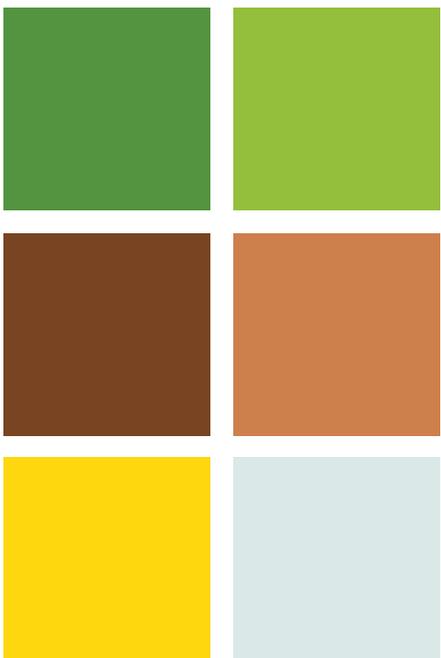




# Solutions from the Land

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Developing a New Vision  
for United States  
Agriculture, Forestry,  
and Conservation





# Solutions from the Land

Developing a New Vision for United States Agriculture, Forestry, and Conservation

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

**MISSION:** SFL's mission is to bring together a broad range of stakeholders to identify and implement policies and practices to enable land to be sustainably managed to produce food, feed, fiber and energy while protecting and improving critical environmental resources.



*“SFL asserts that the wise management of life systems and resources can deliver abundance instead of scarcity.”*

**T**hroughout the history of civilization, transforming landscapes for the production of food, fiber, and fuel has been a necessary transaction between humans and the natural environment. Agriculture and forestry — the intentional management of life systems — now sustains humanity and its domesticated animal populations throughout the world.

Here in the 21<sup>st</sup> century, we have the capacity to adequately feed a world without destroying ecosystems and biodiversity. Sadly, we often lack the will to do so. The most pressing question for the coming decades is whether we can maintain the capacity and marshal the collective will to do both.

There is no guarantee that we can meet this challenge on our current trajectory. In fact, the current global pressures of population, resource depletion, and climatic changes will combine with other factors to create a scenario of unpredictable harvests and scarcity. Furthermore, these changes are occurring in the midst of changing government support for land management.

But success is still possible. By converging our knowledge, experience, and wisdom, we can achieve a task of great consequence. Solutions from the Land — a dialogue that aims to find compatible new pathways for land management — asserts that the wise management of life-systems and resources can deliver abundance instead of scarcity. Land based solutions can continue to bring multiple benefits for both producers and the environment.

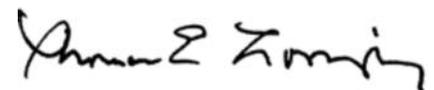
Throughout the world and here in the United States, innovative practices are taking place on farms, ranches, and forests. This report highlights some exciting progress and identifies a number of near- and long-term actions with potential to realize the full range of solutions that farmers, ranchers, and foresters can deliver from the land.

Thought leaders from agriculture, forestry, and conservation participated in a three-year dialogue to produce this report. These volunteers worked tirelessly, and we thank them for their dedicated and enthusiastic input. Please review their recommendations and the examples we’ve shared with you here, and join us in the continuing dialogue on Solutions from the Land.



**AG Kawamura, Co-Chair**

Founding Partner of Orange County Produce, LLC, and former Secretary, California Department of Food and Agriculture

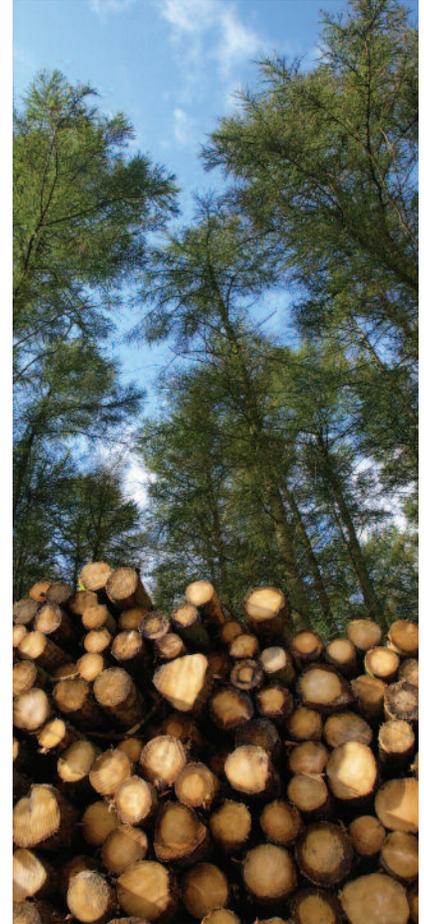


**Tom Lovejoy, Co-Chair**

Biodiversity Chair for the H. John Heinz III Center for Science, Economics and the Environment

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In the 21<sup>st</sup> century, land managers will be increasingly called upon to do more with less. Both at home and across the globe, they will be asked to produce more agricultural products, forestry products, and ecosystem services while reducing their inputs and environmental effects. This is a significant challenge, but it brings new opportunities.

In 2009, a dialogue began among leaders in the United States farm and forestry communities, global and national experts, policy makers, and environmental organizations. This project became known as Solutions from the Land. The participants have varied backgrounds and perspectives, but we share a common premise: the future will be filled with challenges, opportunities, and risks that will require cooperative thinking and action if we are to keep the land — and, by extension, our human communities — healthy and productive. Ultimately, Solutions from the Land seeks to develop a robust vision for American agriculture, forestry, and conservation that will equip us to meet the multiple needs of the 21<sup>st</sup> century through adaptive, resilient land management.

This report outlines ongoing land management challenges and proposes a vision for producing more agricultural and forestry

products and ecosystem services with fewer inputs and environmental impacts. It also offers recommendations for realizing this vision, with several near-term actions that collaborating partners might undertake to accelerate success.

### Land Policies, Land Use, and Current Trends

As of 2007, the United States had 357 million acres of active cropland and about 33 million acres of land in the Conservation Reserve Program. Overall, the amount of active cropland has declined by about 15 percent since 1982, mostly from a loss of cultivated cropland; the amount of uncultivated cropland (orchards, vineyards, etc.) actually increased.

Roughly one-third (about 751 million acres) of the United States is covered by forest, and forests have been increasing slowly. The amount of protected forestland has tripled since 1953, with 10 percent (some

75 million acres) currently in reserve. Ninety-two percent of the harvested timber comes from privately-owned forests, with the greatest amount coming from the South.

Energy needs and resources are having an enormous impact on land management. The rising cost of energy means a rising cost of business, and the extraction of coal, oil, and gas affects the land itself. The need for diverse sources of fuel has brought renewed attention to wood-based energy and sparked corn production for ethanol. Solar, wind, and geothermal energy all have important land use implications and involve a range of stakeholders—from land owners and managers to conservationists and consumers. Such renewable energy markets can bring new sources of income to farm and forest operations, and stabilize narrow profit margins.

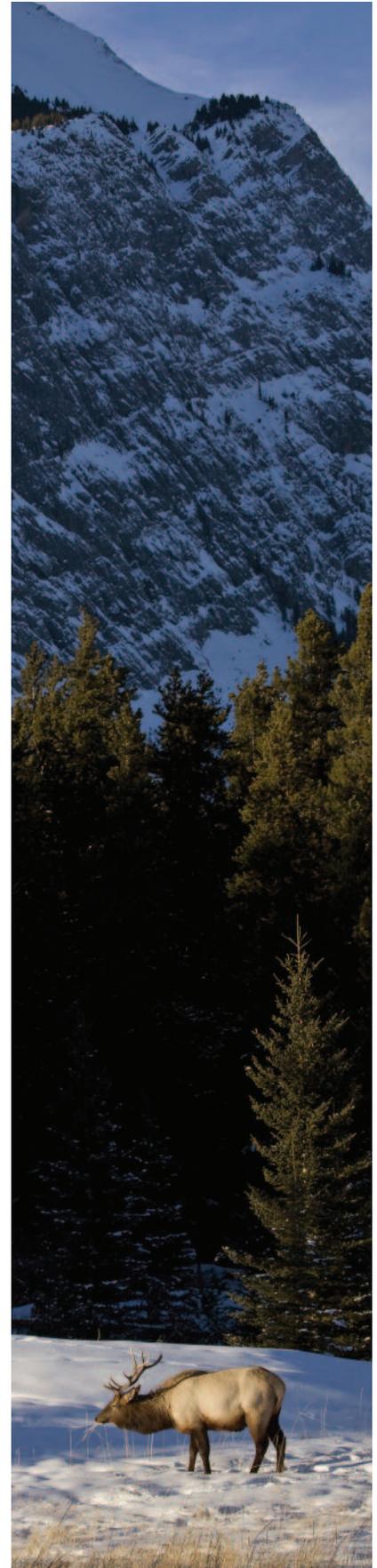
At the same time, development and sustainability concerns are drawing increasing attention to the ecosystem services that the land provides beyond traditional products, such as protecting clean air and water and reducing the effects of climate change. The importance of these services has been increasingly acknowledged and they are beginning to enter the market with a defined value.

Over the last century, American farmers and livestock producers have become incredibly productive through public and private investments in research, technology, and infrastructure. These gains in productivity have led to lower food

costs for U.S. consumers, but at the same time, have made financial survival more difficult for producers. Success now relies on more fertilizer, more pesticides and new seed varieties. More recently, farm practices have begun to reduce inputs while maintaining productivity, reflecting a response to both market and regulatory conditions.

The last 40 years have also seen a rise in forest sector productivity and new management practices in privately-owned forests. Timber, however, does not receive price supports and the industry profitability is directly linked to market demand. Business has been especially difficult, with a slow domestic recovery from the economic crisis, uncertainty in European markets, and other factors. As in agriculture, private and public investments have led to research and programs that have increased productivity, but these investments cannot be viewed as a one-time effort.

Recent decades have also brought new stakeholders to the table. Policy discussions about land management once involved mostly the people that were on the land. Today, from the local level to the federal, these policies attract people from many different organizations, viewpoints, and value systems. Environmental and wildlife organizations have strong positions on Farm Bill provisions, as do growers, processors, and exporters. We need much better ways of handling diverse agendas than the current approach of regulation and litigation — and a multi-stakeholder dialogue is an important first step.



## Challenges for Land Management

Now more than ever, land management must take into account a wide range of goals that address both production and environmental sustainability. This means shifting the focus from single commodities to a broader range of goods and services — including food, fiber, and meat to biodiversity, clean water and air, carbon sequestration, and more. This transition must take place alongside the pressure of increasingly “urbanized” rural neighborhoods and the associated loss of prime farmland to development. Land managers need to understand and address the uncertainty that derives from these challenges, both as they exist now and as they are poised to change in the future.

**1. Loss of working lands:** Between 1982 and 2007, most of the rural land converted to development included more than 11 million acres of cropland, 12 million acres of pasture and rangeland, and 16 million acres of forestland. These conversions cut into agricultural production and are, for all practical purposes, permanent. Private forestland is also being lost to development, especially in fast-growing areas such as the South; increasingly smaller parcels can be more difficult to manage, provide fewer wildlife benefits, and be more vulnerable to invasive species and insect pests.

**2. Conflicting policies and inadequate rewards for ecosystem services:**

Land managers contend with a dizzying array of uncoordinated regulations and policies for

production, conservation, energy, and climate concerns. They also face layered administrative requirements that add to the cost of managing land, whether or not the net environmental trade-offs are consistent with the public interest. Sustainable production chains and ecosystem markets could help achieve some policy objectives more efficiently, but they have not yet been developed to their full potential.

**3. Declining investments in research and innovation:**

Public support for research and outreach programs has declined severely in recent years. Challenges also lie with the dissemination and use of research. An overwhelming quantity of useful information has not been effectively integrated, interpreted, and presented to those who can use it.

**4. The changing climate:** To the extent that the predictions of global climate change are borne out, the impacts on agriculture and forestry, as well as the protected lands such as parks or wilderness areas, will be significant. A change in carbon dioxide levels could increase weed growth and leave animal agriculture with less nutritious forage, needing to consume more to achieve the same level of nutrients. Higher temperatures, along with greater extremes of rain and drought, will strain crops, forests, and livestock.

**5. Managing risk, market volatility, and multiple demands:**

Land managers regularly grapple with a large degree of risk, and market volatility is increasing. Markets are increasingly global, opening up the potential for events in one region

to create effects that ripple across the world. As markets are globalizing, they are also more regional and local in the United States. Specialized production is transforming some of our lands and changing producer decisions. Organic products like walnuts command a high price that rewards a sustainable supply chain. Population and affluence are increasing food demand, and a change in either demand or supply when the supply-demand balance is already tight can increase volatility. Demand for biofuel production will only tighten the balance. Agricultural commodity prices are becoming increasingly correlated with oil prices, which further contribute to volatility.

## Achieving the Vision

Unfortunately, the policies and practices of the past will not meet the needs and challenges of tomorrow. Solutions from the Land hopes to shift our vision toward a future in which U.S. agriculture, forestry, and conservation take effective, collaborative steps toward facing 21<sup>st</sup> century challenges. Rather than defending outdated policies and searching for “silver bullet” solutions to production or conservation issues, we should look at examples of innovation across the nation, and adopt pivotal actions that can fundamentally shift land use management toward practices that achieve multiple goals. We have identified five focus areas for this effort.

**1. Implement landscape-scale solutions and partnerships:**

We need to build broad coalitions of land managers, regulators,



scientists, and civil society around agro-forest ecosystems or landscapes to ensure continued production of essential food, feed, fiber, energy, and similar products, while improving the delivery of environmental and economic values from the land. This multi-stakeholder approach should be the foundation for advancing land use and management policies that meet economic, social, and environmental objectives through consensus-driven solutions. They should also help to set regional objectives for land management and identify the relevant voluntary and/or regulatory strategies that will meet those objectives.

**2. Harmonize policy frameworks:**

Land owners and land managers often face regulations and policies that have overlapping or even contradictory objectives, not to mention redundant procedures and paperwork. Collaborative efforts to align policies and balance outcomes at the federal and state level are essential for sustaining land productivity and reducing implementation and transaction costs for both land operators and public agencies. We must reduce or eliminate conflicting regulations while also advancing the use of ecosystem service markets and sustainable supply chains as tools to meet policy goals.

**3. Reward stewardship of ecosystem services:** New markets for ecosystem services have the potential to substitute for conservation payments, but are rarely structured to adequately provide returns comparable to traditional production.

Producers are concerned that these markets do not meet all stakeholder demand and/or reflect consumption pressures. Without better clarity on the value of the ecosystem services provided, uncertainty limits the scope for landowner/operator decisions and choices. Land management indices, metrics, and other measurements that are understood by land owners and operators will be important to allow the social interaction needed for market evolution.

**4. Energize and coordinate research:**

To achieve the goals of Solutions from the Land, we need a reliable base of information and knowledge. Investments in research and innovation should be restored. A designated research council or overarching organization should set a research agenda that integrates agricultural, forest, and conservation goals. Research should be focused on real-life applications and decision makers, with improved methods for transforming research findings into on-the-ground tools.

**5. Transform and modernize information networks:**

We need to foster a transparent, widely available system of information networks to both collect and share information with a spectrum of public and private sources. These systems should include a science-based scale-responsive network to meet the needs of land managers. This requires moving away from a provider-centric information system, in which research results are communicated outward in the hopes of finding an audience, to a

*“The policies and practices of the past will not meet the needs and challenges of tomorrow.”*

*“Solutions from the Land has articulated a new and compelling vision for adaptive, resilient land management.”*

user-centric system where information is readily available to users when they need and seek it. This work should be accompanied by better monitoring systems for regional-level systems such as air quality, water quality, and biodiversity, with new “meta-metrics” that can serve as broad indicators of sustainability.

### A Path Forward

Through collaboration and dialogue, Solutions from the Land has articulated a new and compelling vision for adaptive, resilient land management to meet the multiple goals of the 21<sup>st</sup> century — global food and energy security, economic development, biodiversity, and climate change adaptation. We have spotlighted the need for land, water, and other natural resources to be managed both in an integrated manner and at the scale necessary for our vision to be realized.

While the recommendations offered in this report provide pathways to change, they are incomplete. Each requires further development, vetting, and broadening. Towards this end, we encourage interested partners and stakeholders to join in our continued dialogue.

Several important near-term opportunities exist for collaboration, such as:

- Create a centralized database or inventory of integrated land management projects that are either planned or under way across the country.
- Identify policies and regulations that work at cross purposes and stymie progress, along with

successful resolutions to such problems.

- Sponsor and facilitate regional dialogues to inventory, explore, and assess market-based mechanisms for ecosystem services and sustainable supply chains.
- Develop ways to prioritize and streamline research processes in a way that would integrate agriculture and forestry with conservation goals and ecosystem services.
- Identify “meta-metrics” that can serve as broad indicators of sustainability.

Going forward, Solutions from the Land will seek partners to facilitate a national conversation with farmers, ranchers, foresters, and other practitioners and leaders who are seeking ways to produce more food, feed, fiber, and energy while preserving and restoring healthy ecosystems. The goal is to draw experienced and well-networked agricultural, forestry, and land management leaders into conversations about solutions that can realistically be delivered from the land. We will also encourage greater participation in the global dialogue, sharing our vision while listening and learning from others. As our work evolves, Solutions from the Land will make an ongoing effort to recruit champions and change agents who will proactively advocate for the policy, market, and institution reforms necessary to achieve our vision. These leaders will forge consensus on strategies for effecting change and will support the formation of coalitions to accelerate further action. 



## SOLUTIONS FROM THE LAND: A NEW VISION

In the twenty-first century, land managers will be increasingly called upon to do more with less. Both at home and across the globe, they will be asked to produce more agricultural products, forestry products, and ecosystem services while reducing their inputs and environmental effects. The challenge tasks the scientific community to develop both new and improved production methods and better environmental management tools. Civil society must build public awareness and support for public policies — the “rules of the game” — that reinforce and expand innovative, multidisciplinary approaches to land, agriculture, and forest management. These policies must provide incentives for land owners and managers to produce socially-beneficial ecosystem services such as clean water and air, wildlife habitat, and carbon sequestration

as well as the meat, milk, vegetables, cereals, timber, fuel, and other essentials for daily living. This is a significant challenge, but it brings new opportunities.

In 2009, a dialogue began among leaders in the United States farm community, global and national experts, policy makers, and environmental organizations. This project became known as Solutions from the Land. Our participants have different backgrounds and perspectives, but we share a common premise: the future will be filled with challenges, opportunities, and risks that will require cooperative thinking and action if we are to keep the land — and, by extension, our human communities — healthy and productive. We also share a dissatisfaction with our ability to address production, economic, environmental and social goals through existing patterns of

*“We share a common premise: the future will be filled with challenges, opportunities, and risks that will require cooperative thinking and action if we are to keep the land healthy and productive.”*



land use. Clearly, we can do better. In seeking multiple benefits from our land, we need ways to build effective compromises; we need a shared understanding of how and where new practices and strategies are already changing the business model; and we must appreciate the different challenges policymakers, land owners, and managers face in making decisions. At Solutions from the Land, we believe that farmers, ranchers, foresters, policymakers, conservation groups, environmental advocates, and the public all have an interest in both this dialogue and its outcome. Together, we asked:

- What is happening in United States land management, and what is changing?
- What emerging risks need close attention?
- What best practices should be showcased and communicated?
- What innovative policies and practices can be replicated and scaled-up?
- How can we incentivize the delivery of multiple goods and services from the land?

- Are land use policies creating conflicts or promoting constructive solutions?

Ultimately, Solutions from the Land seeks to develop a robust vision for American agriculture, forestry, and conservation that will equip us to face twenty-first-century challenges through adaptive and resilient land management. This vision addresses a future that we believe will be significantly different from the past:

- Productivity will increase in ways that allow landscapes to provide the full range of needed ecosystem services.
- Land owners and managers will increasingly make more efficient use of inputs, while reducing waste and overall consumption of natural resources.
- Farmers, ranchers, foresters, and other land managers will be supported and compensated for their stewardship of ecosystems and a broader suite of ecosystem services the land provides, such as clean water and air, wildlife habitat, biodiversity, and carbon sequestration.

- Communities will be engaged constructively at the policy level to participate with land owners and managers in resolving competing priorities in their own home landscapes.
- Policy decisions about land use and land management at all levels will reflect the results of multi-stakeholder assessment and engagement so that regulatory frameworks support, rather than inhibit, sustainable land management.

This report details our findings, outlines a series of ongoing land management challenges, and proposes a vision for producing more agricultural and forestry products and ecosystem services with fewer environmental impacts. It also offers recommendations for how this vision might be attained and near-term actions that collaborating partners and stakeholders might undertake to accelerate the production and delivery of multiple solutions from the land. 🌱

## I. LAND POLICIES, LAND USE, AND CURRENT TRENDS

**G**lobal trends foreshadow a future where people must produce more from the land with fewer inputs and less environmental impact. Population figures alone indicate a steadily increasing demand for land-based goods and services. The United Nations Food and Agriculture Organization estimates that a 70 percent increase in food production will be needed to meet global demand in 2050, when the world population is expected to reach nine billion. In the United States, our population is likely to increase from about 311 million today to 438 million in 2050. Americans will be older, more diverse, and more urban. These changes will require different uses of existing land, more production, and more land-based services.

Historically, land use in the United States has been shaped by the relative abundance of land in comparison with its population and also by the recognition of private property as the foundation for creating wealth. Over time, we developed policies that were designed for specific regions and even specific sites. In modern society, however, this approach has limits. The layers of administrative authorities have increased, and the objectives of local, state, and federal policies often compete or overlap, making it difficult to optimize the benefits we could obtain from our lands.

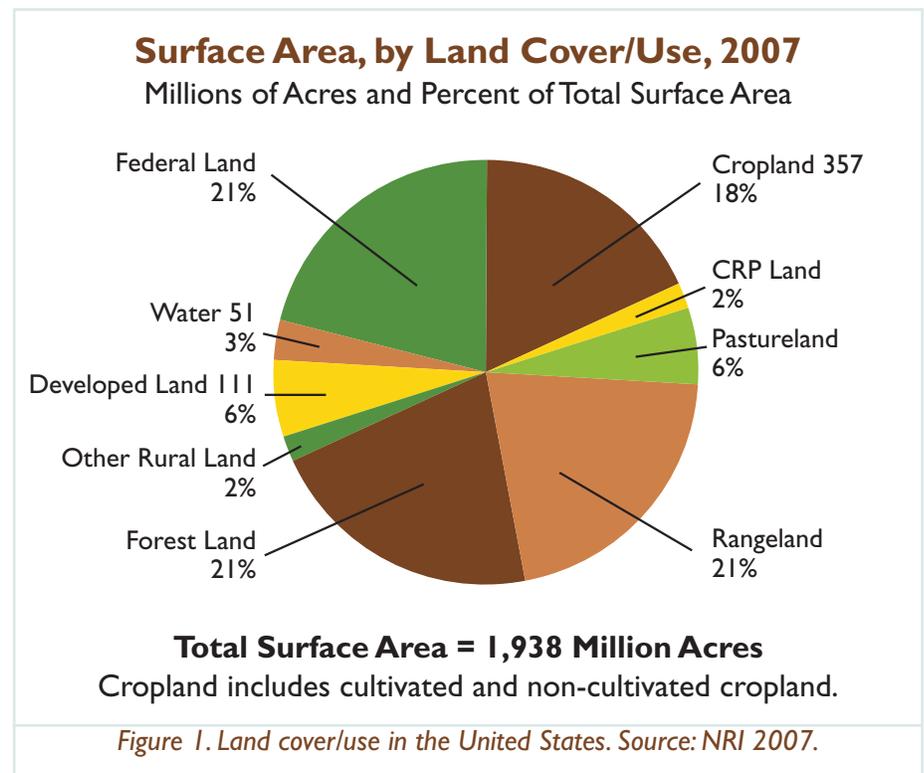
This chapter outlines the major trends that are shaping future land use for American agriculture,

forestry, and conservation. It paints the context for our initial recommendations and will hopefully stimulate further discussion on how farmers, ranchers, foresters, and the communities they serve can best collaborate to protect the productive capacity and the ecosystems services of our lands.

### How Are We Using Land?

The surface area of the contiguous 48 states is just less than 2 billion acres. Of that, about 20 percent is owned and managed by federal agencies.

The non-federal lands, including private lands, tribal and trust lands, and land managed by states and counties, are used largely for grazing lands, forestry, and croplands (Figure 1).



Land use trends on non-federal lands are tracked by the National Resources Inventory conducted by the USDA Natural Resource Conservation Service.

### CROPLAND

In 2007, the National Resources Inventory showed 357 million acres of active cropland and about 33 million acres of land in the Conservation Reserve Program (Figure 2).

The amount of active cropland has declined by about 15 percent since 1982, when the first National Resources Inventory was conducted. Most of the loss was from a decrease in cultivated cropland; the amount of uncultivated cropland (orchards, vineyards, etc.) actually increased (Figure 2). Dryland crops have seen the greatest decline. This is evidenced by the fact that almost 61 million acres of cropland were irrigated in 2007 — an amount almost identical to the irrigated

croplands in 1982. These net figures do not reflect all of the land use changes during this period, but they suggest that the recent reduction in active cropland has occurred largely as a result of dryland crops going out of production or into the Conservation Reserve Program.

The Conservation Reserve Program, created in 1985, has set aside an average of 30 to 35 million acres since 1990. These lands, most of which were former croplands, have been maintained in grass, trees, or wildlife habitat during the contract years. The program is voluntary, with some lands moving in and out of the program as old contracts (usually ten years in length) expire and new contracts are received. The restoration of large areas of grassland under this program has delivered important wildlife and biodiversity benefits in many areas and wildlife and conservation groups have strongly supported the program.

Market conditions and land rents are a major factor as land owners decide whether or not to enter or remain in the Conservation Reserve Program. In 2012, high crop prices were translated into higher land prices and rents, with the effect that there were 2.4 million fewer acres entered into the program than were taken out as old contracts expired.

### GRAZING LANDS

Around 528 million acres (27 percent) of the nation's non-federal lands are used primarily for grazing livestock on pasture and rangelands. Pasturelands grow introduced or planted forage crops, while rangelands are generally covered with native

**Cultivated and Non-Cultivated Cropland, by Year**  
(Millions of Acres)

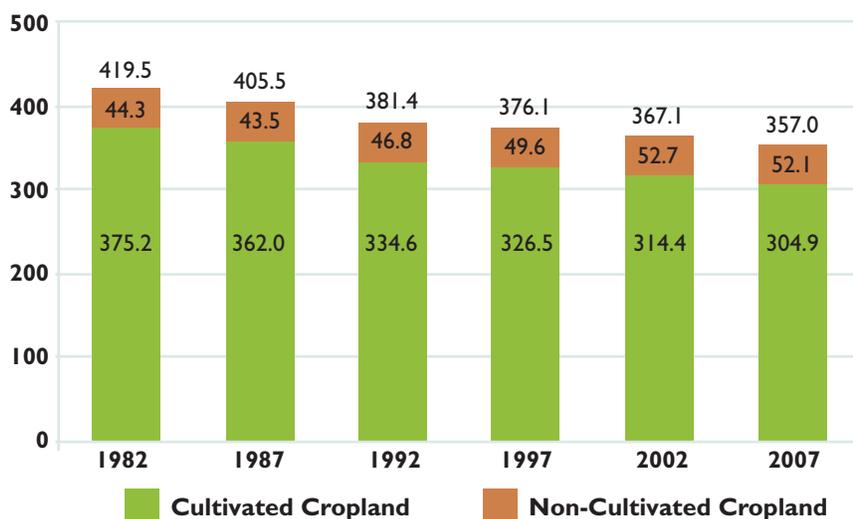


Figure 2. Cropland trends in the United States, 1982-2007. Source NRI 2007.

# I. LAND POLICIES, LAND USE, AND CURRENT TRENDS

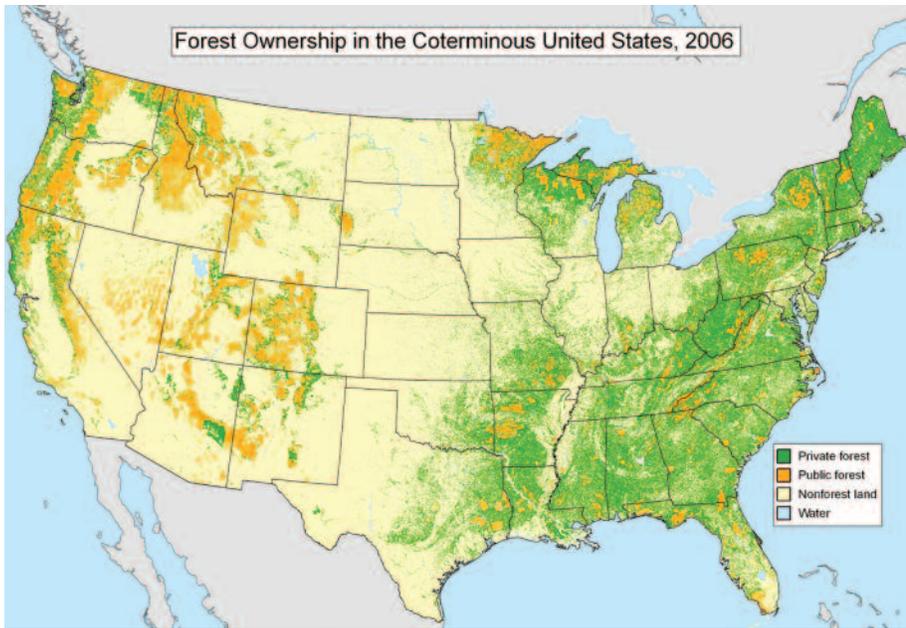


Figure 3. Forests and forest ownership in the United States. Source: Smith et al. 2009.

grasses and forbs. Since 1982, the amount of rangeland has diminished slightly, largely due to conversion to cropland. Pastureland has declined about 10 percent, due to conversion to both cropland and forest.

## FORESTLAND

Roughly one-third (about 751 million acres) of the United States is covered by forest (Figure 3), and forests have been increasing slowly — about 3.8 million acres since the first modern survey in 1953 (Smith et al. 2009). More than half of the forestland in the United States is held by private owners, including corporations and partnerships, timber investment management organizations, and families. Regionally, the majority of the eastern forests are privately owned, while most of the western forests are held by the federal government as national forests, national parks, and other federal lands.

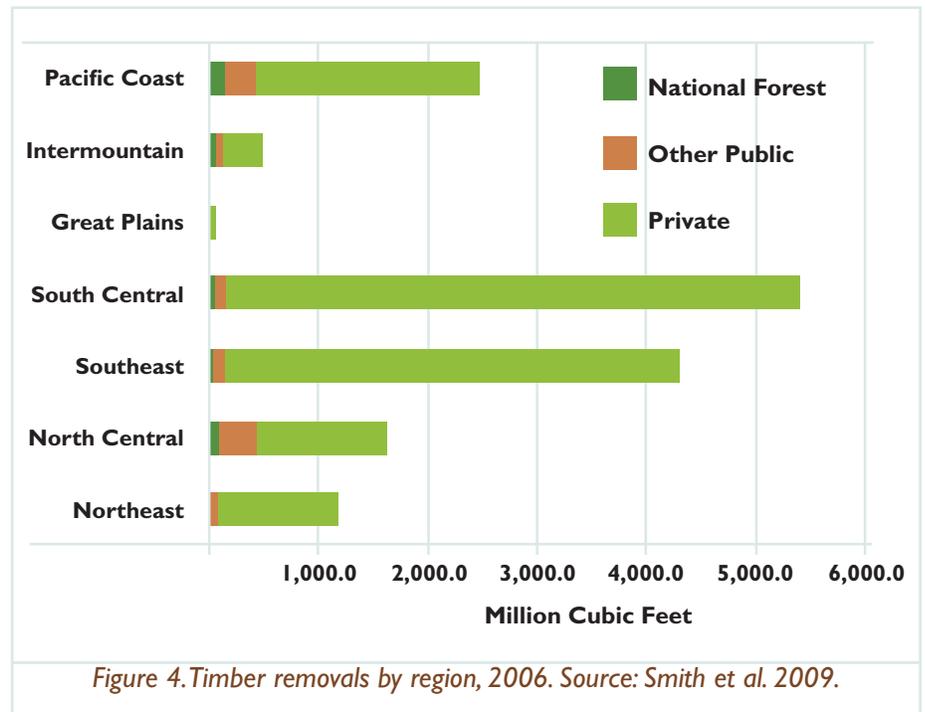
From 1953 to 2007, the amount of forestland reserved for biodiversity and natural forest conditions tripled, and today there are some 75 million acres (10 percent of all forests) in reserve status. This includes national and state wilderness areas, state and

national parks, national monuments, and the forests protected by various forms of conservation easements and trusts.

Most of the timber harvested in the United States (92 percent) comes from the privately owned forests, with the greatest amount coming from the forests of the southern region (Texas to Virginia) (Figure 4). Timber harvests in the South have risen dramatically since 1952, while remaining fairly constant in the rest of the country. Nationally, about 15.5 billion cubic feet of timber was harvested in 2006, which represented about 58 percent of the net forest growth for the year (Smith et al. 2009).

## Energy from the Land

Across the world, reliance on petroleum-based energy sources has soared with the industrial and technological advances of the twentieth century. Agriculture remains a



highly energy-intensive sector and all energy production has implications for land use. In the United States, the production of coal, oil, and gas impacts lands that were or may also be used for agriculture. New drilling techniques (such as hydraulic fracturing) have impacted land owners, communities, and water quality, while expanding domestic gas and oil resources.

Forests have traditionally been major energy sources. In some states facing higher conventional fuel costs, wood and wood waste have been used in new, high efficiency combustion systems to become

important heat-and-power fuels. Exceptionally high corn yields have, over thirty years, encouraged ethanol production for transport fuel. More efficiency in production and processing led to policies that expanded blending requirements. While adding fuel to existing food, feed, and fiber production has raised controversies, it has also improved farm incomes and reduced American dependency on imported oil. Alternative forms of energy such as solar, wind, and geothermal all have important land use implications. Here again, while land owners have an important stake in energy production, consumers also have

interests — and these issues require dialogue and accommodation.

With about half of the world's population currently living in urban areas, urbanites account for 75 percent of global energy consumption and produce 80 percent of global carbon emissions (UNEP 2011). As populations continue to increase and urbanize, their need for energy to heat and cool dwellings, cook food, and expand personal transport will rise as well. The World Resources Institute notes that global energy use per capita increased almost 7 percent between 1990 and 2005. This continuing increase, along with increasing populations, means that continued heavy reliance on non-renewable fossil energy sources is unsustainable.

Renewable sources of energy — solar, wind, and biomass — are therefore an essential part of our future. These sources, as attractive as they may be from a sustainability standpoint, create additional pressures on the land. As agriculture and forestry seek ways to meet growing food, fiber, and shelter needs, the need to provide biomass for energy production adds another layer of demand on the land. This makes it all the more urgent for land managers to balance the production of commodities with the maintenance or improvement of other ecosystem services and environmental quality. For example, where residues become marketable as energy feedstocks, residue removals must not exceed the levels needed to maintain soil health and erosion control. Land managers have recognized that new approaches and better use of systems and technologies can create

## Biomass for Bucks: The Show Me Energy Cooperative



The Show Me Energy Cooperative in west central Missouri is the first producer-owned biomass cooperative in the United States. Through this venture, producers pool resources to produce bioenergy feedstocks while improving the

local economy and ecology. The Show Me Energy Cooperative biomass aggregation and processing facility produces plant materials that can be turned into fuel and power. By doing so, it helps reduce the country's dependence on fossil fuels while bringing a new revenue stream to the region's farmers.

Through the establishment of its state-of-the-art facility, members of the cooperative are connected to all aspects of the renewable energy business. Farmers are given the opportunity to turn marginal land into profitable land by growing fuel stock crops like perennial grass, and the cooperative offers pre-determined rental rates on those otherwise unusable lands.

This project is unique and successful by handing farmers a new revenue stream while simultaneously ensuring marginal lands remain ecologically healthy. It also produces the first "advanced biomass" pellets recognized by the U.S. Department of Agriculture, turning waste products into enough biofuel to heat and power nearly 30,000 homes.

To read more: <http://www.goshowmeenergy.com/>

low-energy and energy-neutral production and processing systems — serving the very multiple objectives we seek to achieve.

Renewable energy markets can also help stabilize the economics of farm and forest operations. For farmers, new crops such as switchgrass or hybrid willow can provide income while improving soil protection and increasing carbon sequestration in the soil. For foresters, an energy market can utilize forest and mill wastes as well as trees that are not marketable in traditional timber markets but that need to be removed from the forest to improve forest health. Where conditions are right, many land managers can realize income from wind generators.

### Increasing Demand for Ecosystem Services

Society’s demand for ecosystem services goes beyond the tangible economic goods and services driven by conventional markets. Since many ecosystem services have historically been provided for free, supply and demand are not mediated through transactions. Nonetheless a great demand has existed; ecosystem services such as potable water and breathable air are indispensable from the human perspective, as they are essential for life.

In recent decades, demand for ecosystem services from farms and agricultural landscapes has grown dramatically – for more types of services, at higher levels and from

multiple sectors. This increase is reflected in new government conservation programs, pollution regulations, sustainability standards in corporate supply chains, agriculture-related programs of nonprofit organizations, eco-standards for public procurement, and demand from consumers and the food industry for the eco-labeling of agricultural products. However, from a land manager’s perspective, these new demands have not yet stabilized or formed into functioning and dependable markets.

The intent of Solutions from the Land dialogue is to develop strategies to guide these growing and maturing demands to create more effective market signals. More organized or coordinated market frameworks

## Ecosystem Services



### Provisioning services:

Products or goods such as food, fuel, fiber, energy, fish, and wildlife.



### Regulating Services:

Ecosystem functions such as flood control, water filtration, and carbon sequestration.



### Cultural services:

Non-material benefits such as recreational, aesthetic, and spiritual benefits.



### Supporting services:

Fundamental processes such as nutrient cycling and photosynthesis that support the other three categories.

Figure 5. Ecosystem Services, based on UNEP, Millennium Ecosystems Assessment. Source: Based on WRI materials

may decrease the cost of securing ecosystem services, for both those seeking or relying on these services and for the farmers, ranchers, and foresters who supply them.

### Productivity and Innovation

Over the past sixty years, agricultural productivity in the United States revolutionized expectations of how much food could be produced and the amount of land and labor needed to achieve it. Two crises — the Great Depression and the Dust Bowl — reshaped government farm policy in the 1930s, expanding research and extension services with the growing land grant university system and government intervention in commodity markets. Farm support payments, regulated practices, and other policies have contributed to shaping land use decisions that impact public perceptions today.

Private firms that supply farm inputs, technology, investments, and services have grown exponentially — and profitably. New technology, including more fertilizer and pesticide use, accelerated productivity gains. Private finance, investment, and research have always been essential to agriculture. Higher productivity of commodities, however, generally means lower per-unit prices if demand remains relatively constant. For American consumers, this has meant abundant and low-cost food; for farmers, it has required innovation and initiative to maintain profitability.

One common rule of thumb reveals that American farmers produce 2.5 times the amount per hectare today compared to 1948. This measure generally tracks the more complex measure of Total Factor Productivity (USDA, ERS) which looks at inputs, innovation, and technology. Examining these decades through the lens of Total Factor Productivity, we see that productivity gains relied on inputs — more fertilizer, more pesticides, and new seed varieties — in the initial thirty years. More recently, farm practices (such as conservation tillage, precision application, better information, and new varieties of crops) have reduced inputs as productivity increased, reflecting a response to the market and regulatory conditions they face.

Livestock producers have faced different challenges, and they have also adapted radically in order to survive. Some ranchers have chosen shorter term “cow-calf” operations; others combined pasture with intensive feeding systems. Poultry

## U.S. Agricultural Output, Inputs, and Total Factor Productivity, 1948-2008

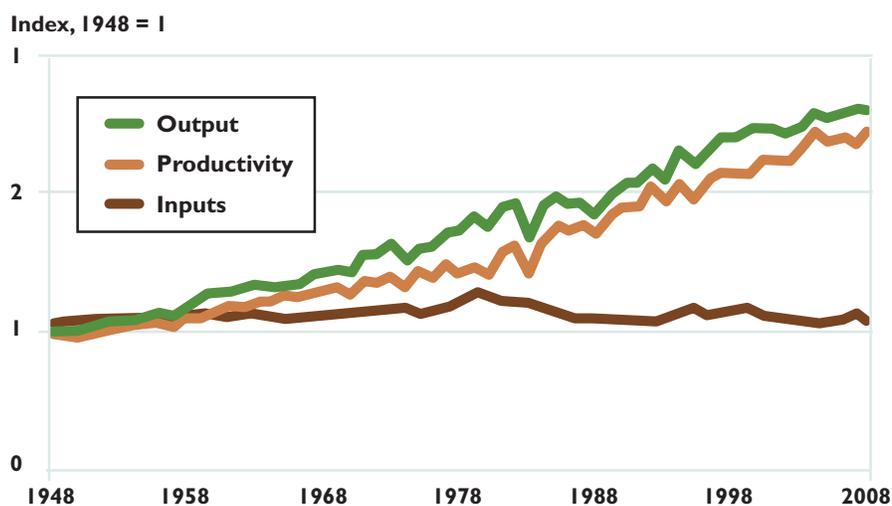


Figure 6. Agricultural productivity, 1948-2008.

Source: ERS data product, *Agricultural productivity in the United States*.

and pork also saw strong productivity gains through intensive production practices.

Breeding has played a critical role in producing more meat and milk per unit of feed within shorter time-frames (See Figure 7 and 8). Farmers and ranchers, in particular, must balance the rising operational and capital costs of production and technology with relatively low prices (and secular price trends) for their commodities. For most producers, this has meant concentration on a single crop (such as corn or soybeans) or a single element of the production chain (such as selling calves within a year) and consolidation (increasing the acreage of land available to an individual producer). The bulk of agricultural production remains dominated by traditional crops of corn, wheat, soybeans, rice, cotton, beef, pork, and poultry.

The success of new practices had its early foundation in the research infrastructure promoted in the private sector through public protection of intellectual property and in the public sector, through successful farm and business associations, the land grant college and university system and, in the last century, an expanded extension service within the U.S. Department of Agriculture. As agriculture became big business, researchers from both the private and public sector worked to solve problems — pests, crop and livestock diseases, soil erosion, water quality and availability. Finance and investment, an essential requirement for an expanding agricultural sector, was mobilized

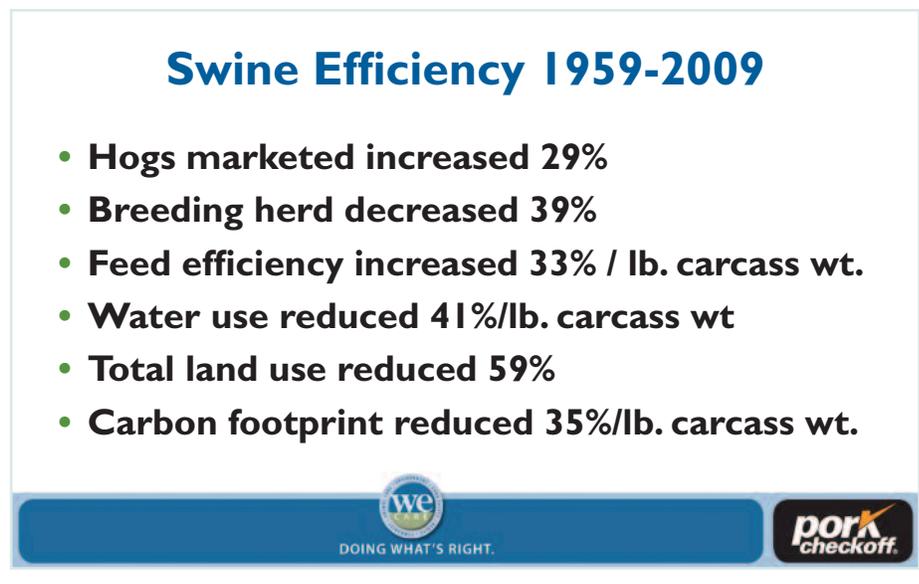


Figure 7. Swine Efficiency 1959-2009, National Pork Board

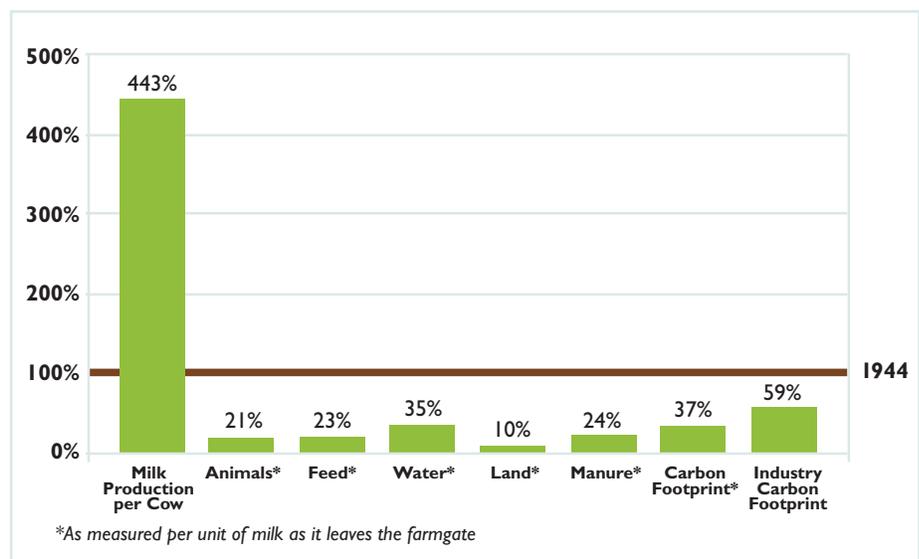


Figure 8. 2007 Milk Production, Resource Use and Emissions Expressed as a Percentage of the 1944 Production System (Adapted from Capper et al., 2009)

privately and later aided publicly by the farm credit system. The strong and mature capital market was an important factor in agribusiness development and may need to play an even greater role in the future.

Productivity increases have been supported by significant public and private investment in infrastructure.

Farm-to-market roads, railroads, highways, and river management systems have made the transport of commodities from rural areas to consumers and export facilities possible. Rural electrification and modern communications systems, including satellites, have connected rural businesses to the modern world. Dams, canals, and irrigation

*“Forests are complex ecosystems that provide water filtration, wildlife habitat, and a range of useful products.”*

systems have delivered essential water to farms in regions where farming would be limited or absent otherwise. Public and private research funding have driven the development of the technologies so important to today’s agriculture, creating a vital information infrastructure base.

Those productivity investments, however, cannot be viewed as a one-time effort. Transportation systems wear down and need maintenance. A disease-resistant crop developed by researchers will soon be overtaken as disease organisms mutate and overcome the resistance. The satellites that guide precision farming will wear down and need replacement. Infrastructure and technology are depreciating assets, needing new investments for maintenance and updates.

The United States forest products sector has long supplied global markets with timber, lumber, and wood products. For much of the industry’s early history, loggers mined existing forests. In the nineteenth century, however, public interest in conserving forests had grown. Forests are complex ecosystems that provide water filtration, wildlife habitat, and a range of useful products. The growth of the environmental movement in the 1960s focused on impacts of the commercial forest industry— erosion, loss of wildlife habitat and water quality, chemicals use — as well as the larger question of land use, reflected in debates over wilderness preservation and threatened and endangered species.

Similarly, as in the farm and livestock sectors, new issues arose among the public, the industry, and other stakeholders. These tensions sometimes led to relocation of certain activities and changes in production practices. Regulatory policies expanded with new federal environmental policies since 1970 and larger commercial firms worked to accommodate these new policies. Commercial forestry, especially in the Northwest and more recently, throughout the country, has often looked to multi-stakeholder dialogues and voluntary compliance systems to mitigate environmental damage.

The last forty years have seen a rise in forest sector productivity and new management practices in privately owned forests. Production has also shifted from the Northwest to the Southeast. Soil conservation measures supported by federal agricultural policies increased forest planting in the Southeast and as public pressure grew to limit logging on federal lands, commercial forestry expanded in that region. Large-scale commercial firms control only about 17 percent of United States timberland and that ownership has been dropping rapidly in recent years, but these firms process virtually all the timber produced on smaller forest plots. Federal support to reforest and afforest regions in all parts of the country led to both public and private investment in forest research. As in agriculture, privately and publicly funded research in applicable areas — improved tree stock, better harvesting techniques — has increased productivity.

These shifts enabled the United States to maintain a significant share in world timber production and respond to changes in both international and domestic markets. Timber, however, does not receive price supports and profitability is directly linked to market demand. Recent years have been especially difficult with a slow domestic recovery from the economic crisis, uncertainty in European markets, and other factors. The dominance of forest product manufacturing companies and their structure, however, is likely to contribute to the resilience of the sector.

Increased productivity, intensification of land use, and land operators' need for economic profitability has led to issues few foresaw four decades ago. Intensive production practices for crops and livestock have led to excess nitrogen and potassium in soil, reduced water quality, and directly and indirectly threatened biodiversity and wildlife habitat. These externalities have driven regulation at both federal and state levels.

The small number of producers that provide food, water, feed, fiber, fuel, and other products face a range of new challenges that are not easily resolved, in part because the public has less knowledge and understanding of the complex decisions each landowner or operator must make. For this reason, the dialogue generated through Solutions from the Land tried to identify the stakeholders and policy changes involved.

## Good Stewardship

The Field to Market Initiative documented improved performance in managing soils, water, and nutrients and also increased productivity from 1980 to 2011.

### COTTON

- Productivity (+43%)
- Land use/pound (-30%)
- Irrigated water use/pound (-75%)
- Energy use/pound (-36%)
- Soil loss/pound (-68%)
- GHG/pound (-30%)

### CORN

- Productivity (+64%)
- Land use/bushel (-30%)
- Irrigated water use/bushel (-53%)
- Energy use/bushel (-43%)
- Soil loss/bushel (-67%)
- GHG/bushel (-36%)

### POTATOES

- Productivity (+58%)
- Land use/cwt (-37%)
- Irrigated water use/cwt (-38%)
- Energy use/cwt (-15%)
- Soil loss/cwt (-60%)
- GHG/cwt (-22%)

### RICE

- Productivity (+53%)
- Land use/cwt (-35%)
- Irrigated water use/cwt (-53%)
- Energy use/cwt (-38%)
- Soil loss/cwt (-34%)
- GHG/cwt (-38%)

### SOYBEANS

- Productivity (+55%)
- Land use/bushel (-35%)
- Irrigated water use/ bushel (-42%)
- Energy use/bushel (-42%)
- Soil loss/bushel (-66%)
- GHG/bushel (-41%)

### WHEAT

- Productivity (+25%)
- Land use/bushel (-18%)
- Irrigated water use/bushel (-12%)
- Energy use/bushel (-22%)
- Soil loss/bushel (-47%)
- GHG/bushel (-15%)

Increasing productivity is one key driver to increased efficiency that has allowed for efficiency to increase without maximizing total resource use in many cases. For the future, a key challenge will be to improve efficiency while staying within the limits of resource use.



Figure 9. Examples of Post World War II Stakeholders

### New Stakeholders in Land Management

Land owners and operators have always made decisions based on their assessment of the best choice of crops and livestock for their lands and on the markets available for their products. However, the overall shape of United States agriculture has changed. In the past, communities organized themselves near food supplies and had a direct stake in successful production and ultimately the prosperity of those who worked the land. The first stakeholders were land owners, farmers and families, farm workers, the consumers they supplied, and local governments. As farms produced surpluses, farmers sought markets. Supplying foreign markets was an early priority — and the potential of trade to improve the return on production was well-

understood by settlers. The country's growth was driven by the expansion of commerce through domestic and international markets, and political leaders recognized the imperative of trade and the specializations that emerged among the states. The valued links between land, labor, and capital and the potential of vast, unexploited land shaped federal policy.

In the twentieth century, new stakeholder groups emerged as both the society and the farm-to-plate food system had become more complex.

Social and political interests in environmental conditions accelerated in the 1960s, when scientific studies began to identify external impacts of industrialization and, later, modern agriculture. Federal policy responded by creating the Environmental Protection Agency, and new legislation

# I. LAND POLICIES, LAND USE, AND CURRENT TRENDS

provided the agency with broad authorities to protect air and water. Agricultural production, which utilizes more than 70 percent of the freshwater in the world, found itself with new regulatory challenges.

Urban dwellers had new priorities. Emergent civil society groups adopted policy objectives that focused on health, water quality, environment, recreation, resource conservation, animal rights, food safety, food culture and other goals. Government took on a range of new policy agendas that impact land, land owners, and land use. Most importantly, the numbers of interested parties increased, translating

into the emergence of political interest groups.

Policy discussions about working lands and land management once involved mostly the people who were on the land. Today, from the local level to the federal, these policies attract people from many different organizations, viewpoints, and value systems. Environmental and wildlife organizations have strong positions on Farm Bill provisions, as do growers, processors, and exporters. These views can be very difficult to reconcile in a political process. At the state and local level, the disputes can get more specific and more personal. On the negative

side, land managers may be increasingly challenged to spend time trying to keep new regulations and policies from imposing costs or limits that threaten their ability to manage the land. On the other hand, if land managers can gain the support of other stakeholders, they can make a positive difference when local issues arise. We believe that land owners and managers are central to policy changes as they must implement new management approaches. The bottom line is that we need much better ways of handling diverse agendas than the current approach of regulation and litigation — and a multi-stakeholder dialogue is an important first step. 🌱





## II. CHALLENGES FOR LAND MANAGEMENT

### Key Challenges for Land Management

- Loss of working lands
- Conflicting policies and inadequate rewards for ecosystem services
- Declining investments in research and innovation
- The changing climate
- Managing risks, market volatility, and multiple demands

**N**ow more than ever, land management must take into account a wide range of goals that address both production and environmental sustainability. Meeting this challenge means shifting the focus from producing single commodities to producing a broader range of goods and services — from high yields of food, fiber, and meat to biodiversity, clean water and air, carbon sequestration, and other ecosystem services. Along with rising demand for goods and services there is rising demand for ecosystems services. The challenge is finding ways to accomplish both. This transition must take place alongside the pressure of increasingly “urbanized” rural neighborhoods and the associated loss of prime farmland to development. Land managers and policy makers need to understand and address the uncertainty that derives from these challenges, both as they exist now and as they are poised to change in the coming decades.

### Loss of Working Lands

While urban and developed lands make up only about 6 percent of the United States land base, these land uses continue to expand. The same characteristics that make good agricultural lands — productive soils, moderate topography, etc. — make land valuable for development. Between 1982 and 2007, the National Resources Inventory found that most of the rural land converted to development included over 11 million acres of cropland, 12 million acres of pasture and rangeland, and 16 million acres of forestland. These conversions cut into agricultural production, and they are, for all practical purposes, permanent. Once developed, these lands are not coming back into agricultural use in any significant measure. Private forestland is also being lost to development, especially in fast-growing areas such as the South. It is also becoming increasingly fragmented. Smaller parcels

## II. CHALLENGES FOR LAND MANAGEMENT

can be more difficult and expensive to manage, provide fewer benefits to many forest species, and be more vulnerable to invasive species and destructive pests.

In addition to converting working lands, urban and developed uses often impose additional costs and restrictions on the working lands that remain in an area. Land values and property taxes may go up as sales for development impact local prices. Costs also increase as traffic clogs farm-to-market roads or neighbors begin to object about the noise, dust, and odors common to

farm and forestry operations. Suburbanites may object to the sight of a timber harvest on a hillside in their view. The sheer increase in the number of stakeholders in an area may mean a more contentious and difficult situation with local land use policies and regulations.

In 2007, about 20 percent of the land in farms was subject to the effects of urban influence. Urban influence expanded fastest in Appalachia and the Southeast, where an estimated 13 percent of land became newly subject to urban influence (O'Donoghue et al. 2011).

### Every State Lost Agricultural Land.

Note: Estimate for Alaska and Hawaii are not currently available.

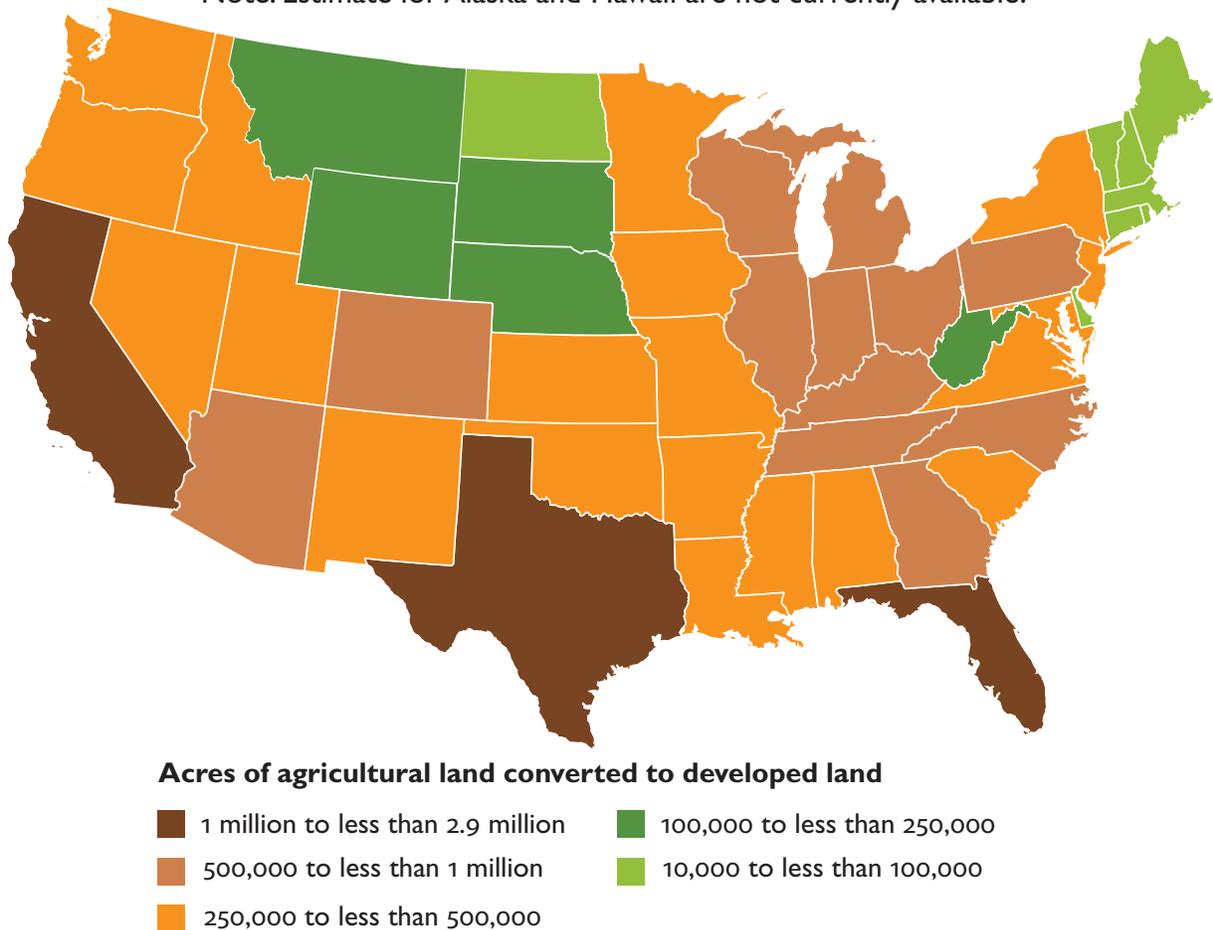


Figure 11. Every state lost agricultural land between 1982 and 2007. Source: American Farmland Trust

### Conflicting Policies and Inadequate Rewards for Ecosystem Services

Land managers contend with a dizzying array of uncoordinated regulations and policies for production, conservation, energy, and climate concerns. Many have overlapping or contradictory objectives.

For example, the U.S. Department of Agriculture may be interested in increasing no-till practices in farming areas while within the same landscape, the Environmental Protection Agency may be enforcing a specific regulation for fertilizer use in order to protect the watershed. If the fertilizer limits are not compatible with crop needs under a no-till system, farmers may find themselves unable to do both.

Similarly, constructed wetlands have been proven to be highly effective best management practices for

reducing post-use nutrient losses. Millions of dollars of federal and state cost-share funds have been allocated to support them. However, many of these resources go unused because farmers fear that any wetlands they establish may end up being defined as “jurisdictional” wetlands and trigger regulations that protect them from the nutrients and pesticides they were designed to absorb.

Policies promoting agricultural expansion in and around urban areas may put local producers in conflict with zoning ordinances or private neighborhood covenants that do not allow agricultural operations or facilities. Suburbanites wishing to let their manicured lawns “go natural” in efforts to save water and reduce nutrient and pesticide runoff can face similar restrictions and limits. Developers seeking to do innovative projects that reduce land needs or

protect environmental conditions may encounter opposition in the form of rigid local ordinances or rules.

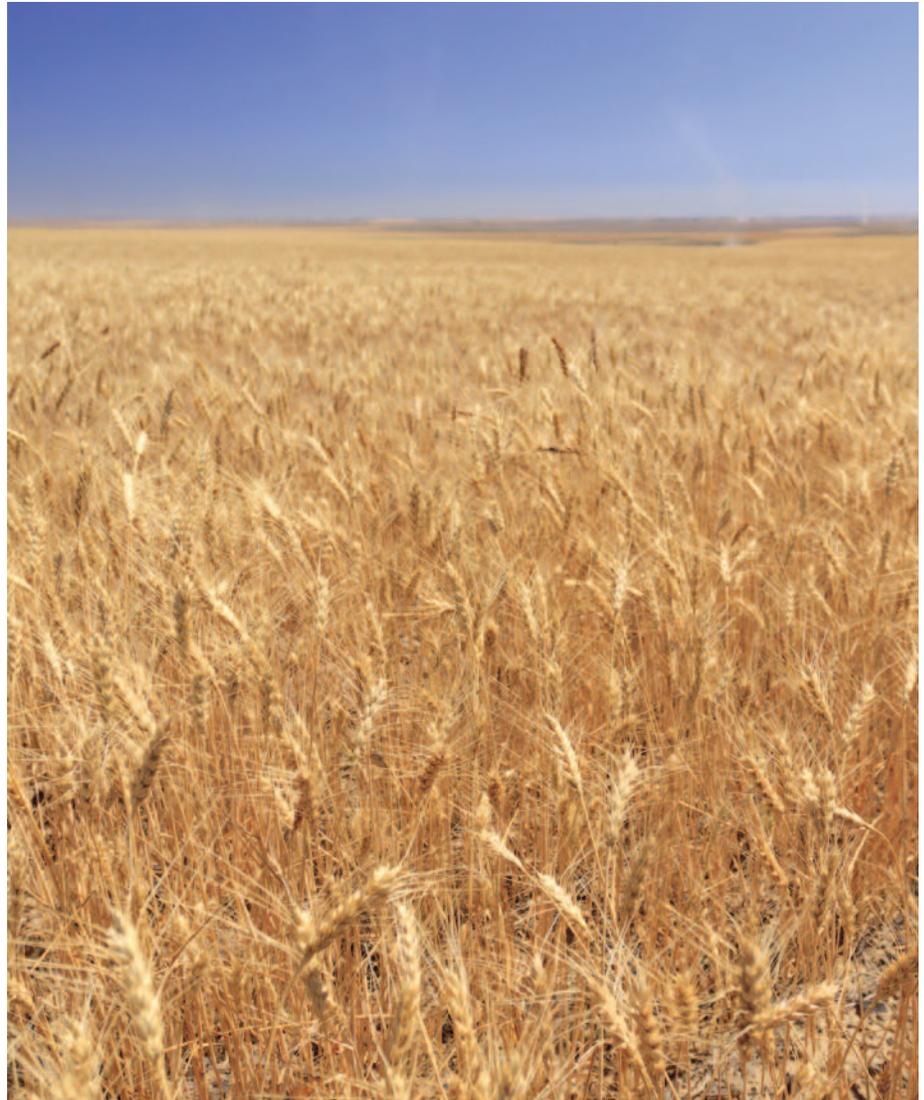
Even where the rules are compatible, land managers are likely to be confronted with layered requirements and forms to fill out to ensure they “follow the rules.” These requirements add to the cost of managing land, whether or not the net environmental trade-offs are consistent with the broader public interest.

Developing and creating new markets for ecosystem services could be an alternative way to encourage and reward sustainable land management. They are, in theory, a powerful tool for involving land owners, managers, and other private sector interests in cost-effective conservation partnerships, but markets for many services do not exist or are not well developed. Such markets could



emerge or develop from several origins. Wetland mitigation banking, carbon trading systems, federal pollution limits, and sustainable supply chains are means to generate new value from land management. Mitigation banking, for example, offers financial tools to preserve wetlands and protect biodiversity. Such market-centered approaches also have the potential to reduce the cost of such actions for land owners, managers, and policymakers. State and federal agencies can also support the transition to market-based systems through their conservation incentive programs. This will require a shift in emphasis from practices to outcomes. A requirement to reduce carbon emissions into the atmosphere can be coupled with the opportunity to purchase carbon sequestration elsewhere. If the regulated emitter can purchase carbon sequestration increases from a land manager more cheaply than it can reduce its own emissions, the result is a net reduction in atmospheric carbon at a lower total cost.

The private sector might also help promote sustainable supply chain management. Already, there are emerging efforts to develop production standards that are imposed by major customers like Walmart or Time-Warner — requirements that suppliers must meet in order to sell products to these customers. While these require more responsible production practices, they may also become an unregulated economic burden for producers if there are no uniform standards across companies and industries, or if those standards are developed without supplier engagement. Also, while efficiencies produced through these practices



can reduce costs in the longer term, they force producers to internalize costs in the early stage.

To fully harmonize government and market incentives, Solutions from the Land will explore developing and aligning land management metrics or similar methods for measuring outcomes.

### Declining Investments in Research and Innovation

Public and private research and investment have been key drivers of expanded productivity in agriculture and forestry. Where private research

## II. CHALLENGES FOR LAND MANAGEMENT

has largely focused on developing new and improved production technologies, public research has also included developments in soil conservation, sustainable agricultural and forest systems, and the social issues surrounding land management.

Given the important contributions of new technologies to the current condition of United States agriculture and forestry, it is amazing that public support for research and outreach programs has declined severely in recent years. In the face of expanding populations and consumption, coupled with the need to produce commodities with fewer inputs and less environmental damage, it would seem that natural resource research and development programs would be a top public priority. Unfortunately, that is not the case. As public budgets for such efforts decline, there is concern that new technologies in these areas may lag behind, and that intellectual property

rights to new production technologies may put small and low-income producers at a disadvantage. The infrastructure that has built and supported modern agriculture (research, water management, storage, transportation systems) is aging and needs upgrading, but public support to invest in these facilities wanes.

Challenges also lie with the dissemination and use of existing research, raw data, and data sets. An overwhelming quantity of useful information lies fallow because it has not been effectively integrated, interpreted, and presented to those who can use it. We need new links between land owners, resource professionals, scientists, and institutions that can take advantage of new information technologies and greatly increase the information-sharing capacity within the agriculture, forestry, and conservation sectors.



## The Changing Climate

A broad consensus of climate scientists holds that the global climate is changing and warming, largely due to an increased concentration of carbon dioxide and other “greenhouse gases” in Earth’s atmosphere. To the extent that the predictions of the global climate models are borne out, the impacts on agriculture and forestry, as well as the protected lands such as parks or wilderness areas, will be significant.

In *Agriculture and Forestry in a Changing Climate: The Road Ahead*, the 25x’25 Adaptation Committee summarized some anticipated climatic changes and their potential impact on the agriculture and forestry sectors:

- Carbon dioxide levels are expected to increase in the coming decades. While this may benefit the production of some crops and forests, it will also benefit weeds and invasive species, potentially requiring increased use of herbicides. Animal agriculture will have less nutritious forage, demanding that livestock consume more to achieve the same level of nutrients.
- The average temperature in the United States is expected to rise from 4 to 11°F by 2100, increasing the chance of heat waves, shortening winter, increasing ozone, and raising nighttime temperatures — all of which will strain crops, forests, and animal agriculture. Though crops might initially benefit from higher temperatures, they will face greater crop failures due to heat. High temperatures will also enable pests, pathogens, and weeds to thrive in higher elevations and latitudes.

- Nationwide, dramatic rainfall events will increase, raising concerns about flooding, runoff, and changes in land use. Droughts are also expected to become more frequent, particularly for the Southwest, increasing fire risk to forests and stressing water systems.
- Hurricanes are expected to become more severe, particularly in the Atlantic Ocean, leading to heavier rainfalls and winds that could damage crops, forests, and agricultural infrastructure.
- Sea level is projected to rise from two to three feet by 2100 in many coastal areas, making them more vulnerable to storm surges and causing changes in land use patterns.

There are many unanswered questions about projected climate change and its impact, but we know for certain that such change will present a less predictable, less stable environment for farmers, foresters, and ranchers, in which “business as usual” may not be enough to meet the needs for food, feed, fuel, and fiber of a rapidly growing world. Land managers will need new technologies and risk management strategies, challenging both the scientific and policy communities.

## Managing Risks, Market Volatility, and Multiple Demands

Land managers work to meet multiple goals while grappling with a constant flow of complications over which they have little or no control. Financial risks are impacted by market availability and prices, as well as the fluctuating costs of doing

*“Business as usual’ may not be enough to meet the needs for food, feed, fuel, and fiber of a rapidly growing world.”*



business; commodity prices respond to a global set of supply and demand signals that are beyond the control of land managers and, often, beyond the reach of public policy in any country. Weather events, seasonal temperatures, diseases, and pests can change growth rates and yields.

In the past, farmers primarily reduced risk by growing diverse crops and by integrating crops and livestock production; this is less true today as many more options are available. The United States financial sector has created futures markets and hedging strategies for agricultural producers that hedge risk. Federal farm policies have minimized risk through direct payments, counter-cyclical payments, and crop insurance. Weather derivatives and carbon credits have had varying, limited success.

Managing risk also involves factors beyond the costs of inputs, finance, management, and taxes. Ensuring long-term productivity demands careful stewardship of soil, water, nutrients, and other inputs, while

dealing with the unpredictable realities of weather and climate.

Public sector investment and active government intervention has sought to help producers mitigate and manage risk. This is the background for programs such as crop insurance, which protects against crop or market failures. Other forms of protection, such as flood or fire insurance, are common to homeowners as well as land managers. Research and extension services have also strengthened practices that can improve and protect productivity. United States domestic policies and support from the U.S. Department of Agriculture have often provided direct and indirect advantages in the global market, such as low-cost financing, commodity price supports, and conservation incentives.

Nevertheless, individual agricultural producers often work with very narrow margins and annual returns must calculate potential gains from government programs, which have

become a factor in producer decisions. While supporting rural livelihoods has been a long-term national policy objective, the policies adopted have had mixed results. Producers of program crops recognize that global and domestic markets have still transformed the farm landscape and created new pressures.

Now, market volatility is increasing due to large shifts in global supply and demand. Markets are increasingly global, opening up the potential for events in one region to create effects that ripple across the world. Population and affluence are increasing food demand, and a change in either demand or supply when the supply-demand balance is already tight can increase volatility; demand for biofuel production will only tighten the balance. Agricultural commodity prices are becoming increasingly correlated with oil prices, which further contribute to volatility. These and other factors suggest that the future may bring even more volatile markets that will affect the ability to plan and manage land for multiple purposes (FAO 2011).

Producers increasingly respond to volatile situations by relying more heavily on forward contracting. In the United States, the share of production under marketing or production contracts increased from 28 percent in 1991 to 37 percent in 2007 (O'Donoghue et al. 2011). Federal crop insurance covers twice as many acres in 2007 as it did in 1989, while premium costs jumped from \$900 million to over \$6 billion a year in the same period. Both of these trends favor large

farms, and suggest that the future will see even more concentration of agriculture. While very small and specialty farms that operate outside the main farm economy are not likely to be affected by these trends, the number of small commercial farms seems likely to continue to decline.

Many farmers and financial experts have proposed shifting price supports to crop insurance, and recent government policies have spurred new programs. In the last two years, where floods and drought have impacted both planting and production, these schemes have proven their worth. In this approach, producer incomes are protected rather than production — creating fewer market distortions and providing farmers more flexibility. With risks highlighted above, insurance products from both the public and private sector could expand.

Society, however, does not always value increased production or farm incomes over other land-based services — clean air, improved water quality, outdoor recreation, and protection of wildlife habitat. Federal environmental regulations have impacted productive agricultural and forest operations in ways that compete or conflict with incentives programs that advance production and conservation. These trade-offs can create tensions among land owners, managers, and the broader public. Moreover, increased costs always impose increased risk for individual producers. 

*“Society, however, does not always value increased production or farm incomes over other land-based services—clean air, improved water quality, outdoor recreation, and protection of wildlife habitat.”*



### III. ACHIEVING THE VISION

#### Solutions from the Land: Achieving the Vision

- Implement landscape-scale solutions and partnerships
- Harmonize policy frameworks
- Reward stewardship of ecosystem services
- Energize and coordinate research
- Transform and modernize information networks

**T**he United States agriculture and forestry sectors are undergoing a rapid transformation. Producers, sensitive to different demands on their management, are taking steps to reduce costs and external impacts. Good stewardship ensures sustainable production. Consumers are also changing their preferences, demanding more fresh, organic food as well as more local sources. Retailers are responding by creating new markets for locally grown fruits, vegetables, meat, poultry, nuts, and other products. This shift increases pressures on producers, but also creates new opportunities.

Unfortunately, the policies and practices of the past will not meet the needs and challenges of tomorrow. As partners in Solutions from the Land, we are shifting our vision

toward a future in which American agriculture, forestry, and conservation take effective, collaborative steps toward facing twenty-first-century challenges.

Rather than defending outdated policies and searching for “silver bullet” solutions to either production or conservation issues, we should look at examples of innovation across the nation and adopt pivotal actions that can fundamentally shift land use management toward practices that achieve multiple goals. A multi-stakeholder effort, including active leadership by land managers, is critical.

#### Implement Landscape-Scale Solutions and Partnerships

We need to build coalitions of land managers, regulators, scientists, and

civil society around agro-forest ecosystems or landscapes to ensure continued production of essential food, feed, fiber, energy, and similar products, while improving the delivery of environmental and economic values from the land. This requires attention to the following actions.

**I. Mobilize broad stakeholder coalitions at the appropriate landscape level (watershed, county, region, etc.) to advance land use and management policies that meet**

**economic, social, and environmental objectives.** With the challenges farmers and ranchers are experiencing today, an integrated land use planning vision must respect private property rights and take into account the full range of services and products provided by the land. Land owners and operators play the essential role in ensuring and maintaining the provision of goods and services.

*“An integrated land use planning vision must respect private property rights and take into account the full range of services and products provided by the land.”*

### Collaborating for Clean Water: The U.S. Water Alliance Dialogue Project



Reducing excess nutrients in the Mississippi River Basin will only be achieved, and sustained, through dedicated efforts from leaders in the region. Recognizing the need to connect these leaders, the U.S. Water Alliance recently

began a series of dialogues that will bring agriculture and water interests into the same room to build trust and understanding of each other’s views on risks, barriers, and solutions.

The dialogues bring together water and wastewater utilities with agricultural producers working to address this challenge. Throughout 2013 and 2014, the alliance will lead several dialogues focused on finding common ground between these groups to protect the health and wealth of the Mississippi River.

Approximately 20 leaders from agriculture and water/wastewater operations along with committed leaders in conservation, public health, scientific research, finance and technology have been identified and invited to participate in the educational series, stimulating the discussion and leading to recommendations at the local, state, and federal levels. The end result will be better working relationships among different sectors, identification of practical steps to make meaningful progress, and promotion of innovative and collaborative nonregulatory strategies to supplement and improve upon current regulatory requirements.

Read more: <http://www.uswateralliance.org/2012/12/13/2592/>

**2. Develop policy decisions about land use and land management at all levels that increasingly reflect the results of multi-stakeholder assessment and consensus-driven solutions.** All forests, watersheds, grasslands, and wild lands exist within broader landscapes of varying ownership and jurisdiction and are connected in some way to lands beyond their jurisdictional boundaries. For this reason, land use management goals must be viewed from an integrated landscape perspective, rather than

treating the natural resources — soil, water, nutrients — as separate from one another.

**3. Establish regional objectives for land management and identify the relevant voluntary or regulatory strategies that will meet these goals.** Land operators, community leaders, conservationists, and other stakeholders should come to consensus on overarching landscape objectives that guide, motivate, and support land owners and operators who are executing decisions about their land.

## Protecting Water with On-farm Conservation: The Indian Creek Watershed Project



In Livingston County, Illinois, farmers improve water quality through an innovative project focused on information-sharing. The Indian Creek Watershed Project, which began in 2010 and is led by the Conservation Technology Information Center, provides farmers with technical assistance and information to help implement new, small-plot conservation practices to minimize nutrient runoff on their farms.

The project showcases real, profitable conservation systems by holding on-farm demonstrations and field days highlighting new and innovative water quality best management practices. In doing so, the project



connects farmers in the watershed to other area farmers and agribusiness, providing water quality data measurements and results. Corporate sponsors support the project through in-kind donations that demonstrate their conservation products, and the state environmental agency assists in monitoring the water quality.

The project seeks to involve half of the watershed's 50,000 acres, and is currently up to 41 percent. The project will continue its field meetings through 2013. To read more: <http://ctic.org/IndianCreek/>

### III. ACHIEVING THE VISION

- Assess regulatory strategies and actions through monitoring and measuring results. The current process-based regulation offers no incentive to innovate or seek the best practices. Instead of regulating process, where appropriate establish goals for outcomes and allow flexible methods and adaptive management.
- Understand that there are still many circumstances where validating the process and practices makes more sense than measuring outcomes, which can be expensive and produce uncertainty.
- Note that land managers can benefit from the feedback that results from outcome-based approaches.
- Identify the risks of inaction, given the acceleration of weather-related impacts on agriculture, forests, watersheds, biodiversity, and people as the first step in developing strategies to adapt to new climate patterns.

#### Wetlands for Waterfowl: Waterbird Habitat Enhancement Program



In California, an innovative program is using the wetlands created by rice production to protect at-risk waterfowl.

The California Rice Commission (CRC), a nonprofit that represents rice growers and handlers began the program in recognition of the role rice production can play in adopting conservation practices to protect the habitats for shorebirds, wading birds, and waterfowl.

During the first phase of the project in 2011, CRC in collaboration with Ducks Unlimited used funds from the Natural Resources Conservation Service to put practices in place that enhance the value of rice fields as wildlife habitat. Participants in the program make



wildlife-friendly improvements, like modifying rice check berms, creating nesting islands, and returning boards back into the rice boxes after harvest to hold more rainwater. Approximately seventy contracts have been signed with rice producers who will make these improvements over the course of three years. In addition to protecting wildlife, the improvements allow rice producers to avoid burning rice stubble, thereby helping to improve air quality in the San Joaquin Valley.

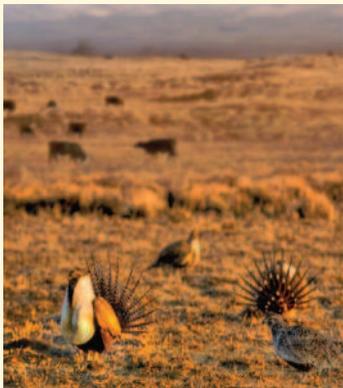
To read more: <http://www.calrice.org/Industry+Info/Conservation+Program.htm>

**4. Work with a broad range of stakeholders to identify and mitigate risks.** Risk is a fact of life for farmers, ranchers, and forest owners, although the calculations may be different in each case. One shared element in assessing risk is the availability of water — the timing of rains, water levels in dams, stock tanks, forage cover, fire and forest growth.

### Harmonize Policy Frameworks

Land owners and land managers often face regulations and policies that have overlapping or even contradictory objectives, not to mention redundant procedures and paperwork. Collaborative efforts to align policies and balance outcomes at the federal and state level are essential for sustaining land productivity and reducing implementation and transaction costs for both

## The Sage-Grouse Initiative



The sage-grouse initiative provides a holistic approach to restoring sage-grouse populations and sustainable working ranches in the West. Partners include the USDA Natural Resources Conservation Service (NRCS),

state fish and wildlife agencies, science institutions, and a host of public and private conservation partners to conserve sagebrush landscapes at a scale that transcends anything attempted to date.

The ultimate goal is to use Farm Bill conservation programs to restore sage-grouse populations before they diminish to unsustainable levels and to make an endangered species listing unnecessary. Through this initiative, NRCS is also helping to orchestrate a paradigm shift in at-risk species conservation by using voluntary and incentive-based approaches rather than regulatory approaches on agricultural lands.

The initiative covers eleven states (California, Colorado, Idaho, Minnesota, North Dakota, Nevada, Oregon, South Dakota, Utah, Washington, and Wyoming) and stakeholder groups that encompass USDA agencies, the Fish and Wildlife Service, Bureau of Land

Management, Association of Fish and Wildlife Agencies, farm and science institutions, independent ranchers, and others. The Canadian provinces of Alberta and Saskatchewan are interested in setting up a similar program.

More than \$20 million were committed to the program in 2010, and more than \$92 million in 2011.

According to NRCS, the sage-grouse initiative is one of the biggest conservation success stories in the West. Its achievements include:

- Securing conservation easements on 208,000 acres
- Managing grazing systems on 1.3 million acres land, which is expected to increase sage-grouse populations by 8 to 10 percent
- Removed high-risk collision fencing, which eliminates 1,500 to 1,900 collisions each year
- Removed encroaching conifers (105,000 acres so far)
- Improved burned and marginal lands (11,000 acres so far)
- Allowing participating land owners/managers to continue normal operations even if the sage-grouse becomes listed as a federally threatened or endangered species.

To read more: [www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb1047443.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1047443.pdf)

land operators and public agencies. Some actions required to address this challenge are detailed below.

## 1. Reduce or eliminate overlapping and contradictory regulations

- to reduce operator compliance costs while achieving key objectives and maintaining productivity.
- Review existing policies in terms of the outcomes they produce at a landscape level.
- Align policies to eliminate contradictory objectives and simplify overlapping authorities.

- Create a more streamlined federal/state regulatory environment that encourages the management of agro-ecosystems for long-term outcomes.

- ## 2. Adopt policies that promote public-private partnerships and optimize public and private investments.
- Land use policy must be designed to encourage private and public investments in essential infrastructure that supports sound land use practice. Federal policies can be

## Tualatin River Program

Clean Water Services, a wastewater treatment provider for nearly 500,000 urban residents in the Oregon's Tualatin River watershed, needed to address new state requirements for water temperature in order to meet federal Clean Water Act standards. The Tualatin River covers twenty-one square miles and provides public drinking water to most of the urban areas in Washington County. It also harbors a run of threatened steelhead trout.

Over the last five years, Clean Water Services developed and implemented a program to offset the thermal load discharged from its wastewater facilities to the Tualatin River by planting trees to shade streams and augmenting summertime in-stream flows. Farmers have established a diverse mix of native trees and shrubs planted at a very high density to out-compete pervasive perennial weeds in the riparian areas and to provide a thick growth of woody vegetation to help shade the streams effectively.

The program has overcome challenges facing many of the nation's water quality trading programs to not only gain consensus on the frameworks needed to authorize trading, but also provide a broad range of ecosystem services. The U.S. Department of Agriculture



Before



After

contracts with farmers to plant trees along streams (through cost-share programs like CREP, EQIP, or AWEP) and Clean Water Services provides additional funding by increasing CREP rental rates, providing free trees and shrubs, and helping defray the expensive costs of maintenance (weed control after planting). The Tualatin Soil and Water Conservation District provides a critical link with the farm community and has hired staff to help implement the projects.

Stakeholders groups encompass the Tualatin Soil and Water Conservation District, West Multnomah Soil and Water Conservation District, USDA Farm Service Agency, Clean Water Services, Oregon Watershed Enhancement Board, Oregon Water Trust, Oregon Water Resources Department, USDA Natural Resources Conservation Service, and Oregon Department of Forestry.

The estimated cost for the five-year program is \$2.2 million. Clean Water Services provided \$820,000 (37 percent) and various partners provided \$1.38 million (63 percent). To read more: [http://www.fsa.usda.gov/FSA/newsReleases?mystate=or&area=home&subject=copr&topic=crp-20&newstyp=crpsuccessstories&type=detail&item=ss\\_or\\_artid\\_860.html](http://www.fsa.usda.gov/FSA/newsReleases?mystate=or&area=home&subject=copr&topic=crp-20&newstyp=crpsuccessstories&type=detail&item=ss_or_artid_860.html)

major drivers for all levels of public investment.

- Create open, transparent markets for goods and services to stimulate private investment.
- Re-think the assumption that protecting the landscape is inconsistent with productive use; demonstrate how production and conservation can co-exist.
- Enhance research in this area, especially at the land grant universities.
- Leverage and prioritize existing public and private partnerships to secure funds for research and implementation.

**3. Develop policy frameworks that support new markets for ecosystem services and that create economic incentives for sustainable management of natural resources.** These policies should:

- Provide land managers with direct incentives that compensate for the environmental services they generate on their working farm lands, such as water retention and improved water quality. This can be done in ways that save taxpayers money, provide additional revenue, preserve rural communities, and enhance wildlife habitats.

### Turning Profit into Reforestation: Delaware Wild Lands' Atlantic White Cedar Restoration



A Delaware Wild Lands project is turning one of the state's largest privately owned forestlands, the Great Cypress Swamp, into a profitable, ecologically beneficial, and sustainably harvested forest. In 2006, the organization began harvesting timber, investing the profits into reforestation and habitat restoration

projects, infrastructure, and future land acquisitions. To date, profits have been used to reforest 88 acres of the swamp with natural Bald Cedar and Atlantic White Cedar, once key features of the swamp but now rare.

The Sustainable Forestry Initiative has certified the Delaware Wild Lands as a Sustainable Forestry Operation. This has attracted partnerships with local government as well as nonprofit environmental and conservation organizations. By building infrastructure funded by forestry revenues, the project leaders are moving to restore other areas of the swamp. One such area is the Roman Fisher Farm, which is now a gathering place for the community. The project also benefits the surrounding community by creating jobs and producing products that enhance the local economy.

This project has shown the immense potential of sustainable forestry. Using selective harvest practices, the project managers have demonstrated how profits can be put towards further restoration and reforestation activities. To read more: <http://www.delawarewildlands.org/wetlands.htm>

### III. ACHIEVING THE VISION

- Draw attention to the value of sustainability certification in both rewarding producers for good practices and building a strong public constituency for sustainable land management.
  - Guide government grants to support small private business in a coordinated way.
- 4. Develop “Certainty” or “Reasonable Assurance” processes and risk-mitigation tools to support or create market drivers for public goods.**
- Identify alternative means, such as indices, metrics, biogeochemical process models, or checklists that describe the necessary actions or outcomes that meet specific resource needs.
  - Develop processes to assess the status of natural resources, identify where improvements can be made, and assure outcomes through confirmation and/or auditing processes.
  - Adopt data governance models that allow land managers to provide data with confidence and anonymity.

#### The nation’s first regional water quality trading market: The Ohio River Basin Trading Project

The Ohio River Basin Trading Project (ORBTP) will create both financial and environmental improvements for farmers, their community, and the planet with an innovative market trading mechanism.

Led by the Electric Power Research Institute, in cooperation with power utilities, government agencies, agricultural organizations, academia, and private sector industrial organizations, ORBTP is designed to reduce emissions of nitrogen and phosphorus from agricultural activity into the Ohio River Basin.

This is done through a market-based trading scheme where participants are permitted to emit a certain amount, and must purchase credits from other participants in order to emit any more. This allows the nutrient pollution reduction to occur in the most cost-efficient way possible, the aim of any pollution-trading scheme. This project will serve to provide an incentive for farmers to reduce runoff from their fields, which means they will need to purchase and apply fewer inputs-reducing their costs from the outset. Other, less tangible benefits will arise from this project in the form of carbon sequestration, protection of pollinator habitats, and improved air quality.



*The picture was taken at the signing of the trading plan on August 9, 2012 in Cincinnati, Ohio – these are the directors of The Ohio Department of Natural Resources, Ohio Environmental Protection Agency, Indiana State Department of Agriculture, Indiana Department of Environmental Management, Kentucky Division of Conservation and Kentucky Department of Environmental Protection.*

By the end of 2014, there will be about 30 pilot trades across Ohio, Indiana and Kentucky, and once the program is fully scaled, it will be the world’s largest water quality trading program, covering eight states, creating a market for 46 power plants, thousands of wastewater utilities, and approximately 230,000 farmers. To read more: <http://wqt.epri.com/index.html>.

### III. ACHIEVING THE VISION

- Develop a process to secure value for the land manager through the use of data in market transactions. Because purchasers cannot own the output of many ecosystem services, they need to “own” data that allows them to prove that their supply chain is sustainable. Purchasers will require that data to account for claims.
- Evaluate current risk management mechanisms, including insurance, hedging strategies, futures markets, and new tools that the financial markets may develop to help manage the likelihood of greater climate and market variability in the future. Federal agencies are key actors in this agenda, but insurance and re-insurance experts should also help look at new ways of managing uncertainty. Land owners/operators and investors should also be at the table.

## Conservation for Stronger Production: The Mississippi River Basin Healthy Watersheds Initiative

Millions of people rely on the Mississippi River to provide water, food, and recreation. So when water quality concerns were identified in the Mississippi watersheds, the USDA Natural Resources Conservation Service stepped in to act. Its Mississippi River Basin Healthy Watersheds Initiative works with agricultural producers to implement conservation projects that address nutrient loading.

The initiative works across thirteen states, engaging producers and land owners to make voluntary improvements to their operations. By optimizing nitrogen and phosphorus use in agricultural fields, minimizing nutrient and water runoff, and improving soil health, program participants improve water quality. The improvements in turn make the land more profitable through reduced input and enhanced soil health.

The program works closely with partners on the ground, such as the Cooperative Conservation Partnership Initiative and the Wetlands Reserve Enhancement Program, using existing Farm Bill conservation programs.

The project, begun in 2009, recently received \$8.4 million in assistance from the U.S. Department of Agriculture to support twenty-three new partnership projects in several Mississippi River basin states. To read more: <http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/farmbill/initiatives/?cid=stelprdb1048200>



## Reward Stewardship of Ecosystem Services

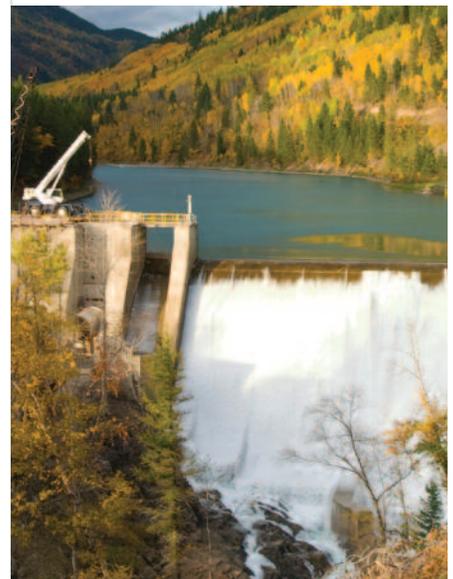
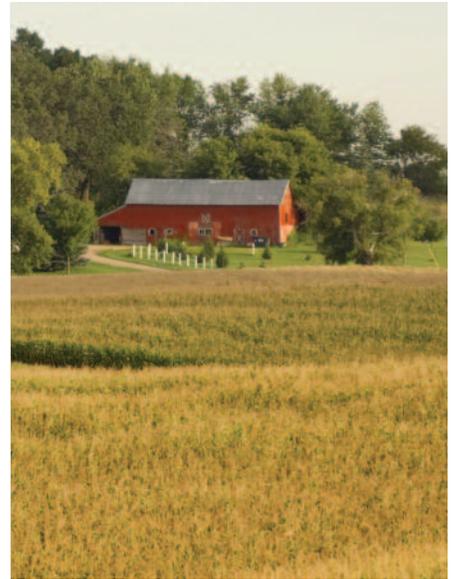
New markets for ecosystem services have the potential to substitute for conservation payments, but are rarely structured to adequately provide returns comparable to traditional production. Producers are concerned that new markets do not meet all stakeholder demand and/or reflect consumption pressures. Without better clarity on the value of ecosystem services provided, uncertainty limits the scope for landowner/operator decisions and choices. Market prices in theory have to reflect the value of the ecological good or service (clean water, more habitats) in comparison with other uses of the land and need to be accompanied by affordable transaction costs. Land management indices, metrics, and other measurements that are understood by land owners and operators can improve the social interaction needed for market evolution. Expanding this opportunity will require the following.

### I. Harmonize ecosystem service market signals to help producers assess the value of both the products and services they supply.

- Identify and harmonize ecosystem services metrics that meet multiple producer, regulatory, and corporate objectives in both sustainability requirements and ecosystem service markets. Measuring ecosystem services and creating viable market signals can be a daunting task due to the data complexity and the rigor needed to instill confidence. Confidence in the accuracy and reliability of

measurements and indices are important to facilitate market operation.

- Minimize ecosystem service transaction costs in relation to ecosystem service value. The costs associated with assessing, measuring, monitoring, recording, and other transaction components are often more than the market value of the ecosystem service, eliminating market interest.
- Map industry sustainability efforts that are using metrics to guide producers toward sustainability goals. Explore harmonization.
- Identify metrics that are compatible with and/or promote production objectives along with non-market objectives. Even among federal and state agencies, there is miscommunication on what is desired from land managers. When non-governmental organizations partake in sustainability markets, an even greater variability exists as to identifying ecosystem service outcomes.
- Identify how government conservation objectives and corporate sustainability efforts can be integrated into a common market signal.
- Create a tiered system for coordinating and consolidating data
- Develop a classification system to organize existing metrics for ecosystem services and to provide guidance for developing new ones.



## Cattle Ranchers become Water Managers: The Florida Ranchlands Environmental Services Project

Over the past century, extensive drainage and water control systems implemented to support urban and agricultural growth in South Florida has dramatically altered the hydrology of this vast area. While the hydrologic and land use changes contributed to economic progress they have also contributed to degraded water quality and aquatic habitats in the Northern Everglades

system – over 3 million acres stretching from Orlando to Lake Okeechobee and including the St. Lucie and Caloosahatchee estuaries. Addressing these adverse environmental consequences requires engaging private landowners in providing environmental services as a complement to the traditional regulatory and public investment solutions.

One such successful effort was the Florida Ranchlands Environmental Services Project (FRESP). Launched in 2005, FRESP was a collaborative project implemented by ranchers, NGO's, state and federal agencies and research scientists to design and field test a payment for environmental services scheme that would provide cattle ranchers with a payment for producing water-related environmental services.



*Surface water retained on a ranch under contract to the NE-PES program.*

During the now completed pilot phase (2005-2011) eight ranchers, in collaboration with FRESP partners, implemented demonstration water management alternatives on portions of their ranches. Lessons were learned about contract design, documentation procedures, methods for estimating service provision, and the design of a payment system. These lessons informed the design of a now

operating program of the South Florida Water Management District (SFWMD), one of the FRESP partners. The Northern Everglades Payment for Environmental Services Program (NE-PES) was launched in Jan 2011. Under the NE-PES program eligible ranchers enter into 10 year contracts with the SFWMD to provide water retention and nutrient load reduction services above what is required by environmental regulations. Ranchers will receive an annual payment subject to provision of documentation required to demonstrate meeting contract obligations. The first solicitation of proposals resulted in 8 signed contracts representing a \$7 million obligation over the life of the contract and the results of a second solicitation launched in Dec 2012 are pending.

To read more: <http://www.fresp.org/>

**2. Address legal risks within the corporate sector associated with developing a sustainable supply chain.** Sustainable supply chain initiatives will require new processes, mechanisms, and relationships to fulfill their goals. These initiatives may run afoul of competition and consumer protection laws and their underlying policies, because of collaboration among competitors. Success will require efforts to:

- Clarify the relationship between anti-trust laws and collaborative efforts as it pertains to sustainability objectives.
- Support standards set through appropriate processes in procurement and regulatory decisions.

**3. Reinforce or adapt existing risk-management mechanisms and develop new risk management tools** to promote resilience and adaptive ecosystem management in the agriculture and forestry sectors.

### III. ACHIEVING THE VISION

- Evaluate current risk management mechanisms, including insurance, hedging strategies, futures markets, and new tools that the financial markets may develop to help manage the likelihood of greater climate and market variability in the future. Federal agencies are key actors in this agenda, but insurance and re-insurance experts should also help look at new ways of managing uncertainty. Land owners/operators and investors should also be at the table.
- Create a risk-management environment that motivates

producers to reduce production-based risks, rather than revenue-based risks. In other words, producers will identify cropping systems and rotations that are more resilient in the face of extreme weather if it reduces their financial risk. These diverse systems, by definition, are not as prone to production or environmental loss due to a singular weather event of drought or deluge.

#### 4. Incorporate sufficient value into sustainable supply chains to compensate producers for risk,

management, production, and verification costs related to sustainability outcomes.

- Ensure adequate and appropriate producer engagement to ensure that production and transaction costs and feasibility are appropriately considered during the process of standards development.
- Follow internationally accepted best practices for development of sustainable supply chain initiatives.
- Identify existing agricultural and forestry industry efforts to define sustainability within their realm.

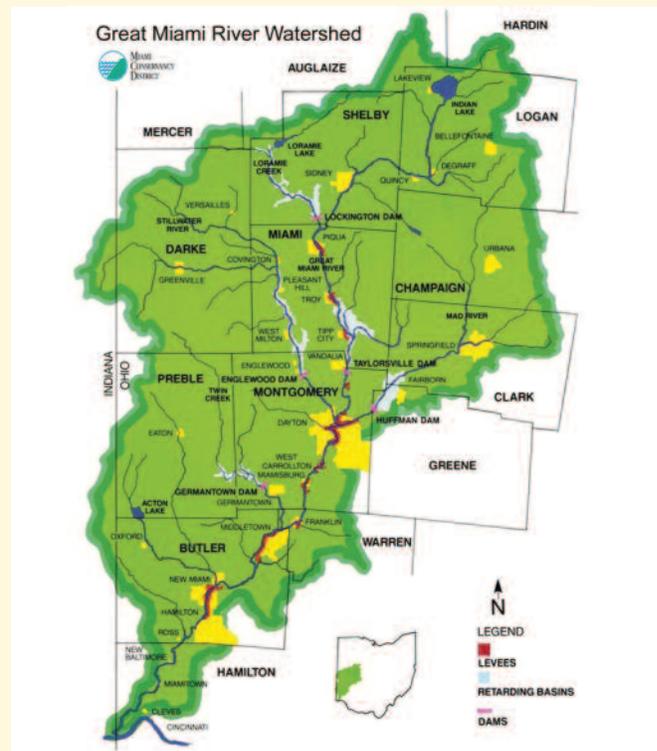
## Reducing Runoff for a Stronger Economy: Great Miami Water Quality Credit Trading Program

When 40 percent of Ohio's rivers and streams did not meet state guidelines for fishing, swimming, and other designated uses, new regulations were put in place to clean them up.

Under the Clean Water Act, nutrient limits are in place for one of three subwatersheds in the Great Miami River basin and further limits are under development for the remaining two. Wastewater treatment plants are handling most of the needed improvements, but farmers often can improve water quality more efficiently and cheaply than the plants.

The Great Miami pilot project, which began in 2006, encourages facilities to purchase nitrogen and phosphorus credits to help comply with their permit limits. Local farmers opt to voluntarily change their farming practices to reduce runoff from fertilizer and manure through projects funded by the wastewater treatment plants. The projects will generate "credits" that wastewater treatment plants can use to meet their regulatory requirements. Already a total of 397 projects have been funded, with payments to farmers totaling \$1,629,521.49 and delivering 572 tons in nutrient reductions. This new program could save communities more than \$300 million over the next twenty years while significantly improving water quality.

To read more: [http://www.miamiconservancy.org/water/quality\\_credit.asp](http://www.miamiconservancy.org/water/quality_credit.asp)



**5. Improve the ability to establish ownership of ecosystem services that are currently public goods.**

Marketing of ecosystem services may involve the separation of an environmental attribute from an underlying commodity, product, or land – that is, creating of a new property right. Even where property rights in ecosystem services can be identified, the relationship between buyers and sellers and the processes that account for transfer of ownership still need to be clear. This will require efforts to:

- Identify market relationships and valuation systems for ecosystem service values.
- Define property rights and how they are associated with ecosystem service values.
- Identify the relationship between traditional commodities and ecosystem service attributes so that the ownership of each value is clear.
- Identify the new transaction “relationships” that may need to be developed to ensure ownership is efficiently transferred.

**6. Strengthen verification and certification processes for supply chain and ecosystem services markets.**

Verification and certification is a requirement in several markets for both traditional goods and ecosystem services to provide value to the producer and ensure that the customer/consumer receives the value they pay for. This calls for actions to:

- Strengthen the technical capacity of professional individuals and organizations involved in verification

and certification processes to reduce transaction costs and increase the value they provide to producers and clients.

- Identify professionals that are intimately involved with the production objective of land managers that could develop the capacity to identify and account for ecosystem services, such as private foresters and agricultural advisors.
- Evaluate and enforce the laws protecting consumers from false and misleading claims as it relates to sustainability values.

**Energize and Coordinate Research**

To achieve the goals of Solutions from the Land, we need a reliable base of information and knowledge. Agriculture, forestry, and conservation are expected to meet multiple societal objectives and they must be managed so that the natural resource base is sustained or improved, in order to provide public goods and sustainable products along the value chain. This management approach will require that we:

**1. Adopt integrated research agendas centered on advancing a systems approach with a focus on real-life application and decision makers.**

Just as productivity has reached unprecedented levels in the last one-hundred years, we will have to continue to increase the productivity of the land over the next one-hundred years while simultaneously improving environmental quality and increasing environmental stewardship. While great strides have been made in reach-

ing these goals, we need to strengthen a systems approach in research, incorporating agriculture and forestry production with conservation and the increased production of ecosystem services: biodiversity, water filtration, water storage, carbon sequestration and storage, etc.

**2. Strengthen the institutional context for research.**

With the radical decline in political will to support public goods and the implicit belief that we are wiser spending money individually than we are collectively, state and federal research and outreach institutions are suffering unprecedented cuts in budget, staff, departments, and functions. This trend must be reversed if future needs are to be met.

**3. Empower a designated research council or overarching organization to set a research agenda that cuts across all land uses.**

The current system evaluates research priorities in silos. Streamlining these processes and/or identifying an appropriate venue for research priorities to be regularly evaluated, such as a biannual interagency advisory council for integrated land management research, would be a huge step forward. A national system should be informed by regional and local discussions to ascertain what we know (information base), what we need to know (research priorities), what we can know (information analysis), and how we implement our knowledge most effectively (adaptive research and management).

### III. ACHIEVING THE VISION

#### 4. Prioritize research and development that will:

- Ensure the science is accessible and contains feedback loops for decision makers, including land owners and managers, policy community, funders, and private sectors.
- Employ a systems approach to research, cross-disciplinary and across various scales of inquiry.
- Optimize the use of multiple limited resources (land and

inputs), increase productivity of agriculture and forestry products, and increase ecosystem services.

- Promote basic research in natural and social sciences that gives the background for the actionable science, analysis, and models necessary to lead to widespread adoption of these actions.
- Address multiple societal benefits and capitalize on the economic benefits of the public goods provided.

- Lead to localized management that captures regional or local knowledge and conditions and simultaneously lead to adaptive management approaches in the face of uncertainty.
- Inform the development of policy or market forces that incentivize the adoption of sustainable working lands management practices.

#### 5. Create a new emphasis on development designed to get research out of the lab and onto the land as rapidly as possible.

### Strong Research for Healthy Food: The Center for Produce Safety



Food safety is a top concern for produce producers, and a new initiative will help ensure producers have the best research at their disposal. The University of California - Davis, through a public-private partnership, launched The Center for Produce Safety (CPS) to leverage the combined expertise of industry, government and the scientific and academic communities to identify research needed to enhance food safety. The cooperative model maximizes the research output,

and helps identify and fund gaps in food safety research.

Since its inception, CPS has awarded \$10.6 million and funded 69 one and two-year research projects at 26 universities and organizations. They are currently expanding their research efforts to a global scale. CPS's goal in the coming years is to triple its research efforts in order to connect research to practice.

To read more: <https://cps.ucdavis.edu/>

### III. ACHIEVING THE VISION

#### 6. Educate a new generation of land owners and managers.

Future generations of land owners and managers will play a critical role in our ability to adapt to future uncertainties. Agriculture and forestry management in the United States has serious implications for global problems and career potential along the value chain should be understood in this context from farmers and foresters to food and fiber product industries. Actions include:

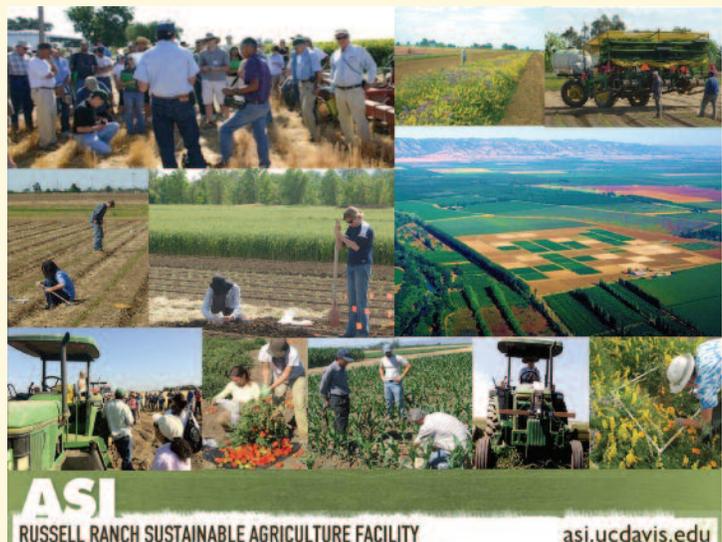
- Support school-based agricultural and forestry education programs that combine classroom instruction, experiential education, and leadership development.
- Integrate forestry and other land uses/ management practices to agricultural education programs.
- Educate youth about the career opportunities that exist in agriculture, forestry, and conservation, and the potential global impacts of working in these fields.
- Create opportunities and support systems for young people to succeed in land-based careers, and highlight multiple entry points.
- Continue to redefine opportunities in agriculture and natural resource management for youth.
- Remove economic barriers and create opportunities for people that want to take over the family business or to begin careers in agriculture and forestry.

#### University of California-Davis Agricultural Sustainability Institute

The mission of the Agricultural Sustainability Institute at the University of California-Davis is to continue access to healthy food and promote the vitality of agriculture for future generations.

The institute provides a hub for agricultural sustainability initiatives across the UC Davis campus, from integrative research, education, and communication to immediate action on emerging issues. This is a new model for conducting research and sharing knowledge that embraces multiple stakeholders in community and policy dialogues, and showcases agriculture, natural resources, and environment integrated systems. Projects and achievements include:

- Russell Ranch Sustainable Agriculture Facility
- Sustainable Agriculture Research and Education Program
- Student farm at UC-Davis
- Inter-university Network for Food, Agriculture and Sustainability
- Nine affiliated professorships in agro-ecology, sustainability science, sustainability and society, economics of sustainability, plant disease management/soil microbiology, soil science, pollination ecology, and sustainable animal systems; and



- Various degree programs, such as a doctoral emphasis in agro-ecology and a bachelor's degree in sustainable agriculture and food systems

The Agricultural Sustainability Institute truly understands the breadth and diversity of stakeholders that are involved in and affected by agriculture. They make efforts to connect to all stakeholders of the land, from producers and industry to students of all ages, researchers and extensionists, commodity organizations, and consumers.

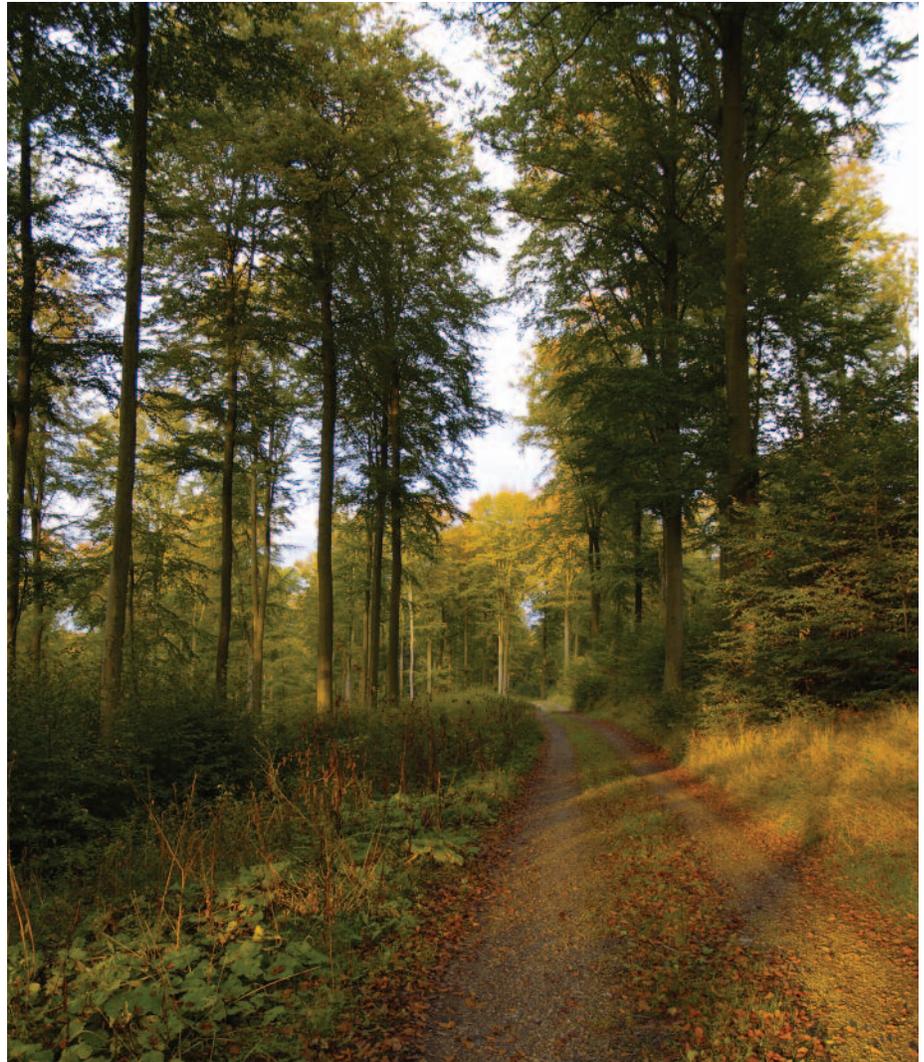
To read more: <http://asi.ucdavis.edu>

## Transform and Modernize Information Networks

This involves two separate but interconnected information networks. The first serves the needs of land managers, with a focus on the land and its production opportunities. From a land manager's viewpoint, the information and technologies involved are place-specific and product-specific. Land managers need access to information that is directly relevant to their situation without being distracted by a huge volume of secondary information. They rely heavily on science and technology, and their need will grow exponentially as the scope of production is broadened to include ecosystem services and environmental functions.

The second information network serves the needs of policy, programs and markets. This group covers the people whose interest in the land extends beyond individual properties into broader communities. They may be public officials or agency program managers, business executives, planners, representatives on non-governmental organizations, or the general public. They are concerned with the overall outcomes associated with different types of land management, and the short- and long-term effects on economic, environmental, and social conditions.

While policy is usually focused on broader issues and longer time horizons than commonly concern individual managers, the two are often interrelated. Most land managers have community and sustainability concerns that are



broader than their individual responsibilities, and policy makers are reliant on the success of individual land operations and commercial sectors to achieve their broader goals. The need, therefore, is a transparent, widely available system of information networks, which are capable of serving all needs, at the request of the user. This will require transforming from a producer-centric information system, in which research results are communicated outward in the hopes of finding an audience, to a user-centric system where information is readily available to the user when they need and seek it.

To meet that transformative need, many actions will become important, including the following.

**1. Improve access to information that we already have.** Using widely accepted software tools ensures not only easy access and use, but it also leverages a large user, development, and support community. It also promotes better documentation, tutorials, and example datasets from which others can learn. Utilizing licenses that allow full and unrestricted use of data can increase their chance of interoperability with other data.

**2. Enable data, information, and knowledge gaps to be more easily collected from a spectrum of public and private sources,** from automated satellite observations and wireless sensor networks to observations from scientists, farmers and other land users. Integration of existing data sources will also be critical in the long-term understanding and management of the land. This will require actions to:

- Establish standardized baselines, identify gaps, and provide the information depository necessary for new research, modeling, and support for decisions made on the land.
- Standardize data and meta-data from a variety of sources to streamline the collection, storage, and transfer of these foundational assets.
- Develop a standard federal approach for the collection, deposition, and curation of environmental, agricultural, and

ecological data collected with public research funding.

**3. Create a science-based, scale-responsive information network within the land management community to serve the needs of producers.** This envisions a multi-scaled recording matrix that would integrate field-level data from a variety of existing networks and sources. The “network of networks” would be developed through a collaboration of producers and trusted producer partners such as grower groups, non-governmental organizations, conservation organizations, and consumer health groups. The goal of this network of networks is to build infrastructure within the agricultural-producer community for sharing and using data related to efficiency and impacts more effectively.

This data commons will allow producers to upload data and compare geospatial changes over time on a publicly accessible data-management system; it would be “land manager centric” by incorporating the input of producers in its development, allowing for user-friendly self-reporting, and by yielding data that are useful for daily decisions and long-term planning. An approach could be:

- Begin with producers in order to build trust between and amongst users of the data.
- Stakeholders from the producer, data management, and landscape assessment communities should develop a clear vision of the system and a strategy for its creation. We believe that the USDA Natural

Resources Conservation Service is best suited to initiate this discussion. However, the process of its development should represent collaboration between producers, non-governmental organizations, and multiple levels of government.

- The network should be piloted on a smaller scale before being debuted on the national level; a series of site and watershed-scale pilots would be effective at identifying strengths, opportunities, and challenges in implementing this network.
  - Qualitative and quantitative metrics can both be utilized in this framework if the assessment and utilization criteria for those metrics are standardized.
- 4. Develop and coordinate systems for communication for a spectrum of land owners and managers.** Agriculture alone requires information for a diversity of decision makers, from absentee land owners and multi-generation land owners to tenant farmers and young farmers with no background in agriculture, all working on a plethora of production systems, from urban and rural family farms and corporations, producing commodities, livestock, dairy, and specialty crops. They need access to diverse information sources that encompass the following approaches:
- Use and integrate traditional and non-traditional forms of extension across agriculture, forestry and conservation sectors — extension with a lower case e. Producer organizations, non-profit alliances, crop consultants, agricultural



industry, small scale/ local partnerships, soil and water conservation districts and the Internet are all connecting farmers to resources they may not have access to through the traditional Cooperative Extension System.

- Bring important technologies to scale more rapidly. Researchers, government, or private sector actors should engage with land managers during demonstrations, training sessions, and pilots to speed adoption.
- Expand programs that increase implementation, such as farmer-to-farmer mentoring and information sharing programs, and support existing efforts. This ensures localized and lateral transfer of knowledge on common ground.

5. Develop additional monitoring systems for watershed/regional-level systems such as air and water quality and biodiversity to serve policy needs. The goal of these monitoring systems is to identify the highest priority impacts from land use decisions so that the areas and producers with the highest impact receive the most attention first. Given the public benefits of such a system, the creation of better monitoring systems for water quality, air quality, and biodiversity will require a collaboration of state, federal, and regional government bodies. These monitoring systems will be best managed at the watershed level and should involve the input of stakeholders from their inception.

6. Identify “meta-metrics” which can serve as broad indicators of sustainability. For example, soil erosion and soil organic carbon are meta-metrics to measure soil health; managing the land to reduce soil erosion and to preserve or increase soil organic carbon will have multiple other benefits on the landscape. Solutions from the Land should serve as a convener of stakeholders to identify the most critical meta-metrics for soil, water, air, and biodiversity. Their determinations should then be prioritized for monitoring by government and producers. 🌱



## IV. A PATH FORWARD

### Ideas for Collaborative Projects

- Create a nationwide inventory of integrated land management projects.
- Identify conflicting policies and examples of successful solutions.
- Hold regional dialogues on ecosystem markets and sustainable supply chains.
- Develop a way to prioritize and streamline research processes.
- Identify “meta-metrics” that can serve as broad indicators of sustainability.

**T**hrough collaboration and dialogue, Solutions from the Land has articulated a new and compelling vision for adaptive, resilient land management to meet the multiple goals of the twenty-first century — global food and energy security, economic development, biodiversity, and climate change. We have spotlighted the need for land, water, and other natural resources to be managed both in an integrated manner and at the scale necessary for our vision to be realized. We have also identified a number of near-term and long-term actions needed to support and accelerate the delivery of multiple solutions to the mega-challenges facing our nation and the world.

While the recommendations offered in this report provide pathways to change, they are incomplete. Each requires further development, vetting, and broadening. Towards

this end, we encourage interested partners and stakeholders to join in our continued dialogue about ways to deliver a wider range of good and services from the land. Solutions from the Land is not alone in this effort and much can be gained by partnering with those who are pursuing a common vision.

### Opportunities for Collaboration

Several important near-term opportunities exist for collaboration. For example, there is currently no centralized data base or inventory of landscape-scale projects where Solutions from the Land objectives are being tested and implemented. To fill this void, our partners could join in a mapping exercise to identify integrated land management projects that are either planned or under way across the country. It would be especially helpful to know who is providing leadership for

these efforts (e.g., land owners and managers, nonprofit organizations, and/or government agencies), the objectives, and the resources or results that might help others who would like to pilot similar projects.

A second collaborative opportunity is the identification of policies and regulations that work at cross purposes and stymie progress toward multiple goals. A similar inventory of successful resolutions to conflicting policies would also help those working to overcome process or input-based regulations that prevent or impede outcome-based land management.

Much work also remains in developing and strengthening markets that reward stewardship of ecosystem services. Towards this end, our partners might sponsor and facilitate regional dialogues to inventory, explore, and assess market-based mechanisms that are being tested across multiple landscapes. Creating forums where managers and participants in sustainable supply chain initiatives and certification schemes could exchange views and experiences and contribute baseline data for further analysis would be very valuable. One focus area for these forums might be how these emerging mechanisms could be modified to create more value for land managers and therefore more incentives to participate.

In the research arena, Solutions from the Land could develop ways to prioritize and streamline research processes in a way that would integrate agriculture and forestry with conservation goals and

ecosystem services. Our partners could also help design a council or network that could be employed to guide future research agendas.

There is also a critical need to identify “meta-metrics” that can serve as broad indicators of sustainability. To meet this need, we could work together to identify the most critical meta-metrics that government agencies and producers can use in tracking soil, water quality, air quality, and biodiversity.

### Champions and Dialogue

Going forward, Solutions from the Land will seek support and partners to facilitate a national conversation with farmers, ranchers, foresters, and other practitioners and leaders who are seeking ways to produce more food, feed, fiber, and energy while

preserving and restoring healthy ecosystems. The goal is to draw experienced and well-networked agricultural, forestry, and land management leaders into conversations about solutions that can realistically be delivered from the land. We will also encourage greater participation in the global dialogue, sharing our vision while listening and learning from others.

As our work evolves, Solutions from the Land will make an ongoing effort to recruit champions and change agents who will proactively advocate for the policy, market, and institutional reforms necessary to achieve our vision. These leaders will forge consensus on strategies for effecting change and will support the formation of coalitions to accelerate further action. 🌱





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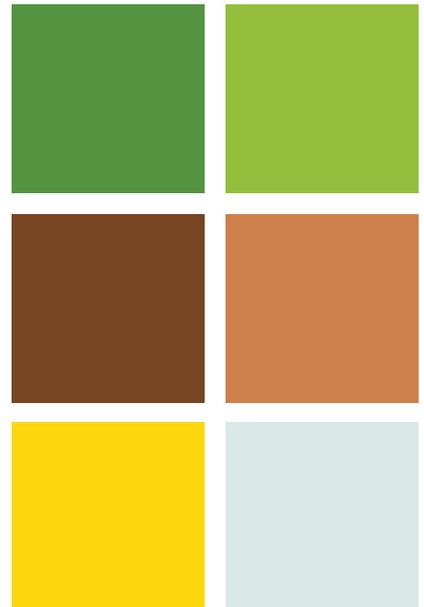
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## Work Groups

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