Annex to AGree Consensus Recommendations

Working Landscapes: Achieving Productivity, Profitability, and Environmental Outcomes

NOVEMBER 2014
## Contents

**Introduction** ................................................................. 1  
**The Challenges Ahead** ...................................................... 1  
**AGree’s Framework for Transformative Change** ......................... 4  
1. **Diverse Agricultural Systems** ........................................ 6  
   Embrace diverse agricultural systems to ensure achievement of sustainability, productivity, and profitability goals  
2. **Cooperative Conservation** .......................................... 10  
   Expand producer-led cooperative conservation across U.S. working lands  
3. **Soil Health and Water Quality and Quantity** ...................... 20  
   Improve soil health and water quality and quantity through targeted investments  
4. **Measurement and Research** ........................................... 30  
   Increase understanding of the overall benefits, costs, and health and safety of agricultural inputs, practices, and systems  
5. **Supply Chain Collaboration** .......................................... 35  
   Foster collaboration across the supply chain to drive innovation and improved environmental outcomes  
**Endnotes** ................................................................. 38
Introduction

AGree has developed five consensus strategies to set U.S. agriculture more firmly on a path toward increasing productivity while improving environmental outcomes over the long term, even as new challenges and opportunities emerge:

1. Embrace diverse agricultural systems to ensure achievement of sustainability, productivity, and profitability goals.
2. Expand producer-led cooperative conservation across U.S. working lands.
3. Improve soil health and water quality and quantity through targeted investments.
4. Increase understanding of the overall benefits, costs, and health and safety of agricultural inputs, practices, and systems.
5. Foster collaboration across the supply chain to drive innovation and improved environmental outcomes.

AGree’s consensus recommendations to advance these strategies are detailed in ACHIEVING PRODUCTIVITY, PROFITABILITY, AND ENVIRONMENTAL OUTCOMES IN U.S. AGRICULTURE. This Annex is a companion document to that report. There is a high degree of alignment among AGree Co-Chairs and Advisors regarding what is contained in this report, though not every individual supports every statement and proposal. The Annex serves two purposes. First, it provides context and background related to the five consensus strategies along with more detailed implementation options. Second, it highlights inspiring projects already happening on the ground that exemplify elements of AGree’s proposed approach to achieving economic, social, and environmental outcomes on working lands. This additional material is intended to further identify and explain opportunities for diverse stakeholders to build a path forward for tackling the grand challenge of producing food for a growing population while reducing pressure on natural resources and promoting strong and prosperous farming communities.

The Challenges Ahead

U.S. agriculture has made extraordinary progress over the past 50 years, harnessing innovative technology to feed a growing world and engaging in a greater diversity of production systems to meet evolving consumer needs and preferences. In many places across the United States, producers, landowners, and others in agriculture have developed successful strategies to manage challenges inherent to agriculture – weather and price volatility, soil, water and habitat conservation, and disease and pest management. Significantly greater adoption of conservation practices and systems is needed to address continuing soil, water, habitat and other challenges.

The next 50 years offer promise both to further increase production and to reduce environmental impacts of agriculture. To do so, we must work together. We must accelerate widespread adoption of tools, technologies, and practices already proven to simultaneously advance long-term productivity, profitability, and environmental quality, such as reduced tillage practices1 and more targeted fertilizer applications.2 Farmers, commodity groups and associations, scientists, engineers, and businesspeople must continue to develop innovations in agricultural systems, practices, and technology that create new opportunities.

All AGree participants recognize that alongside exciting new opportunities for agriculture, challenges are increasing in many regions and can affect both long-term productivity and environmental outcomes. These challenges vary considerably geographically, and there are significant differences of opinion regarding their nature and severity, their impacts, and the best strategies for addressing them. Lack of sufficient data also impedes progress in identifying problems and crafting solutions. Nevertheless, we recognize the following challenges facing agriculture:

• Ensuring Global Production Can Meet Future Demand for Nutritious Food: World population is expected to rise from 7 to 9 billion by 2050.3 The vast majority of this growth will occur in developing countries, especially in South Asia and sub-Saharan Africa, regions already plagued with chronic hunger. Rising incomes globally also are expected to bring changes in dietary patterns, and there is increasing recognition that greater attention must be paid to the nutritional value of the food produced for all populations. Estimates of needed increases in food production are hard to pin down4; such estimates should account for what portion of increased food availability can likely be achieved through waste reduction and improvements in distribution. Increased levels of international support for agricultural development both to increase production and reduce waste will be needed to meet future demand (Box 1).
The Challenges Ahead

• Achieving Healthy Soils: Healthy soils are essential to long-term productivity, profitability, and healthy agricultural ecosystems. They lead to robust crops, reduce water pollution, limit vulnerability to pests, sequester carbon, and increase resilience to weather events. However, in too many places soils are threatened by erosion, compaction, nutrient depletion, and limited biological diversity. In the United States, soil erosion has been reduced substantially (41 percent from 1982 to 2010). Progress slowed, however, after 1997, negligible erosion reduction took place between 2007 and 2010, and erosion remains a major issue in some areas. Building soil organic carbon (SOC) stocks and maintaining healthy soil biology are also critical to long-term soil health.

Box 1. U.S. Agriculture and the Global Food and Agriculture System

U.S. agriculture has been extremely successful in achieving high productivity over the past 50 years as measured in crop per acre or pounds of animal product and net economic returns. During this period, the United States has played an important role in supplying global markets and ensuring an adequate global food supply.

While American agriculture will continue to play a vital role in meeting global demand for food, increases in productivity to feed a growing world need to occur primarily in the countries that will face population growth and have significant yield gaps.

There are a range of estimates on the amount global production needs to increase to meet future demand, and a range of views on how much of that additional production will need to come from the U.S. Factors that need to be taken into consideration include the capacity for increasing productivity in developing countries, the amount of loss across the entire supply chain that can be reduced, how much farmland will be developed or degraded, and the extent to which dietary preferences will shift, both in the United States and other developed countries (trending now toward lower per capita consumption of grain-intensive animal products) and in developing countries (trending now toward higher per capita consumption of grain-intensive animal products).

AGree believes that the global community should focus on closing major yield gaps, particularly those in developing countries, by supporting development of productive agricultural systems that communities deem appropriate to their social, economic, and ecological context.

The U.S. can lead efforts to help the world’s developing countries increase domestic production in ways that are economically, environmentally, and culturally appropriate, encourage the development of sustainable conservation practices, and lead a resurgence in agriculture-related research, extension and education focused on the challenges of sustainability, climate variability and water scarcity, all problems facing farmers around the world.

Exchanging knowledge and strategies between the U.S. and developing countries will benefit both. However, strategies to transfer knowledge, production systems, or landscape-scale working lands conservation approaches from one agro-ecological and socio-cultural context to another requires great care and the active involvement of relevant stakeholders.

AGree has established a targeted set of recommendations that focus on the development of a new food systems approach for international development. See AGree’s International Development Initiative: Promoting Development through Food and Agriculture, November 2014. [ADD LINK]

•Securing Water for Agriculture: Water supplies for agriculture are critical to food security. In the United States, the 16 percent of all harvested cropland that is irrigated generates nearly half the value of all crops sold. Agriculture faces growing competition for water from other sectors, including urban areas, energy production, and wildlife protection efforts, particularly but not only in the West. Aquifers, a significant source of water for agricultural withdrawls, are in many cases being rapidly depleted. Depletion rates in the United States from 2000 to 2008 averaged 25 km³ per year, compared to a 9.2 km³ average rate over the past century. The real-time threat of current droughts and projections for more intense and prolonged drought events in the future due to climate change amplifies the risks of an increasingly limited water supply.
• **Improving Water Quality:** Though water quality has improved since passage of the Clean Water Act in 1972, water pollution continues to be a threat to public health, downstream coastal livelihoods, and aquatic life across the United States. Forty-four percent of assessed stream miles, 68 percent of assessed lake acres, and 78 percent of assessed bay and estuarine square miles across the country are not clean enough to support uses such as fishing and swimming. The National Water Quality Inventory cites agricultural nonpoint source pollution, including excess nutrients, pesticides and other chemical inputs, sediments, and pathogens, as one of the leading sources of these water quality impairments.

• **Managing Pests, Disease and Invasive Species:** Pests, weeds, and pathogens – both endemic and invasive – threaten crops and livestock, require costly management, and can directly and indirectly degrade the health of the landscape. The U.S. Fish & Wildlife Service estimates that American agriculture loses $13 billion annually in crops from invasive insects alone. Crop pathogens cause approximately $21 billion in losses and livestock diseases account for $14 billion in losses and damages each year. Invasive species also put pressure on farmers and ranchers by exacerbating threats to biodiversity: more than 40 percent of species listed under the Endangered Species Act are at risk due to predation, competition, and displacement by invasive species – increasing landowner and producer costs, presenting significant management challenges and threatening ecological health.

• **Farming and Ranching in a Changing Climate:** Climate change is expected to affect both temperatures and precipitation rates in various parts of the world, with effects varying significantly by region. Climate change is also predicted to affect growing seasons, soil moisture levels, rates of pest invasion and other critical agricultural practices and lead to rising sea levels and inundation and salinization of coastal areas, deltas, estuaries and aquifers. Current models suggest the most affected regions will be those with the least adaptive capacity, accentuating already great disparities in agricultural productivity. Food and agriculture is about 4.8 percent of U.S. GDP and 9.2 percent of U.S. employment and produces approximately 8 percent of U.S. greenhouse gas (GHG) emissions in 2012. Agriculture has the potential to play a major role in reducing GHG emissions. Many practices that reduce the global warming potential per unit of crop and livestock production also improve profitability and long-term productivity, for example, sequestering carbon in soils through conservation tillage and cover crop practices, fertilizer and manure management, improving energy efficiency, and other practices.

• **Ensuring Strong and Prosperous Farms and Rural Communities:** A food system that can produce affordable and nutritious food depends on the viability and sustainability of farm businesses and its workforce, which in turn depend on strong rural communities. With the average age of principal farm operators rising to 57 in 2007 from age 50 in 1978, and the proportion of farmers under age 35 declining to 5 percent, attracting and training the next generation of farmers and ranchers is critical. Without policies in place to guarantee a stable, legal farm workforce, farm labor also remains a challenge, creating significant uncertainties and vulnerabilities for operators and workers alike.

• **Reducing Uncertainty in Policies and Markets and Building Trust Across Sectors:** In some cases, regulatory compliance with state, federal, and local laws; sustainability requirements from food manufacturers, retailers, and others; and labeling certification standards for organic producers and other labeled products can demand significant time and resource investments by landowners and producers. Duplicate and changing requirements of various certifications, agencies, and buyers can create uncertainty for producers attempting to plan and make investments for their operations. At times, approaches to natural resource protection have resulted in adversarial rather than collaborative processes, especially between farmers, ranchers, and landowners and regulatory agencies. Strengthening trust and mutual understanding, setting clear and fair standards, and reducing uncertainty, will be essential to creating the new partnerships and cooperative efforts needed to achieve healthy landscapes and profitable and productive operations.

**These challenges are magnified by declining public investments (in inflation adjusted dollars) in research, education, extension, working lands conservation, infrastructure, and data collection.** New investments, collaborations, and partnerships will be needed to harness the ingenuity and capacity for innovation of U.S. producers and others in the agricultural sector to address both existing challenges as well as new challenges on the horizon.
AGree’s Framework for Transformative Change

Meeting the challenges ahead and succeeding in producing affordable nutritious food to meet growing and changing demand, ensuring healthy working landscapes and ecosystems, and achieving strong and prosperous farms and communities will require significant and rapid adaptation and scaling up of effective production and conservation practices, systems, and strategies. This in turn will require a transformation in the way that producers, landowners, commodity groups and associations, the entire supply chain, scientists, the conservation community, environmental advocates, the public at-large, and government understand these challenges and then work together, both at a national and institutional level as well as on the ground, to address them.

Box 2. AGree’s Framework for Transformative Change to Achieve Productivity, Profitability, and Environmental Outcomes

**Goals and Strategies:** The green center of the triangle details five core strategies for driving positive change on the ground to achieve three key goals: advance long-term productivity to produce affordable nutritious food, create strong and prosperous farm operations and communities, and contribute to healthy working landscapes and ecosystems (the outside edges of the triangle). All of these strategies require active engagement by producers and landowners, the heart of the food and agriculture system.

**Drivers and Enablers:** The blue corners of the triangle represent partners that provide opportunities, incentives, accountability, knowledge and information, and support to producers and landowners in implementing strategies to achieve goals.
Producers and landowners are at the center of AGree’s framework for transformative change (Box 2). Pioneering producers have demonstrated that crops and livestock can be profitably produced while achieving environmental outcomes and managing risks. Practices they employ include, where appropriate, building soil, managing inputs efficiently, utilizing integrated pest management, conserving water, growing cover crops, diversifying rotations, employing state of the art grazing systems, and maintaining and enhancing habitat for pollinators and native species. Leading producers and landowners also participate in and provide leadership to cooperative efforts to achieve productive and healthy working landscapes.

A changing marketplace is one of three critical drivers and enablers of change in agriculture. Consumers in the United States are increasingly interested in how their food is produced. Demand for locally produced food has grown rapidly, as has the market for organic products. Major brands and retailers want to demonstrate to their customers that their products are healthy and produced in environmentally responsible ways, and these companies are putting increasing pressure on producers to document environmental and social performance. Demand from abroad is changing, with export markets for animal protein growing. The supply of agricultural technology and inputs also is changing, creating both new opportunities and new risks for producers and the environment.

The public sector is a second critical driver and enabler of change. The federal government needs to conduct long-term planning, ensure equitable treatment of all agricultural sectors, and focus limited public resources on critical infrastructure, research, and other investments for specific and targeted purposes where public action is required to advance the public interest. Many current USDA initiatives reflect such an approach (e.g., the Natural Resources Conservation Service [NRCS] Soil Health Awareness Initiative, consideration for altering risk management tools to better support cover crop use, and the COMET-FARM greenhouse gas reporting system for farms and ranches). Other critical roles for federal and state governments are to collect and make available data that serve producer communities and the broad public interest, provide natural resources planning and technical assistance to producers and landowners (Box 3), ensure that farmers have access to adequate risk management tools, provide incentives for conservation practices that go beyond those identified as responsible land ownership and yield important public benefits, and set achievable environmental quality and land management standards.

Science, metrics, and data serve as a third critical driver and enabler of change. Better understanding is needed of tradeoffs and synergies among improving productivity, protecting natural resources, improving environmental quality and enhancing profitability in order to find optimal solutions. Goals, metrics, baselines, and the capacity to measure change over time at multiple scales all are necessary to set a bar for performance, enable innovation to improve both productivity and environmental outcomes, and establish systems to measure progress from field to large landscape scales. Developing widely accepted goals, standards, and associated metrics relevant to producers and landowners, commodity groups and associations, policymakers, supply chain leaders and the public will be critical to focus activities of multiple sectors and actors and leverage public and private investments around commonly shared objectives.

Box 3. Extension and Technical Support: Key to Increasing Productivity and Improving Environmental Outcomes

Efforts to increase productivity, profitability, and environmental outcomes rely on translating cutting-edge research and technological and management innovations into accessible, user-friendly tools, strategies, and practices tailored to the diverse needs of the agricultural community. Robust feedback loops and partnerships between researchers and producers are vital to enable and sustain technological innovation on the ground.

Extension and other public and private technical support resources (e.g., NRCS, conservation districts, private consultants and crop advisors, etc.) are critical in linking landowners and producers and the scientific community with one another and with the private sector and government officials.

Implementation of many of AGree’s strategies will rely on these institutions and actors having the capacity, resources, expertise, and leadership skills to support landowners and producers as they experiment with and evaluate new approaches and technologies, set baselines and monitor agronomic environmental outcomes over time, and develop new pathways to collaborate with diverse stakeholders.
1. Diverse Agricultural Systems

**Embrace diverse agricultural systems to ensure achievement of sustainability, productivity, and profitability goals**

A critical challenge in the next several decades is ensuring that producers and other stakeholders have the tools and resources they need to feed a growing population in a manner that promotes human and environmental health. This will require widespread adoption of available tools, such as improved seed and livestock genetics in developing countries and advanced agricultural technologies in the United States, as well as development of new agricultural technologies and systems. It will necessitate new strategies for increasing long-term production of agricultural goods that support human health while maintaining and/or improving environmental outcomes across landscapes. Determining how much additional agricultural production is needed to meet future demand for food also depends, in part, on how much of that production is lost due to waste or spoilage between the farm and table (Box 4).

To feed a growing world, we can think more flexibly about how a wide range of tools and resources can be used in different combinations to create farming and ranching systems with high long-term productivity of agricultural products demanded in the marketplace and low, if any, long-term impact on environmental quality. To ensure that we do not advance technologies and practices that have unintended consequences, new agronomic tools, technologies, and systems, from tillage practices to new chemistry and genetics to organic and agro-ecological systems, should continue to be objectively and transparently evaluated in terms of both their agronomic effectiveness and their possible human and ecological health impacts.

**In Summary:** Stakeholders must move beyond debates about big vs. small, organic vs. conventional or low vs. high tech to focus on what works best to achieve these concrete outcomes: reliable and consistent production of affordable, safe, and nutritious food; healthy working lands and ecosystems, and prosperous farms and communities. All producers must have the tools and resources they need to successfully and sustainably deliver agricultural products while serving diverse consumer values and markets. Food value chains everywhere must be sufficiently resilient to adapt to changing market and environmental conditions and to recover from short-term weather, market, or resource-based crises.

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**Box 4. Reducing Food Waste: An Essential Strategy**

In less-developed countries, 15 to 50 percent of harvests are estimated to be lost both in the field and post-harvest owing to pests, diseases, and lack of adequate storage and other infrastructure, especially for transporting goods to market.\(^{21}\) Reducing post-harvest losses in developing countries requires both public- and private-sector investment in agricultural research, development, and extension, including in appropriate storage technologies and in improved infrastructure to better connect smallholder farmers to local, regional, and international markets. Training and education about effective drying and storage practices are particularly critical.

In the United States and other developed countries, food waste is also a significant problem. A recent study estimates that in the United States, more than 600 pounds of food are wasted per person per year. The majority of waste is at the consumer level, where about one-half of the food purchased is wasted.\(^{22}\) High food waste at the consumer level is attributed to relatively cheap food prices in developed countries and minimal awareness about the scale of food waste. Although improvements have been made, better management throughout the supply chain and at the consumer level is needed to reduce loss. Reducing both post-harvest losses and food waste requires multiple strategies, including increasing consumer awareness, changing consumption behavior, and refining incentives among private sector supply chain participants.
U.S. agriculture has been highly successful in achieving agricultural productivity as it has traditionally been defined. Many have come to understand, however, that there are limitations to restricting our understanding of agricultural productivity to only raw commodity production and economic returns on an annual basis. Broader definitions and measures are important because they will guide policy, programs, investments, and individual behavior.

Development and adaptation of tools, strategies, and systems to increase both long-term productivity and environmental quality will require significant ongoing investments in their development and in evaluation of both their effectiveness and unintended impacts. Some believe that current investments in research and development are at times misplaced and inadequate. The institutional capacity for agricultural research and development could be strengthened and focused on technologies and production systems that enable significant intensification of production of nutrient-dense foods while conserving and enhancing soil, water, and habitat. Continued and focused research, exploration, and assessment of, and evidence-based societal conversation about, new innovations — from accelerated conventional breeding to biotechnologies, from new organic inputs to emerging RNA interference technology—are needed.

Maintaining profitable farm operations, meeting future demand for affordable nutritious food, and achieving healthy working landscapes and ecosystems in the context of a changing climate, shrinking water supplies, shifting dietary preferences and growing populations in the United States and globally will require models of innovation that create stronger linkages among researchers, producers, commodity groups and associations, educators, NGOs, and public and private institutions. Strengthened linkages among these key stakeholders would support problem identification and priority setting and help ensure research outputs will be adopted and adapted by producers and others to successfully address challenges. Social, technical, and institutional innovation all would be required.

Different stakeholders bring different perspectives and prioritization of values (yields, profit, externalities, etc.) in their evaluation of the benefits of an agricultural technology. There are a range of views on the likely productivity trajectories of various systems, including biotechnology. Some producers, companies, researchers, and advocates view biotechnology and genetically modified organisms as critical for meeting future demand. Others believe the global community can and should feed itself through widespread adoption and scaling up of agro-ecological and organic methods, while still others see opportunities for these options to be complementary. The potential for negative effects on human and environmental health of new technologies should be rigorously and transparently evaluated before they are released to the market. Agricultural systems should be designed to serve specific ecological and social contexts, and a systems-based approach should be used to develop and evaluate all agricultural technologies, rather than one focused on specific traits, tools, or practices in isolation. For example, herbicide tolerant cultivars are currently being evaluated on the basis of the direct human health risks, long-term productivity, and environmental impacts of those crops. The impacts on ecological systems, human health, and long-term productivity of the whole agricultural system of which those cultivars are a part (e.g., reduced tillage, use of herbicides to which the cultivars are tolerant, etc.) should be further assessed.

There are opportunities to increase productivity in a wide variety of systems employing diverse technologies, tools, and practices that are continually evolving. These include reduced tillage systems that prevent erosion and build soil organic matter; promotion of robust life systems beneath the surface; precision application of inputs based on high resolution data; innovative large-scale and small-scale grazing strategies and integrated crop and livestock systems; expanding tools for integrated pest management; improved crop and livestock genetics through conventional breeding, intragenic engineering, transgenic engineering, and genetic marker breeding; preservation of germplasm of heirloom and legacy-heritage animals; improved water management for both irrigation and drainage; cover crops and diversified crop rotations; integrating habitat for pollinators and wildlife; low input conventional cropping systems; RNA interference; agro-forestry systems; permaculture systems; and others.

These technological and management approaches can be integrated in varying combinations and different operational contexts. Private agricultural lands, innovative production systems that enable food production in new environments (e.g., oceans, deserts, indoor environments and on buildings, urban areas), as well as all public lands that might produce food (both national lands that historically have supported grazing and other national, state, and local lands that either are abandoned or could incorporate food production while fulfilling their primary purposes) all should be considered when assessing the production potential of U.S. agriculture.
Many farmers are using practices that promote both productivity and environmental quality to great benefit (Box 5). However, many that could be doing so are not. Potential barriers to implementation and strategies for addressing these challenges include:

- **Real and perceived economic risks:** Emerging practices and technologies often require startup costs, such as investments in new equipment, inputs, or expertise as well as additional producer time. If a new approach has not demonstrated its economic benefits in a local community or region, landowners and producers may be reluctant to make the investments to transition to a different system.

- **Uncertainty in policies or markets:** Landowners and producers may be less likely to engage in new practices or experiment with new technologies if it is unclear whether these approaches will be accepted and supported by the regulatory framework or sustainable sourcing initiatives.

**Box 5. In the Field: Aligning Productivity and Environmental Outcomes**

**Success Stories**

- **Great Lakes Cover Crop Initiative (GLCCI):** GLCCI, a three year project funded by EPA's Great Lakes Restoration Initiative in partnership with regional Land Grant Universities and the Conservation Technology Information Center, provided technical, educational, and social support to farmers in the Lake Michigan, Lake Erie, and Lake Huron watersheds to implement cover crop rotations and conservation tillage systems. Covering nearly 37,000 acres, the project sought to demonstrate the economic and productivity benefits of these conservation systems to new users, while reducing nitrogen, phosphorous, and sediment pollution loads in the Great Lakes.

- **Eastern Municipal Water District Recycled Water System:** Southern California's Eastern Municipal Water District has been a leader in water recycling and reuse, providing recycled water to farmers irrigating feed and fodder crops since the 1960s. Over the following few decades, EMWD made substantial infrastructure investments to improve recycled water capacity and delivery. Today, EMWD's Recycled Water System provides the community with 45-50 million gallons of recycled water each day and can store more than 2 billion gallons, a three to four month supply, which helps mitigate the effects of drought. Much of the reclaimed water goes to agriculture, supporting specialty crops, grain crops, fiber, and fodder. In addition to taking pressure off of water supplies critical to many species, EMWD's constructed wetlands wastewater treatment center provides habitat for wildlife.

- **Clearwater River Watershed District Targeted Fertilizer Application Reduction Project:** Minnesota's Clearwater River Watershed District worked with farmers to save money on fertilizer inputs, optimize yields, and improve water quality using precision agriculture techniques. Rather than applying fertilizer at a standard rate across the field, the District helped farmers test their soil at strategic intervals to determine soil fertilizer requirements and allow farmers to apply fertilizer at a variable rate, optimizing input use. Following a successful pilot phase, the District is now planning to enroll 10,000 acres into the program, which is projected to satisfy approximately 17 percent of a required nutrient load reduction from agricultural sources while providing farmers with financial benefits.

- **Innovation Center for U.S. Dairy Energy and Climate Initiatives:** The Innovation Center for U.S. Dairy, an effort supported through dairy industry check-off funds, works with farms and dairy companies to improve their energy efficiency, which saves farmers money, protects them from volatile energy prices that can affect profitability, and reduces greenhouse gas emissions. The Center has worked to expand the use of energy audits and efficiency measures, anaerobic manure digester systems, and improved manure and nutrient management. In addition to significant cost-savings, these efforts have advanced the industry's goal of reducing its greenhouse gas emissions from fluid milk by 25 percent by 2020.
• **Lack of knowledge among producers or consumers:** Adopting new practices or technologies requires both technical assistance to landowners and producers learning how to implement a new approach as well as broad acceptance among consumers.

• **Other risks:** Depending on the management practice or technology, landowners and producers may have additional concerns that may limit the adoption of a new approach. Innovations in precision agriculture, for example, while demonstrating great promise for productivity, profitability, and conservation, also raise concerns about proprietary data security and privacy. These barriers will need to be managed on a case by case basis.

The choices made by producer groups, the private sector, and government regarding the problems, systems, and technology in which to invest research and promote awareness and education are critical. It is equally as important to foster better use of existing knowledge and technology as it is to create new knowledge and technologies.

To drive innovation in the food and agriculture sector and to enable producers of all kinds in the United States and abroad to better access and utilize information and tools to improve the productivity of their operations, options for implementation include:

a. USDA, state departments of agriculture, input manufacturers and suppliers, sustainable sourcing initiatives, and agriculture and conservation organizations should promote innovation and widespread adoption of proven technologies, practices, and systems by (1) supporting local leaders willing to test promising practices; (2) promoting peer-to-peer learning around new practices through field days, workshops, and other events; (3) investing in further research and proof of concept pilot projects in target regions and communities; and (4)

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**Box 6. Investing in Infrastructure: Building a Stronger Future**

The success of the U.S. food and agriculture system – in meeting future demand for food, creating prosperous farming and ranching communities, and driving improved environmental outcomes on the ground – has historically relied on public and private investments in essential infrastructure investments. Public and private funding for the following types of infrastructure could empower landowners and producers to achieve these interrelated goals over the coming decades:

**Water:** Government as well as private sector beneficiaries must find creative ways to provide for the operation, maintenance, and modernization of existing water supply infrastructure for conveyance, storage, and drainage using green and biodiversity-friendly technologies wherever feasible. Public and private investments and partnerships are also needed to develop, adapt, and implement new technologies that increase water use efficiency, filter and recover waste water suitable for reuse and recycling, and make brackish and produced water usable.

**Food Storage, Transport, and Processing:** In both the United States and internationally, investments are needed in infrastructure that helps producers connect along the supply chain with actors who can transport, store, refrigerate, process, and/or package products. These improvements will reduce food waste and safety concerns and improve producer livelihoods.

**Food Safety:** Infrastructure to ensure the safety of agricultural products must be both robust enough to manage risks while also maintaining efficient and straightforward processes to limit regulatory burdens on producers. Harnessing the technology, expertise, and effective systems needed in this arena will require public and private sector investments and ongoing coordination.

**Invasive Species:** The productivity, profitability, and ecological health of agricultural landscapes requires greater investments in infrastructure to prevent the introduction of invasive species and identify and eradicate invasive populations before they become established and spread, such as through the Early Detection and Rapid Response (EDRR) system.
improving opportunities for knowledge exchange among farmers, commodity groups and associations, scientists, companies, public sector institutions, and civil society by modernizing existing extension efforts to integrate emerging cutting-edge technologies and engaging end-users of research outputs early on in priority setting and technological development;

b. Congress, State Legislatures, state and federal agencies, and companies across the supply chain should provide clear and fair environmental standards and, with adequate safeguards, the regulatory and programmatic certainty, alignment, and flexibility necessary for landowners and producers to take risks to develop, adapt, and adopt new practices and technologies;

c. A broad coalition of stakeholders should thoroughly assess the public research, education, and extension (REE) system in the context of current and emerging challenges and the role of the private sector in REE and provide strategic leadership to shape an REE system for the 21st century that updates priority setting mechanisms, modernizes existing funding flows for research and development, adapts curation and management of big data to fit existing and emerging needs, revitalizes built infrastructure, and integrates stakeholder input early-on in the research process;

d. The public and private sectors should increase investments in: basic agricultural and ecological sciences; efforts to increase productivity while strengthening the capacity of agricultural systems to adapt to changing climatic, ecological, and economic conditions; and, robust extension services, including support for cooperative conservation of working lands; and,

e. The Federal government should identify and commission the appropriate agency to independently and transparently evaluate the agronomic effectiveness and human and ecological health impacts of new agronomic tools, technologies, and systems before their release and ensure accountability for the safety of new technologies by requiring government-funded and controlled, independently conducted assessment of impacts immediately after technologies are released.

f. The public and private sectors should also support productivity increases across systems by ensuring adequate investment in critical infrastructure for agriculture, including for transportation, storage, water delivery, and flood control (Box 6).

2. Cooperative Conservation

Expand producer-led cooperative conservation across U.S. working lands

In Summary: U.S. agriculture should capitalize on and extend proven successes of producer- and landowner-led efforts to advance conservation and improve environmental outcomes. Farmers, ranchers, and landowners should be empowered by federal policy to take the lead in initiating efforts to:

- determine a basic standard of care- performance and practice standards that should reasonably be expected of landowners and producers in their watersheds or regions and should be in place whether or not public cost-share dollars are available;
- encourage all producers to participate in meeting those standards, and test innovative approaches to meeting these standards while also achieving production goals;
- assess the productivity and profitability of these practices over the long term;
- work with relevant agencies, technical experts, and organizations to identify additional on-farm practices and infrastructure that support achievement of natural resource conservation goals;
- determine implementation and financing strategies and identify sources of funding to support implementation; and
- provide safe harbor to those who are willing to take voluntary action to achieve desired outcomes or early adopters who achieve such outcomes in an unconventional or extraordinary manner.

“Taking the lead” does not mean “doing it alone.” The value of public research and extension systems in providing science-based advice is well-recognized and will be an essential complement to producer-led efforts. Indeed, strengthening public agricultural education and extension would facilitate additional acceptance and implementation among producers, landowners, community groups, and state and federal agencies to advance effective conservation at both the farm and landscape scale.
Effective, integrated management of land and water in the United States will require crossing jurisdictional boundaries and transcending adversarial approaches through creative collaboration among landowners, tenant operators, agribusiness service providers, environmental advocates and conservation groups, urban interests, and agencies across all levels of government. Successful approaches will contribute to the long-term economic viability of farm operations and the value of agricultural lands while achieving conservation outcomes at the watershed or landscape scale.

Inspired by outstanding examples in the field (Box 7), cooperative conservation efforts should be established on a broader basis. Farmers, ranchers, and landowners should take the lead, with robust technical support, in determining: (1) what performance and practice standards can reasonably be expected of landowners and producers in their watersheds or regions and should be in place whether or not public cost-share dollars are available; (2) what additional on-farm practices and infrastructure are necessary to achieve natural resource conservation goals that taxpayers, or other funders

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**Box 7. In the Field: Cooperative Conservation Success Stories in the United States**

In their AGree Point of View Paper, *Cooperative Conservation: A Producer-Led Approach to Achieving Healthy Agricultural Landscapes*, authors Kristin Weeks Duncanson, Jim Moseley, and Fred Yoder further explore and make their own recommendations about pursuing cooperative conservation across the American landscape. They highlight the following examples of successful on the ground projects with features that inspired their concept:

- **Lime Creek Watershed Improvement Association**, located in Northeast Iowa, has used a community-based approach to engage local landowners to achieve a set of agreed-upon nutrient reduction goals. Forty-five percent of watershed residents are 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 are paid incentives for sustainable land stewardship as measured by improved index scores and reduced corn stalk nitrate. The Association has successfully improved environmental outcomes by leveraging incentives, harnessing data and metrics, and engaging the local community.

- **Little Snake River Conservation District, Wyoming** 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. The District has been highly successful in conducting outreach, building trust with and a sense of ownership among landowners, engaging agencies, and securing project funds – all of which are critical ingredients to successful cooperative watershed projects.

- **Nebraska's Natural Resource Districts** are a unique system among U.S. conservation districts in that they are governed by locally elected boards, organized by river basins to improve watershed management, and have the ability to assess local property taxes to fund projects. They provide technical and cost-share assistance as well as local regulations where necessary to improve conservation and natural resource management across the state, including flood control, groundwater quantity and quality, soil erosion, and irrigation runoff. Self-funded, locally governed, and with jurisdictional boundaries that match resource management concerns, Nebraska's Natural Resource Districts are models of effective conservation institutions.

*Continued on the next page*
• **Yahara Pride Farms Conservation Board** is a voluntary, incentive-based coalition of Dane County, Wisconsin, landowners and producers, agronomists and technical advisors, recreational interests, and business leaders working to address phosphorous and sediment loading in the lakes in the Madison area and build a sustainability certification program. Partnering with NRCS, University of Wisconsin Extension, and the Clean Lakes Alliance and supported by private grants and member contributions, the Board has worked with local producers to improve their practices, engage in peer-to-peer learning, and leverage state and federal programs and technical assistance to gain the benefits of sustainability certification, including improved stewardship, expedited permitting from regulatory agencies, discounts from business partners, and brand recognition. Another ongoing project is the Yahara Watershed Improvement Network (WINs), a collaboration with the Madison Metropolitan Sewerage District (MMSD) to pilot an adaptive management approach to reducing nutrient runoff from non-point sources.

• **Indian Creek Watershed Project, Illinois** was established in 2009 to support area farmers working toward improved nutrient management and water quality. The Conservation Technology Information Center (CTIC), in collaboration with Illinois EPA, NRCS, and the Livingston County Soil and Water Conservation District, provides farmers with technical, informational, and financial support for conservation practices and technologies while also providing on-farm education and demonstration projects. Led by a steering committee headed by local producers, the project has garnered strong community support—55 percent of local farms have enrolled. Partners in local government provide technical support through lake monitoring services, including regular data collection on sedimentation, fish habitat, nutrient loading, and other project concerns to help participants track progress and engage in adaptive management.

• **Sand County Foundation’s Ag Incentives Program** provides financial support to farmers for experimenting with new nutrient management practices to improve water quality in Midwestern rivers and lakes and the Gulf of Mexico. The project measures the results of such efforts to ensure progress and adaptive management. Current projects include work on the Milwaukee River, Boone River, and Yahara Lakes.

• **Sage Grouse Initiative** is a Natural Resources Conservation Service (NRCS)-led collaborative effort to bring ranchers, agencies, researchers, conservation organizations, and the private sector together to proactively conserve sage grouse and sage grouse habitat to prevent the species’ listing under the Endangered Species Act. Voluntary projects, such as conservation easements, new grazing systems, and invasive species and fence removal, are ongoing across 11 western states.

For more examples of the landscape-scale conservation approach, please see AGree’s report, *Collaborative Management of Agricultural Landscape: Achieving Measurable Conservation Improvements*.

should be expected to help with; and (3) what mix of funding should be used to support implementation. Local leaders – farmers, ranchers, landowners – should take responsibility for helping to encourage all producers and landowners to participate in local efforts that are aligned with state and federal goals, plans, and standards for natural resource outcomes. Such efforts could be integrated into a wide range of local institutions (e.g., conservation, irrigation, drainage, and/or invasive weed districts/councils), depending on which institutions have interest and capacity in a particular place.

Widespread implementation of cooperative conservation is a long-term prospect that would require significant capacity development and reorganization and integration of authorities. This includes significantly increasing skilled volunteer and professional leadership in agricultural communities across the United States that can provide necessary technical support and engage effectively with landowners and producers and the commodity groups and associations to which they belong. Higher quality and better integrated data on
both practices on the land and outcomes from field to large landscape scale as well as more detailed scientific analyses of their relationships will also be needed.

The emergence of a local effort often comes in response to a catalyzing event or unexpected conditions—what might be termed an “igniter.” Igniters might come in the form of significant new market or technological opportunities, supply chain requirements, unusual events that lead to widespread recognition of a problem that needs to be addressed, an emerging statewide strategy to address nutrients, and/or a new law, policy, or standard. Safe harbor agreements coupled with adequate enforcement of existing or new regulation, “sustainable sourcing” premiums, and other incentives will encourage participation. Where there is insufficient interest in, or capacity to, achieve conservation outcomes through a cooperative approach, alternative approaches will be needed.

Though in some cases local groups are poised to make rapid progress, intensive efforts at multiple levels over 10 to 20 years will be necessary to establish the foundation for this strategy to succeed across the country. Given the fiscal constraints of both federal and state governments for the foreseeable future, strategies and policies to align agricultural production, profitability, and environmental outcomes must be prioritized. Creative means to secure financial resources needed for success should also be sought.

The following actions can help scale up cooperative conservation of working landscapes in regionally appropriate ways:

a. Farmers, ranchers, and landowners should take the lead in initiating efforts to determine, with technical assistance, what performance and practice standards should reasonably be expected of landowners and producers in their watersheds or regions (whether or not public cost-share dollars are available); encourage all producers to participate in meeting those standards; and work with relevant agencies and organizations to identify additional on-farm practices and infrastructure that are necessary to achieve natural resource conservation goals that taxpayers or other funders should be expected to help with; and identify sources of funding to support implementation.

b. Congress should shift up to 50 percent of USDA conservation program spending for technical and financial support of producer-led watershed or landscape-scale based cooperative conservation efforts to address priority resource concerns, such as those that will be supported by the Regional Conservation Partnership Program established in the 2014 Farm Bill, in order to realign USDA and other conservation funding, technical support, and incentives to stimulate, empower, and support cooperative conservation of working landscapes. This would shift funding within existing programs and/or from existing to new programs to drive conservation outcomes at a landscape scale rather than supporting ad hoc conservation on individual operations that may not achieve broader environmental goals. This may also require shifting funds from financial assistance to technical assistance to hire and train staff focused on proactively engaging and supporting producers and landowners in watershed/landscape scale cooperative conservation.

c. Agencies (e.g., U.S. Environmental Protection Agency, U.S. Department of Agriculture, U.S. Army Corps of Engineers, U.S. Department of the Interior, state agencies) should be granted and exercise flexibility in the implementation and enforcement of regulations to allow space for and actively catalyze, support, and empower landowners and producers to undertake the innovation and cooperation necessary to achieve improvements in environmental outcomes and meet standards more quickly and effectively.

d. USDA, academia, and other agricultural and conservation organizations should invest in research to understand best practices in organizing and sustaining producer-led cooperative conservation that leads to changes in management decision-making and behavior resulting in both long-term productivity and improvements in environmental outcomes. Significantly greater effort should be focused on engaging absentee landowners.
e. **Agriculture and conservation organizations and agencies should promote the concept of mutual accountability and responsibility** among landowners, producers, commodity groups and associations, regulators, environmental groups, conservation organizations, and the public. Multi-stakeholder efforts focused on joint action to address resource challenges, such as Solutions from the Land and the Mississippi River Nutrient Dialogues, are critical for identifying and advancing opportunities for cooperative conservation across sectors.

f. **Agricultural and conservation organizations, government, universities, and the private sector should invest in developing the leadership required for scaling up cooperative conservation efforts.** Inspiring and skilled professional and volunteer leadership with trusted technical competence and strong interpersonal skills is needed to drive positive change on the ground. While in some communities, producers, landowners, extension and/or conservation district staff provides strong leadership, the skilled volunteer and professional leadership necessary to effectively engage landowners/producers at the grassroots has yet to emerge or be developed in many communities. While leadership can initially come from landowners, producers, extension staff, conservation organizations, and/or local agency staff, leadership among producers and landowners is vital in order to grow and sustain participation in the agricultural community. Conservation organizations and agencies are most effective when serving in the background as facilitators. Local leaders ensure that communities are engaged in the process and have “skin in the game” and that solution strategies will be more practical and effective. Opportunities for leadership training and development are detailed in Box 8.

g. **Agriculture and conservation organizations and agencies should also secure additional funding sources for agricultural conservation through a wide range of alternative strategies.** In order for cooperative conservation to spread as a model for achieving productivity and environmental outcomes on working lands across the United States, sufficient resources are needed. Although sustained federal funding for conservation will continue to be essential to achieving environmental outcomes on working lands, a variety of alternative sources of conservation financing should be explored at the federal, state, and local levels to enhance available resources and support natural resource stewardship. Alternative funding mechanisms (Box 9) have already been proven effective in many cases, and these models could benefit from greater visibility and strategies for encouraging their widespread adoption.

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**Box 8. Recommendations for Investing in Conservation Leadership**

- Support training, development, and mentorship for producers and landowners to engage in peer-to-peer outreach to educate producers and influence practices over time. Good candidates might include board members of conservation districts and other local or regional institutions as well as individuals recognized as progressive leaders in the farming community.

- Provide paid and volunteer staff of federal, state and local organizations in the public, private and NGO sectors with professional training and ongoing development opportunities to engage landowners/ producers in designing and implementing landscape and watershed scale conservation plans.

- Create regional and national networks for producers, landowners, and others who are taking – or would like to take – a leadership role in innovative efforts at the intersection of production and conservation, including: watershed- or landscape-scale working lands conservation; development, adaptation, and adoption of technologies and management approaches that maintain or increase yields while reducing environmental impacts of production; and/or, development and implementation of strategies for diverse operations to increase resilience and adapt to changing climatic conditions.

- Build a common understanding of the best strategies and practices to attract and retain young people in careers in food and agriculture and investing in training and leadership development programs to help young people understand the intersection of food, nutrition, agriculture, and natural resources management.
Box 9. Alternative Funding Mechanisms for Cooperative Conservation

The following are potential sources of funding to support cooperative conservation:

Local Funding Sources

• **Payments for Ecosystems Services**: A variety of payments for ecosystem services projects and programs have proven successful, including collaborations between water utilities and agriculture through which utilities achieve point-source pollution reductions by investing in cost-effective watershed management rather than by installing costly additional filtration technology. Successful models include the Indian Creek Watershed Project and the Miami Conservancy District’s Water Quality Credit Trading Program, which provide financial incentives for increased nutrient use efficiency to Illinois and Ohio farmers, respectively.

• **Conservation District Assessments**: Conservation districts in about a fifth of states have the authority to raise revenues through fees and assessments to fund technical assistance and projects that support conservation. Because these funds are locally raised and distributed, they can be prioritized based on community needs. Montana Conservation Districts, for instance, are funded by a levy of up to 1.5 mills on real property values within each District. Montana Conservation Districts, for instance, are funded by a levy of up to 1.5 mills on real property values within each District. Conservation Districts in Washington State may assess fees of up to $5 per parcel, or up to $10 per parcel in counties with more than 1.5 million residents.

State Funding Sources

• **State Revolving Loan Funds**: State revolving loan funds that provide below market loans to qualified applicants are increasingly being used as a tool to incentivize agricultural conservation on individual operations in addition to funding traditional municipal infrastructure investments. Since 1992, the Clean Water State Revolving Fund (CWSRF) has distributed more than $400 million to agricultural water quality improvement projects. For instance, the Iowa’s Local Water Protection Program (LWPP), for instance, harnesses CWSRF resources as a source of low cost financing to support farmers working to improve their conservation practices. Surveys indicate LWPP has been well received by nearly all participants and has succeeded in increasing investments in conservation. This successful initiative could be expanded to other states. Another example from Iowa is billed as “two water improvement projects for the price of one.” The Iowa State Revolving Fund (SRF) allows municipal utilities undertaking a facility upgrade to use a portion of the interest they would have paid back to the SRF as a grant for a nonpoint source project in the watershed where the utility is located.

• **State Taxes**: Establishing state taxes that specifically set aside funds for conservation is another mechanism for enhancing natural resource protection on working lands. For example, in 2008, Minnesota voters passed the Clean Water, Land and Legacy Amendment to their state constitution, which raised the state sales tax by 3/8 of one percent, and dedicated those funds to investments in clean water, environment and natural resources, outdoor heritage and parks and trails, and arts and cultural heritage. The Clean Water Fund alone received $179.43 million during fiscal year 2012-2013, almost 60 percent of which went to on-the-ground protection and restoration activities, including on agricultural lands. Similar initiatives may be viable in other states.

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• **Lottery Funds:** States could also set aside a portion of lottery funds for agricultural conservation. Nebraska, for instance, allocates more than 40 percent of its state lottery profits to the Nebraska Environmental Trust, which provides $15-20 million each year in grants for conservation projects across the state.

• **Input Assessments:** Assessments on agricultural inputs have been implemented in several states as a tool for raising funds for conservation. The Illinois Nutrient Research & Education Council, for example, is a private foundation funded by an assessed amount per ton of fertilizer sold in the state and supports research and education efforts to improve nutrient management on Illinois farmland. Iowa's fertilizer and pesticide fees support the Iowa State University Leopold Center for Sustainable Agriculture's conservation research, education, and on the ground projects. Similar designated funds could be collected elsewhere.

• **Agricultural Conservation License Plates:** Some states, such as Maine, Texas, Minnesota, Iowa and Missouri, offer their drivers the opportunity to purchase specialty conservation license plates, the proceeds of which fund natural resource enhancement projects. Similar programs with a specific focus on agricultural conservation could be established.

**Federal Funding Sources**

• **Regional Conservation Partnerships:** Farm Bill conservation programs and other federal conservation funds could be allocated to watershed groups or conservation entities rather than individuals (such as through the Regional Conservation Partnership Program authorized in the 2014 Farm Bill). Other strategies include leveraging matching funds from non-federal partners, using funds to facilitate transitions in production systems within whole landscapes, and targeting funds to address priority issues (such as has been done through the Natural Resources Conservation Service (NRCS) Mississippi River Basin Initiative and the joint Sage Grouse Initiative of NRCS and the US Fish and Wildlife Service).

• **Conservation Check-off Program:** Although a portion of some check-off funds are already used for natural resource protection and enhancement, such as at the Iowa Soybean Association, a check-off specifically for conservation could be explored further. Elected producers and industry representatives could be in charge of distributing funds through federal- or state-level boards with some U.S. Department of Agriculture (USDA) oversight, as is the case with existing check-off programs. An additional conservation check-off could be integrated into the existing commodity check-off programs as a means of collecting funds.

• **Federal and State Income Tax Check-off:** An opportunity to make a contribution to federal and state agricultural land and water conservation funds could be added to federal and/or state tax returns. The Minnesota Nongame Wildlife Check-off, for example, provides 80 percent of Minnesota Nongame Wildlife Program funds. A similar “Chickadee Check-off” in Iowa provides funding for wildlife restoration, public education, research and monitoring, and land acquisition. Check-offs could be expanded and focused on enhancing wildlife habitat on working lands, including for pollinators.

• **Conservation Loans:** New opportunities could be included in USDA's Rural Development Loan Assistance program for conservation investments that support rural development goals.
Box 10. Opportunities for Collaboration between Agriculture and Water Utilities

Collaboration between agriculture and water and wastewater utilities to reduce nutrient pollution has the potential to create significant economic benefits for both partners in addition to promoting healthier landscapes and communities as well as improving conditions in such places as the Gulf of Mexico, Lake Erie, and Chesapeake Bay. The following recommendations for collaboration between the sectors were developed by a group of leaders in agriculture, water and wastewater utilities, government, environmental groups, and other organizations and associations who came together four times over the course of 2013-2014 in what was called the Mississippi River Nutrient Dialogues (MRND).

- **Expand Effective Watershed-Based Cooperative Leadership and Decision-Making:** Locally led, watershed-scale organizations should undertake watershed assessment, planning, monitoring, and projects to improve water quality that are supported by both the agriculture and water communities, as well as by other stakeholders. Key recommendations to advance this strategy are testing it through opportunities such as USDA’s new Regional Conservation Partnership Program, EPA’s new integrated planning initiative, and experimentation with watershed-based permitting.

- **Further Develop and Implement Market Mechanisms for Reducing Nutrients:** Provide cost-effective nutrient reductions to utilities and additional revenue streams to agriculture through market-based payments for ecosystem services efforts. To help establish and expand markets, stakeholders should determine the magnitude and potential margin of water quality markets and identify opportunities to increase agriculture and water leaders’ participation in creating such markets.

- **Improve Data, Monitoring, and Modeling to Support Decisions and Markets:** Further data is needed both for producers to continually improve nutrient management and to inform potential water sector investments in and partnerships with agriculture aimed at reducing nutrient pollution, including through payments for ecosystem services projects. To strengthen baseline assessments, monitoring, and data aggregation, a wide range of partners should be engaged; monitoring should be linked to watershed-scale efforts; and improved, cheaper nutrient sensors should be developed.

- **Develop “Watershed Protection Utilities” - Institutions Focused on Cost-Effective Results:** This new institution would raise funds and invest them in the lowest cost opportunities to address nutrient loading and other issues on behalf of the general public. This concept, which integrates components from all three of the areas above to advance a statewide or regional strategy to reduce nutrient loading, deserves further consideration and development.

2. Cooperative Conservation

Box 11. International Cooperative Landscape Conservation Case Studies and Funding Strategies

International Cooperative Conservation Success Stories

• **Landscapes for People, Food and Nature Initiative:** Cooperative conservation is already being implemented and scaled up in an international context, including in developing countries, to support healthy food and agriculture systems. The Landscapes for People Food and Nature Initiative is an effort led by EcoAgriculture Partners and its co-organizers to assess the potential of, engage stakeholders on, and advocate for a landscape approach to managing agricultural-ecological systems. The Initiative is conducting a Global Review of the evidence regarding ecoagriculture and its current status in developing countries, convening a multi-stakeholder dialogue to discuss opportunities for expanding ecoagriculture, and engaging in action and advocacy to promote landscape scale approaches at the national and international level.

• **Africa Centre for Holistic Management:** The Africa Centre for Holistic Management facilitated a collaborative process in Zimbabwe to restore degraded Hwange communal lands that provide both grazing opportunities and rich biodiversity. Hwange community members led a landscape management planning process with Centre support and worked to improve pasture health through self-regulating herd size, grazing time, and acceptable disturbance levels as well as fencing systems to reduce livestock losses to lions. Through these cooperative efforts, grazing operations became more productive and profitable and forage, groundcover, and the Dimbangombe River flow were restored.

• **Turrialba, Costa Rica Landscape Management:** Facing the challenge of meeting the needs of local communities, agriculture, ecotourism, and forest product harvesting while protecting biodiversity and water resources, stakeholders in the Turrialba region of Costa Rica engaged in a collaborative conservation process to improve their landscape management. With the support of the Costa Rican government, local and international nonprofits, and stakeholders from coffee growers and livestock farmers to tourism and energy representatives and community groups, the process has achieved increased crop and livestock production, higher ecotourism revenues, greater community empowerment, and greater species and water resource protection. Community agreements, research on improved agricultural practices, biodiversity monitoring and tree planting programs, and the establishment of biological corridors and model forests for research and education contributed to these successes.

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• **Rupa Lake Rehabilitation and Fisheries Cooperative**: Nepal’s Rupa Lake and surrounding wetlands are critical to local aquaculture, fishing, and tourism industries and biodiversity but had been degraded by agricultural runoff, erosion, and deforestation as well as overfishing and unsustainable aquaculture. Local and international nonprofits worked with farmer cooperatives and other key stakeholders to develop a community-led landscape management plan for restoring the region, in part through a payments for ecosystem services initiative. Payments to upstream farmers from downstream beneficiaries has resulted in higher household incomes, more sustainable forestry, agriculture, and aquaculture, improved water quality, and increased habitat for threatened species.

**Funding Sources for International Cooperative Landscape Conservation**

More work is needed to develop mechanisms for financing collaborative landscape-scale conservation in developing countries. Traditional sources, including foreign aid (e.g., U.S. Agency for International Development’s *Feed the Future* program), nonprofit and foundation-led efforts (e.g., the *Succulent Karoo Ecosystem Programme*), government initiatives, and international financial institution support (e.g., the *Loess Plateau Watershed Rehabilitation Project* supported by the World Bank and implemented by the Chinese government) could all be harnessed to support natural resources stewardship in agricultural landscapes. Increasingly, private sector investments and institutions have also supported international landscape-scale conservation through financial institutions supporting conservation work through impact investing (e.g., the *Livelihoods fund*, the *EcoEnterprises Fund*) and sustainable sourcing efforts (e.g., the *Ethical Tea Partnership*). In many cases, public-private partnerships have been formed to more effectively leverage resources and coordinate conservation efforts (e.g., *Imarisha Naivasha*). For more information and case studies on financing international landscape-scale conservation, please see *Financing Strategies for Integrated Landscape Investment*, a report from *Landscapes for People Food and Nature* initiative.

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**For additional perspectives on cooperative conservation that have informed AGree’s recommendations**, AGree’s Point of View Papers offer expert insight on the institutions, new partnerships, and regionally tailored approaches needed for locally-led, watershed-scale conservation to succeed. They include:

*Cooperative Conservation: A Producer-Led Approach to Achieving Healthy Agricultural Landscapes*, by Kristin Weeks Duncanson, Jim Moseley, and Fred Yoder

*Increasing Sustainability of America’s Working Landscapes through Improved Public-Private Collaborations at Multiple Scales* by Jim Faulstich, Steve Jester, and Jim Stone

*Securing the Future of Western Agriculture: A Perspective of Western Producers* by Pat O’Toole and Dan Keppen
3. Soil Health and Water Quality and Quantity

Improve soil health and water quality and quantity through targeted investments

An integrated, systems approach to soil, water, and nutrient management will be critical to both long-term productivity and ecosystem health in agricultural landscapes. Soil, water, and nutrient conservation are most effective when tailored appropriately to local conditions. In many cases, the sound management of these resources is in line with economic incentives to maintain the long-term asset value of healthy and productive lands. In some instances, farmers’ and ranchers’ short-term business interests may not be aligned with conservation, making incentives and government action necessary.

AGree strongly favors tackling agricultural production and conservation issues through watershed or landscape-scale cooperative efforts, yet recognizes that establishing the capacity to implement this approach across the landscape will take significant time, and that not all issues can be effectively and efficiently addressed through this approach. There are critical challenges that need to be met and promising opportunities that can be pursued through complementary and/or alternative strategies as cooperative conservation takes root. Following are some critical natural resource issues that require greater attention and select policy and action recommendations to address them.

a. Soil: Recognition of the importance of soil health is growing, with significant efforts under way by USDA’s National Resources Conservation Service and many others. Improving soil health leads to increased production over the long term, improved nutrient cycling, pest management, and water quality as well as lower net greenhouse gas emissions and greater resilience to droughts and severe storms, while protecting the asset value of landowners. Critical aspects include erosion control, healthy soil biology, reduced compaction, and increased organic matter. There are many practices and strategies for enhancing soil quality. Expanding the use of conservation tillage including no-till, more diverse rotations, and cover crops are critical opportunities in annual row crop systems. These methods can decrease soil erosion by as much as 60-90 percent, reduce runoff, and improve crop resilience to droughts while saving producers time and money.31

In Summary:

- Farmers and other stakeholders should take an integrated, systems-oriented approach to soil, water, and nutrient management tailored appropriately to local conditions and farming practices. While soils vary dramatically across topography, they are the most basic, precious and critical resource for agricultural production. Degraded soil quality reduces the effectiveness for roots to access both water and nutrients, which leads to the need for higher levels of applied fertilizer and irrigation water when crops are actively growing. Farmers must have the correct levels of nutrients for their crops to perform and need access to the knowledge and tools necessary to maintain and improve long-term fertility by promoting soil quality. In summary, improvements in soil quality benefit society with lower food costs, cleaner water and reduced atmospheric carbon while landowners experience higher land values due to greater productivity from the resilience naturally inherent in improved soil.

- Federal and state agencies as well as commodity groups and business leaders should invest in the research, education, and tools needed by farmers to more efficiently manage soil, water, and nutrients so that long-term productivity, profitability, and ecosystem health are improved and sustained.

national priority given the myriad benefits to producers and society at large and the tremendous unrealized opportunity for increased productivity and environmental benefits. Federal, state, land grant institutions, and NGOs should dramatically ramp up their efforts to assist producers in better understanding and taking additional action to improve soil health. This should include increasing targeted investments in soil health research, technical assistance that can provide cutting-edge information to landowners and producers on the ground, incentive
programs for practices like cover crops and conservation tillage, and cooperative conservation projects that emphasize soil health. A good starting point for action are the recommendations in the Soil Renaissance Strategic Plan (developed by the Farm Foundation, NFP and The Samuel Roberts Noble Foundation) “to incorporate soil health measures into standardized soil testing that is readily available, affordable, and commercially viable; quantify the effects of soil health on economic risks and returns; reawaken the public to the importance soil health; and, convene the research community to advance soil health.” See Box 12 for further detail and examples of other promising soil health initiatives.

b. **Crop Rotations and Cover Crops:** Incorporating additional crops into field rotations coupled with the planting of cover crops in appropriate regions and operations has the potential to increase yields and reduce yield variability, improve soil health, reduce losses of nitrogen, phosphorus, and pesticides to surface and groundwater, break pest cycles, and combat climate change through carbon sequestration. Such systems can also reduce inputs for disease and pest control and slow the development of resistance, an increasingly important challenge given the spread of herbicide-resistant weeds. Currently, however, crop rotations, especially those involving three or more crops in conjunction with cover crops, are not used on a broad scale due to a number of barriers, including lack of research on where cover crops may be agronomically beneficial, disincentives and penalties embedded in the crop insurance program, lack of markets for rotational crops, shortages of well-adapted cover crop seeds, inadequate infrastructure, and a lack of research and technical support. **Targeted investments and policy reforms are needed to incentivize more diverse crop rotations and the use of cover crops that can enhance the long-term health of working lands.** Opportunities to expand the use of cover crops and crop rotations are detailed in Box 13.

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**AGree Goal:** Increase continuous no-till where compatible with regional farm and crop practices by 50 percent and plant cover crops on 65 percent of annual row crop acreage to decrease soil degradation ratings by 2025.
Box 13. Actions to Increase Use of Crop Rotations and Cover Crops

The following actions by the private sector, civil society, and government will increase the use of crop rotations and cover crops where they are agronomically beneficial:

All sectors:

- Increase funding for targeted research to assess where cover crops are an agronomically beneficial part of rotations; further quantify and understand the benefits of crop rotations and cover crops; and, improve plant breeding efforts for more widely adapted cover crops that are regionally appropriate. More research, particularly in long-term, focused projects through the USDA Agricultural Research Service (ARS), academia, and the private sector, is needed to identify what climates, regions, and agronomic systems stand to benefit from cover crops and quantify the impact of crop rotations and cover crops on soil health, input reduction, and pest control, as well as to resolve questions about yield impacts and profitability. Cover crop breeding and agronomic research adapted to diverse regions, climates and operations as well as efforts to develop more reliable cover crop planting equipment, including for planting in standing crops, should also be a priority. Research that can be translated into regionally appropriate tools, strategies, and business models for landowners and producers, extension agents, crop advisors, and other technical support professionals would be a significant contribution to the widespread adoption of rotations and cover crops.

The private sector:

- Support the development of markets for forage-based cover crops and small grains, including through the creation of new infrastructure for the food and livestock feed supply chains that enables more robust local and regional markets for third crops in rotations. Businesses manufacturing multi-ingredient livestock feeds that can be easily stored and shipped could play a particularly important role in creating demand for a diversity of rotational crops and forages. In some regions, biofuel operations will also create new marketing channels and income opportunities.

- Include diversifying crop rotations and planting cover crops in “sustainable sourcing” initiatives. Provide incentives and technical assistance to food companies and landowners and producers to encourage these practices.

- Provide farmers with training and high quality seed. Training events should be held on how to grow cover crops and diversify rotations, and efforts should be made to ensure that seed stocks are consistently high quality. Support for university-based cover crop breeding and agronomic research would be beneficial.

Civil society and conservation organizations:

- Prioritize increasing the adoption of cover crops and more diverse crop rotations within conservation districts and organizations, at land-grant universities, and among local extension agents. Greater attention, promotion, education, and technical assistance supporting these practices should be provided to landowners and producers at the local level. Field demonstration days, speakers and educational events, and other engagement opportunities, including through NRCS’s Soil Health Awareness initiative, are key to educating communities about the benefits of these practices and how they can be implemented. NGOs and other civil society institutions interested in the long-term health of working lands in their communities should support these efforts.

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• **Encourage landowners to establish longer-term rental agreements that allow producers to implement profitable crop rotations.** Longer leases lasting from three to six years give producers farming the land the time horizon necessary to design and implement more diverse crop rotations or use cover crops in a profitable way. Landowners benefit from these practices as investments are made in the long-term health and productivity of their fields.33

**State or local government:**

• **Provide incentives for investments in infrastructure to support the production, transportation, and storage of small grains and other rotational crops in raw and processed forms.** Storage facilities and other infrastructure in close proximity to farmers are often necessary for producers to include new crops in their rotations, especially forage crops. In communities where landowners and producers demonstrate interest in pursuing these practices, state and local governments should create tax and other incentives, such as no or low interest loans, for local cooperatives to invest in the equipment necessary to expand use of cover crops, or make the targeted investments themselves to develop the necessary infrastructure. Local USDA Farm Service Agency (FSA) offices could also consider purchasing cover crop and small grain planting equipment to rent to farmers at low cost in order to help them experiment with these practices before making significant investments in machinery.

**The federal government:**

• **Encourage innovation as well as optimization through extension and technical assistance.** NRCS conservation technicians and university extension agents should receive the education and training needed to shift their mindset from optimizing existing systems to the broader goal of helping landowners and producers implement high performance agricultural-ecological systems in ways that may require significant shifts in practices. Programs such as the NRCS Soil Health Awareness initiative can be expanded to educate and empower NRCS officials in this regard. In an era of increasing weather variability and climate change, NRCS and other technical assistance professionals’ expertise in helping landowners and producers experiment with innovative systems and adapt their practices to changing conditions will be increasingly in demand.

• **Promote and expand incentives for cover crop adoption or crop rotation diversification.** Technical assistance providers should prioritize educating farmers about existing financial incentives for resource-conserving crop rotations, such as through the Conservation Stewardship Program (CSP) and the Environmental Quality Incentives Program (EQIP). Where possible, these voluntary incentive programs should be expanded with a special emphasis on cover crops and crop rotations, such as providing cost-share funds for cover crop and small grain planting equipment or support for cover crop seeding.

• **Reform federal crop insurance programs.** Targeted reforms to the current crop insurance program may be needed to remove penalties for adoption of multi-year rotations and cover crops and to provide incentives for growers to shift from continuous cropping systems to rotations and cover cropping.
c. **Nutrient management**: Improved nutrient management would enhance water quality, protecting human health and wildlife habitat downstream, and increase the profitability of farm operations by saving producers money on fertilizer and manure, while maintaining and even increasing yields. A path forward should include a systems approach to nutrient management that optimizes inputs by keeping nutrients in the soil-plant system through on-farm practices, edge of field management, and off-field infrastructure where needed. Cutting-edge technologies, such as precision application of fertilizer based on high resolution data, as well as traditional best management practices, including cover cropping that builds soil health, should be harnessed to achieve nutrient management goals. In order to advance this approach, the fertilizer industry should continue to create incentive structures aligned with their program for nutrient stewardship (the “4 Rs” – right fertilizer source at the right rate, at the right time, and in the right place), for example, by not creating a strong economic incentive to apply nitrogen in the fall. The fertilizer industry, farm organizations, crop advisors, and agricultural conservation organizations and agencies should together develop and implement a plan to phase out any remaining excessive fall application of nitrogen. Land grant extension services should update their recommendations for fertilizer use consistent with a systems-based approach. Appropriate levels of N use efficiency will vary by region, soil, type of irrigation (if any), and source of nitrogen. Box 14 highlights three case studies of collaborative partnerships working to improve nutrient management.

**AGree Goal: Increase water supplies suitable for irrigation by 33 percent and mitigate overdraft of aquifers by 2025 by increasing irrigation water efficiency, increasing environmentally sound water storage and recharge, reducing losses in water conveyance, and bringing into greater alignment the water needs of crops/livestock grown in regions and long-term projections (including potential for enhancement) of water supply.**

**Box 14. In the Field: Nutrient Management Success Stories**

**Adapt Network**: The Adapt Network is a collaborative initiative led by land grant universities, agricultural groups, crop advisors, and **Environmental Defense Fund** that works with farmers in Michigan, Illinois, Indiana, Ohio, and Pennsylvania to optimize on-farm nutrient efficiency. A similar network, the AIM program, is operating in North Carolina. To improve efficiency, farmers, farm advisors, and/or other partners gather farm-specific data which is then compared with results across other farms within the region to help improve on-farm management decisions. Participants in the program have reduced nitrogen application by an average of 25 lbs. per acre, which correlates to a direct financial benefit to farmers and healthier waterways.

**Mississippi River Basin Healthy Watersheds Initiative (MRBI)**: MRBI is a 13 state initiative led by **NRCS** to improve water quality in the Mississippi River Basin at a landscape scale through more targeted use of conservation funds. Through the program, NRCS partners with state and local agencies, universities, conservation districts, and NGOs to provide farmers in high priority watersheds with the option to participate and receive technical and financial assistance to improve water quality outcomes downstream. Efforts include optimizing nitrogen and phosphorous use efficiency, minimizing runoff, improving management practices (crop rotation, cover crops, conservation tillage, etc.), and enhancing soil health.

**Boone River Watershed Project**: **Coca Cola**, **Cargill**, **Monsanto**, and **Walmart** are working with local farmers to improve the environmental impacts of the corn used in their supply chains in Iowa’s Boone River Watershed Project in collaboration with **Field to Market**, **The Nature Conservancy**, the **Iowa Soybean Association**, and **NRCS**. Nutrient management plans encouraging better management practices, including cover crops and conservation tillage, have reduced nitrates in runoff by nearly 76,000 pounds each year.

**On-Farm Network**: Iowa Soybean Association works with growers to achieve improved nutrient management through precision agriculture technology, such as remote sensing, GPS, and yield monitors. The initiative supports a variety of research projects partnering agronomists with farmers to determine the best combinations of input applications and conservation practices for improved environmental outcomes that enhance producers’ yields and bottom lines.
d. **Water Use**: Agriculture in the United States is increasingly vulnerable to water scarcity – as are other sectors. The consistency and predictability of rainfall is decreasing, demands for water across the U.S. are growing, and critical maintenance of the national water infrastructure has been deferred. We face increased likelihood of water scarcity in the West and more frequent droughts and floods in the Midwest, South, and East. In this context, AGree developed a set of principles to guide policy reform to address water availability and management for agriculture to maintain food security while balancing other economically, socially, and environmentally beneficial water uses (see Box 15).

**AGree Goal**: Universalize methods of nutrient application that result in efficient uptake by plants, retention of nutrients in the soil, and reduced release into water and air. Acceptable levels of nitrogen and phosphorus use efficiency will vary by region, soil, type of irrigation (if any), and source of nutrient. In impaired watersheds, require producers who chose not to participate in voluntary efforts to conduct nutrient management planning and other necessary practices to reduce offsite environmental effects of nitrogen and phosphorus and protect the watershed.

**Box 15. Water Use: Principles to Guide Policy and Action**

The following principles should guide water policy in the agricultural context:

- **Recognize the critical importance and broad societal benefits of agricultural uses of water and consider impacts of transferring water away from agriculture.** Water availability is central to U.S. agriculture’s long-term ability to feed America; sustain farm families, workers, and communities; and, help meet the increasing demands of a growing population. Agriculture should not be viewed as the default source of water for other needs. State and local governments must consider the impacts of continued growth that relies on water transfers from agriculture. No transfers to municipalities and other holders of domestic water rights should be approved unless efforts to conserve, reuse, and maximize existing water supplies have already been pursued and adequate mitigation is provided for harm to agricultural and the environment resulting from the transfer.

- **Base decisions on a holistic understanding of hydrological systems and land use.** Integrated water resource management and permitting must reflect hydrological realities and interdependencies of private and federal forest, grazing, and agricultural lands. Research investments to understand hydrology need to be prioritized and coordinated.

- **Continue to give deference to state and local laws and institutions.** Decision-making on water rights and water resource allocation, use, control, and transfer should happen at the state and local level. Locally-developed solutions consistent with equitable outcomes across communities and users should be encouraged and adopted.

- **Invest in water delivery and drainage infrastructure.** Stakeholders must find creative ways to provide for the operation, maintenance, and modernization of existing water supply infrastructure using green and biodiversity-friendly technologies wherever feasible. Government as well as private sector beneficiaries should be expected to contribute funds. In the development of drainage infrastructure in the Midwest in particular, efforts to increase water quantity should be aligned with water quality goals.

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e. Nutrient and Sediment Runoff and Leaching: Runoff and leaching of nutrients and sediment from agricultural operations is a significant cause of water pollution in many agricultural landscapes and causes ecological and economic harm downstream. Maintaining clean water is vital for human health, aquatic ecosystems, and recreation. The 2004 National Water Quality Inventory found that 44 percent of assessed stream miles, 64 percent of assessed lake acres, and 30 percent of assessed bay and estuarine square miles were not clean enough to support uses such as fishing and swimming. Nutrients and organic enrichment/low dissolved oxygen were leading causes of impairment, and agriculture is a top source of impairment. Strategies to reduce such leaching and runoff include in-field nutrient management (fertilizer and manure management, cover cropping, improving soil health, etc.), edge-of-field drainage water management, and off-field green infrastructure and restoration of natural filtration. The success of such efforts in resolving effects far downstream in the Gulf of Mexico, Lake Erie, or Chesapeake Bay, for example, can be challenging to determine given that multiple factors, especially weather, affect outcomes. Another challenge are the significant time lags between changes in practice and quantifiable reductions in pollutant levels, as pollutants such as sediment and phosphorus tend to persist once introduced into waterways. State nutrient reduction strategies and other state-level efforts to address excess nutrients and sediment should incorporate cooperative landscape-scale conservation strategies, with mutual accountability among key stakeholders and with government and the development of funding mechanisms for the off-farm, stream channel, and riparian restoration practices required to fully addresses these issues in many places.

Agregate Goal: By 2025, reduce by 30 percent the number of rivers, lakes and streams currently designated as impaired primarily because of legacy and current nutrient, pesticide, and sediment runoff from cultivated cropland.
f. **Integrated Pest Management (IPM):** Producing safe, affordable, and nutritious food requires healthy plants, animals and agricultural systems. Key indicators of system health are the avoidance of pathogens that are resistant to available drugs in humans, preventing the resistance of pests to common control techniques, and a robust toolbox of pest management strategies that create stability in agricultural ecosystems. Maintaining healthy plants, animals, and systems allows for well-managed integrated crop and livestock operations as well as the integration of habitat and wildlife in crop production. Management of pests in horticulture (e.g., nurseries as well as residential, municipal, and recreation settings) must also be focused on maintaining the health of the entire system and the efficacy of available tools. Ensuring the health of plants, animals and agricultural systems is vital to the health of communities and people, the long-term profitability of producers, and the long-term health of working landscapes and ecosystems.

**Landowners and producers should continue to refine and implement Integrated Pest Management (IPM) on a broad scale to harness the potential of biological and ecological processes to reduce pests, prevent productivity losses, reduce risks to human and environmental health from potentially harmful pesticides, and maintain the efficacy of pest management technologies by slowing the development of resistance.** IPM includes robust practices such as diverse rotations, refuges, preserving efficacy of existing chemistry, minimizing resistance to both conventional and organic control methods, and multiple modes of action with multiple tools.

The agricultural community, herbicide manufacturers, government agencies, and environmental advocates should continue to work together to advance research to understand the impacts of pesticide use on resistance, soil health, and human health, and to develop strategies and agreements to modify their use to reduce negative impacts to levels of acceptable risk. Other essential elements for promoting healthy plants, animals, and agricultural systems include maintaining the biological health of soil, such as through improved microbial diversity, and maintaining a strong public system that effectively excludes, diagnoses, prevents, and controls invasive species, disease, and resistance to pesticides.

g. **Invasive Species:** Invasive species present significant economic and ecological challenges to the food and agriculture system. In a world where global trade had increased more than twenty-fold since 1950, plants, animals, and microorganisms that hitchhike on cargo and conveyances to new areas or are deliberately imported can spread unchecked by natural enemies and cause great harm to agriculture and other natural resources. In addition to threatening crops and livestock directly through disease and predation, invasive species also reduce soil health, property values, water and grazing land quality, and native wildlife populations. They often require costly additional management controls and can ultimately undermine food security and trade. In total, invasive species likely cost the U.S. economy more than $120 billion each year. The U.S. Fish & Wildlife Service estimates that American agriculture loses $13 billion annually in crops from invasive insects alone. Even as climate change makes ecosystems more vulnerable to invasions, state and federal budgets for invasive species prevention and management are declining. Boxes 16 and 17 provide an example of successful invasive species management and more detailed principles and recommendations for mitigating this threat to productivity and the environment.

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**Box 16. In the Field: Invasive Species Management Success Story**

Landowners and producers have worked together across the U.S. to collaboratively address invasive species challenges. One example of common action to avoid escalating invasive species concerns are Noxious Weed Control Boards, which maintain a given state’s official list of noxious weeds that landowners may be required to control. Boards often publish field guides and other educational materials about noxious weeds and distribute them to the public. Boards survey their jurisdictions for noxious weeds and work with landowners to ensure they are controlled and eradicated. Civil infractions can be filed and fines can be assessed on landowners who fail to control weeds.
Box 17. Invasive Species: Principles to Guide Policy and Action

The following principles should guide invasive species policy reform in the agricultural context to manage this threat to productivity, profitability, and the health of the landscape:

- **Recognize that prevention and exclusion is the most successful and cost-effective strategy to protect resources from invasive species risks.** The productivity, profitability, and ecological health of agricultural landscapes are best protected by a sustained investment in preventing the introduction and spread of invasive species. Regulatory programs and supporting voluntary best management practices should be adopted so as to put the burden on foreign suppliers and shippers to ensure that the products they ship and the containers and conveyances which hold them are as free of potential invasive species as possible subject to screenings and enforcement at borders.

- **Ensure that agriculture does not unintentionally introduce additional invasive species.** New crops, such as ornamentals, range grasses, and some biofuel stocks, should be screened and then rejected or monitored if there is a scientific basis for believing they could become invasive. State governments especially should ensure they have the funding and infrastructure in place for effective screening.

- **Invest in effective Early Detection and Rapid Response (EDRR).** Even the best prevention efforts will not block all invasive species. Once widely established, invasive species are increasingly difficult and sometimes impossible to remove. Plans and resources must be in place to identify and eradicate invasive populations before they become established and spread. The National Invasive Species Council’s EDRR proposed program is the most effective current mechanism for achieving this and should be supported. As time is of the essence in invasive species identification and eradication, new and existing rapid diagnostic technologies should be incorporated into the infrastructure of invasive species detection.

- **Increase the resilience of agricultural systems to all invasions at regional scales.** Local initiatives that increase the resilience of agricultural systems to all invasions are more effective and efficient than reacting to individual pests, plants, and pathogens. Prevention and EDRR plans should be implemented at a regional scale to increase overall resilience proactively rather than responding ad hoc to each crisis.

- **Further engage landowners and producers.** Access to reliable technical assistance and extension services are needed so that landowners and producers can implement new practices and continue to be good stewards of their farms and ranches as they work with government and private partners to manage invasive species effectively. Policy alignment for eradication procedures and practices on federal and state owned properties must also be in place to avoid regulatory delay in addressing invasive species concerns.

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• **Involve the public, private sector, and NGOs in invasive species prevention and management.** Members of the public should better understand the importance of responding effectively to the threat of invasive species, how they can support prevention efforts, and how they can cook and garden without introducing invasive species. Businesses from pet stores to global shipping companies whose actions may increase the risk of introducing invasive species should financially support screening and prevention efforts. Foundations and non-profit organizations have the flexibility to pursue projects and education initiatives to address invasive species in innovative ways.

• **Invest in invasive species scientific research.** Increased public and private investment in research is essential for effective risk management and resource protection. Research is needed to better evaluate the invasive risks of non-native species, scientifically identify species, prevent the establishment and spread of invasive species, develop new tools and strategies for eradication and control, and respond to long-term management challenges.

• **Consider advancing comprehensive federal legislation on invasive species exclusion, prevention, and management.** Currently, there is no national law that clarifies the authorities and responsibilities of the 25 federal agencies that carry out invasive species policy. A comprehensive federal strategy to protect agricultural businesses and landscapes from the threat of invasive species could be pursued to benefit all stakeholders. In the near-term, efforts should be made to adopt coordinated implementation policies within and across levels of government.

h. **Wildlife and Habitat:** Government programs and incentives, private sector sustainable sourcing initiatives, and conservation and recreation groups should support producers’ efforts to enhance wildlife populations and habitat in working landscapes while providing reasonable safe harbor from Endangered Species Act (ESA) enforcement. Stakeholders and policymakers should work together to develop practical approaches to improve implementation of ESA that will lead to proven recovery of listed species through collaborative, incentive-oriented public-private partnerships that maintain productive use of land, reduce conflicts with rural communities, and allow for adaptive management over time. In addition, reasonable food safety compliance should protect human health while supporting wildlife.

In addition to working to promote overall biodiversity, protecting and strengthening pollinator populations is especially important. Insect pollination, primarily by bees, is critical for productivity. This service is needed for the production of 75 percent of all crops used directly for human consumption worldwide. In recent decades, however, dramatic bee colony losses have been documented in some regions, including a 60 percent decline in the United States between 1947 and 2005. Documented drivers of this change include habitat loss and fragmentation, environmental pollution including pesticide applications, invasive species and pathogens, and climate change. In order to protect this critical service for productivity and food security, **the federal government and the private sector, where applicable, should continue to invest in global, domesticated, and native pollinator population monitoring to assess trends, further research on the potential interactions and synergies among threats, and develop targeted mitigation strategies.**
4. Measurement and Research

**Increase understanding of the overall benefits, costs, and health and safety of agricultural inputs, practices, and systems**

A diverse range of stakeholders stand to benefit from accessible data and analysis that quantifies the linkage between conservation practices, such as cover crops and conservation tillage, and average yields, yield variability, and environmental quality over time. USDA on-farm data collection programs could be merged and/or managed so that detailed, comprehensive, farm-specific information is available to quantify the impacts of farm enterprise design, farming system choices, conservation practices and systems, technology, and policy on all critical aspects of farm-level performance, impacts, and sustainability. This information could be used to design programs and incentivize conservation practices that result in long-term productivity, resilience, and reduced greenhouse gas emissions. Researchers could better determine the effectiveness and productivity implications of various conservation practices; crop advisers could better help producers adopt practice systems designed to achieve producers’ objectives; supply chain leaders could improve the scientific basis of their sustainability standards; and, policymakers, NGOs, foundations, and other groups could build greater understanding of the implications of current policies and potential policy changes. Such information might also be used to inform the development of crop insurance products that reward conservation practices that lead to increases in yield resilience and long-term yields. Efforts should be made to:

**AGree Goal: Merge and/or manage USDA (e.g., NASS, ERS, NRCS, etc.) on-farm data collection programs so that detailed, comprehensive farm-specific information is available to quantify the impacts of farm enterprise design, farming system choices, conservation practices and systems, technology, and policy on all critical aspects of farm-level and watershed/landscape scale performance, impacts, resilience, and sustainability.**

**In Summary:**

Well integrated and publicly available data and further analyses are needed to accelerate progress, as are better aligned goals and standards:

- **Invest in baseline data collection, long-term monitoring, research, and the merging, mining, and analysis of existing public and private databases (while effectively protecting proprietary information) to understand the relationships between production systems, conservation practices, yields, resilience, and environmental outcomes and to support both on-farm management and watershed/landscape scale natural resource conservation.**

- **Craft widely accepted goals, standards, and associated metrics relevant to producers and landowners, commodity groups and associations, policymakers, supply chain leaders and the public to focus activities of multiple sectors and actors, and leverage public and private investments around commonly shared objectives.**

- **Develop knowledge that can be used to design programs and incentivize conservation practices and systems that result in long-term productivity, resilience, and environmental quality. Increase capacity of the federal government to conduct independent and transparent, government-funded assessments of the agronomic effectiveness and human and ecological health impacts of new agronomic tools, technologies, and systems while modifying and streamlining the regulatory permitting processes to accelerate timely use of new tools and technologies that meet environmental, health, and safety standards.**

**Integrate existing data:** Several USDA agencies currently collect farm level data that could be helpful in filling this gap—the **Natural Resource Conservation Service** (NRCS) collects data on adoption of conservation practices by participants in conservation programs, while the **Risk Management Agency** (RMA) and the **Farm Service Agency** (FSA) collect data on farmers’ crop yields under the programs they collect.
Operate. The Economic Research Service (ERS) and the National Agricultural Statistics Service (NASS) have since 1966 jointly surveyed farmers on an annual basis (the Agricultural Resource Management Survey [ARMS] and its precursor survey) regarding use of a range of farm practices. The Conservation Technology Information Center (CTIC) has also conducted an annual survey on farmers’ adoption of conservation tillage practice since 1989, producing observations that might be compatible with USDA databases if variables can be identified that are unique to individual farmers whose operations are covered in most or all of the databases. While no single agency has a survey- or program-based database that could be used to fully evaluate conservation, yield, and resilience relationships, all USDA agencies that collect and analyze data could better work together and with external research assets to merge existing databases to generate data that could be used to analyze whether there is evidence for risk management benefits from conservation practices. Protocols to protect personal and proprietary data need to be developed and implemented. Active cooperation from these agencies or institutions would be crucial in determining what type of constructed database from these sources would be feasible for use in research on conservation, yield, and resilience, but no special grant or legislative provisions should be necessary.

a. Improve data collection – including establishing baseline data and regular monitoring of both practices and outcomes at multiple scales to better substantiate the links between conservation practices, yields, resilience, risk reduction, and environmental outcomes, while effectively protecting proprietary information. A public-private partnership to increase voluntary agricultural data collection could include producer and industry organizations, technology and supply chain firms, independent crop advisors, foundations and NGOs with an interest in agriculture, and the research community. If a voluntary program is successful, consideration could be given to linking data collection and sharing with receipt of crop insurance premium subsidies. Landowners and producers should be engaged in the design and implementation of any such data collection initiative. Those who choose to contribute data could receive targeted recommendations to improve their farm management, productivity, and profitability; streamlined certification processes from sustainable sourcing initiatives or government requirements; or, financial compensation for their time and efforts. Data should be managed in a secure system that allows researchers to analyze spatially and temporally explicit data effectively, while protecting individual landowners’ and producers’ privacy.

b. Where possible, USDA’s Risk Management Agency, NRCS, the Federal Crop Insurance Corporation, and crop insurance companies, in partnership and consultation with landowners and producers, should use knowledge to leverage large-scale opportunities to reward conservation practices. Investment in data integration and analyses could also help establish a strong scientific case for designing programs and creating incentives for conservation practices and systems that result in long-term productivity, resilience, environmental quality, and/or reduced net greenhouse gas emissions (and marketable carbon greenhouse gas emissions where carbon markets emerge).

c. Scientists, in partnership with government, the private sector, and the conservation community, should develop a set of commonly used “key performance indicators” or “leading agronomic indicators” of agricultural productivity, environmental performance, and social and economic wellbeing (Box 18). Some might be measured and reported on a regional basis, some for a specific commodity across the United States, and some at the individual farm or field scale both for use by growers and for measuring trends. Like leading economic indicators, these indicators would show directional change regarding key outcomes at the regional or sector level, and in some cases might provide the basis for specific measurements of progress over time. For some such indicators, there is broad agreement on what to measure and how it should be interpreted, while in other cases, indicators will need to be developed and broadly vetted. In some cases, the needed data are already collected and accessible at the relevant scales, while in other cases new data collection or integration will be required. For landscape scale indicators, such as water use and water quality, it is important to recognize that agriculture is not the only sector impacting the resource, and indicators will need to account for the agricultural share specifically. It is also important to recognize that there are in some cases inherent tradeoffs among these various indicators (for example, between fertilizer use efficiency and percentage of technical yield potential achieved), which makes it challenging to establish specific targets for a comprehensive suite of key performance indicators.
**Box 18. Key Performance Indicators**

The following are potential key performance indicators for productivity, environmental outcomes, and profitability and social and economic performance.

**Productivity Performance Indicators**

**Fertilizer Use Efficiency**

Crop fertilizer use efficiency (FUE) measures the proportion of applied nutrients that are taken up by a crop at field scale, or the yield mass divided by the fertilizer mass. In the high yielding, intensively managed cropping systems that typify U.S. agriculture, fertilizer amounts in excess of those required to satisfy plant demand cost farmers money and frequently become pollutants that can harm air and water quality. The higher FUEs associated with application rates well matched to crop demand are generally desirable for both profitability and environmental outcomes.37

Achieving the highest possible FUE (or water use efficiency – see below) in a system often will not optimize percentage of technical yield potential achieved or profitability. The first few increments of fertilizer or irrigation added will achieve the highest rates of efficiency per unit of additional input, and maximizing absolute efficiency may therefore conflict with high levels of productivity and profitability. Therefore, reasonable *minimum* levels of FUE and water use efficiency should be identified for particular growing contexts below which the yield benefits do not warrant the economic cost and/or environmental impact of additional fertilizer or water use. Producers could be encouraged to not apply greater inputs when use efficiency for the total amount of input falls to the suggested minimum level.

**Percentage Technical Yield Potential Achieved**

Technical yield potential measures how high crop yields can be for a particular crop using current technology in a given environment when nutrients are non-limiting and pest and pathogens are not a factor. With irrigation, yield potential is a function of the growing season temperature regime and solar radiation. In rain-fed systems, maximum yields are also a function of precipitation.

Percentage of technical yield potential achieved on individual fields is a metric of interest because gaps between yields and potentials represent an unrealized management opportunity for farmers. Conversely, when on-farm yields approach potentials, additional inputs will have diminished benefits and system efficiency metrics will decrease. Estimating yield potentials can best be done with crop growth models.38

**Water Use Efficiency**

Water use efficiency (WUE) is the volume of annual yield per unit of water used during production. WUE characterizes an agricultural system’s ability to turn water into food, thereby providing a basis for identifying and addressing a range of water-related issues on individual farms, including potential on-farm management improvements, crop choices, land use, etc.39

**Total Factor Productivity**

Total factor productivity (TFP) measures the value of an index of outputs compared to the value of an index of inputs, providing a general measure of production efficiency that primarily reflects technological change.40 TFP can be measured at many scales, from farm to nation, as well as both for specific crops as well as for agricultural activity in general.

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Environmental Outcomes Performance Indicators

Water Quality: Dissolved Nitrogen Concentrations and Total Phosphorous Concentrations

Dissolved nitrogen and total phosphorous are water quality measures that capture the concentration of nutrients in surface and groundwater, which are critical water quality indicators. Agreed upon methodologies are needed to determine the extent to which agricultural lands and practices are the source of nutrients where levels exceed water quality standards. These two water quality indicators could be supported by additional measurements of Total Suspended Solids (TSS), which captures sediment levels and are an indicator of erosion, and agriculture-related pharmaceutical concentrations.

Improving these indicators, which can be monitored through laboratory analyses of water samples collected in the field, would (1) reduce the number of impaired streams that fail to meet state and federal water quality standards that protect human health and fishing and recreation values, (2) improve groundwater quality, and (3) reduce the size of the hypoxic zone in the Gulf of Mexico and other coastal areas and the number and extent of harmful algal blooms, such as those in Lake Erie.41

Water Quantity

Aquifer Stabilization and Recharge: Aquifers are a key source of water to agriculture that is being depleted in many areas.42 Stabilizing aquifer levels (ensuring rates of water withdrawals are no more than estimated rates of natural recharge) and in some places recharging aquifer levels (limiting rates of withdrawals below rates of natural recharge) would halt depletion of groundwater levels in key aquifers and increase recharge of groundwater levels in aquifers showing significant depletion (e.g., the western portion of the Ogallala aquifer).43

Irrigation Efficiency: Increased efficiency in water conveyance, application, and storage can help farmers make the most of limited water resources. Calculating or estimating the volume of water lost at each of these stages can help producers, irrigation districts, and other water and water infrastructure managers determine which management strategies or technological changes may be needed.44

Water Reuse: Measuring the volume of water that is recaptured by cities and municipalities and reused for agricultural purposes provides an indicator of the level of adoption of water reuse technologies that benefit agriculture.45

Soil Health

Total Soil Carbon: Field tests measuring total soil carbon content are used as a proxy for soil organic matter (SOM), which is more difficult to measure but fundamental to soil health. SOM promotes soil biological activity, aggregate formation and stability, nutrient cycling and supplies, and water infiltration and retention while reducing compaction, surface crusting, and soil erosion. Typically, SOM is about 50 percent carbon, and analyses of total soil carbon are used to estimate SOM. Levels of SOM are a function of additions and losses where organic inputs from residues and roots and applications of manures/mulches and sediment deposits are countered by losses from microbial degradation of SOM, eluviation, and erosion. Overall SOM storage potential is regulated by climate, topography, soil type, and vegetation, but higher levels within each production context are generally beneficial to productivity through improved soil health and to environmental outcomes through carbon sequestration and reduced sediment and nutrient runoff.46

Soil Conditioning Index: The Soil Conditioning Index (SCI) is an estimate of trends in SOM based on a model that predicts the results of cropping systems and tillage practices on soil organic matter levels at the field scale. The SCI is based on crops grown, soil type, tillage and field operations, and predicted soil erosion. Because it is a model rather than a direct measurement, the SCI is most applicable in providing landowners and producers at low cost with short-term directional information (i.e., whether soil health is improving or not rather than absolute values of SOM). SCI can be used by farmers on a regular basis to assess and identify strategies to improve soil health.47

Continued on the next page
Climate

Global Warming Potential per Unit of Production: This indicator assesses the global warming potential of a commodity over the course of its lifecycle for every unit of its production. Global warming potential is the sum of different emissions’ contribution to climate change translated into equivalent terms (methane and nitrous oxide, for instance, are more potent greenhouse gases than carbon dioxide, and those emissions must be converted into units of “carbon dioxide equivalent”). This indicator provides a sense of efficiency – a commodity’s climate impact over its lifecycle per unit of production – rather than total climate impact.

Total Global Warming Potential by Commodity: Total global warming potential by commodity measures the global contribution to climate change produced over the course of the lifecycle of a commodity’s production. As above, global warming potential is the sum of different emissions' contribution to climate change translated into carbon dioxide equivalent terms. Total global warming potential for a commodity, however, measures the absolute climate impact of all production of a commodity in a specific geography rather than per unit of production.

Profitability and Social and Economic Performance Indicators

Net Farm Income
Net farm income measures the return on an agricultural operation, or the total farm income less the production expenses, including labor, capital, and inputs. Considering this measure, both in absolute terms and as a trend relative to a baseline, provides an important indicator of farmers' and ranchers’ economic wellbeing and the profitability of the agricultural sector.

Median Farm Household Income and Wealth
In addition to net farm income, median farm household income and wealth are important indicators of the overall economic wellbeing of farm families and rural communities. Farm household income measures the annual income of farming or ranching families from both agricultural and non-agricultural sources. Farm household wealth is the total value of a farm household’s assets minus any debts.

Farm Sector Debt to Assets Ratio
The national debt to assets ratio measured for the farm sector as a whole on an annual basis is an indicator of the overall financial position of the sector. Lower values generally denote stronger financial health.

Agricultural Sector Consolidation
The consolidation of the agricultural sector has both social and economic impacts on farming and ranching communities. Considering the distribution of farm sales and share of farms contributing to each sales category is one way to monitor this trend.

Agriculture’s Contribution to U.S. Gross Domestic Product
Agriculture's contributions, both in terms of dollars and as a percentage of U.S. Gross Domestic Product (GDP), are a measure of the sector’s economic success.

Median Age of Farmers and Ranchers
Attracting talented young people to agriculture is important to the future vitality of agriculture and rural communities. Examining the median age of landowners and producers, as well as the percentage of those under 35, can help assess progress in this area.
5. Supply Chain Collaboration

Foster collaboration across the supply chain to drive innovation and improved environmental outcomes

Retailers and food companies seeking to demonstrate responsible sourcing practices to their customers are an increasingly significant driver of changes in agricultural operations to achieve, measure, and document improvements in their environmental performance. Though these efforts are growing and expanding, most companies are still learning how best to structure such efforts, particularly their relationships with producers. Building trust, shared knowledge, and a sense of mutual support among stakeholders, including diverse businesses, farmers’ organizations, commodity groups, NGOs, and governmental actors, will be necessary to realize the potential for improving “the triple bottom line” of strong economic, social, and environmental outcomes across the supply chain in the national and international context. “Sustainable supply” from healthy value chains requires high-quality engagement and continuous learning up and down the chain to create an equitable distribution of costs and benefits and deliver value for all. Producers and buyers both benefit when they adopt the perspective that the goal of conservation improvements is to ensure long-term profitability, resilient yields, and sound stewardship of the land. There is also growing recognition among both producers and others along supply chains that conservation requires focusing on continuous improvement of outcomes at

In Summary: Move from checklists where large companies make demands of farmers and ranchers to mix and match “sustainable” practices to collaborative partnerships among food companies and producers focused on improving the “triple bottom line” (economic, social and environmental outcomes) at both farm and watershed/community scales, and indeed all along food value chains. Adopt new policies to promote and reward the widespread adoption of successful models. The goal is to create an equitable distribution of costs and benefits associated with transformative system changes, and create and share added value along the entire supply chain through high-quality engagement, commitment to ethical principles, and continuous learning.

Box 19. In the Field: Sustainable Supply Chain Sourcing Success Stories

Country Natural Beef (CNB), a sustainable beef cooperative, brings together nearly 70 family ranches raising more than 100,000 mother cows on millions of acres of private and public lands in an effort to improve land stewardship. Ranchers who are part of CNB commit to developing stewardship plans and goals for grazing, animal welfare, water, and biodiversity through the Food Alliance Certification system.

Unilever and Archer Daniels Midland are working with farmers in Iowa to meet Unilever’s Sustainable Agriculture Code in the production of soybean oil while bringing value to producers in order to produce sustainable Hellmann’s Mayonnaise. Project partners, including Field to Market, World Wildlife Fund, the Iowa Soybean Association, and the United Soybean Board, will help the companies to establish a platform for peer-to-peer learning among growers, sharing insights across the supply chain, and measuring progress on achieving sustainability goals and improving profitability. The project has also engaged Iowa’s Department of Agriculture and NRCS to make them aware of opportunities for partnership to achieve Iowa’s sustainable agriculture priorities.

Through the Idaho Snake River Valley Collaboration, General Mills and Syngenta are collaborating with wheat farmers in Idaho to use the Field to Market tool to develop environmental baselines and demonstrate continuous outcome improvement. The project has expanded to regional verification for other crops grown in rotation with wheat, including barley and potatoes, which brought in Coors and J.R. Simplot as partners.
the landscape scale as well as on individual operations rather than checklists of practices. Box 19 highlights three examples of sustainable sourcing initiatives that incorporate key elements of this proposed approach to new partnerships among companies and farmers and ranchers.

In order to support this path forward, the following actions should be taken by key stakeholders:

**The private sector:**

- **Develop partnerships between companies and producers (both individuals and groups) to (1) set and achieve goals (based on a common understanding of what is doable), commitments, and outcomes that are flexible enough to allow farmers to adapt as technology, science, and climate evolve; and, (2) ensure that these objectives are communicated across the supply chain in a non-competitive manner that engenders trust and confidence. Success requires direct and ongoing interaction and mutual education between companies and producers. Consider separating company partnerships with producers to achieve stewardship goals from efforts to ensure legal compliance (e.g., with labor codes).**

- **Focus on those outcomes that matter most to both producers and companies, including passing on a profitable operation to the next generation (to maintain continuity of farming families and continuity of supply); managing for soil health to pass fertile ground to the next generation (with all of the attendant benefits to productivity, water quality, water use, greenhouse gas emissions, and resilience); managing costs, including opportunities to reduce inputs, which also reduces risks of pollution; and, building consumer and public trust based on accurate information and understanding of agriculture and the environment. Efforts should begin with efficiencies that contribute both to on-farm economic returns and to environmental improvements.**

- **Incentivize continuous improvement across each operation.** Avoid prescriptions and checklists that lead to managing for minimum compliance. Collaborate with individual producers to set operation-specific goals using common metrics for benchmarking. Provide for flexibility to addresses variation in operations, production conditions, etc. Base programs and metrics on whole rotations, not a single crop within a rotation. Assess outcomes over appropriate timeframes to accommodate exceptional annual circumstances (e.g., floods, droughts, pest outbreaks, etc.).

- **Establish industry standards for data collection and reporting and protecting proprietary information and make information transparent up and down the supply chain (including market data that drives company decision-making, producer practices in aggregate, environmental outcomes, etc.). Make clear the economic valuation of benefits to each player for participating in the program.**

- **Provide tools to growers** to track and understand implications of management decisions and conduct meaningful, science-based comparisons across farms/fields.

- **Leverage the power of peer-to-peer learning, sharing, and goal-setting in groups of producers.**

- **Integrate company sustainability programs with locally-led cooperative conservation, as well as with other natural resource conservation efforts, such as those developed by commodity associations.**

- **Share some costs between companies and producers** such as for independent technical support to set goals and ensure continuous improvement over time (as well as costs for third-party verification when that is necessary). Base company claims (e.g., percent of “sustainably sourced” ingredients by 2020) on reasonable expectations of what producers can and will do based on consultations with producers.

- **Develop a common definition of “sustainability” with common indicators across the agricultural supply chain.**

- **Use “book and claim” certificates for non-traceable commodities.** Pioneered in the palm oil supply chain before a segregated supply was available, “book-and-claim” certificates became a valuable and efficient means to reward producers directly and send market signals in support of sustainable production practices. Manufacturers purchase these certificates, with premiums going to producers.
who meet sustainability standards. Certificates do not enable a marketing claim in the ingredient list for a product. Nonetheless, this is a logical next-step approach for many U.S. commodities like corn, soy and beef that are very difficult to trace to origin. Certificates support sustainable production practices and fulfill food company goals of sourcing verified sustainable raw materials until such time as traceability can be established. Certificates also create an incentive for farmers to adopt practices they might not otherwise be willing to try.

- **If and where traceability is a business imperative, invest in and support the necessary infrastructure changes.**

**Civil society:**

- **Create opportunities for ongoing education of growers in partnership with food companies,** focused on aligning productivity, profitability, and environmental outcomes and delivered by leading experts without vested interests. Costs should be shared among NGOs (commodity organizations, conservation organizations), companies, and producers.

**The federal government:**

- **Invest in monitoring and data infrastructure** to support assessment of conservation outcomes at the field, farm, and large landscape scale.

- **Invest in research activities** necessary to understand relationships among practices, yields, and environmental and socioeconomic outcomes.

- **Direct cost-share resources** to those practices that have significant costs and significant public benefits but exceed the reasonable economic expectations of responsible landowners.

- **Link public and private technical support networks** to ensure adequate technical support for producers as they seek to engage with supply and value chain sustainability initiatives, including (1) land grant extension services, NRCS, and other government conservation resources; (2) commodity group programs and services; (3) private sector agricultural services; and, (4) technical support that buyers may provide to producers to meet their specific requirements.

- **Ensure integrity, clarity, and consistency of marketplace claims on labels and advertising.** Address and prevent confusion about terms and claims along the supply chain and among consumers.

- **Harmonize certification and compliance processes where possible,** specifying appropriate roles for the private sector and the federal government based on needs and expertise.

**Near-Term Actions** Those seeking to foster collaboration across the supply chain to drive innovation and improved environmental outcomes should take the following actions to test and advance the recommendations above:

- **Foster opportunities for producers and food companies to engage in open dialogue outside of existing contractual relationships.**

- **Build relationships between food companies and networks of independent crop consultants and others in civil society and government who provide extension services to further develop models for engagement and provision of technical support.**

- **Identify opportunities for several companies to work together in specific watersheds or regions to test and develop models for improving outcomes on a landscape scale.**

For further information and insight into how sustainable sourcing can support agricultural conservation and profitable farms and ranches, see AGree Point of View Paper Food and Beverage Company Sustainable Sourcing Initiatives in Farming Regions by Hal Hamilton and Elizabeth Reaves, which informed the development of these recommendations.
Endnotes


10. Soil Survey Staff, “Rapid Assessment of U.S. Soil Carbon (RaCA) project,” 1 June 2013, United States Department of Agriculture, Natural Resources Conservation Service.


23. Safe harbor agreements are voluntary contracts between a regulatory agency and a regulated entity or person stipulating that if the entity or person voluntarily engages in actions agreed to by both parties that contribute to the regulatory goal, the agency will not require any additional action or bring enforcement against the entity or person. In the instance of cooperative conservation groups, a safe harbor agreement could be made between the group (or individual group members) and relevant regulators (U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, state agencies, etc.) that if the group and its members carry out their conservation plans in good faith, no additional regulatory action will be taken or required.


33. See for example the joint effort of Drake University’s Agricultural Law Center and the Leopold Center for Sustainable Agriculture at Iowa State University: http://sustainablefarmlease.org/.


37. FUE is a metric that easily enables allows farmers to easily monitor their status against crop and cropping system performance targets given that they already collect the data (yield mass, fertilizer mass) needed for FUE calculations.

38. Numerous crop-specific and generic models are available; models must be calibrated and verified for the general conditions to be simulated (e.g. crop, weather, soil, water regime and management). The ongoing Agricultural Model Intercomparison and Improvement project (http://www.agmip.org/) is an anticipated source for guidance on model selection for specific crops and locations. Other sources for estimates of yield potential include field experiments, yield contests, and surveys of maximum farmer yields. Yield potentials from these sources can be derived from: (1) upper percentiles of farmers’ yield distributions, (2) maximum yields from carefully managed experiments and grower contests, and (3) boundary-function analysis of farmers’ yields as a function of water supply. In boundary-function analysis, all farmer yields are plotted as a function of water available during the growing season and a curve is fit to the maximum yields per increment of water or the upper boundary of the data array.

39. Data to calculate this metric are readily available to landowners and producers who already measure the volume of their yield and water inputs.


41. The U.S. Environmental Protection Agency’s ongoing National Aquatic Resource Surveys (http://water.epa.gov/type/watersheds/monitoring/aquaticsurvey_index.cfm) provide information about nitrogen and phosphorous levels in American waters. Regional water quality trends are already available for some water bodies.

43. The U.S. Geological Survey provides information on groundwater levels. Please see http://water.usgs.gov/ogw/ for more information.

44. Irrigation efficiency will vary by individual operation. USDA Cooperative Research and Extension Services may be able to help landowners and producers identify strategies for estimating and increasing their irrigation efficiency.

45. Water reuse apportioned to agriculture will vary locally by water utility. Those interested in assessing this indicator in their community should contact utility managers. The Water Reuse Association has developed a National Water Reuse Database (https://www.wateruse.org/info/nwrd) that has begun to compile these data on a national level.

46. The U.S. Department of Agriculture Natural Resources Conservation Service’s recent “Rapid Assessment of U.S. Soil Carbon (RaCA) for Climate Change and Conservation Planning” report (May 2013, http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050979.pdf) provides a starting point for evaluating soil organic matter on agricultural lands on a regional basis. Now that this baseline has been established, the assessment should be carried out at regular intervals to assess progress in increasing SOM levels.

47. The U.S. Department of Agriculture Natural Resources Conservation Service provides the SCI to farmers interested in assessing their soil. For more information, please see http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ia/newsroom/factsheets/?cid=nrcs142p2_008548.

48. The U.S Environmental Protection Agency provides a chapter on Agriculture in its annual “Inventory of U.S. Greenhouse Gas Emissions and Sinks” report (http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html) detailing annual carbon dioxide equivalent emissions from some food production subsectors, but more work is needed to develop lifecycle analysis data on the total global warming potential and global warming potential per unit of production by region and by agricultural commodity.


52. These data are collected and published by the U.S. Department of Agriculture (USDA) Economic Research Service (ERS). Please see http://www.ers.usda.gov/topics/farm-economy/farm-sector-income-finances/assets,-debt,-and-wealth.aspx#.U62jdVldVZs.

53. These data are collected by the USDA National Agricultural Statistics Service (NASS) Census of Agriculture. Please see http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Farm_Economics/.

54. These data are collected and published by the U.S. Department of Commerce Bureau of Economic Analysis. Please see “Industry Data,” http://www.bea.gov/iTable/index_industry_gdpIndy.cfm.

55. These data are collected by the U.S. Department of Agriculture’s Agricultural Census and demonstrate a steady increase in the age of the principal operator over the past thirty years. Please see http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Farm_Demographics/#average_age.
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 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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