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Nutrient Management: Completed Leopold Center Grants 1988-2015

Leopold Center for Sustainable Agriculture

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Abstract
This summarizes information about 94 projects related to nutrient management and supported by the Leopold Center from 1988 through 2015. Titles, key words, investigators and abstracts are included for each project and issue team. More about the Leopold Center's work to manage nutrients.

LEOPOLD CENTER

Nutrient Management: Completed & Current Leopold Center Grants (1988-August 2015)

The Leopold Center for Sustainable Agriculture has provided nearly $5.3 million for manure and nutrient management research, demonstrations and educational workshops since it was created. This includes 94 competitive grant and special projects, between 1988 and 2015.

In addition, the Center gave five years of research support for the Manure Management Issue Team, six years of support to the Hoop Group Initiative, and sponsored 14 conferences and workshops on nutrient management. The Center has also supported ISU Extension's Statewide Manure Management Education Initiative. Explore our work at www.leopold.iastate.edu. *Active grants are in italics.*

Key words	Competitive Grants
Corn-soybean cropping systems, Nutrient management , Soils and agronomy	**Does long-term use of cover crops affect soil health and quality as measured by the Haney Soil Test?** *ESP2015-01* *Sarah Carlson, Midwest Cover Crops Research Coordinator and Stefan Gailans, Research Scientist and Cooperators' Program Coordinator, Practical Farmers of Iowa.* *Soil physical properties were assessed at the onset of an on-farm cover crop field study in 2009 and five years later in 2013. There was virtually no change in steady-state infiltration, steady-state runoff, bulk density, total carbon, and total nitrogen over that period at the farms regardless of the presence or absence of the cover crop (Dunn and Juchems, 2013). A lack of perceptible change to soil properties in soils under cover crop might be related to time and or the choice of soil test. Investigators are using the Haney test, a novel soil test that assesses soil microbial activity (soil health) and soil carbon, nitrogen, and organic matter concentration, to examine soil from 47 on-farm strips that remain in the long-term cover crop study (initiated 2008, and 2009)*
Corn-soybean cropping systems, Nutrient management Soils and agronomy	**Improving Soil Health and Water Quality through Better Soil Phosphorus Assessment and Management Practices** *E2015-13* *Antonio P. Mallarino, Agronomy, Iowa State University; Matt Helmers, Agricultural and Biosystems Engineering, Iowa State University* *This research assesses the value of no-tillage and subsurface banded applications of phosphorus fertilizer, especially as they relate to surface runoff. The information will be used to improve soil test recommendations for farmers. The project uses data collected from several long-term experiments with corn-soybean rotations at Iowa State University research farms.*
Corn-soybean cropping systems, Multi-year rotations, low-external input, Climate change, greenhouse gas emissions, Life Cycle Assessment, Soils and agronomy	**Crop diversity effects on soil organic matter and nitrate retention in surface and subsoils** *E2015-17* Michael Castellano, Agronomy, Iowa State University; Matt Liebman, H.A. Wallace Chair for Sustainable Agriculture, Agronomy, Iowa State University; Hannah Jane Poffenbarger, graduate research assistant, Agronomy, Iowa State University *This research looks at what happens deep within the soil profile (2-3 ft. below the surface) when alfalfa is added to the typical corn-soybean rotation. They hypothesize that the extended rotation improves the soil's ability to store carbon and organic matter at lower depths, making the soil more resilient to drought and to soil erosion and nutrient losses after heavy rainfall. Data will be collected from established research plots at the Marsden* Research Farm in Boone County.

Multi-year rotations, low-external input, Nutrient management , Climate change, greenhouse gas emissions, Life Cycle Assessment, Economic and environmental impacts	**Impacts of contrasting rotation systems and weed management regimes on weed dynamics and agroecosystem health** *XP2015-02* *Matt Liebman, H.A. Wallace Chair for Sustainable Agriculture, Agronomy, Iowa State University* *This project uses data from a 22-acre cropping systems experiment at the ISU Marsden Farm to investigate differences in crop yields, soil properties, pathogen dynamics, agrichemical and energy use, production costs and net returns and selected ecological impacts. The plots compare three rotations: conventional 2-year rotation of corn-soybean and two more diverse systems, a 3-year corn-soybean-oat + red clover rotation and a 4-yr corn-soybean-oat + alfalfa-alfalfa rotation. This project will provide new knowledge about weed seed bank dynamics and how herbicide regimes affect fossil energy inputs, greenhouse gas emissions, ozone formation and factors in* Life Cycle Assessment (LCA). Leopold Center funds leverage other USDA grants related to this research.
Cover crops, double crops, strip cropping, Multi-year rotations, low-external input, Nut. mngt , Environmental im-pacts	**Linking soil and water quality with crop performance across a continuum of tillage and management strategies, Years 2 and 3** *XP2015-03* Kathleen Delate, Horticulture and Agronomy, Iowa State University *This project uses established experiments, each with a unique crop rotation and management history, to look at long-term impacts of changes in soil microbiology on soil health. The three sites are the Long-Term Agroecological Research (LTAR) Experiment established in 1998 near Greenfield, the USDA-ARS Organic Water Quality site on the ISU Agronomy Research Farm in Boone County in its third year, and the Organic Reduced-Tillage site in its seventh year, also on the ISU Agronomy Farm. Additional soil and water samples will be collected as part of this grant, as well as development of Best Management Practices guides based on research results.*
Animal management and forage Farming Systems Manure nutrient and compost management Soils and agronomy Integrated crop/livestock systems Wildlife	**Use of adaptive grazing management to provide multiple ecological services while increasing profitability of beef cow-calf production in Iowa** *XPSP2014-01* Jim Russell, Animal Science, Diane Debinsiki, Ecology, Evolution & Organismal Biology; Patrick Gunn, Animal Science; Mark Honeyman, Outlying Research Farms; Dan Morrical, Animal Science; Jim Reecy, Animal Science; Lee Schulz, Economics; Joe Sellers, Extension Livestock Field Specialist; *Create an interdisciplinary research team comprised of team member expertise and farmer expertise from GreenHorn Grazier and Certified Grazier programs, conduct a resource inventory of McNay Research Farm and adjoining properties; develop an adaptive grazing system and design an experimental comparison of the new system to more standard options, create ongoing educational training opportunities for graziers, and secure outside funding.*
Corn-soybean cropping systems Conservation practices Economic and environmental impacts Soils and agronomy Watershed and ecoregions	**Economic impacts of soil erosion in Iowa** *E2014-17* Richard M. Cruse, Agronomy, Iowa State University; Iowa State University: Mack C. Shelley, Statistics; C. Lee Burras, Agronomy;John Tyndall, Natural Resource Ecology and Management; Melissa Miller, Agronomy This Iowa Water Center project complements ongoing USDA Corn CAP grant efforts. It aims to quantify soil erosion and topsoil depth lost across Iowa's HUC 12 watershed regions, determine how these values correspond to lost corn and soybean yield, and estimate the economic value of this loss. Since crop yield is linked to economic productivity in Iowa, the results of this research will inform stakeholders of the economic value of conservation measures that mitigate soil erosion.
Conservation practices Economic and environmental impacts Water quality, quantity and management Watershed and ecoregion	**Quantifying the effects of alternative surface inlet protection strategies on water quality** *E2014-08* Martin Shipitalo and Mark Tomer, USDA-ARS National Laboratory for Agriculture and the Environment Investigators worked in four counties affiliated with the South Forth Watershed Alliance in north central Iowa to test modest, uncomplicated inlet protection practices to see if surface inlets to tile drainage systems contributed to water quality problems in Iowa and if there viable alternative practices to reduce their impact. Researchers found that current designs of surface inlets do allow high concentrations of sediment, sediment-bound phosphorus, and dissolved phosphorus to enter the drainage system and that blind inlets and filter socks amended with alum can reduce these concerns. Choosing the best practice to use depends on site-specific conditions.

Conservation practices Soils and agronomy Water quality, quantity and management	**Soil health and productivity in riparian grass buffers: A re-evaluation after 13 years** *E2014-07* *James W. Raich, Ecology, Evolution and Organismal Biology, and Richard C. Shultz, Natural Resource Ecology and Management, Iowa State University* *The investigators will revisit 24 riparian grassland buffer plots established in 2001 along Bear Creek. They will collect data on soil properties, plant biomass and productivity, root biomass, soil food web community structure and soil respiration. The 2014 data will be compared with what was collected in 2001 to quantify how land-use conversion from pasture or row crops to buffer strips has changed soil health and productivity of the landscape after 13 years.*
Nutrient management Conservation practices Soils and agronomy	**Determining threshold responses of plant-soil feedbacks to nitrogen deposition,** *E2014-01* Lori Biederman and William Harpole, Ecology, Evolution and Organismal Biology, Iowa State Universitye University This project studied how nitrogen (N) deposition affects the stability of coupled-plant-soil (CPS) systems in perennial grasslands. By linking nutrient-driven changes in plant-soil interactions with C storage, the project contributed baseline data to study the effect of chronic, low-level nitrogen addition in grassland ecosystems, such as tall grass prairie. Site specific threshold effects from N deposition were inconclusive. Research contributed to the global Nutrient Network and researchers established a Nitrogen Network (NitNet) to complement the existing NutNet for grasslands.
Watershed and ecoregion Water quality, Nutrient management, erosion	**Sediment source contributions to lake sedimentation in agricultural watersheds of Iowa** *ESP2014-01* *John Downing and Christopher Filstrup, ISU Ecology, Evolution and Organismal Biology* *Investigators are employing extensive sampling to quantify the relative contributions of topsoil erosion versus streambank erosion in 15 Iowa watersheds.*
Water quality and nutrient management . environmental impacts	**Simple and fast detection of E. coli in agricultural water sources and runoff** *ESP 2014-02* *R. Cademartiri, ISU chemical and biological engineering and materials science and engineering and M. Soupir, ISU agricultural and biosystems engineering* *The investigators are working to advance water quality monitoring by development of a low-cost, paper-based device for detecting water-borne pathogen indicators (such as E. coli). Work was to generate preliminary data regarding the stability of bacteriophages on paper, followed by development of a sensitive colorimetric assay for bacteria on paper. They will use data as the basis for acquiring funds to put the two processes together into a simple test*
Nitrogen Potassium Phosphorus Nutrient capture Water quality	**Increasing the number of herbaceous species appropriate for restoration of nutrient capture by forest remnants in agricultural landscapes** *ESP 2014-04* Jan Thompson, Cathy McMullen and Emily Altrichter, Dept. Natural Resource Ecology and Management *Investigators are evaluating local vs non-local herbaceous perennial transplants for forest understory for nutrient uptake and performance. From this they will make recommendations to local growers for geographic regions from within which plant material should be sourced, and which species would be most beneficial to begin to grow and sell*. $4,000
Corn-soybean cropping systems; Climate change, greenhouse gas emissions; Conservation practices, Farming systems, Soils & agronomy Watershed and ecoregion	**Agricultural soil erosion and carbon cycle observations in Iowa: Gaps threaten climate mitigating policies -** *ESP2010-TP* Thanos Papanicolaou, Project PI; and Ramanathan Sugumaran, Management PI, University of Northern Iowa The central objective for this NASA EPSCoR (Experimental Program to Stimulate Competitive Research) project is to quantify the links between land use/land cover, net CO2 emissions, and Soil Organic Carbon sequestration potential. The project developed methods and models for carbon budgets at smaller regional scales to eventually provide a large-scale assessment of the carbon sink in the Midwest that may be attributed to an agricultural ecosystem. This grant was allocated as part of a three-year EPSCoR grant submitted to NASA by UNI.

Multi-year rotations, low-external input; Nutrient Mngt; Climate change, greenhouse gas emissions; Life Cycle Assessment; Economic and environmental impacts;	**Impacts of conventional and diversified rotation systems on crop yields, soil functions and environmental quality: Stage II/Year 2** *XP2014-01* Matt Liebman, H.A. Wallace Chair for Sustainable Agriculture, Agronomy, Iowa State University; Michael Castellano, Agronomy, Iowa State University The investigators looked at soil nitrogen dynamics in a conventional 2-year rotation (corn-soybean) and two more diverse systems: a 3-year rotation (corn-soybean-oat + red clover) and a 4-year rotation (corn-soybean-oat + alfalfa-alfalfa), both of which periodically receive cattle manure, and determined that diversifying corn- and soybean-based cropping systems improved environmental performance characteristics while maintaining or improving profitability. Attention was directed to estimating soil erosion with the RUSLE2 model, measuring soil nitrogen transformations and nitrogen uptake by corn, and assessing the farm economics using enterprise budgeting techniques. Work was a continuation of XP2013-01 and was conducted at the ISU Marsden Farm.
Cover crops, double crops, strip cropping, Models and assessment tools	**Predicting long term cover crop impacts on soil quality using a cropping systems model** *E2013-19* *Fernando Miguez, Crop Production and Physiology, Iowa State University; and Sotiris Archontoulis and Andrea Basche, Agronomy, Iowa State University* *This project will monitor crops and soils at a corn-soybean field site with a winter rye cover crop to provide information for a process-based model, APSIM. The model is eventually expected to facilitate use of cover crops in Iowa by providing improved understanding of crop production/cover crop management under Iowa soil and climate conditions. The model's simulations will answer questions regarding the impact of cover crops on soil organic carbon, nitrogen availability, soil erosion, soil water dynamics, average yields and yields following extreme climate events.*
Corn-soybean cropping systems, Cover crops, double crops, strip cropping	**Suitability of winter canola for enhancing summer annual crop rotations in Iowa ,** *E2013-16* Mary Wiedenhoeft, Agronomy and Chair of the Graduate Program in Sustainable Agriculture, Iowa State University ; Rafael Martinez-Feria and Andrew Lenssen, Agronomy, Iowa State University ; Tom Kaspar, USDA-ARS National Laboratory for Agriculture and the Environment, Ames, IA Growing winter canola after summer annual crops such as corn or soybean might improve grain production and soil management, but represents a challenge in the cooler climates of the Upper Midwest. This project determined optimal Iowa seeding dates for a winter canola cover crop and explored practices to enhance production. It was estimated that the latest seeding date for winter survival varies from around August 31 in the north to September 12 in the southeast. As a general rule, plant no later than early September in order to achieve maximum agronomic performance and provide the greatest environmental benefits, either as a cover crop or a cash crop.
Water quality, quantity and management	**Reconnecting riparian buffers with tile drainage: An emerging technology to reduce nitrate loss from croplands** *E2013-13* *Dan Jaynes and Tim Parkin, USDA-ARS National Laboratory for Agriculture and the Environment, Ames, IA* *Tom Isenhart, Natural Resource Ecology and Management, Iowa State University* *The first two years of observing a saturated buffer showed that about half of the tile flow from a 10 ha field could be diverted through 1000 m of a riparian buffer with all nitrate in the diverted water removed before reaching the stream as shallow groundwater. Could this kind of removal be sustained for an additional year and, if so, would there be the same order of removal at a saturated buffer installed at a new site? Could geophysical methods (ground resistivity survey) be used to characterize the variability of soils within riparian buffers. Researchers found In 2013, the project was able to redirect more than 21,630 m3 (5,714,650 gal) of flow from fi eld tile outlets as subsurface fl ow within existing riparian buffers at the two sites. The redirected tile flow contained a total of 352 kg (777 lbs) of NO3-N. Based on the strong decrease in concentrations within the shallow groundwater across the buffer, the researchers conclude that all of this NO3 was removed within the buffer and did not enter the stream.*

Nutrient management, Bioeconomy and energy, Climate change, Greenhouse gas emissions, Life Cycle Assessment, Soils and agronomy	**Understanding microbial contributions to soil aggregation and organic matter accumulation** *E2014-19* *Kirsten Hofmockel and Elizabeth Bach, Ecology, Evolution and Organismal Biology, Iowa State University* *The investigators will characterize soil bacterial and fungal communities and the rates at which they break down plant-derived carbon in soil from three different farming systems: continuous corn, prairie and fertilized prairie. Different farming system activities change the diversity and health of soil microbial communities. Understanding how factors including microbial biomass, community composition and activity affect soil characteristics such as organic matter formation and accumulation will eventually lead to land management recommendations that enhance the microbial communities, soil health and productivity of crops on farms. This project continues work started by the Comparison of Biofuel Systems (COBS) group.*
Farming systems Soils and agronomy	**Understanding soil organic matter change: Modeling root and soil interactions across agricultural landscapes** *E2012-11* *Cynthia Cambardella, USDA-ARS National Laboratory for Agriculture and the Environment; Todd Ontl and Lisa Schulte-Moore, Natural Resource Ecology and Management, Iowa State University; and Randall Kolka, USDA Forest Service-Northern Research Station* *The research team aims to quantify spatial variability in root traits associated with three cropping systems (continuous corn, triticale/sorghum and perennial switchgrass), and predict changes in soil carbon pools by modeling the interactions among roots and soil characteristics. The results showed that despite no change in total soil carbon, all three bioenergy cropping systems studied improved soil structure and increased the protected forms of soil carbon that result in storage of soil carbon. The greatest improvement to soil structure and organic matter levels occurred under switchgrass—likely due to the large amount of root biomass associated with this crop—while continuous corn showed the smallest changes. Additional analyses revealed that soil properties influenced shifts in protected forms of soil carbon through impacts to soil structure and root biomass .*
Manure nutrient and compost management, Soils and agronomy, Water quality, quantity and management	**Investigation of bacteria transport and resistance mechanisms and implications for water quality from confinement swine and beef grazing production systems in Iowa,** *E2012-05* *Michelle Soupir and Matt Helmers, Agricultural and Biosystems Engineering; Michael Thompson, Agronomy; Laura Jarboe, Chemical and Biological Engineering; Antonio Mallarino, Agronomy; Ramesh Kanwar, Agricultural and Biosystems Engineering, Iowa State University* *This research team will investigate the fate and transport of bacteria from land that receives manure applications. A monitoring study will examine the impact of different agricultural systems on water quality and address emerging issues related to antibiotic resistance in pathogens. In addition, investigators will study the mechanisms of pathogen transport, specifically, if pathogens are attached to manure, soil or sediment particles during transport, and identify related environmental factors.*
Corn-soybean cropping systems, Cover crops, double crops, strip cropping, Farming systems	**Winter rye cover crop effect on corn seedling pathogens** *E2012-03* *Tom Kaspar and Tom Moorman, USDA-ARS National Laboratory for Agriculture and the Environment* *While cover crops are an excellent management tool for sustainable agriculture, decreases in corn yield have been observed following winter rye cover crops. This project tests the hypothesis that glyphosate-killed rye cover crops are hosts for corn seedling pathogens. There will be studies in a controlled environment and on-farm field studies, as well as testing of management strategies to prevent or minimize corn yield decreases . [EXTENDED]*
Cropping systems, corn – soybean, bioeconomy & energy-biomass, nutrient mngt, water quality, quantity and mngt	**Impacts of Crop, Biomass Harvest Systems, and Nutrient Management Subsurface Drainage Water Quality** *DSP 2012-01* Matthew J. Helmers, ISU Agricultural and Biosystems Engineering; and Antonio P. Mallarino, ISU Agronomy The goal of this study is to evaluate effects of cropping and harvest systems for continuous corn harvested for grain or biomass, corn-soybean rotation harvested for grain, and a perennial warm-season grass harvested for on nutrient biomass loss through subsurface tile drainage, dissemination information from the study through Extension events.

Cropping systems Water quality Swine manure Tillage Corn Soybean	**Drainage water quality impacts of current and future agricultural management practices** *XP2011-04* Matt Helmers and Ramesh Kanwar, Agricultural and Biosystems Engineering, Iowa State University; and Antonio Mallarino, Agronomy, Iowa State University This multi-year cropping systems study at ISU Nashua Research and Demonstration Farm examined drainage water quality impacts of various cropping practices (winter cover crops, with or without stover removal, with or without tillage, continuous corn v. corn-soybean). The investigators concluded that tillage and residue removal had little impact on nitrate-nitrogen concentrations in drainage water, but cover crops reduced concentrations, as did applying manure only before corn in a corn-soybean rotation.
Human systems, demographics and beginning farmer programs, Watershed and ecoregion	**Farmer perspectives on ecosystem service management, land-use targeting and the future of Corn Belt agriculture** *E2011-15* John Tyndall, Natural Resource Ecology and Management, Iowa State University ; Drake Larson, Practical Farmers of Iowa; Matt Helmers and Brian Gelder, Agricultural and Biosystems Engineering, Iowa State University ; J. Arbuckle, Sociology, Iowa State University What kind of perspectives do Iowa farmers have on targeted conservation? Most of the participating farmers recognized the importance of producing multiple benefits (or at least minimizing "bads" such as erosion) but lacked broad-scope information (e.g., nature of various problems and, in turn, what specifically to do about them in a low-cost way). There was a tacit acceptance of a targeted approach to conservation, yet uncertainty regarding the cost, broad management consequences and the availability of incentives. Incentives independent of strict policy initiatives (e.g., driven by the NRCS) may be required to engender more autonomous conservation management that is aligned with targeted conservation; such as environmental markets and/or Payment for Ecosystem Service opportunities.
Nitrogen Phosphorus Water quality Nutrient capture	**Getting the most from Iowa's forests: Linking forest understory composition to stream water quality and enhancing nutrient capture in forest remnants in agricultural landscapes** *E2011-05* Jan R. Thompson, Natural Resource Ecology and Management, Iowa State University Investigators found that preserved forest understories had higher biomass production and higher potential for nutrient capture compared to degraded forests and woodlands. Stream water nutrient content (especially nitrate concentration) was high in urban streams compared to grazed or preserved forests. Three key understory species reintroduced to urban forests demonstrated persistence and reproduction within two years, and interaction with forest landowners/forest managers indicated interest in forest restoration activities
Nutrient management, Soils and agronomy	**Crop availability of phosphorus in beef manure** *E2010-12* Antonio P. Mallarino, Agronomy, Iowa State University This research attempts to determine how much phosphorus in beef manure is plant-available to be used as a fertilizer for cropping systems in Iowa. Current recommendations are outdated, and information from other states is incomplete. This study showed that for most beef cattle manure types, and under most field conditions, the P availability is higher; ranging from 80 to 100 percent compared to fertilizer. Analysis of manure-soluble P and other fractions did not help to identify the reasons for variation in availability. To minimize risk of yield loss due to P deficiency, the lower part of the availability range should be assumed when the manure is applied to low-testing soils, and the higher part of the range assumed when the objective of the application is to maintain soil-test P in the optimum category for crops.

Integrated crop-livestock systems and diversity	**Transitioning to ecologically functional production systems** *E2010-10* Kirsten Hofmockel, Ecology, Evolution and Organismal Biology, Iowa State University; Lisa Schulte-Moore, Natural Resource Ecology and Management, Iowa State University ; Tom Isenhart, Natural Resource Ecology and Management, Iowa State University Randy Kolka, USDA Forest Service Northern Research Station A gap in transitioning to ecologically beneficial farming practices is the lack of understanding of how soils store carbon (C) and nitrogen (N)long term. This project quantified root productivity, root decomposition, soil microbial dynamics, soil aggregation, and belowground C allocation in annual and perennial biomass cropping systems across multiple landscape positions. By examining crop-microbe interactions in multiple landscape positions, PIs identified which cropping systems were best suited to increase soil carbon storage. They found that across all landscape positions switchgrass had more roots than corn, which increased the activity of soil microorganisms, especially when crops were full grown. More roots and greater microbial activity coincided with greater soil aggregation. Soil aggregation is important for storing carbon, nitrogen and water.
Multi-year rotations, low-external input, Soils and agronomy	**Impacts of conventional and diversified rotation systems on crop yields, profitability, soil functions and environmental quality** *E2010-02* Matt Liebman, Agronomy, Iowa State University,Craig Chase, Leopold Center for Sustainable Agriculture; Tom Sauer & Mark Tomer, USDA-ARS National Laboratory for Agriculture and the Environment, Michelle Wander, University of Illinois, Urbana-Champaign Comparisons were made among contrasting cropping systems within a long-term, large-scale field experiment in Boone County, Iowa. Combining crop diversity with lower herbicide inputs and non-transgenic crops was effective in reducing requirements for nitrogen fertilizer; maintaining or improving weed suppression, grain yields, and profits; and increasing several soil quality indicators
Conservation practices Water quality, quantity and management	**Reconnecting Iowa riparian buffers with tile drainage** *E2010-01* Dan Jaynes, USDA-ARS National Laboratory for Agriculture and the Environment, Ames, IA Tom Isenhart, Natural Resource Ecology and Management, Iowa State University Changing the configuration of tile drainage structures to allow subsurface flow through a riparian buffer could offer farmers another option for nitrate removal. This project examined the effects of using tiling and buffers to enhance the denitrification process. A literature survey indicated that riparian buffers have a large capacity for nitrate removal via denitrification. But in much of Iowa and the Midwest this removal mechanism is limited by the lack of water flowing through buffers as groundwater by the prevalence of tile drains out letting directly to surface waters. This idea was tested by re-plumbing a tile outlet to route some of the tile water through an existing riparian buffer and measured the amount of water redirected and the fate of the nitrate contained within the water.
Water quality Nutrient mngt Ccorn-soybean cropping systems	**Drainage Water Quality Impacts of Agricultural Management Practices** *ESP 2009-Nashua* Matt Helmers, ISU Agriculture and Biosystems Engineering Comparisons of common cropping systems management for corn and sb to track phosphorus and nitrate, done at two research farms.

Water quality, quantity and management	**Performance of cropping systems designed to reduce nitrate leaching into shallow municipal well** *E2009-22* Robert DeHaan, associate professor and department chair of environmental studies, Dordt College Farming to reduce the risk of nitrate-N movement into the shallow aquifers that supply water for the city of Sioux Center: it is possible to generate a reasonable return for farmers and also reduce the risk of nitrate-nitrogen contamination of shallow municipal aquifers. When compared to a continuous corn system, the oat-alfalfa-corn rotation reduced average residual nitrate-nitrogen levels in the top six feet of soil by 75 lbs./acre and generated $41/acre more profit. Continuous grass hay, however, resulted in lower residual nitrate-nitrogen levels more than any of the other systems. For any given cropping system, residual nitrate-nitrogen levels in the soil were fairly consistent from year to year, while profit was more variable, due to fluctuations in yield and price from one year to the next.
Multi-year rotations, low-external input	**Evaluating canola (Brassica napus) as an alternative oilseed crop and enhancing winter cover in Iowa -** *E2009-21* Mary Wiedenhoeft, Iowa State University Agronomy ; and Stefans Gailans,(now Practical Farmers of Iowa) The viability of canola and winter cover crops as alternative 'third' crops in Iowa were studied. Though the alternative cropping systems were not as competitive on a production or economic basis, they did show tremendous promise in terms of reducing the potential for soil erosion and the leaching of nutrients into the water.
Soils and agronomy Water quality quantity and management	***Quantifying the effect of perennial vegetation on soil and water quality*** *E2009-16* *Thomas Isenhart, Natural Resource Ecology and Management, Iowa State University; Keith Schilling, Iowa DNR; Richard Schultz, ISU Natural Resource Ecology and Management* *The investigators are using data from a well-established research site (Bear Creek in Story County) to interpret the influence of perennial vegetation on soil biogeochemical processes. The information will be used to develop a tool to assess the potential impact of changes in land use on the quality of stream water. The researchers hope to document the influences of perennial plants on various plant communities and groundwater. [EXTENDED]*
Nitrogen Water quality Tile drainage Bioreactors	**Evaluating denitrifying bioreactors for edge-of-field nitrogen management in Iowa's tile-drained landscapes** *E2009-11* Matt Helmers, Agricultural and Biosystems Engineering, Iowa State University The investigators tested the design and management of pilot- and field-scale bioreactors to optimize nitrate removal from Iowa's tile-drained fields. Evaluation of four bioreactors showed they were able to remove between 12 and 57 percent of the annual nitrate load. Effective characteristics were long, narrow bioreactors with woodchips. The retention time was strongly correlated with nitrate removal.
Nitrogen Water quality Tile drainage Corn Prairie Biofuel	**Conversion to perennial vegetation: Quantifying soil water regime, aeration and implications for enhancing soil resilience to climate change** *E2009-18* Robert Horton and Aaron L. Daigh, Agronomy, Iowa State University; and Thomas Sauer, USDA National Laboratory for Agriculture and the Environment This project, part of the Comparison of Biofuel Systems (COBS) experiment at ISU's South Reynoldson Farm, found that multispecies prairies fertilized with a moderate rate of nitrogen provided about 70 percent of the aboveground biomass of corn that had been fertilized at a substantially higher rate. Nitrate loss to tile drainage was between five and 30 times less in the perennial systems compared to corn. Prairie plots had approximately eight to twelve times more roots.

Cattle grazing Nitrogen Pollutants Water quality	**Site specific implementation of practices that alter the spatial/temporal distribution of grazing cattle to improve water quality of pasture streams in the Rathbun Lake watershed** *E2009-08* Jim Russell, Animal Science, Iowa State University This study tracked the movement of cattle with GPS collars to determine if the physical characteristics of a pasture influence the likelihood of cattle causing non-point source pollution. The investigator concluded that the size and shape of pastures is the primarily factor controlling the congregation of cattle in and near pasture streams, and the smaller the pasture, the greater the need for intensive management. Restricting stream access to stabilized crossings reduced the time cattle spent in streams. Unrestricted stream access increased time spent in streams, especially in small pastures. Providing off-stream water, without other restrictive practices, proved ineffective.
Nitrogen Cropping systems Water quality Biofuel	**Agronomic, environmental and economic performance of alternative biomass cropping systems** *E2008-24* Lisa Schulte Moore, Natural Resource Ecology and Management, Iowa State University, et. al. This long-term project conducted by the Landscape Biomass team investigates alternative biomass systems, including their effect on nitrate leaching. Systems explored include continuous corn and rotations of corn, soybean, sorghum, triticale, switchgrass and aspen trees. Systems with corn in the crop rotation had higher nitrate-nitrogen concentrations in root zone soil water, especially directly following fertilization. Concentrations consistently were above the standard set for protecting drinking water sources and aquatic ecosystems. Nitrate-nitrogen levels from triticale/aspen trees and switchgrass systems remained below the drinking water source standard.
Water quality Riparian buffers Grassed waterways Conservation practices Corn Models	**Impacts to the land-water-human system of rural Iowa from high intensity continuous maize production** *EPSP2008-01* C. Lee Burras, Agronomy, Iowa State University; and Thanos Papanicolaou, IIHR-Hydroscience & Engineering, University of Iowa This study, part of ongoing research at the Clear Creek watershed in east-central Iowa, evaluated the effectiveness of grassed waterways and buffers in continuous corn systems to protect water quality. Modeling with WEPP showed that well-designed grassed waterways reduced runoff and sediment contribution to streams across a wide range of landscape and cropping scenarios. However, water quality appeared weakly correlated with buffer strips along Iowa streams in year 2 of the experiment, suggesting improvement takes time.
Nitrogen Manure Compost Hoop houses Swine	**Energy use and nutrient cycling in pig production systems** *E2008-03* Mark Honeyman, Iowa State University Research Farms, and Peter Lammers, Animal Science, Iowa State University Investigators performed a Life Cycle Assessment on each phase of pig production under various management scenarios. They found that nitrogen management was essential for minimizing non-solar energy use. Conventional production systems stored liquid manure in deep pits and effectively returned nutrients back to cropland. In hoop barns, solid manure was composted, which can result in greater nitrogen losses. However, hoop barns required considerably less fossil fuel for building maintenance.
Riparian buffers, nutrient mngt, water quality, quantity and mngt	**Quantifying the Role of Perennial Vegetation in Removing Nitrate from Groundwater in Riparian Buffers** *E2007-22* W. Simpkins, ISU geological and atmospheric sciences; R. Schultz and T. Isenhart, ISU natural resource ecology and management; and T. Parkin, USDA-ARS National Soil Tilth Laboratory, Ames Using field and laboratory experiments, this study will quantify the ability of established perennial plant communities to remove nitrate from groundwater and apportion nitrate loss via plant uptake versus denitrification. A Groundwater Nitrate Removal Index (GNRI) will be developed to help guide the strategic placement of perennial plants in riparian buffers across the agricultural landscape. Experimental sites will be established in existing riparian buffers in the Bear Creek watershed. The narrowed its focus due to the loss of a PhD student, but will continue to collect data on the potential ecosystem services resulting from the conversion of row-cropped lands to perennial vegetation for biofuel feedstock. Continuing analyses include soil aggregation, carbon dynamics (total and particulate organic matter), microbial biomass, and infiltration.

Nitrogen Fertilizer Water quality Corn Soybean Alfalfa Cropping systems	**Agronomic, ecological and economic comparisons of conventional and low-external-input cropping system** *E2007-09* Matt Liebman, Agronomy, Iowa State University; Craig Chase, Iowa State University Extension, and Michelle Wander, University of Illinois This multiple-year research project compared three cropping systems: conventional corn-soybean and three- and four-year rotations that added alfalfa and small grains. Synthetic N fertilizer use was 89 and 93 percent lower in the three- and four-year systems, respectively, than in the two-year system. Diverse rotations had less risk of water quality impacts while maintaining crop yields and economic returns.
Pollutants Nutrient capture	**Reduced stormwater runoff via increased use of rain gardens** *ESP2007-02* Inger Lamb, Prairie Rivers of Iowa RC&D Rain gardens, shallow depressions planted with native vegetation, capture and filter pollutants from runoff by increasing soil infiltration. The investigator installed two rain gardens in Ames, Iowa and developed an outreach program to educate landowners about native landscaping.
Nutrient capture Water quality Nitrogen	**The role of herbaceous woodland perennial diversity for improving nutrient uptake of riparian areas** *E2006-03* Jan Thompson and Cathy Mabry McMullen, Natural Resource Ecology and Management, Iowa State University The project found that the number, frequency and abundance of different understory herbaceous species, especially spring-growing species, are greater in preserved forests than in secondary or distributed forests, and are important for contributing to nutrient capture. Certain spring-growing species produce large amounts of biomass and substantially increase nutrient capture in the understory.
Prairie Cover crops Nitrogen Water quality	**Native cover crops and timing of planting: Effects on 15N uptake, weed invasion and prairie establishment** *E2006-11* Brian Wilsey, Ecology, Evolution and Organismal Biology, Iowa State University The investigator varied the cover crops and timing of prairie seeding on experimental plots to determine whether prairie establishment would change according to treatment. Five native plants were used as cover crops and total N uptake did not differ significantly between them. Results showed that nitrogen loss to nearby water bodies was not likely to be reduced by having cover crops before prairies; any kind of perennial plant cover caused nitrogen to be retained at similar rates.
Cattle grazing Nutrient loss Phosphorus Erosion	**Quantifying the role of riparian management to control non-point source pollution of pasture and cropland streams** *E2004-24* James Russell, Animal Science, Iowa State University This project quantified the losses of sediment and phosphorus from stream banks in pastures grazed under different stocking systems and sought management strategies for improving water quality. Banks were more susceptible to erosion in pastures with continuous stocking and unrestricted stream access. Restricting stream access or using rotational grazing had the potential to reduce sediment, phosphorus and nutrient loading; however, hydrologic processes seemed more responsible for bank erosion in pasture streams than grazing management.
Prairie Erosion Nitrogen Phosphorus Nutrient capture Corn Soybean	**Variations in water and nutrient cycling and soil properties during agricultural landscape restoration** *2004-E14* Heidi Asbjornsen, Natural Resource Ecology and Management, Iowa State University, et. al. The STRIPs Research Team examined differences in nutrient, water and carbon storage and output for selected mixtures of annual and perennial plant communities. Prairie strips were planted within crop fields at the Neal Smith National Wildlife Refuge. Significant reductions in sediment and nutrient loss from the watershed were found using this practice.

Nitrogen Potassium Phosphorus Nutrient capture Water quality	**The role of herbaceous woodland perennial diversity for improving nutrient uptake capacity of riparian areas** *2004-E04* Cathy Mabry McMullen and Jan Thompson, Natural Resource Ecology and Management, Iowa State University This study examined the role of herbaceous perennials in nutrient uptake in three central Iowa woodlands. Plant tissue concentrations for nutrients did not differ between the sites; however, above-ground and below-ground biomass was two to four times greater in intact verses disturbed forest areas in early spring. Biomass differences resulted in overall nutrient storage nearly three times greater on the intact sites. The absence of spring ephemerals from disturbed sites accounted for much of the difference.
Phosphorus Manure Poultry Corn Soybean Alfalfa	**Developing ecologically sound and profitable alternative fertilizer and manure phosphorus management strategies** *E2004-29* A.P. Mallarino, Agronomy, Iowa State University Revised guidelines for the Iowa State University phosphorus (P) recommendations and management may be needed. This project utilized fertilizer and poultry manure P and experiments at research farms and producers' fields with corn-soybean or alfalfa-corn rotations to evaluate several P management practices and provide new knowledge about P management.
Riparian buffer Phosphorus Bank stability	**Economically sustainable riparian buffer to promote bank stability and reduce gully erosion and phosphorus runoff in the Loess Hills** *2002-E30* J. M. Kelly, Natural Resource Ecology and Management, Iowa State University; Sally Logsdon and Mike Burkhart, National Soil Tilth Lab, Ames This project considered what types and configurations of vegetative buffers might be effective in slowing soil loss at a Loess Hills site. The researchers found that 1) a planted buffer (grass and trees), with periodic harvest of the cottonwood trees, allowed phosphorus entrapment and removal before reaching the stream, and 2) the nearby stream did not extend further into the field, as had occurred in the past seasons.
Phosphorus Manure Commercial fertilizer Leaching	**Understanding the potential of phosphorus transport to water resources via leaching** *2002-40* James L. Baker, Agricultural and Biosystems Engineering, Iowa State University This study found that phosphorus concentrations in tile drainage water are much lower than in water percolating down to the water table from the surface, due to subsoil extraction. The investigators predicted that the subsoil extraction process can be a beneficial process for several decades, if not longer.
Grazing Phosphorus Stocking rate Surface runoff	**Impacts of managed grazing on stream ecology and water quality** *2002-U19* Jim Russell, Animal Science, Iowa State University This project measured and analyzed the varying effects different grazing systems have on the nutrients that appear in surface runoff. The results demonstrated that sediment and phosphorus loading from upland areas of pastures may be controlled by using grazing management practices that maintained forage height at 4 inches or greater. Similarly, maintaining adequate forage along pasture streams limited sediment and phosphorus loading from stream bank erosion. However, the confounding of stocking management practices with stocking rate and climatic variables make it difficult to define which management practices are most beneficial.

Nitrogen Corn Root health Organic matter Perennial forages Manure	**Improving farm nutrient management by optimizing organic matter inputs and root health** *2002-41* Walter Goldstein, Michael Fields Ag. Institute, Troy, WI; and Cynthia Cambardella, National Soil Tilth Lab, Ames Farmer cooperators conducted strip trials to help investigators create a nutrient and organic matter budgeting system that offered whole farm management guidelines to tighten nitrogen budgets for corn. Corn root health also was analyzed. The researchers concluded that more work is needed for the budgeter to be a useful tool to plan sustainable farm systems. On-farm testing of organic matter, nutrients, and corn used to validate the model 1) showed a positive relationship between nitrogen (N) uptake by corn and corn root health, with healthier roots apparently better being more efficient at N uptake regardless of the source of the N, and 2) indicated that corn grown in systems with perennial forages and animal manures tended to have healthier roots. The work raised further questions about N and carbon soil dynamics and root interactions.
Phosphorus Manure	**Agronomic and environmental soil testing for phosphorus and threshold levels in soils** *2001-11* A.P. Mallarino, Agronomy, Iowa State University The overall goal of this project was to provide practical information that can be used to improve phosphorus (P) management, improve soil test interpretations for manured soils, develop guidelines for environmentally sound land application of P, and contribute to more efficient use of P in agronomic settings.
Manure Manure application Manure distribution Commercial fertilizer	**Optimizing solid manure application by improving distribution** *2001-24* H. Mark Hanna, Thomas L. Richard and Graeme R. Quick, Agricultural and Biosystems Engineering, Iowa State University Improving the uniformity of manure distribution may make it a more effective substitute for commercial fertilizer and allow farmers to take proper nutrient credit for the manure. This work shows what manufacturers need to know to improve equipment performance and what farmers need to know about using manure-spreading equipment effectively.
Wetlands Nitrogen Phosphorus Water quality	**Evaluating the effectiveness of restored wetlands for reducing nutrient losses from agricultural watersheds** *2001-60* Arnold G. van der Valk, Ecology, Evolution and Organismal Biology, Iowa State University Investigators found that runoff from only 20 percent of the upland areas in the Iowa Great Lakes watershed passes through restored wetlands before reaching the lakes. Most wetlands did not receive agricultural runoff. Wetlands were found to be effective sinks for total nitrogen, but their effectiveness as sinks for total phosphorous was less clear.
Livestock Manure Manure testing	**Livestock and the environment in Sioux County** *2000-36* Joel DeJong and Kris Kohl, Iowa State University Extension Crop Specialists The goal of this project was to help livestock producers make better use of their manure. By forming focus groups, the researchers determined common barriers to improving manure management in Sioux County, IA. As a result of the findings, ISU Extension recommendations for manure testing were updated.
Anhydrous ammonia Commercial fertilizer Nitrogen Nutrient application	**Reducing anhydrous ammonia application by optimizing distribution** *2000-34* H. Mark Hanna and James L. Baker, Agricultural and Biosystems Engineering, Iowa State University; Tom S. Colvin, National Soil Tilth Laboratory, Ames; and Michael L. White, Warren County Extension, Indianola Anhydrous ammonia 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. This project found that improved distribution of anhydrous ammonia fertilizer application equipment discouraged excessive nitrogen application. In field tests, plumbing techniques and newer manifold styles improved row-to-row distribution allowing less total fertilizer to be applied.

Corn Zinc	**Crop response to zinc as a micronutrient in Iowa** *2000-04* Randy Killorn and Anna Bickel, Agronomy, Iowa State University The objectives of this study were to measure corn grain yield responses to zinc fertilizers within fields, and to define soil characteristics in responsive areas, thereby providing a basis for differential Zn applications. The most common result was that Zn application had no effect on grain yield. There were six sites (of 12 total) where grain yield was significantly affected on one or more soils. However, there were only nine significant grain yield responses to Zn application in the 61 comparisons. Grain yield decreased in seven instances.
Hoop houses Manure Compost Crop yields Weeds	**Soil amendment effects on crop-weed interactions** *2000-11* Matt Liebman, Agronomy, Iowa State University; and Tom L. Richard, Agricultural and Biosystems Engineering, Iowa State University This project evaluated the impacts of composted swine manure on soil characteristics and the growth and seed production of weeds. Applications of compost increased soil organic matter, P, K and nitrate-N levels. While compost increased the nutrient concentration, heights and seed production in some certain weeds, overall there was no effect on corn grain yield in the majority of comparisons. Investigators hypothesize that the potential for compost to increase the competitive effects of weeds on corn is greatest when weeds emerge close to the time of crop emergence.
Hoop houses Manure Compost Swine	**Optimizing swine hoop manure management of soil quality and crop system performance** *2000-42* Tom L. Richard, Agricultural and Biosystems Engineering, Iowa State University In this project, investigators looked at the impact of alternative hoop manure management strategies on soil quality and cropping system performance. They found that if the bedded manure pack is being cleaned out in the fall, both direct application and composting have similar crop effects. But for spring clean-out, composting is recommended, as direct application of heavily bedded manure can cause soil immobilization and crop N stress.
Compost Swine	**Demonstration of swine carcass composting as part of an environmentally friendly production system** *2000-33* Jay D. Harmon, Agricultural and Biosystems Engineering, Iowa State University The investigators found that 12 percent of Iowa swine producers were using composting as their sole method of morality management/disposal. The demonstration project showed that composting of swine carcasses worked well with two different types of swine production farms, two different types of facilities, and several co-composting materials.
Poultry Manure Commercial fertilizer Nitrogen Corn Soybean Phosphorus	**Environmental impacts of use of poultry manure on water quality** *1999-68B* Rameshwar S. Kanwar, Jeff Lorimor and H. Xin, Agricultural and Biosystems Engineering, Iowa State University Year four of this four-year project confirmed that poultry manure applications at a lower N rate resulted in lower concentration of nitrate-nitrogen, phosphate-phosphorus, and pathogenic bacteria in subsurface drainage water, as well as the highest average corn yields.
Poultry Manure Commercial fertilizer Nitrogen Corn Soybean Phosphorus	**Environmental impacts of use of poultry manure for agricultural production system** *1999-68A* Rameshwar S. Kanwar, Jeff Lorimor and H. Xin, Agricultural and Biosystems Engineering, Iowa State University Investigators monitored two application rates of poultry manure and commercial fertilizer nitrogen on corn and soybeans for leaching of nitrate-nitrogen, phosphate-phosphorus, and pathogenic bacteria to subsurface drainage water and shallow ground water in field experiments. They found that lower application rates resulted in less leaching, as well as the highest average corn yields.

Manure Dairy Grazing	**Dairy manure quantification and characterization in grazing systems** *1999-16* Wendy Powers and Marjorie Faust, Animal Science, Iowa State University This project examined the amount and nutrient concentration of manure generated by lactating dairy cows managed in an intensive grazing system. These manure nutrient figures can be used to determine the maximum animal stocking density that will safeguard against nutrient runoff or degradation of water quality by concentrated nutrients. This work confirmed that input-output models to predict fecal excretions work well for grazing herds. Nutrient concentrations were different between breeds and seasons. The observed differences between breeds were attributed more to differing management practices than genetics
Organic Vegetable production Poultry manure Compost	**Evaluation of organic soil amendments for certified organic vegetable and herb production** *1999-50* Kathleen Delate, Horticulture and Agronomy, Iowa State University Responding to increased interest from the state's organic farmers, this study analyzed some of the natural soil amendment/fertilizer products used in the production of organic vegetables and herbs. Using both on-farm and university research sites, yield and postharvest quality of peppers, three herbs, and broccoli were assessed. Increased yields were obtained with vegetables (broccoli and green pepper) fertilized with composted turkey manure, but results with herb crops were not consistent. Compost increased herb (Echinacea and lemon balm) leaf growth, but not root growth. Imported biological fertilizers also increased plant growth and yields but did not provide any advantage over locally produced compost.
Swine Hoop houses Manure Compost Nitrogen Carbon	**Nitrogen conservation in swine manure composting land-application systems** *1999-62* Thomas L. Richard, Agricultural and Biosystems Engineering, Iowa State University; Cynthia A. Cambardella, National Soil Tilth Laboratory Ames; and Thomas E. Loynachan, Agronomy, Iowa State University In the swine production hoop houses, the use of bedding generates large volumes of manure that composts easily. However, composting results in nutrient losses, especially for nitrogen, which then diminishes its value as a fertilizer. This study looked at carbon and nitrogen dynamics in the composting process and subsequent soil mineralization.
Manure Socio-technical dimension	**Socio-technical and environmental dimensions of swine manure management decisions** *1999-69* Clare Hinrichs, Sociology, Iowa State University; and Thomas Richard, Agricultural and Biosystems Engineering, Iowa State University Once strictly a farm management concern, manure management is now a matter of state and societal interest. This qualitative study examines why and how farmers in two Iowa watersheds have made decisions about manure management for their operations. Farmers interviewed explained the motives, logic, opportunities, and constraints that guide their use of particular management practices.
Tillage No-till Ridgetill Commercial fertilizer Corn Soybean Phosphorus Potassium	**Development and implementation of cost-effective fertilization and tillage management alternatives for improving soil quality in corn-soybean rotations** *1998-36* A.P. Mallarino, Agronomy, Iowa State University Tillage and fertilization treatments for corn were tested in research settings and on producers' farms. Project objective included: development of phosphorus, potassium, and starter fertilization recommendations for corn and soybean under different tillage systems; evaluation of improved diagnostic tools to assess P and K soil fertility in no-till and ridge-till; economic analysis of alternative fertilization and tillage practices; and demonstration of a methodology for on-farm research and demonstrations based on precision agriculture technologies.

Rotational cropping Soil quality	**Soil quality, yield stability and economic attributes of alternative crop rotations** *1998-05* Douglas Karlen and Cynthia Cambardella, National Soil Tilth Laboratory, Ames; and Antonio Mallarino, Agronomy, Iowa State University Three long-term rotational crop studies in Iowa and one in Wisconsin were examined for conclusive evidence of rotational effects on soil quality. Long-term yield data also were evaluated to determine if there was a quantifiable relationship between soil quality and yield or yield stability. Quantifying the rotation effects through soil quality assessment proved to be very difficult. As a result, very few significant differences were found between rotations for the soil quality indicators evaluated. No soil quality indicator was consistently sensitive to the rotational effects for all sites.
Manure Education	**Statewide manure management education initiative** *1998-51* Gerald A. Miller, College of Agriculture, Iowa State University After manure management was identified as a high priority issue for programming in 1996-97, ISU Extension launched a statewide initiative that made education and individualized assistance on manure nutrient management available to crop and livestock producers in every Iowa county. The initiative involved educational workshops for producers as well as on-farm demonstrations and increased publicity concerning the economic and environmental value of managing manure nutrients for crop production.
Nitrogen Tillage Swine Corn Soybean	**Impacts of swine manure application and alternative N-management practices on productivity, sustainability and water quality** *1997-60* Rameshwar Kanwar et al, Agricultural and Biosystems Engineering, Iowa State University For this project, the effects of nine N-management practices under different tillage and cropping systems were evaluated. Forty experimental plots equipped with individual sumps and subsurface drainage metering and monitoring devices were used for the study. Overall results have indicated if the appropriate amount of N from swine manure can be applied, application rates and methods can be successfully managed for corn-soybean systems without damaging the water quality.
Corn Soybean Nitrogen Education	**Education based incentive program to enhance long-term adoption of sustainable nutrient/pest management – A demonstration with farmers in northeast Iowa** *1997-21* Gerard A. Miller, College of Agriculture, Iowa State University Over three years, a series of nutrient/pest management planning workshops helped participants develop and refine management plans for their farms. Sixty-five producers enrolled over 20,000 acres in the program. A majority of those surveyed reduce their nitrogen use.
Swine Manure Corn Nitrogen	**Development of guidelines for application of swine manure to optimize nitrogen management for corn** *1996-10* Alfred Blackmer, Agronomy, Iowa State University Results from on-farm trials were analyzed to develop guidelines that will help farmers evaluate and improve their manure-N management, including utilizing swine manure as a cost-effective substitute for commercial fertilizer. The experimental methods included use of the late-spring test for soil nitrate and the end-of-season test for cornstalk nitrate to measure N availability at each research site.
Conservation practices, Water quality, quantity and management -	**Constructed wetlands to reduce agricultural chemical transport to water resource -** *1995-48* W.G. Crumpton, Botany, Iowa State University This project was part of a larger five-year, multi-phase research and demonstration effort to study water quality and agricultural drainage wells (ADWs). The goal was to evaluate the use of constructed wetlands for treatment of subsurface drainage prior to release to groundwater through ADWs and to develop design and operation criteria for these treatment wetlands.

Manure Livestock Education	**Mahaska County livestock manure/crop nutrient management demonstration project** *1995-05* Joe Sellers, Iowa State University Extension field livestock specialist, Chariton; and Alan Seim and Grant Wells, Iowa State University Extension (retired) This demonstration project was developed at the behest of Mahaska County producers, desiring more information relating to the nutrient management of their livestock systems. Multiple demonstration sites were selected, reflective of different production systems and soil characteristics. The effects of various application methods on surface residue were emphasized. After three years, yields and profit measurements for various methods were evaluated. The researchers concluded that producers want more guidance about residue management and consistency of manure nutrient content.
Manure Compost Urban	**Animal manure/municipal yard waste composting project in Wright County, Iowa** *1996-06* Randy Killorn and Don Wetterauer, Agronomy, Iowa State University Two of Iowa's waste disposal problems are manure from livestock confinement facilities and yard waste. Considered separately, they present special difficulties in disposal, but when combined, the researchers discovered they could make a good compost material suitable for use by gardeners and landscapers.
Commercial fertilizer Tillage No-till Ridge-till Banding	**Fertilizer placement for ridge-till and no-till systems** *1995-55* A.P. Mallarino, Agronomy, Iowa State University The overall goal for this project was to identify fertilizer practices that increase profits and decrease phosphorus contamination of water supplies in no-till and ridge-till cropping systems. The researchers concluded that though subsurface banding for phosphorus or deep banding for potassium will not always result in economic gains, it a) is not economically detrimental and b) will potentially reduce the contamination of surface water supplies.
Nitrogen Hay Banding	**Effect of tillage, crop rotation and innovative nitrogen and pesticide management practices on productivity, sustainability and water quality** *1993-14* Rameshwar Kanwar, Agricultural and Biosystems Engineering, Iowa State University, et. al. In this project, the effects of seven N management practices on water quality were evaluated after collecting data from 40 experimental plots. In comparison with the higher rate of N application, lower rates of N application and strip and hay cropping systems help produce lower concentrations of NO3-N in the shallow groundwater. Also, banding of herbicides has resulted in lower herbicide losses to shallow groundwater. The use of the late spring NO3-N test (LSNT) and strip cropping show a great deal of promise to protect water quality.
Manure Nitrogen Phosphorus Potassium Nutrient application	**Animal manure utilization in crop nutrient planning** *1993-10* Gerald A. Miller, Agronomy Extension, Iowa State University This project cooperated with and built on other initiatives aimed at encouraging livestock producers to take credit for the nutrients in their livestock manure. Improved management of the manure resource can help avoid over-application of purchased nutrients and potential pollution of water supplies. Cooperating farmers were instructed in manure spreader calibration and other means for taking advantage of manure's fertilizer value.
Manure Education Nitrogen Testing	**Calibration of the late-spring soil nitrate test for manured soils** *1992-28* Alfred Blackmer, Agronomy, Iowa State University Iowa farmers cooperated at 111 sites to calibrate the late-spring soil nitrate test on manured cornfields. Results showed that the guidelines for using the late-spring test in manure cornfields needed to be revised to decrease amounts of fertilizer nitrogen recommended.

Manure Education Nitrogen Phosphorus Testing	**Manure management education and demonstration project** *1992-19* Jerry W. Long, Greg Brenneman and Kenneth Muller, ISU Extension This project demonstrated a feasible, economical testing program to evaluate the nutrient content of livestock wastes. A portable kit was used that can test for ammonia nitrogen and phosphorus in both liquid and solid manure, facilitating on-site testing. The results of this on-farm testing kit, which is currently available to producers, were then compared with laboratory analysis to determine the kit's accuracy. By analyzing the nutrient value of manure immediately prior to land application, producers can make more environmentally sound manure management decisions.
Manure Compost Fertilizer Pathogens Biocontrol agents	**The effect of organic verses chemical fertilizers on insect pathogens** *1992-18* Leslie C. Lewis, UDSA-ARS National Soil Tilth Laboratory, et. al. The project studied the effects of various fertilizers (fresh cow manure, composted cow manure, and urea) on potential biocontrol organisms (nematode *Steinernema carpocapsae* and fungus *Beauveria bassiana*) for the black cutworm, a major corn seedling pest. Results show that *S. carpocapsae* is more active in soils with no fertilizer or composted manure than fresh manure or chemical fertilizer, *B. bassiana* is adversely affected by fresh manure.
Wetlands Nitrogen Atrazine Pollutants	**Transformation and fate of nitrate and atrazine in freshwater wetlands** *1990-63* William Crumpton and Arnold G. van der Valk, Iowa State University This study, conducted at a complex of 48 experimental wetland mesocosms at ISU's Hinds Irrigation Farm, sought to determine the assimilative capacity of wetlands for nitrate and atrazine. Results confirmed that freshwater wetlands have considerable capacity to transform nitrate. In simulations, a one-acre wetland receiving drainage from 100 acres of corn reduced nitrate by 60 percent after three days. Atrazine disappeared rapidly from water overlying wetland sediments.
Nitrogen Water quality Corn Soybean Tillage	**Evaluation of tillage and crop rotation effects on groundwater quality – Nashua project** *1990-41* Rameshwar Kanwar, Agricultural and Biosystems Engineering, Iowa State University, et. al. With experimental plots, investigators studied the effects of tillage and crop rotation on leaching of pesticides and nitrate into groundwater. They found that nitrate-N concentrations in tile drainage water were highest under moldboard plow and lowest under no-till. However, N losses through tile drainage were greater under no-tillage and chisel plow systems because more water moved through the profile. The three-year average for N concentrations were significantly higher under continuous corn compared to corn-soybean.
Fertilizer Nitrogen Water quality Corn Soybean Education Testing	**Implementing nitrogen management to protect Iowa's groundwater** *1990-28* Kris Kohl and Stewart Melvin, Iowa State University Extension, and James Hultgren, farmer, Alta Investigators sought to determine current contamination levels in tile water under typical Iowa farming practices and found that all samples during the growing season exceeded the EPA standard for safe drinking water. They determined that the nitrogen recommendations based on the late-spring soil nitrate test were unlikely to reduce tile water concentrations below the EPA standard. The test proved a valuable tool for reducing nitrogen application in dry years but less accurate in wet years.
Agroforestry, conservation, nutrient management, water quality, quantity and management	**Sustainable tree-shrub-grass buffer strips along waterways** *1990-07* Richard Schultz, Forestry, Iowa State University This project to conceptualize and design constructed Multi-species riparian buffer strips (CMRBS) was conducted by Schultz in conjunction with the Iowa State Agroforestry Research Team, IStART. . Data considered included Atrazine, NO3-N, sediment, infilitration, biomass, wildlife, ruffoff, and plant species characteristics.

Fertilizer Nitrogen Corn Soybean Education Testing	**Operating procedures for use of the late-spring soil test by fertilizer dealers and consultants in Iowa** *1989-28* Alfred M. Blackmer, Agronomy, Iowa State University This project developed operating procedures by which fertilizer dealers and consultants can use the late-spring soil test, a promising tool for improving nitrogen management. In all, 104 trials were conducted in 36 Iowa counties. Averaging 40 trials in 1991, use of the soil test resulted in a 36 percent reduction of fertilizer N application, while maintaining profits
Fertilizer Manure Nitrogen Corn Alfalfa Tillage Testing Pollution Water quality	**Monitoring and modeling cropping system nitrogen for a sustainable agriculture** *1988-19* Delmar Vander Zee, Dordt College, et. al. This study assessed ways to minimize nitrate loss and optimize N uptake by plants, thus reducing adverse effects on groundwater and maximizing benefits to crops. Nitrate was found in all samples of well water in the study area. Cropping and manure fertilization history strongly affected soil nitrate concentrations. Nitrate concentrations were up to eight times higher in row-cropped fields compared to alfalfa, regardless of tillage. The researchers concluded that including alfalfa in rotations and monitoring soil in late spring for nitrate had great potential for reducing groundwater pollution.
Fertilizer Nitrogen Corn Tillage	**Nitrogen management alternatives for ridge tillage corn** *1988-17* Richard M. Cruse, Agronomy, Iowa State University, et. al. This study investigated corn's response to ridge-till and nitrogen fertilizer placement methods. Results of this study indicated that efficiency of plant uptake of nitrogen is increased significantly if applications are injected instead of broadcast on the surface, although it did not seem to matter if applications occurred in the row or between the ridges.
Fertilizer Nitrogen Water quality Corn Tillage	**Nitrogen efficiency with no-till and conventional tillage cropping systems for energy conservation and water quality benefits** *1988-20* Rameshwar Kanwar, Agricultural and Biosystems Engineering, Iowa State University, et. al. Investigators measured macropores in the soil profile under no-till and conventional tillage to determine how water transport relates to the fate and leaching of nitrate-nitrogen and herbicides to groundwater. On average, the no-till sites had less macropore area, and smaller macropores, compared to conventional tillage sites. The project helped refine experimental methods for fate and transport of chemicals.
Fertilizer Nitrogen Water quality Corn Tillage	**Effect of split N-fertilizer applications on drainage water quality and NO3-N leaching** *1988-07* Rameshwar Kanwar, Agricultural and Biosystems Engineering, Iowa State University Field experiments at the ISU Agronomy and Agricultural Engineering Research Farm measured the effects of dividing nitrogen over several applications on drainage water quality and nitrate leaching. Data showed considerably less nitrate-nitrogen concentrations in drainage water under no-till with split N applications at lower rates. Corn yields were not affected by tillage or fertilizer management schemes.
Manure Nitrogen Phosphorus Corn Soybean	**A comparison of agricultural systems at the Allee Research Center** *1988-09 and 1991-36* Dennis Shannon, Mark Honeyman and Roger McMillan, Iowa State Research Farms This six-year project compared a petrochemical-based, high-tillage, low-management cropping system; a ridge-till, reduced fertilizer and pesticide, high management system; and a rotational, conventionally tilled, low-pesticide, low-fertilizer, high management system. Overall, the study suggested that 1) a complex, rotational cropping system can compete economically if high management is applied and adequate time allowed for transition, and 2) additional management information can replace the need for capital.

Hoop houses Manure Swine Cattle Livestock	**Hoop Group Initiative** *1997-2002* Mark Honeyman, Jim Kliebenstein, Jay Harmon, Tom Richards, and Don Lay, Iowa State University The work of the ISU Hoop Group, supported by the Leopold Center from 1997-2002, involved construction of hoops and a scale model confinement facility at the Rhodes Research Farm ($10,000, completed in the fall of 1997) as well as research on key producer questions regarding comparisons of hoops and confinement operations. The group continued to receive support from the Leopold Center competitive grant program and expanded from swine to beef and dairy cattle and other livestock.
Manure Education	**Nutrient Management Conferences and Workshops** *1994-1996* Between Jan. 1994 and Jan. 1996, the Leopold Center, ISU Extension and other agencies and organizations sponsored 14 conferences and workshops on manure and nutrient management around Iowa.
Manure Nitrogen Phosphorus Corn Soybean	**Manure Management Issue Team** *1991-1995* Stewart W. Melvin, Iowa State University This team's work, funded from 1991-1995, revolved around four major research thrusts: sustainable systems; a large plot study of manure; manure application to soybeans; and an economic study.

Summaries of these and other grants are listed at: www.leopold.iastate.edu/grants/completed

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