The Challenge of Conserving and Enhancing Water, Soil, and Habitat

Agriculture is inextricably linked to the environment. Natural resources must be managed, conserved, and protected if producers are to meet the demands of a growing global population over the long term. Farmland with healthy soils and adequate water are the basic inputs that, when enhanced by technology and good management practices, produce affordable food, fiber, and fuel. Although some agricultural activities and practices can degrade environmental quality, a growing body of work suggests that managing agriculture as an ecosystem can achieve both strong agricultural production and a healthy environment.

But agricultural systems will be pushed significantly harder in the coming years. Fifty to 100 percent more food will be needed by 2050 to meet the needs of a population that will top 9 billion. Production will need to be dramatically increased while safeguarding biodiversity, conserving habitat, and reducing the environmental footprint of agriculture.

Obstacles to meeting this challenge are significant, numerous, and varied. In addition to increasing water scarcity and the expected effects of global climate change, constraints include policies that encourage—or fail to discourage—practices that can harm the environment and lack of financial rewards or benefits for conserving natural resources. In some parts of the world, significant financial risk prevents producers from adopting high-yield and/or environmentally protective practices and technologies. Regulation plays a vital role in protecting the environment, but the complexity and diversity of agricultural operations make development of effective regulatory approaches appropriate to all landscapes and farms difficult. Overly broad regulations can be onerous and costly, discourage innovation, and, often, are ineffective. More attention will be needed to development of regulatory approaches that set clear performance standards while providing flexibility to producers in the methods they employ to achieve standards. A lack of coordination and underinvestment in integrative research and innovation also impedes development of the solutions that will be needed to simultaneously increase production and reduce environmental impact.

At the same time, significant progress has been made in improving the environmental performance of agriculture, and there are many opportunities for continued progress. The United States and many other developed countries have steadily increased food production while also improving the efficiency with which inputs are used. Soil erosion has sharply declined in many areas, and toxicity to mammals and persistence in the environment of agricultural pesticides have decreased during the past 50 years. In developing countries with large exploitable yield gaps, greater investment in research and development as well as adaptation of practices and access to technologies that support both greater yields and improved environmental quality are key to ensuring food security,
conservation of natural resources, and sustainable economic development.

Meeting the challenge ahead will require deploying public and private scientific and technology resources alongside management practices, agricultural systems, and innovations that achieve sustained high yields while conserving and enhancing natural resources. Moreover, the development and sale of innovative technologies for environmental protection specific to improving agricultural productivity will provide opportunities for new businesses and good quality jobs in the U.S., which has comparative advantages for global leadership in R&D (both public and private sector) as well as the supporting industries (inputs, farm equipment, information technology). The United States has an opportunity to be a leader in this area.

There also are potential financial rewards for farmers who are able to participate in markets for the environmental services and benefits that they provide through the use of environmentally sound practices and technologies. Usually, regulation or product-specific standards are required to set the parameters of a market in which farmers and ranchers can derive rewards. Where the potential for such markets can be realized, it will not only be possible, but advantageous, for agricultural producers to engage in conservation and environmental protection efforts.

Americans view agriculture as having a positive impact on the environment. The farmers and ranchers working with AGree and their peers concur with the belief among American producers that resource conservation and environmental stewardship are important priorities that are compatible with high levels of agricultural production. There are people of good will on all sides of these issues who are ready to roll up their sleeves and get to work improving the alignment between agricultural production and environmental quality. Yet, an adversarial approach—whether by environmental advocates, agricultural producer groups, government agencies, or politicians—too often leads to a perception that agriculture and environmental protection cannot coexist.

Though clearly a significant challenge, the goals of increasing global production, improving the environmental performance of agriculture, and maintaining a good financial return can together be achieved through supportive policies; incentives for adopting current technology and practices; the discovery and adoption of new, appropriate technologies, practices, and approaches; and collaboration. The tough question is: How do we achieve all of these goals together?

**Current Resource Availability, Environmental Quality, and Agricultural Production**

Agriculture is by far the dominant user of water and land to support human activities. The expansion of irrigated areas throughout the world played a major role over the past 50 years in increasing food production. Worldwide, agriculture consumes 70 percent of the surface water withdrawn for use. Irrigated agriculture is practiced on about 20 percent of cultivated land worldwide yet accounts for 40 percent of crop production. In the United States, agriculture accounts for more than 80 percent of water consumed, with the 16 percent of all harvested cropland that is irrigated generating nearly half the value of all crops sold.

In the absence of new sources of water, however, further increases in the use of irrigation pose technological,
geographical, and political challenges due to competition for water resources from other economic sectors as well as an increased human population.  

Looming water scarcities present a serious threat. According to the United Nations, almost a half billion people in 29 countries suffered from water shortages in 2008—and the situation is expected to get worse. By 2025, the United Nations estimates that “two out of every three people will live in water-stressed areas.”

Pressure on water resources can be addressed through policies, institutions, and incentives for improved management of ground and surface water resources as well as by adopting existing technologies or developing new ones, such as modernized storage and water delivery infrastructure, high-efficiency irrigation, water reuse/storage, and desalination of ocean and brackish water—where they are affordable.

Climate change is expected to affect both temperatures and precipitation rates in various parts of the world. Even though it is a global phenomenon, its likely effects will vary significantly by region. Incidence of drought from changing rainfall patterns could dramatically reduce yields in some regions that rely heavily on rain-fed agriculture. An example of such a region is sub-Saharan Africa, where approximately 95 percent of the crop production area relies entirely on rainfall. In addition to affecting precipitation rates and patterns, climate change is expected to affect temperature; growing season; soil moisture levels; sea level rise leading to inundation and salinization of coastal areas, deltas, estuaries, and aquifers; rates of pest invasion; and other critical agricultural production factors.

Though some regions of the world may actually benefit from increased temperatures and rainfall, current models suggest the most affected regions will be those with the least adaptive capacity, accentuating already great disparities in agricultural productivity. Further, research suggests that adverse consequences of a changing climate will disproportionately affect the world’s poor. “Hardest hit will be small scale farmers and other low income groups in areas prone to drought, flooding, salt water intrusion, or sea surges.”

In regard to water quality, agriculture is one of a variety of sources of water pollution in the United States and globally. In the United States, the U.S. Geological Survey concluded, based on analyses of stream water samples collected over time, that “increases in nutrient loadings from agricultural and, to a lesser extent, urban sources have resulted in nutrient concentrations in many streams and parts of aquifers that exceed standards for protection of human health and (or) aquatic life, often by large margins.”

At the same time, research by the USDA demonstrates the effectiveness of conservation practices in improving water quality, as well as reducing soil erosion, and improving conditions for wildlife. Such research also suggests the potential for additional improvements in water quality by more widespread adoption of conservation practices (Figure 1).

Figure 1

While average nitrogen use on corn has leveled off since 1980, average yields have continued to grow. USDA estimates a potential reduction in N use by 18 to 35 pounds per acre on 52 million acres if all corn in the corn belt were grown using conservation best practices (USDA/NRCS Conservation Effects Assessment Project).

Globally, the impact of nutrient loadings on the environment is expected to grow in developing countries unless new tools and practices are adapted and adopted to avoid movement of nutrients from agriculture to surface waters. At present, the proportion of producers who use fertilizers and herbicides in developing countries is lower than in developed
countries, but current use per acre is often highly inefficient, especially in rain-fed agricultural systems. If yields are to keep pace with population growth in developing countries without harming the environment, targeted and efficient fertilizer use and use of practices that raise soil organic matter and soil fertility are imperative.

Concerns remain that pesticides can also harm environmental quality and pose risks to wildlife and human health via occupational exposure, food, drinking water, and the air. Pesticides used in the United States and other developed countries have become progressively less toxic to mammals and less environmentally persistent over the past 50 years. Also, many agricultural producers have moved toward use of integrated pest management and other information-based techniques that suppress pest populations, thereby reducing the need for pesticides. Pesticides can still be found in surface and groundwater in the United States, sometimes in concentrations that may harm aquatic life or fish-eating wildlife. However, human exposure to high-risk pesticides via drinking water has declined in the last two decades, and regulators remain focused on better understanding and further reducing drinking-water-based risks.

Within the last decade, the United States and other countries have adopted transgenic seed varieties. Transgenic crops now constitute more than 80 percent of soybeans, corn, and cotton grown in the United States. Farmers using this seed may enjoy lower costs and/or higher yields, and such seed has reduced insecticide use on cotton and corn crops. However, recurrent use of genetically altered seeds over large acreages has resulted in the rapid rise of herbicide-resistant weeds. This has both exacerbated crop protection challenges for many growers and led to increased use of other herbicides. An additional challenge is "genetic drift," in which genetically altered materials infiltrate nearby farm fields with nontransgenic crops.

Globally, some older pesticides banned in the United States are still used in developing countries. Developing countries contend they cannot afford, for reasons of cost and/or efficacy, to ban some of these older pesticides. The dilemma of cost/efficacy versus ecological impacts remains a contentious global issue.

Around the world, prime farmland is fiercely contested. At present, crops and livestock use nearly 40 percent of the earth’s terrestrial surface. This includes nearly all land suitable for crop production under available technologies. In the United States, prime farmland is being converted to nonagricultural uses, especially where there is pressure for development. A similar trend is underway in China, and in most developing countries, with a consequent loss of crop production capacity.

In the United States, soil erosion, although still a major issue in some areas, has been reduced substantially through programs in effect since 1985 (Figure 2). The USDA’s quid pro quo arrangement (Conservation Compliance) requires recipients of commodity, farm, or loan payments to achieve a minimum standard for soil erosion reduction on highly erodible cropland. The USDA’s Conservation Reserve Program (CRP) makes payments to farmers who idle environmentally sensitive farmland. The CRP has also enhanced wildlife habitat on arable lands and strengthened rural economies. The soil and water conservation provisions of the 1985 Farm Bill are recognized by many in both the conservation and agriculture communities as both successful and an excellent investment of public funds.
Opportunities for Integrating Agricultural Production and Environmental Protection

Given enormous variation in agro-ecological circumstances across the planet, no one farming system or approach will best feed the planet while also protecting the environment. Instead, a wide diversity of crops, livestock, and farming systems is needed. Indeed, coexistence of different farming systems will help promote diversity and resilience, and likely will play a key role in future food and ecosystem security.

Agricultural systems produce both commodities and a range of ecosystem services. Examples include wildlife conservation, biological pest control and pollinator management, and water recharging. Farming also can provide storage capacity for carbon that would otherwise be released into the atmosphere as a greenhouse gas (Figure 3).

Figure 3

Estimated Maximum Potential Carbon Sequestration from Improved Cropping/Management Practices

<table>
<thead>
<tr>
<th>Practice</th>
<th>Carbon (MWT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture mngt</td>
<td>1</td>
</tr>
<tr>
<td>Improved irrigation</td>
<td>2</td>
</tr>
<tr>
<td>Improved fertilizer use</td>
<td>3</td>
</tr>
<tr>
<td>Crop rotations</td>
<td>4</td>
</tr>
<tr>
<td>Conservation tillage</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Lewandowski et al., ERS/USDA

Many agricultural practices have the potential to add carbon back to the soil over time, helping to mitigate climate change.

While there are many “off-the-shelf” technologies that can improve yields without regard to long-term environmental consequences—and many that can reduce environmental impact without regard for increasing yield—there are few that can do both.

One such approach to designing agro-ecological systems is called ecological or sustainable intensification. Sustainable intensification increases crop production while also improving environmental, social, and economic sustainability by enhancing nutrient flows and managing biodiversity and ecosystem services. Intensification can include a variety of methods to achieve multiple goals, such as increasing yields, reducing water use, protecting ground and surface water quality, avoiding negative impact on wildlife and biodiversity, and decreasing greenhouse gas emissions.

Globally, the regions most amenable to increasing crop yields while still meeting the other sustainable intensification criteria include land with yields currently well below global averages, including sub-Saharan Africa, parts of Latin America and South Asia, and Eastern Europe, where nutrient and water limitations are strongest. Opportunities abound, particularly in the developing world, for technological “leapfrogging” by applying advanced irrigation, improved crop varieties, soil building techniques, targeted nutrient application, pest management practices, communications, energy, and other technologies to transform low-productivity agricultural sectors.

Diversified farming systems, which can be combined with sustainable or ecological intensification, are another approach for integrating agriculture and ecosystem management. Diverse systems compose a modest but growing component of U.S. agriculture and include conservation agriculture, organic farming, integrated (hybrid organic/conventional), alternative livestock production (e.g., grass-fed), and mixed crop/livestock systems. These systems rely on a set of common practices, including diverse crop rotations and soil-building practices. In some cases, diverse farming systems may have lower yields than their conventional counterparts, while in others cases yields may exceed conventional systems. Diverse systems often can better integrate production, environmental, and economic objectives. With more research and extension investment in these systems, crop yields on par with or even exceeding conventional systems may be possible under a greater range of conditions.
In addition to diversification of systems, landscape-scale initiatives show promise. Collective efforts among farmers and ranchers can transform entire river basins, watersheds, aquifers, bird flyways, or other geographically dependent catchments. Yet, there are challenges to managing such programs. Landscape-scale areas tend to extend across multiple jurisdictions, and environmental impacts in them frequently result from multiple sectors (for example, both farm runoff and municipal wastewater). Thus, managing efforts to improve the environment requires collaboration. In the United States, the federal government is a partner in a suite of voluntary multi-jurisdictional efforts to achieve critical thresholds or to set inspirational and scalable precedents.

One such landscape-scale effort is the U.S. Fish and Wildlife Service’s (USFWS) Partners for Fish and Wildlife Program. Under this program, USFWS provides technical and financial assistance to private landowners and Tribes who are willing to work with the agency and other partners on a voluntary basis to meet the habitat needs of Federal Trust Species. Since the program was established in 1987, its managers have worked with more than 44,000 ranchers, farmers, and other private landowners as well as 3,000 partnering organizations to successfully restore and enhance more than one million acres of wetlands, 3 million acres of uplands, and 9,000 miles of stream habitat.

Also initiated by the USFWS, Landscape Conservation Cooperatives (LCCs) are public-private partnerships working across political and jurisdictional boundaries to “allow a region’s private, state and federal conservation infrastructure to operate as a system rather than as independent entities” by using an approach that is “holistic, collaborative, adaptive and grounded in science.” All federal agencies involved in conservation-related activities participate in the 22 LCCs that cover the geography of the United States, as do many state agencies, universities, and private-sector partners. Efforts such as these demonstrate the potential for public-private collaboration in both setting and achieving landscape-scale conservation goals. The Nebraska Natural Resource Districts are another example of cross-jurisdictional natural resource management in heavily agricultural landscapes.

**Obstacles to Addressing the Challenge**

Both in the United States and globally, a wide range of factors influence the extent to which both high agricultural production and conservation of soil, water, and habitat are achieved.

**The nature of agriculture.** The most fundamental obstacle to finding global solutions to increased production while protecting the environment is the diverse, dispersed, and site-specific nature of agricultural production itself. Agriculture as a whole is characterized by unique combinations of soil, climate, topography, hydrology, and biological diversity as well as a diversity of crops and production systems. Add to this unpredictable weather and market conditions, and together, these factors require flexible, adaptive, and localized management systems that are not easily covered by one-size-fits-all policies. This interest in more flexible policies is one driver for growing interest in performance-based standards, as opposed to practice-based incentives or regulations.

**Current investments in R&D are misplaced and inadequate.** Another obstacle is the lack of coordination in setting research priorities and carrying out research, as well as declines in public investments in agricultural research in the United States since 2002. Productivity-enhancing R&D and conservation R&D need to be integrated. A systems approach to research on environmentally compatible agriculture is essential, including on-farm and applied research that producers can use to help adapt management practices to real-world circumstances. In addition, cuts to extension services and applied agricultural sciences departments threaten the adaptation and widespread adoption of improved management practices and technologies. Research investments that produce publicly available information, tools, and technologies that are available for use in extension and directly by farmers are critical.
Institutionalizing an integrated approach to research, development, education, and extension will likely require new organizational structures, innovative approaches to education, and changes in professional incentives. Currently, there is no mechanism in place that Land Grant University and CGIAR systems, other national and private universities, major research funders, and private research entities can use to coordinate research efforts in order to avoid redundant research, heighten synergies, and minimize gaps in R&D efforts.

Climate change, water scarcity, invasive pest and disease pressures, and food insecurity are global problems. Technologies that better integrate environmental and production goals are needed by every country in the world. Countries that pioneer R&D efforts in this area are likely to enjoy the benefits of creating new industries, jobs, and export markets. Given the nature of the challenges facing the food and agriculture system and the 8-15 year lag time between initiating research and commercial availability of new technologies, it is imperative to shift and align research priorities now.

Cost of conservation. Few farmers can adopt conservation systems and provide ecosystem services at a loss. Keeping biologically sensitive or highly erodible lands out of production can reduce short-term revenue and profit, and adopting conservation systems and technologies can be expensive. For example, the costs of installing grassed waterways and buffer strips to keep sediment and nutrients out of rivers and lakes are not recouped in commodity prices. Although markets for ecosystems services that reward resource protection for the public good are developing, they are few and generally small.

Farmers frequently also depend on financing through the existing banking system, and securing credit for projects that do not bolster the producer’s bottom line is difficult. Not surprisingly, conservation is practiced to a higher degree by well-off farmers and ranchers than by smaller producers with fewer financial resources. Farmers and ranchers, especially those with smallholdings or precarious finances, tend to be highly risk averse when it comes to yields. Uncertainty and the perception of yield risk from the adoption of conservation practices is a barrier everywhere, from Ethiopia to the United States.

Suitability and complexity of some environmental regulations. Strategies that have been successful in dramatically improving air quality and reducing toxic emissions from specific sources, such as regulation of pollution from factories or car emissions limits, are not easily applicable to agriculture given its dispersed nature. In addition, states vary considerably in their approaches to, for example, addressing water quality impacts from nonpoint source pollution from agriculture. This compounds problems with compliance and leads to highly uneven results in improving environmental quality.

Many regulatory programs are complex and in some cases overlap, making compliance difficult and burdensome. Often the only interaction farmers and ranchers have with the U.S. EPA involves enforcement. Agencies could likely improve compliance rates and environmental outcomes by simplifying regulations and focusing less on enforcement and more on supporting operators’ efforts to understand and comply with them. Regulation succeeds best when it establishes clear and enforceable standards while providing flexibility to the
private sector regarding which technologies and practices to employ to achieve standards, such as has been the case with dramatic reductions in the sulfur dioxide emissions that cause acid rain. Successful performance-based regulation requires widely applicable metrics and measurement tools, which in many cases have yet to be developed.

**Multiple and sometimes conflicting policies and objectives.** Public policies sometimes have unintended consequences or create conflicting incentives. For example, subsidizing input costs, which may be critical to increasing production and closing yield gaps in some developing countries, can lead to overuse. And countries that subsidize agricultural production or artificially increase commodity prices create incentives for producers to produce more than a free market would support and overuse yield-enhancing inputs. This can lead to increased production on environmentally sensitive, marginal lands. In the United States, policies and programs also sometimes function at cross-purposes. For example, the Renewable Fuel Standard and ethanol tax credit have created strong incentives for farmers to plant fence post to fence post, while at the same time the Conservation Reserve Program encourages farmers to set aside highly erodible acreage for conservation. Conflict also arises in the implementation of the multiple statutes that govern agriculture and the environment.

In some cases, enhancements in one area take away from enhancements in others. For example, flood irrigation uses more water than some other forms of irrigation, but it can enhance habitat for certain species of birds or other water-loving creatures. Clearing land around fields may address food safety concerns that result from intermingling of animal excrement with crops, but it removes wildlife habitat.

Agencies often lack the flexibility required to effectively balance competing policy objectives. The requirements of statutes can limit the ability of government agencies to try new approaches to solving problems. Moreover, policies often are not designed to achieve landscape-scale environmental outcomes. For example, many current USDA conservation programs limit the ability of the agency to focus limited resources on the most serious issues and fail to include mechanisms to evaluate their effectiveness or to anticipate change.

**Lack of knowledge about and resistance to new techniques.** Lack of information, scientific knowledge, and extension services are barriers to adopting conservation practices. Social learning, whether it occurs at a village festival or during coffee shop chats, is vital to promoting the adoption of new techniques or technologies. Custom and culture also play a role. Producers may be discouraged from adopting new technologies or practices by time-honored practices. People are often more comfortable doing things as "they have always been done," including methods for growing crops and managing land or allocating government resources and operating programs. In addition, technologies developed and used in the United States do not always transfer well to developing countries, particularly when farming occurs on small plots and institutions and infrastructure to support the technology are not in place.

Adoption has lagged of the many profitable and effective conservation practices and systems that have been developed. The link between discovery of new conservation practices and systems and their adoption is complex and far from automatic. A better understanding is needed of what stands in the way of wider adoption of existing, proven conservation practices.
Adversarial politics and practices. There are, in fact, many examples of farm and environmental groups that work well together and devise effective compromises.\textsuperscript{42} Unfortunately, however, tension and poor relationships among government agencies, business interests, and environmental advocates persist and needlessly hinder advances in agricultural production, resource conservation, and environmental quality. The views of many have hardened, reducing their willingness to try new approaches. In some cases, parties resort to lawsuits, leading to significant expense and gridlock.

Opportunities for Innovation in Conservation Policy and Practice

Well-designed policy can drive innovation, increasing the effectiveness and lowering the costs of technologies and practice systems that improve both productivity and environmental performance of agriculture. One opportunity, for example, is to develop better performance-based standards and incentives to achieve the environmental outcomes specified by law. Rewarding achievement of specific environmental performance standards accomplishes more than using incentives to adopt best management practices.\textsuperscript{43} Measuring and monitoring the environmental performance of agricultural systems requires accurate metrics, however, both that quantify local and national and global level impacts.\textsuperscript{44} Such metrics must be able to support and inform decision-making. Investment is needed to develop a set of widely applicable metrics and the measurement tools.

“Regulatory incentives” provide another opportunity to improve environmental performance. Expedited review of permit applications, compliance assurance, or priority for regulatory relief could encourage producers to institute conservation practices that achieve more than the minimum standards established by regulations. An example of such incentives is the NRCS’s Sage Grouse Initiative. In exchange for making certain changes now, farmers and ranchers will be exempt from future conservation actions if the Sage Grouse is later listed as threatened or endangered under the Endangered Species Act. Since its launch in 2010, it has become a conservation success story of the western United States.

Regulation can create the incentive for private markets for ecosystem services that benefit farmers and ranchers. Indeed, without government policies that set up the need for, and the operation of, private markets, markets for agriculture environmental services will exist under only limited conditions.\textsuperscript{45} Generally speaking, a regulated or multi-jurisdictionally agreed upon maximum level of sediment, nutrients, effluent, greenhouse gases, or other measurable pollutants is needed to define the boundaries within which agricultural participants can produce, accumulate, trade, or sell credits that prevent maximum levels from being exceeded.

When an environmental service market policy is appropriately specified and designed to include agricultural sector participation, farmers and ranchers can benefit from the sale of environmental services from existing or modified agricultural practices. Ideally, this is accomplished without an unwieldy administrative burden. Such programs are most successful when farmers receive positive messaging, incentives, and trust in their expertise.\textsuperscript{46}

There are specific cases in which the public sector has purchased ecosystem services directly from farmers. The City of New York pays farmers who operate on land upstream of their drinking water source to adopt practices that reduce run-off. This option proved to be
less expensive for the city than upgrading its water treatment facility. Similarly, in the Florida Ranchlands for Environmental Services Project, state water districts pay ranchers to retain water on their property and/or reduce phosphorus levels rather than spend resources on expensive infrastructure projects. These are examples of projects that are succeeding in part because they are crafted to address very specific circumstances.

Private-sector initiatives also can drive increased alignment between agricultural and food production and environmental quality. Increasingly, food companies, from Stonyfield (food producer), to Walmart (food retailer), to McDonalds, are responding to customer demands by requiring that the farmers and ranchers that supply them adhere to specific production practices. Some producer groups also are creating tools and programs to assist their members in improving environmental performance. For example, the Iowa Soybean Association’s Ag Technology and Environmental Stewardship Foundation helps farmers assess and improve environmental impact associated with nutrient management. The Dairy Farmers of America are driving improvements in greenhouse gas intensity through a carbon footprint tool and recognizing leadership through their annual U.S. Dairy Sustainability Awards. Private-sector efforts are also underway to develop comprehensive sustainability standards that can be applied to individual operations and products.

Looking Forward

Sustained and intensive public- and private-sector attention, investment, and collaboration will be needed—both in the United States and globally—to integrate improved environmental protection and resource conservation with increased agricultural production at the scope and scale required to meet the critical challenges ahead. Key questions\(^1\) include:

- How do we redirect research priorities and mobilize resources to achieve game-changing breakthroughs needed in both agricultural productivity and environmental performance around the world?

- How can U.S. agriculture, conservation, and environmental protection policies, programs, research, and agencies avoid working at cross-purposes?

- What policy changes will achieve environmental quality, spur innovation, and provide regulatory certainty for U.S. producers?

- If public funds for traditional cost-share programs diminish, what is the alternative to ensure meaningful progress is made?

- To what extent can producers everywhere be rewarded for the ecosystem services they provide?

- How do we ensure that actions necessary to meet the very real and serious challenges of the not-too-distant future are not postponed?

- What can be done to reduce adversarial politics and promote the collaboration needed to protect the environment and ensure the vitality of U.S. agriculture?

\(^1\)These questions are illustrative of the types of issues AGree will address; they are not exhaustive.
Notes

13 In China, up to half of the nitrogen applied to crops is lost by volatilization and another 5-10 percent by leaching. This contrasts with the situation in Africa, where use rates of fertilizers are very low and limit agricultural production there. See FAO (2002).
14 A class of moderately persistent pesticides has been linked in a recent study to bee colony collapse disorder. Whitehorn, Penelope R., Stephanie O’Connor, Felix L. Wackers, and Dave Goulson. (2012). Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production. Science 335 (6076): 351-352.
18 This includes seed in which the genes of a biological insecticide, Bacillus thuringiensis (Bt) have been inserted in corn and cotton, as well as corn, soybean and cotton seed with engineered properties that convey herbicide resistance so that the weed killer glyphosate (Round-Up) doesn’t also kill the crop. See National Research Council. (2010). Impact of Genetically Engineered Crops on Farm Sustainability in the United States. Washington, D.C.: National Academies Press.
19 At least eight weed species have evolved resistance to glyphosate in fields using glyphosate-resistant crops, and the number is growing. See National Research Council (2010).
The Challenge of Conserving and Enhancing Water, Soil, and Habitat


18 The degree to which these services can be provided depends on management practices. Some have suggested that for this approach to be successful on a global scale, dramatic changes in agricultural consumption patterns, such as reducing meat consumption in human diets and reducing bioenergy crops on our most productive farmlands, would be required. See Foley, J.A., et al. (2011). Solutions for a cultivated planet. Nature 478:337-342.


27 The National Research Council, in reviewing the U.S. Land Grant University system identified a need to (1) develop and expand research programs and academic curricula to reflect a contemporary view of the agri-food systems, (2) remove historic barriers to encourage interdisciplinary research, teaching, and extension collaborations, and (3) engage a wide variety of stakeholders to assess their needs and develop priorities, targeted programs, and effective information delivery modes. See National Research Council. (1997). Colleges of Agriculture at the Land Grant Universities: Public Service and Public Policy. Proceedings of the National Academy of Sciences 94 (5): 1610-1611. A subsequent series of studies by the Kellogg Foundation came to similar conclusions. In particular, the third report in the series “Returning to Our Roots: The Engaged Institution” (1999) emphasized the importance of community engagement, outlining seven characteristics of an engaged institution – responsiveness, respect for partners, academic neutrality, accessibility, integration, coordination, and resource partnerships. Moreover, the report noted that lack of stable funding for engagement was a critical problem. See Kellogg Commission on the Future of State and Land-Grant Universities. (1999). Returning to Our Roots: The Engaged Institution. Washington, D.C.: National Association of State Universities and Land-Grant Colleges.

28 The Consultative Group for International Agricultural Research (CGIAR) system, which has been highly effective in developing technology, raising productivity and alleviating poverty in developing countries, was evaluated by the World Bank. The Bank urged the CGIAR system to more clearly and systematically prioritize its research goals, and to strategically target its resources to achieve priorities. See World Bank (2003).

29 Certainly there are great examples of public-private, cross-institutional and transnational partnerships in agricultural and natural resource research. See Ridgway, Richard L. and Charles Valentine Riley Memorial Foundation. (2011). Agriculture, Food, Nutrition and Natural Resources R&D Round Table: Research Partnerships Yield Greater Societal Returns. Washington, D.C.: Charles Valentine Riley Memorial Foundation. Available at http://www.farmfoundation.org/news/articlefiles/1733-Proceedings_web.pdf. Yet, there is no policy or institution whose responsibility it is to coordinate on global and cross-sectoral scales. There are institutions for the coordination of health efforts (World Health Organization), for development of voluntary international standards for business performance (International Organization for Standardization, ISO agreements), and various conventions for the inter-institutional and international coordination of priorities, but no such institution exists to target, focus and optimize multiple research efforts.


42 In one case, long-time foes, the Humane Society and the United Egg Producers developed a legislative proposal to regulate chicken cage size. These groups’ compromise, which did not meet either group’s original demands, is reported to have been prompted by a personal meeting between two top executives who recognized that the costs of continuing to fight against each other’s position was greater than the losses each side would incur from a compromise. See Neuman, William. (7 July, 2011). Egg Producers and Humane Society Urging Federal Standard on Hen Cages. New York Times, p. B6.


