follows the **Bay TMDL and Watershed Implementation Plan** developments and progress. For example, WRI uses Watershed Model output to estimate average load reduction goals per state or watershed that are consistent with the TMDL. WRI also participates in the Bay Program Water Quality Goal Implementation Team meetings and calls and for the past year has chaired this subcommittee's Trading and Offsets Workgroup, facilitating dialogue on trading among EPA, the states, and NGOs. WRI also identifies the challenges and solutions of expanding trading opportunities beyond wastewater treatment plants and agricultural operations to **stormwater utilities**. Finally, WRI has also conducted many studies on nutrient trading and other performance-based measures to accelerate adoption of agricultural practices and reduce nutrient pollution.

Responses to relevant prompt questions

- **How do you measure success?**

WRI envisions several metrics of success could be measured in the MRBI projects beyond the customary administrative metrics (counting of practices, acres, contracts, or dollars spent). For example, projects will hopefully be measuring water quality indicators that improve at edge-of-field, in-stream or watershed outlet monitoring stations (N and P concentrations, sediment concentrations, TSS in streams, etc). In stream there could be critter surveys and/or habitat

characterizations conducted. There could be in-field improvements measured by RUSLE or phosphorus site indices, or estimated by nutrient management plans (e.g. measuring the delta between N and P fertilizer application rates before and after the plan). However, it remains to be seen if the MRBI project leaders will pursue such creative metrics or if they will have much guidance on protocols for such metrics or encouragement from NRCS to do so.

- **To what extent have you been able to measure changes in environmental outcomes (e.g., improved water quality, increasing numbers of species of concern, etc.), soil quality (e.g. increased soil organic matter), yield, and/or production costs?**
    - **If you have measured change, please provide a snapshot of your findings.**
    - **What have been the challenges associated with monitoring and measuring change?**

WRI's review of 45 MRBI projects indicates there are several significant challenges associated with monitoring and measuring environmental change including: lack of a watershed-based planning approach to the projects, lack of tying environmental outcome goals to intentional monitoring protocols, lack of establishing adequate water quality monitoring data baselines, lack of protocols for methods to report creative performance metrics (mentioned above), and lack of protocols and point persons within states to coordinate collection, aggregation, analysis, and reporting of the state's MRBI monitoring data, lack of protocols and point person at NRCS headquarters to do the same for all 13 states' MRBI data for reporting to the national public.

- **What are the most significant impediments to achieving intended objectives, particularly measurable improvements in environmental outcomes – and how might they be addressed (consider policy at multiple levels, private sector, civil society)?**

WRI has identified several barriers to better targeting. Main categories of barriers include: political and statutory, institutional, scientific and technical. Also identified are barriers specific to improving cost-effectiveness of targeting conservation funds.

- **What are some of the key lessons you have learned about what it takes to engage producers and landowners in participating in and taking ownership of efforts to improve environmental outcomes in their watershed?**

From interviews and meetings with MRBI project leaders, WRI has learned that many leaders find it challenging to discuss a project's desired water quality outcome goals with producers. Instead, they feel more comfortable discussing the individual producer's conservation concerns and solutions. While this is completely understandable, WRI hopes to learn of success stories that lead to successful discussion of desired water quality goals with producers so as to achieve a greater sense of ownership and buy-in to landscape-level outcomes goals by many more farmers in a watershed.

The Watershed Approach – A Systemic, Strategic and Comprehensive Approach to Solving Water Quality Problems

Eileen McClellan

The challenge of meeting water quality goals

Farmers across the MidWest have a proud legacy of taking care of the land, and their conservation actions have done much to improve water quality. Just as agricultural knowledge has improved over the past century, so has our understanding of the problems associated with loss of nutrients and sediment from farmland—losses which are often not immediately visible to the landowner. Downstream from farm fields these losses create problems for fish populations in local streams, can lead to contamination of drinking water, and contribute to algal blooms and fish kills in the Gulf of Mexico and Great Lakes. Reducing these downstream impacts will require reducing nutrient losses from Midwestern farmland by 45% or more – much greater reductions than have been achieved through conservation efforts to date.

Addressing the causes of nutrient export from Midwest farmland

Nutrient export from Midwestern farmland is driven by four characteristics of row crop production which changed the landscape at the time of initial settlement and continue today: increased application of nutrients (fertilizer and manure) needed to support increased yields of corn; loss of perennial vegetation (prairies and pastures) from the landscape as row crop acreage has increased; artificial drainage (ditches and subsurface tile lines) needed to support corn and soybean growth on historically wet soils; and loss of nutrient filters (wetlands) which historically served as nutrient traps, preventing downstream export. To reduce nutrient export, all of these factors must be addressed – but our ability to reduce fertilizer inputs, restore perennial vegetation and reverse artificial drainage is limited by our need to increase regional production of food and feed. Restoring nutrient filters, however, can create disproportionate environmental benefits with little impact on regional food production.

Restoring nutrient filters – underappreciated practices that are critical to meeting water quality goals

EDF has been working with a group of water quality scientists up and down the Mississippi River and across the Corn Belt to understand the role that the next generation of nutrient filter practices can play in meeting water quality goals. These practices – including bioreactors, saturated buffers, tile drainage treatment wetlands, 2-stage ditches, stream restoration, floodplain reconnection and instream treatment systems – can achieve 45% reductions in nutrient export while taking very little land out

of production – approximately 1% across the whole region. Although infield practices such as improved fertilizer management, conservation tillage and cover crops have a vital role to play in improving both water quality and agricultural production, ambitious water quality goals can only be met if these practices are combined with practices to restore nutrient filters (McLellan et al, in review).

The watershed approach

The watershed approach recognizes the importance of combining in-field practices with the restoration of nutrient filters in a way that is systemic, strategic and comprehensive:

- Systemic, in combining practices at multiple points in the landscape – in-field, edge-of-field, edge-of-stream and in-stream – in ways that deliver benefits for multiple pollutants (nitrogen, phosphorus, sediment, pesticides, bacteria);
- Strategic, in using a science-based approach to identify key pathways of water and pollutant flow across the landscape, and targeting conservation practices to critical source areas and critical interception points; and
- Comprehensive, in using combinations of practices at a scale sufficient to deliver the needed water quality benefits.

Integrating biophysical science, social science and economics

While the watershed approach has its roots in biophysical science to understand the flows of water and pollutants and the opportunities to reduce, trap and treat these, implementing the watershed approach requires a combination of biophysical science with social science and economics.

- Biophysical science is used to identify critical source areas, key interception points, practices suitable for avoiding/controlling/trapping pollutants in specific landscapes, sites suitable for practice implementation, and to quantify the environmental benefits of practice adoption'
- Social science is essential to understanding how landowners view conservation in the context of their overall land management goals, their motivations for adopting various types of conservation practices, the obstacles and opportunities they see for practice adoption, and the extent to which cooperative conservation that crosses individual property boundaries will be feasible;
- Economics is critical to ensuring that landowners are appropriately compensated from a mix of private and public sources for producing ecosystem services as well as traditional food and feed.

Demonstrating the watershed approach in 3 Midwestern watersheds
Through a Contribution Agreement with NRCS, EDF is currently laying the groundwork to demonstrate the watershed approach in 3 Midwestern watersheds: Beaver Creek in the Upper Cedar River of Iowa; Watson Creek in the Root River of Minnesota; and Matson Ditch in the St. Joseph River of Indiana. These watersheds, although very different from one another, represent a variety of landscapes typical of the Midwestern Corn Belt. In each watershed, the goals are to:

- Identify the appropriate nutrient reduction goal(s) for the watershed in the context of downstream water quality problems;
- Identify a suite of conservation scenarios (mixtures of existing and innovative conservation practices at multiple locations) capable of achieving this goal;
- Engage the community in discussion of watershed-scale conservation options, and the potential environmental and economic impacts of alternative conservation scenarios;
- Identify and resolve technical/economic/social/programmatic/policy/funding obstacles to implementing the chosen scenario(s);
- Monitor and evaluate nutrient reductions achieved through practice/project implementation; and
- Document project progress, outcomes and "lessons learned" for transfer to other watersheds.

Key lessons learned to date

- The importance – and challenge - of targeting across varied landscapes;
- The need to significantly expand the toolbox of conservation practices and the opportunities/challenges of doing so;
- The importance of connecting biophysical and social science analysis at the watershed and farm scale;
- The importance of connecting and validating both local and outsider knowledge and expertise;
- The critical role of a watershed coordinator as the focus of local/expert connections.
- The challenge of coordinating watershed planning, implementation and monitoring across multiple agencies, programs and funding sources.

For more information
Dr. Eileen McLellan, Environmental Defense Fund, Washington, D.C.; emclellan@edf.org; 202-276-5492.

USDA NRCS Programs Target High Priority Watersheds

Thomas W. Christensen, Regional Conservationist

USDA Natural Resources Conservation Service

Mississippi River Basin Healthy Watersheds Initiative (MRBI)

Since 2010, the Natural Resources Conservation Service (NRCS) has been working with partners to target technical and financial assistance aimed at improving the health of the Mississippi River Basin. Through MRBI, NRCS and its partners are helping producers in strategic small watersheds in the Basin to voluntarily implement conservation systems that avoid, control, and trap nutrient runoff; conserve water use; improve wildlife habitat; and restore/enhance wetlands—all while maintaining agricultural productivity.

*NRCS has dedicated **$288 million** in funding to the Mississippi River Basin Healthy Watersheds Initiative, primarily to 640 small watersheds, over the past four fiscal years.*

The Initiative builds on the past efforts of producers, NRCS, partners, and other federal and state agencies in thirteen states to address nutrient loading in priority small watersheds of the Mississippi River Basin. **To date, NRCS has dedicated approximately $288 million in MRBI funding primarily to support 123 projects, covering 640 12-digit watersheds, and over 577,500 acres of targeted conservation.**

To meet the goals of MRBI, NRCS uses an approach that involves conservation practices used in combination to improve effectiveness. Practices include, but are not limited to, nutrient management, conservation cropping sequences, conservation tillage, cover crops, erosion control structures, waste storage facilities, and the management of agricultural drainage water.

In FY 2012, NRCS placed an additional emphasis on the following new opportunities and issues under MRBI:

- **Agricultural drainage water management (in the Upper Mississippi River Basin)**
- **Critical water quantity issues (in the Lower Mississippi River Basin)**
- **Adaptive nutrient management**
- **Batture Lands Wetlands Restoration- in the past year added over 8,700 acres Wetland Reserve Program enrollment, bringing total WRP enrollment up to 16,000 acres, primarily through a new project to enroll acres in the vulnerable floodplain of the Lower Mississippi River.**

Gulf of Mexico Initiative (GoMI)

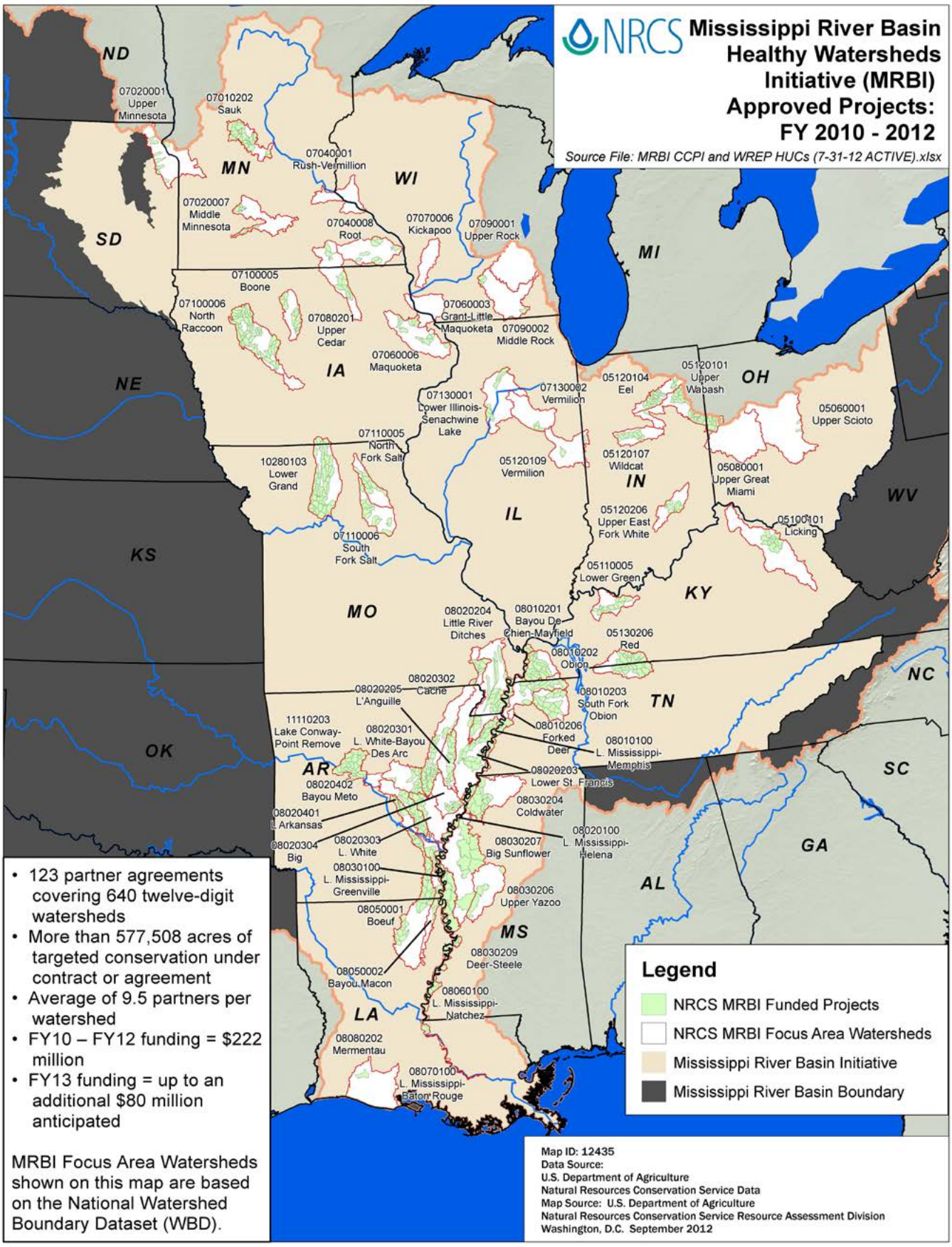
In December 2011, Agriculture Secretary Tom Vilsack unveiled NRCS's Gulf of Mexico Initiative (GoMI), which is part of the Administration's broader plan to restore Gulf Coast ecosystems and improve water quality. NRCS provided over $8 million for conservation efforts on 49,000 acres in FY 2012, and will focus up to $30 million more over the next two years in conservation assistance to farmers and ranchers in priority areas along seven major rivers that drain to the Gulf.

GoMI builds on the collaborative process already underway to gain improvements in water quality by ensuring that NRCS conservation program funding is focused for the greatest effectiveness.

Sixteen priority watersheds in all five states along the Gulf Coast are targeted for participation in the initiative, including areas within the Mississippi River Basin. With financial and technical assistance from NRCS, farmers and ranchers will invest in voluntary conservation systems that will result in cleaner water, more abundant wildlife, and healthier fisheries for many communities in the Gulf.

National Water Quality Initiative (NWQI)

Launched in 2012, the NRCS 2012 National Water Quality Initiative (NWQI) targeted 154 small (12- digit) watersheds in all 50 states and Puerto Rico to improve water quality, particularly in water bodies that are on the 303d list or are in threatened status. Nationally, NRCS dedicated almost **$34 million** in funding in FY 2012 to producers who voluntarily implement conservation systems to address agricultural sources of water pollution, including nutrients, sediment, and pesticides. In FY 2013, NRCS will again dedicate at least 5 percent of its general Environmental Quality Incentives Program funding to the NWQI. Through NWQI, NRCS is also piloting the use of its new Water Quality Index for Runoff Water from Agricultural Fields in at least one watershed per state. The Index will enable producers to evaluate the effects of alternative conservation systems.



- 123 partner agreements covering 640 twelve-digit watersheds
- More than 577,508 acres of targeted conservation under contract or agreement
- Average of 9.5 partners per watershed
- FY10 – FY12 funding = $222 million
- FY13 funding = up to an additional $80 million anticipated

MRBI Focus Area Watersheds shown on this map are based on the National Watershed Boundary Dataset (WBD).


NRCS
Gulf of Mexico Initiative
TX
LA
MS
AL
GA
SC
FL
Mexico
Lower San Antonio River Texas
Mermentau Basin Louisiana
Barataria-Terrebonne National Estuary Louisiana
Jourdan River Mississippi
Weeks Bay Upper Fish River Alabama
Escambia River Alabama/ Florida
Suwannee River Florida
Gulf of Mexico
Overall Initiative Area
Focus Areas Within Initiative
Priority Watersheds


NRCS National Water Quality Initiative 2012
Approved Watersheds
WA
OR
ID
MT
ND
MN
SD
WY
WI
MI
NY
VT
NH
ME
MA
CT
NJ
PA
NV
UT
CO
NE
IA
IL
IN
OH
WV
MD
DE
VA
KS
MO
KY
CA
AZ
NM
OK
AR
TN
NC
SC
MS
AL
GA
TX
LA
FL
Alaska
Hawaii
Puerto Rico & U.S. Virgin Islands
NRCS SSRA-RAD
Legend
NWQI watersheds 2012
Water bodies
State boundaries
Major rivers

AGree is designed to tackle long-term food and agriculture issues.

The initiative seeks to drive positive change in the food and agriculture system by connecting and challenging leaders from diverse communities to catalyze action and elevate food and agriculture policy as a national priority. AGree also recognizes the interconnected nature of agriculture policy globally and seeks to break down barriers and work across issue areas.

AGree is a collaborative initiative of nine of the world's leading foundations, including the Ford Foundation, Bill & Melinda Gates Foundation, The David and Lucile Packard Foundation, W.K. Kellogg Foundation, The McKnight Foundation, Robert Wood Johnson Foundation, Rockefeller Foundation, Surdna Foundation, and The Walton Family Foundation, and will be a major force for comprehensive and lasting change.

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AGree

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