Measuring Sustainability and Resilience

A Workshop of the Leopold Center for Sustainable Agriculture

May 25, 2011

This workshop explored what we mean by sustainability and resilience, and some of the practical applications in Leopold Center research and demonstrations.

Investigators from 20 Leopold Center projects prepared the following posters that summarized their work and how they measured sustainability and resilience.

You may want to use the full-screen option when viewing these posters.
Q Can a network of working groups catalyze and support the development of regional food systems in Iowa?

A A communities of practice framework to conduct research, facilitate partnerships, share learning, and leverage funds is useful to ensure that farmers and farm-based businesses have the support necessary for creating viable food, fiber, or energy based value chains in Iowa.

Overview: A regional food system supports long-term connections between farmers and consumers while helping build the social, economic and environmental capacity of communities within that region. Producers and markets are linked via efficient infrastructures that 1) promote environmental health; 2) provide competitive advantages to producers, processors and retailers; 3) encourage identification with a region's cultural history and ecology; and 4) share risk and rewards equitably among all partners in the system.

- We offer a collaborative environment for a diverse group of farmers, community leaders, and non-profit, government, and private organizations to share resources and support.
- We work to maximize the potential for community-based, economically sustainable, and environmentally and socially responsible regional food enterprises by supporting education, conducting research, and facilitating partnerships.

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Sustainability & Resilience Indicators:

What aspect of sustainability and resilience have you been targeting in your research?
- Economic viability of businesses
- Diversity of crops and enterprises
- Use of sustainable practices

What sustainability and resilience measures did you use?
- Sales data
- Monetary investment by communities, counties, state, and federal entities
- Customs, practices, and policy change

How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
- Leverage monetary and other support for communities and their local food systems
- Change food system policies, regulations, and/or enforcement
The Alternative Livestock Production Systems Issue Team, a.k.a. the Hoop Group

Abstract/Overview: The Alternative Livestock Production Systems Issue Team, a.k.a. the Hoop Group, successfully researched and demonstrated new systems of livestock production that used a housing system distinctly different than conventional confinement barns or feedlots—the bedded hoop barn. The livestock is usually kept in the hoop barn, and bedding (often cornstalks) is used to modify the environment and absorb animal wastes. The hoop barns were primarily used for housing finishing pigs, feedlot beef cattle and gestating sows.

Methods:
- Hoop barns were built at ISU Research Farms for finishing pigs, sows, feeder cattle in central, western and southern Iowa.
- Trials were done to determine proper stocking density, costs, feed efficiencies, animal growth & reproductive performance, animal behavior, manure characteristics, and meat characteristics.
- Field days were held to show the barns.

Findings/Results: More than 10,000 visitors from multiple states and countries visited and learned about the barns. Finishing pigs housed in bedded hoop barns perform similarly to pigs in conventional confinement, except in winter when they are less efficient. Because the hoop barn has a lower fixed cost, the total cost of production is similar.

Beef cattle fed in a bedded hoop barn perform similarly to cattle fed in conventional feedlots with open shelter. Beef quality was similar.

Gestating sows housed in groups in bedded hoop barns produced larger litters with more piglets than sows housed in confinement gestation crates, although they needed more feed in winter.

Results were published in scientific journals and extension reports.

Sustainability & Resilience Indicators:
- What aspect of sustainability and resilience have you been targeting in your research?
  - Low initial cost, reduced risk, flexibility of facility use, niche markets, natural animal behaviors, lower entry barriers and reduced environmental impact.
- What sustainability and resilience measures did you use?
  - Budget analyses with lower fixed costs
  - Technology adoption estimates
  - Minimized manure nutrient runoff
  - Interdependence with existing on-farm resources
- How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
  - The work provided highly useable information leading to the rapid adoption of hoop barns for livestock in Iowa and provides insight into increasing levels of on-farm adoption of other new technologies. Additionally, the hoop barn technology has larger scale implications for environmental impacts if adoption is taken to a watershed level.

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Reducing Anhydrous Ammonia Application by Optimizing Distribution

Abstract/Overview:
Anhydrous ammonia (NH₃) is one of the most popular ways to fertilize U.S. crops. As it has risen in cost, farmers and researchers have been seeking more efficient ways to apply this nitrogen fertilizer. Improved distribution discourages excessive nitrogen application. In field tests, plumbing techniques and newer manifold designs improved row-to-row distribution allowing less total fertilizer to be applied.

Methods:
• NH₃ distribution was evaluated during on-the-go field tests

• Conventional (open-chamber) manifold was compared to newer designs

• Impellicone prototype was also developed and tested

Findings/Results:
• At 75 lb N/acre rates, all newer manifold styles improved distribution

• At 150 lb N/acre rates, rotary and smaller-chamber style manifolds improved distribution beyond conventional

• Replacing a conventional open-chamber manifold with a newer manifold style can pay back in improved application often in 100 – 500 acres

Sustainability & Resilience Indicators:

What aspect of sustainability and resilience have you been targeting in your research?
• Iowans apply about 1 billion lbs of NH₃/yr
• Improved distribution avoids need for ‘insurance’ application of nitrogen

What measures of sustainability and resilience did you use?
• Individual knife-to-knife application was measured

How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
• N application is often based on adequate crop response to minimum knife output along toolbar applicator
• Improved N distribution allows average N application to be lowered while still maintaining adequate minimum output to each knife
• Less N released into environment
• Impellicone now on market

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Assessment of Woody Biomass as a Niche Feedstock for Biobased Products in Iowa

Abstract/Overview: The Energy Independence and Security Act of 2007 (EISA) stipulates by 2022, at least 16 billion gallons of US ethanol must be cellulosic ethanol made from biomass (lignocellulosic) feedstocks. Iowa, the nation’s leader in grain based ethanol production has the potential to contribute significantly to the nation’s cellulosic requirements yet the economic, agronomic, and environmental availability of biomass could prove challenging in this region. Our goal is to examine the wood-based feedstock supply in the Iowa, including the availability, scalability, and infrastructural requirements needed for woody feedstock to sustainably supply fiber for bioenergy fuel and other biobased products.

Methods:
Woody biomass that finds its way into a bioenergy market will take a variety of forms (listed below). However, the availability of these different biomass sources is a function of several dynamic and regionally variable factors, such as the willingness and capacity of public and private entities to sell biomass (or otherwise make available). To develop a comprehensive understanding of all potentially available woody resources, we use a combination of primary and secondary data to evaluate availability from the following biomass forms:

- **Standing biomass** (natural forests or short-rotation plantations) & logging residues
  - **Secondary data** – (a) U.S. Forest Service using Forest Inventory & Analysis (FIA), (b) and Timber Product Output (TPO) data.
  - **Primary data** – (a) a mailed survey of private woodland owners across Iowa, (b) phone interviews with state agency foresters, (c)and phone interviews with rural electric cooperative utility line clearance managers.

- **Primary and secondary wood industry residues** (e.g., sawdust, end boards, bark)
  - **Primary data** - phone interviews with owners/managers of wood industry businesses across Iowa.

- **Urban wood waste** from public and private tree systems or solid waste streams.
  - **Primary data** – phone interviews with (a) public (city) urban land managers, (b) urban tree services.
  - **Secondary data** – analysis of the most recent waste facility records.

Findings/Results:
- **Preliminary findings from two selected analyses:**
  - **FIA Analysis:** The majority of available woody biomass is concentrated in the Northeastern and Southeastern quadrants of the state.
  - **Woodland owner survey:** Sample of 1,502 Iowa woodland owners; 50% response rate
    - 45% were somewhat or very likely to harvest and sell biomass, while 55% were not likely.
    - 34% of respondents were interested in converting non-wooded areas to biomass plantations.
  - The likelihood that woody biomass harvesting will have a low impact on the environment was of greatest importance among landowners regarding their decisions, while technical assistance was of greatest importance as a resource needed to help with their decision to harvest and sell biomass.
  - One landowner noted, “As long as it improves woodland quality, doesn't harm the environment and improves wildlife habitat I would be interested in hearing more.”

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Measuring Sustainability & Resilience: The Balanced Scorecard

**Marketing and Food Systems:**
Developing new marketing strategies that allow Iowa’s farmers and communities to retain more of the value for energy, food or fiber produced.

- Funded Projects:
  - Fruit and Vegetable Mkt. Planner
  - High Tunnel R&D
  - Micro Enterprise Foundation
  - Regional Economic Impacts for a Local Food System
  - Regional Food Systems Working Group
  - Pork Niche Mkt. Working Group

**Policy:**
Developing research that will help policy makers formulate, analyze, and evaluate agricultural policy.

- Funded Projects:
  - Local Food and Farm Plan
  - Land Tenure Project
  - Graduate Program in Sustainable Agriculture
  - Renewable Energy Feed-in Tariffs: Potential Opportunities for Iowa’s Small Farmers

**Mission:**
The Leopold Center for Sustainable Agriculture explores and cultivates alternatives that secure healthier people and landscapes in Iowa and the nation.

**Ecology:**
Developing "new generation" agricultural systems to secure ecologically resilient landscapes and healthy rural communities.

- Funded Projects:
  - STRIPS aka perennializers aka Neal smith prairie strips
  - Bear Creek RIMS (contiguous adoption after funding)
  - Low External Input cropping systems
  - Reducing anhydrous ammonia application by optimizing distribution
  - Relative Emergence Sequence for Weeds of Corn and Soybeans

**Cross Cutting:**
Developing cross-disciplinary research to address common issues that span food systems, policy, and ecology.

- Funded Projects:
  - PFI On-Farm Research
  - Grass-Based Livestock Working Group
  - Assessment of woody biomass as a niche feedstock for bio-based products in Iowa
  - (LTAR) Long Term Agroecological Research
  - Hoops Group

**Average score out of 5 points**

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**Leopold Center’s Average Multi-Functionality Score:**

2.8
Multi-Species Riparian Management Systems

Abstract/Overview:
The goal of the Bear Creek Watershed Project is to develop locally-acceptable, economically viable, watershed management systems that increase the sustainability of agriculture in the Midwestern United States with respect to surface and ground water quality, while improving the integrity of the aquatic and terrestrial ecosystems.

Methods:
These systems include re-establishing a suite of perennial plant-based conservation buffers, stabilizing strategic streambeds and banks with in-stream or bioengineering techniques, constructing or restoring strategically placed wetlands, and implementing management practices that are meant to complement in-field best management practices.

Findings/Results:
• Buffers can remove 95% of sediment & 80% of nutrient load in surface runoff contained in sheet flow
• Soil quality is greater under buffers
• Infiltration rates increased 5x
• Soil microbial biomass increased 2.5x
• Perennial root biomass much greater
• Denitrification rates increased 4x
• Greenhouse gas emissions greatly reduced
• Soil organic matter increased (It is all about the carbon1)
• Buffers reduce stream bank erosion by 60%
• Buffers provide wildlife habitat (4x increase of bird species)
• They look great!!

Sustainability & Resilience Indicators:
What aspects of sustainability and resilience have you been targeting in your research?
• Water quality
• Soil quality
• Greenhouse gas reduction
• Aquatic integrity
• Biodiversity

What sustainability and resilience measures did you use?
• Above- and belowground plant biomass
• Soil carbon accrual/microbial biomass/denitrification potential/soil aggregate dynamics
• Soil-water infiltration
• Sediment and nutrient flux to streams
• Groundwater quality
• Greenhouse gas flux
• Avian biodiversity/fish assemblage and growth

How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
• The project has been designated a National Restoration Demonstration Watershed (USEPA) and a Riparian Buffer National Research and Demonstration Area (USDA).
Black Hawk County and Partners: Regional Community Economic Impacts for a Local Food System

Abstract/Overview:
For over a decade, the University of Northern Iowa’s local food program (NIIFFP) has been developing, promoting, and strengthening northeastern Iowa’s local food infrastructure by partnering with area farms and businesses to increase the percentage of food dollars kept in the local economy and the freshness of food available to consumers.

Methods:
- Tracking the increase in local food dollars spent by area businesses and institutions over the last thirteen years
- Partnering with an ISU economist to determine the potential economic impact of Iowans increasing the amount of locally grown fresh fruits and vegetables they consume
- Calculating the impact of each dollar invested in promoting local food systems

Findings/Results:
- Between 1998 and 2009, area businesses increased local food expenditures from below $500,000 to more than $2.5 million
- If Black Hawk County area residents sourced their “5-a-day” servings of fruits and vegetables from local farms just three months out of the year, an additional $6.3 million in sales and 475 jobs would be added the local economy
- From 1998-2008, for every dollar NIIFFP raised to strengthen the local food economy, $14.60 was invested back into local food and farm businesses

Sustainability & Resilience Indicators:

What aspect of sustainability and resilience have you been targeting in your research?
- Strengthening Black Hawk County region’s sustainable agriculture by expanding the area’s local food infrastructure

What sustainability and resilience measures did you use?
- The amount of locally grown food purchased by businesses and consumers

How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
- Continuing to connect with businesses and institutions to increase the amount of locally grown food they purchase
- Publicizing the major positive impact buying locally grown food has on rural economies

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Overview: The GPSA trains students in MS and PhD degree programs to design and manage agricultural systems that enhance food security, support human communities, and protect environmental quality. Students master agroecological principles, investigate the social relations underlying sustainable farming and food systems, and gain experience with practical techniques of sustainable agriculture. The GPSA balances depth in disciplinary knowledge with broad, systems-level thinking.

Methods: The GPSA curriculum integrates the natural and social sciences through team-taught core courses that emphasize higher-order critical thinking skills and collaborative learning. Students obtain interdisciplinary perspective by taking courses in six thematic areas that complement their primary research focus.

- Landscape & Watershed Management
- International Development & Food Security
- Crop & Livestock Production & Protection
- Policy, Governance & Economics
- Engagement & Communications
- Philosophy, Ethics & History

Active mentoring by faculty advisors assures students acquire the tools they need to succeed in the classroom, in the field, and on the job.

Results:
- 51 active students pursuing graduate degrees
- 75 participating faculty from 18 different departments
- 59 graduates with MS and PhD degrees
- Over $29 million in external grant funding obtained by participating faculty in the last fiscal year
- Alumni working nationally and globally at institutions of higher education, in agribusiness, for US and state governmental agencies, as farmers, and in NGOs

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Abstract/Overview: The Grass-Based Livestock Working Group was initiated in 2008 as a democratic, inclusive collaboration of grass-based livestock practitioners and their support personnel, intended to identify and address the most pressing educational needs of Iowa’s graziers in the areas of production, marketing, ecology, and policy.

Methods: Using a “community of practice” framework, ISU Extension (in collaboration with numerous other grazing & grasslands stakeholders) has convened 3-4 meetings per year of grazing livestock farmers and outreach professionals focused on educational and networking opportunities. The working group has also provided mini-grants for participant groups to conduct research & demonstration in areas of focus prioritized by the working group at large.

Findings/Results: Although the commodity grains market has not provided the most hospitable climate for grass acres in the state of Iowa, interest in and commitment to grass-based livestock agriculture remain substantial, especially in the areas of production economics and ecological stewardship. Both researchers and producers have addressed the working group on topics of rotational grazing, mob grazing, extending the grazing season, grass-banking, grass-based dairy, grazing on restored prairie pastures, and grazing for bird habitat. Research & demonstration projects in many of these areas are ongoing. Going forward, the working group will continue to strive to pursue and identify situations in which grazing livestock can be an economically viable and environmentally beneficial enterprise, especially when accounting for societal and ecosystem services.

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Local Food and Farm Plan

Abstract/Overview: The Iowa Legislature passed an amendment in 2010 mandating that the Leopold Center for Sustainable Agriculture develop an Iowa Local Food and Farm Plan (ILFFP) that would support and expand local food systems and overcome obstacles necessary to increase locally grown food production.

Methods: More than 1,000 individuals across the state participated in the development of the ILFFP recommendations through working sessions, workshops, listening sessions, one-on-one visits, and surveys. Initial recommendations were distributed to representatives from 21 different state agencies, institutions, and organizations mentioned in the plan. Twelve emerging stakeholder issues surfaced:

- Affordable loans to start or expand businesses
- Incentives such as tax credits, tax rebates and cost-share programs to supply markets
- Access to land and water
- Insurance to minimize risks in crop production, liability and health
- Education and technical assistance
- Food safety and environmental regulations that fit small and mid-sized farmers
- Access to a skilled, reliable and affordable workforce
- Statewide investment in aggregation, distribution, storage and processing facilities
- Marketing networks
- Consumer access to local foods
- Coordination of technical assistance
- Creative ways to fund new programs other than taxes.

Findings/Results: The Iowa Food and Farm Plan contains 34 unique recommendations grouped in three main sections:

1. Recommendations for state appropriation.
2. Recommendations to create a Local Food and Farm Advisory Board and a Local Food and Farm Program Fund.
3. Recommendations related to operation of the Plan that address: Business development models; Financial assistance; Processing; Food safety; Beginning, minority and transitioning farmers; Assessing progress; and Local food incentives.

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Sustainability & Resilience Indicators:

What aspect of sustainability and resilience have you been targeting in your research?
Local food commerce as a driver of local and state economic and community development was the primary aspect of sustainability and resilience targeted in the food and farm plan. Research focused on supporting and expanding local food systems.

What sustainability and resilience measures did you use?
The number of participants and regions providing feedback on sector-specific policy obstacles that prevent Iowa from having a strong local and regional food business sector.

How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
The results are useful for enacting legislation aimed at building profitable community-based local food businesses that can serve as models for bankers, economic development officials, and aspiring local food businesses.
Low External Input Cropping Systems

**Abstract/Overview:** This project compares the agronomic, ecological, and economic performance characteristics of three cropping systems: a conventionally managed corn-soybean rotation and two more diverse rotations (corn-soybean-oat/red clover and corn-soybean-oat/alalfa-alalfa) receiving much smaller quantities of nitrogen fertilizer and herbicides. Measurements include nitrate leaching, greenhouse gas emissions from soil, carbon sequestration, and soil organic matter transformations. Soybean and corn plots have been split to allow side-by-side comparisons of genetically engineered and non-genetically engineered hybrids and varieties.

**Methods:** Thirty-six experimental plots, each 60’ x 285’, comprising four replicates of each crop phase in each rotation system, were established at the Iowa State University Marsden Farm in Boone Co., IA, in 2002. In addition to the soil and environmental measurements noted above, measurements have been made of crop yields, weed dry matter production, and weed seed densities in soil. Costs and returns are calculated each year for each production system. Fossil energy use was tracked in 2003-2008.

**Findings/Results:**
- Corn and soybean yields have been higher in the two more diverse LEI systems than in the conventional system, despite substantial reductions in fertilizer and herbicide use.
- Net returns to land and management have been slightly higher in the LEI systems than the conventional system.
- Weed control has been excellent in all systems.
- Particulate organic matter C and potentially mineralizable N levels in the soil of the LEI systems are higher than in the conventional system.

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Methods to Quantify Regional Self-Sustainability

Abstract/Overview: This project developed ways to quantify how effectively a region could become self-sustaining in regard to food production. Emphasis is on minimizing distance between cropland and markets using more localized, diversified agricultural technologies. Results are based on targeted dietary requirements that account for production and spoilage losses, livestock conversions, and variations in yield among forty staple crops.

Methods: In general, linear programming is used to allocate deficit capacity to surplus capacity for all supply and demand centers located in an eight state region of the Midwest. The goal is to minimize aggregate geographic distance. Within this context, we draw attention to two key performance metrics: 1) The per capita cropland requirement identifies how much acreage is needed to produce all dietary requirements for an average person for one year, and 2) The regional self-sustainability index characterizes how extensively an area can become self-sustaining in regard to food production.

Findings/Results: Overall, we estimate the region could become self-sustaining with just 10.7% of available cropland. On average, current cropland coverage in the studied region ranges from 27% to 69%. Each consumer requires 0.49 acres (+/-0.09). If changing economic circumstances were to draw the closest cropland to the nearest consumer, net average distance could be reduced to 13.6 miles. Over half of demand could be serviced within a five-mile range. Major exceptions include: Chicago (76 miles), Minneapolis (37 miles), St. Louis (27 miles), Kansas City (24 miles), and Des Moines (10 miles).

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Sustainability
& Resilience Indicators:

What aspect of sustainability and resilience have you been targeting in your research?

Resilience to rising transportation costs:
- Rising demand and parasitic losses for petroleum (or any alternative).
- Cost to rebuild end-of-life interstate system (Eisenhower + 50 years).
- Costs to address global and local emissions.
- Paradigm shift from mass-production to digital/modular technologies.

What sustainability and resilience measures did you use?
- Developed new ways to target and assess food system capacity, under the assumption that shipping costs will rise relative to costs of adaptive technologies.

How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
- Quantifying and positioning regional self-sustainability is intended to promote industrial marketing systems towards more diverse and poly-cultural farming methods.
Creating a Microfinance Intermediary to Support Local Food Development

Abstract/Overview: Iowa MicroLoan was organized by a steering committee of 16 leaders representing diverse interests. A three year demonstration project was created by leveraging federal, state, local and private sector funds. Collaboration across eight multiple entrepreneurial networks was developed. The impacts and outcomes were evaluated at the end of the three year project.

Methods:
1. Key staff brought microlending, community banking, and entrepreneurial development expertise to the new organization.
2. Loans of up to $50,000 were provided to applicants who had workable business plans but who denied conventional loans.
3. A statewide Technical Assistance Network was developed using a wide variety of affiliate coaching networks, including Affiliate Networks, SBDCs, Extension, Community Foundations, RC&Ds, Main Street, MyEntreNet, ISED Ventures, Northeast Food and Farm Coalition, Western Iowa Advantage Development, Fairfield First, etc.

Findings/Outcomes:
A statewide microfinance intermediary such as Iowa Microloan can develop programs and networking relationships that culminate in loans to local food entrepreneurs who were denied access to conventional credit locally.
- 32 Iowa MicroLoans were approved in 2009 and 2010
- 23 of 32 microloans were from non-metro areas of Iowa
- 6 of 32 microloans involved value-added agriculture enterprises
- 3 microloans involved affiliate food network screening & coaching

Sustainability & Resilience Indicators:

What aspect of sustainability and resilience were targeted in the research?
- Diversification across sectors: local foods, main streets, and self-selected sectors.
- Diversification across funding sources: Federal Agencies, State Agencies, Banks, Foundations and Private Sector Sources.
- Incentives for addressing individualized technical assistance plans for each client with quarterly coaching visits, training for coaching networks, and staff capacity for building endowments for entrepreneurship.

What measures did you use, or what do your results tell us about progress toward sustainability and resilience?
- Success of Loan Clients, Financial Performance of Loan Portfolio, & grants.
- Business Starts, Existing Businesses, Jobs Created and/or Retained, MicroLoan Capital, Loan Loss Reserve Capital, Technical Assistance Grants, & Operating Fund Grants.

How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
High tunnel adoption could create benefits:
- Positive economic impact for participating producers and distributors.
- Increased consumer access to safe, healthy, affordable, fresh produce that is grown locally.
Pork Niche Market Working Group

Overview: The Pork Niche Market Working Group (PNMWG) formed in 2002. It has advanced this segment of the pork industry by focusing on challenges facing individual producers and niche pork companies. It leveraged this tight focus and board-based participation into over thirty projects funded by nearly $1.4 million in grants and contributions. A plan was needed to continue the PNMWG. Input systematically gathered from members on desired products and services was incorporated into a business plan. The Iowa Pork Industry Center at Iowa State University is leading an effort to use this plan for a transitioning process to assure the PNMWG continues.

Methods:
• A survey with ten possible services was used in interviews with member businesses.
• Results were discussed and refined at PNMWG meetings.
• Individual meetings were held with leaders of stakeholder groups.

Results: A twelve-page business plan was written that describes two main services for the PNMWG: 1) production assistance to help producers raise hogs for niche markets by seeking partners and funding to develop and implement research, outreach, and education projects; 2) business development assistance to help niche pork companies succeed by providing professional assistance tailored to the needs of the companies.

The business plan also describes a possible organizational structure. The Iowa Pork Industry Center at Iowa State University is leading a transitioning process to put in place the needed partners, people, and funding.

Sustainability & Resilience Indicators:

What aspect of sustainability and resilience have you been targeting in your research?
• People working together towards common goals is one of the most effective ways to address complex challenges facing agriculture.
• How can diverse members of an existing working group continue to collaborate in the face of changes in leadership?

What sustainability and resilience measures did you use?
• A well-conceived and articulated working group business plan was developed.
• Organizational champions were secured to lead the working group forward.

How could people use your results to take action to improve sustainability and resilience in agriculture?
• People can learn how working groups like the PNMWG have effectively addressed complex challenges facing agriculture.

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Renewable Energy Feed-In Tariffs: Potential Opportunities for Iowa’s Small Farmers

Abstract/Overview:
Electric and gas utilities are regulated monopolies. Farmers who generate renewable energy using wind, solar, or other technologies cannot sell their product to the highest bidder in a competitive marketplace, but rather have only one buyer – their local, monopoly utility. Public policy has a critical role to play to ensure that farmers can sell their clean power for a fair price. Feed-in tariffs (FITS) are a promising policy tool for this purpose. Also known as standard offer contracts, advanced renewable tariffs, or incentive rates, FITs provide a upfront, fixed and fair price over a fixed period of time, usually ten years, in order to spur renewable energy development.

Methods:
1. Conduct a policy analysis of different approaches utilities and policy makers have used in the United States and around the world to create and implement FITs.
2. Develop case studies of successes for utilities and on-farm use of renewable energy, specifically focused on the use of FITs.
3. Provide background information for farmers, policy makers, and others regarding the use and integration of on-farm and distributed renewable energy.

Findings/Results:
FITs are a dynamic, flexible, and effective policy tool that can be designed to accomplish many results, including a substantial increase in on-farm renewable energy that can also provide benefits beyond the farm, including benefits to the electric system and local economy.

Sustainability & Resilience Indicators:

What aspect of sustainability and resilience have you been targeting in your research?
A significant increase in on-farm renewable electricity will help Iowa decrease its reliance on coal-fired power plants. Coal currently accounts for about 70% of Iowa’s electricity use and is a highly polluting and non-renewable energy source. Iowa imports all its coal, from as far as Wyoming.

What sustainability and resilience measures did you use?
We are analyzing how current policies and practices in Iowa inhibit the use of on-farm renewable energy and how use of FITs would help transform Iowa farms to be renewable energy generators.

How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
Our results will allow farmers, utilities, and policy makers to change policies and practices to increase on-farm use of renewable energy, like solar and wind power.

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Sustainable Land Tenure Project

Abstract/Overview: Land tenure relations are essential elements in the structure of agriculture and farm policy. Researching these relations is complicated by the personal and increasingly diversified nature of land ownership, the recognition of new forms of property rights such as those relating to wind energy and environmental services, and the corresponding variety of legal documents. This project was established to study land tenure relations in order to further the development of policies and educational resources that improve the sustainability and resiliency of our farmland, agricultural system, and rural communities.

Methods: Develop and analyze an inventory of land tenure agreements, including farm leases, conservation easements, wind and mineral leases, timber sale contracts, recreational lease agreements, and ecosystem service contracts; interview landowners, farm operators, advisors, and agency personnel; and research local, state, and federal policies and legal practices impacting stewardship adoption across Iowa landownership regimes.

Findings/Results: There is a degree of disconnect between law and policy and current land tenure trends (e.g. land-use decision-makers, often tenants, lack the authority to enter, and ability to receive benefits from, conservation and environmental service contracts). Lease arrangements often lack sufficient provisions to require and incentivize sustainable and resilient practices. Resources, in print, video, and online, were developed to improve capacity for incorporating lease provisions that enable sustainability and resiliency. Since the release of SustainableFarmLease.org on March 2, 2012 the resources have been viewed by more than 2,500 users. The project has spawned collaboration on land tenure and sustainability issues between more than a dozen state and regional stakeholders.

Sustainability & Resilience Indicators:

What aspect of sustainability and resilience have you been targeting in your research?
• The impact of land tenure arrangements on soil conservation, water quality, climate change mitigation, beginning and diversified farm operations, and the rural economic and social framework.

What sustainability and resilience measures did you use?
• The utilization and acceptance of educational materials developed.
• The number of people who attend or hear land tenure project related presentations.
• The number and range of entities and institutions who partner in land tenure discussions.

How are, or could, people use your results to take action to improve sustainability and resiliency in agriculture?
• Incorporate provisions into lease contracts that enable or require conservation practices, allow for diversification of farm enterprises and marketing, or assist beginning farmers.
• Develop policy, programs, and legal arrangements that recognize and incorporate changing land tenure relations.

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Abstract/Overview:
We are quantifying biophysical & socioeconomic benefits of including native prairie vegetation (NPV) in annual crop production systems. Our central hypothesis is that strategic placement of small amounts of NPV within ag-dominated landscapes will have disproportionate effects on the functioning of the biophysical (e.g., water quality & flow, biodiversity) and socioeconomic (i.e., quality of life, economic & social stability) systems.

Methods:
Twelve experimental watersheds (0.5 to 3.2 ha each) were established in 2007 at the Neal Smith National Wildlife Refuge, to test the effects of NPV on ecohydrologic & biodiversity responses (fully replicated, incomplete block design with 3 replicates X 4 treatments in 4 blocks). The treatments consist of varying proportions (0%, 10%, & 20%) of NPV within a row-crop system. Each watershed is monitored for various ecohydrological & biodiversity variables. Additionally a statewide public survey is ongoing to determine the degree to which the public is willing to pay for (or otherwise support) enhanced ecosystem service capacity.

Findings/Results:
- Native prairie vegetation (NPV) supported 83 non-crop taxa, 54 of which were native species and 29 of which were non-native; observations of bird & beneficial insect were greatest in areas of NPV.
- During 2008, sediment loss in watersheds with 100% row crop was at least 10 times more than in watershed with 10% NPV (Fig. 1).
- In 2007, Nitrate-nitrogen concentrations in groundwater were lower in watersheds with NPV; despite the relatively young age of these strips, there was a positive impact on reducing nitrate-N concentrations.

For more info visit our website http://www.nrem.iastate.edu/research/STRIPs/ or contact members of our research team representing ecohydrology, biodiversity and socioeconomic aspects of this project:
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Tunnels to Tables: High Tunnel Production and Distribution Model for Produce

Abstract/Overview:
High tunnel facilities offer a production alternative for specialty crop farmers, but also require a new set of management skills and tactics.

Methods:
Production models and budgets were developed for a variety of fruit and vegetable crops utilizing high-tunnel facilities at the ISU Armstrong Research Farm and the ISU Horticulture Research Farm. These production models were compared and evaluated against the following three business structures:
1. Sole Proprietor
2. Partnership/Coop
3. Aggregator

Results of the production research were shared in publications and outreach workshops.

Findings/Results:
Results indicated that high tunnel technology offers a realistic way to add additional income to existing farm operations and it can serve as an affordable enterprise for new or existing farmers.

Results of the study were distributed in outreach efforts that included high tunnel projects/workshops. Workshops were attended by potential and current producers interested in utilizing high tunnels, as well as SARE, NRCS, and local food groups.

This project resulted in additional leveraged projects related to high tunnels that included, for example, research regarding various crop profitability scenarios and a project regarding water conservation.

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Sustainability & Resilience Indicators:

What aspect of sustainability and resilience have you been targeting in your research?
- Farmer profitability
- Reducing post-harvest fruit and vegetable loss
- Extending the growing season for high value crops

What sustainability and resilience measures did you use?
The economic sustainability and resilience of various high tunnel based business structures were evaluated using the following five criteria: (1) Management, (2) Market, (3) Financial, (4) Technical, (5) Economic Impact.

How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
Results suggest that greater high tunnel adoption could create benefits, including:
- Positive economic impact for participating producers and distributors
- Increased consumer access to safe, healthy, affordable, fresh produce that is grown locally
Abstract/Overview:
The success of integrated weed management relies on matching control strategies to the specific weed problems. The time of weed emergence influences which species will be the most serious weeds in a given crop production practice and determines the optimum time to implement control tactics. Better information on weed development and populations could help growers determine the optimum time for tillage and crop planting to reduce weed populations and maximize effectiveness of management efforts.

Methods:
- Classification of Midwest weed life cycles
- Evaluation of order and rate of emergence among and between identified species
- Meta analysis of North Center research data on weed management as it relates to environmental and production management factors
- Aggregation and interpretation of relevant research into user-friendly format

Findings/Results:
- Many factors complicate predication of weed emergence patterns: tillage, crop rotation, weed history, weather, crop, soil, among others.
- General emergence trends among species are predictable
- General emergence trends can be used to improve management of weed populations in cropping systems

Sustainability & Resilience Indicators:
- What aspect of sustainability and resilience have you been targeting in your research?
  Using biological systems knowledge to improve the effectiveness and efficiency of on-farm crop production.
- What sustainability and resilience measures did you use?
  Combination of social and environmental factors, including:
  - Temperature, precipitation, moisture
  - Soil type, residue, history
  - Crop type and crop/biomass yields
  - Management, including tillage
  - Weed biology
- How are, or could, people use your results to take action to improve sustainability and resilience in agriculture?
  Growers and consultants can use this to optimize tillage and planting times, improve weed control effectiveness with reduced use of herbicides, and minimize weed impacts on crop yield.

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Working together to farm better: PFI’s Cooperators’ Program

**Approach** Practical Farmers of Iowa’s Cooperators’ Program turns farmer research questions into on-the-ground projects. PFI believes that farmers learn best from other farmers, that improving the sustainability of a farm is an on-going process and that diversity leads to resilience. Since 1987, PFI farmers have conducted over 800 individual trials and held more than 1,500 events where farmers are experts, teaching others about the benefits and practical application of diverse farming systems. Our membership is a “big tent”; our members’ farms span a wide sustainability spectrum. In addition, our impact is widespread—almost half of those who attend our events every year are not members.

**Methods** To verify that our approach is successful, PFI surveyed its membership (81% response rate) in 2010 asking “How has your participation in PFI impacted your farm’s performance in the following areas:”

- Profitability
- Stewardship/conservation ability
- Overall efficiency

**Results** PFI has been most effective at helping farmers improve their stewardship and conservation ability, with 65% of respondents claiming their ability has “somewhat increased” or “greatly increased”. Nearly 64% of respondents reported that PFI has helped them improve the overall efficiency of their farm, while nearly 53% say their profitability has increased. All credit the improvements to their involvement in PFI.

The Gilbert Farm has *survived many shocks* in recent years, from severe flooding and hail to low milk prices and escalating input costs.

*Diversity helps the Gilbert Family stay resilient*—enterprises on this farm include a dairy herd, hogs, food-grade soybeans, and corn, hay and oats for the livestock.

*Diversity in seeds and breeds also are a priority* for the Gilberts, so they participate with PFI in a *trial to test and increase the varieties of corn seed available.*

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