

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Natural Resources And The Environment

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	25%		10%	
112	Watershed Protection and Management	15%		15%	
123	Management and Sustainability of Forest Resources	10%		15%	
132	Weather and Climate	15%		10%	
133	Pollution Prevention and Mitigation	10%		10%	
134	Outdoor Recreation	0%		10%	
135	Aquatic and Terrestrial Wildlife	5%		15%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		5%	
405	Drainage and Irrigation Systems and Facilities	5%		5%	
605	Natural Resource and Environmental Economics	0%		5%	
806	Youth Development	15%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	6.0	0.0	9.0	0.0
Actual Paid Professional	0.0	0.0	5.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
262415	0	541221	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
262415	0	541221	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1376582	0	2669080	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Activities included the National Atmospheric Deposition Program's ongoing work collecting and analyzing precipitation chemistry and atmospheric chemistry samples and the dissemination of collected data to support research and education, ongoing analysis of soil samples to assess phosphorus retention in a long-term wetland, research conducted on the role of cultural ecosystem services in landscape decisions and regional well-being, brownfield reclamation at the U.S. Steel South Works plant site in Chicago, preliminary characterization and measurement of soils and sediment deposit at three locations that experienced recent natural and man-induced levee breaches to identify patterns of soil and crop damage, ongoing work on an online database of Empoasca species that resulted in 84 species being added to the online database and 47 new synonyms being recognized [approximately 6,500 new images were added to the online keys and database to illustrate diagnostic morphological features of various leafhopper species; data is available at <http://imperialis.inhs.illinois.edu/dmitriev/index.asp>], work to improve our understanding of the role urban agriculture plays in the conservation of species and the provisioning of ecosystem services, research that has generated data on non-target effects of agricultural use of pesticides on the ecology of vector mosquitoes [this data will aid public health agencies in development of policies on how to converge integrated pest management with integrated vector management to promote crop production while mitigating the risk of mosquito-borne diseases], and work to evaluate the efficacy of a fire-grazing model on grasslands in the upper Midwest in terms of improving conditions for grassland birds and potential benefits accruing to livestock producers.

Activities also included analysis and economic modeling of existing and potential groundwater management systems that showed that alternate policies can have very different impacts both on resource condition and on farm-level profitability [in particular, transferable permit systems, when designed to address instream flow and other local concerns, are often less costly than alternate policies to producers for any given level of required streamflow], an investigation into the relationships between plant community composition and soil microbial community composition in a prairie restoration which found that soil microbial community composition was more closely related to plant communities from five years ago than to the contemporary plant community [this suggests that invasive plant impacts on soil communities take some time to manifest], the statistical analysis of the results of a choice experiment survey regarding the values people in Illinois place on hypothetical restored grasslands with varying levels of biodiversity, the development of a model of the value to agriculture of improved biocontrol of pests in row crop agriculture, the demonstration of the applicability of a relatively new econometric methodology, the generalized method of moments, to take advantage of both stated preference and revealed preference data to estimate the value of economic losses from environmental contamination, and research to estimate the potential for water quality markets in the corn belt to yield cost savings in efforts to reduce nitrogen flows

into Midwestern waterways.

Conference presentations included the National Atmospheric Deposition Program Symposium, International Symposium for Society and Resource Management, An Intersection of Society and Nature [Uppsala, Sweden], Mid-American Landscaping, Illinois Mosquito and Vector Control Association, Indiana Dunes National Lakeshore Science Conference, International Association for Great Lakes Research, Ecological Society of America, Illinois State Academy of Science, 15th International Clay Conference, 50th Anniversary Annual Meeting of the Clay Minerals Society, Soil Science Society of America, Water Environment Federation, American Society of Agricultural and Biological Engineers, NADP 2013: Western U.S. Monitoring and Analysis: Progress and Current Issues, and the Association for Environmental Studies and Sciences.

Extension activities encompassed a variety of delivery methods to provide education regarding climate, soil and water management, forestry, and environmental stewardship. A description of some of the major areas of focus follows.

New programming included the development of a curriculum for the four-part **Weather Observer Course**, with one session consisting of which training for the volunteer precipitation monitoring program that is a part of the national volunteer precipitation monitoring program. YouTube videos on weather/climate topics were an additional educational effort to address climate and weather.

In addition, two new online self-study modules for Certified Crop Advisers were developed this past year to provide continuing education credits. The new modules address water table management and bioreactors. The latter module explores the effects on the reduction of nutrient loss through subsurface field tile drainage into local surface water sources. There are now 13 online CCA courses available in several subject areas including nutrient management, integrated pest management, and soil and water management. The annual **Soil and Water Management Workshop** for Certified Crop Advisers included topics on climate change, biomass crops, soil and water issues, cover crops/bioenergy crops, and drought.

The **Illinois Master Naturalist** [ILMN] program completed a sixth year of statewide implementation. Using the 20 chapter curriculum that included a chapter on weather and climate, training offered in 11 multi-county locations to certify new Master Naturalists has been completed or was in process. Slightly more than 500 individuals are actively engaged in a wide variety of projects as environmental stewards. A web-based reporting site is being used to collect information on all Master Naturalists' and Master Gardeners' training, volunteer hours, and projects.

This past year the **Soil Fertility Webinar** targeted for Certified Crop Advisers was hosted at 16 local Extension offices across the state in February of 2013 and included topics focusing on successful nutrient management, secondary and micronutrients, utilizing GPS and remote sensing, and phosphorus and potassium budgets. 'Nitrogen Management after the Drought' was a topic addressed at the six **Corn and Soybean Classics** that was presented by an Extension crop science specialist. Information about drought and crop management and the effects of the 2011 Ohio and Mississippi River flooding and induced levee breach on agricultural lands were also topics included in the four regional **Crop Management Conferences**.

Educational efforts carried out with respect to air quality addressed radon home testing and mitigation and recent requirements that impact day care facilities. Presentations are supported using grant dollars and through partnerships with the Illinois Department of Public Health with leadership provided by an Extension staff member with an engineering degree. This area of focus is also related to the Human Health and Human Development planned program.

Extension campus and field staff continued to conduct outreach focusing on the Emerald Ash Borer and other invasive pest identification and control practices. Six **First Detector** trainings were developed and delivered across the state this year to prevent the loss of shade trees that remove and sequester carbon from the atmosphere [also discussed in the Plant Health, Systems, and Production planned program]. The Extension pesticide training program reached 2,793 private [farmer] pesticide applicators and 9,203 commercial applicators this past year providing information on proper and safe use of pesticides that is vital to Illinois residents in terms of public health protection and environmental stewardship.

The majority of forestry-related education focused on forest landowner education and outreach that extends beyond management to include urban forestry, forest product marketing and utilization, and carbon sequestration by providing technical assistance through woodland owner conferences, seminars, workshops, field days, and Extension forestry bulletins. Many of the face-to-face programs included information on control of invasive plant species in woodlands. **Ask A Forester** is a key feature of the Extension forestry website. Iowa State University Extension forestry and University of Illinois Extension again partnered to offer the **Tri-State Extension Forest Stewardship Conference** that included 27 session choices related to tree diseases and pests, pruning and grafting, forest vegetation management, chainsaw sharpening, planting techniques, and timber sale contracts and marketing.

Youth conservation days with hands-on activities were held in many locations in the state and the **Think Green** curriculum [used to engage youth in investigating how living things interact with each other and with their environment] reached 1,245 3rd to 5th graders. In addition, a survey of 115 4-H youth campers indicates that 94% agreed or strongly agreed that they increased their understanding of how people can use but protect natural resources as a result of attending 4-H camp.

2. Brief description of the target audience

Members of the target audience included urban farmers, gardeners, planners and policy makers, professionals and academics focusing on natural resource management and landscape planning, natural resource managers and scientists involved with and concerned about optimal management of brownfields and other human-altered ecosystems, professional insect taxonomists, Extension specialists, professional insect diagnosticians, students, amateur naturalists, insect ecologists, public health agencies, mosquito abatement districts, scientists and conservation biologists at the state, regional, and national levels, USDA Forest Service scientists and staff, natural resource managers, agricultural producers, water managers of groundwater management districts, livestock producers, regulators, environmental scientists and environmental engineers, scientists and regulators working in the area of agricultural non-point pollution control, and federal, state, and local government agencies that make policy and management decisions regarding environmental quality and natural resource management. Extension activities also targeted pesticide applicators and youth.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	23342	69791	68834	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2013

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	33	33

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Projects

Year	Actual
2013	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number Of Individuals That Increased Knowledge Of Human Actions That Negatively Affect The Environment
2	Actions Taken By Program Participants To Protect The Environment [Water Quality, Air Quality, Soil Loss, Wildlife, And Natural Vegetation]
3	Dissemination Of Air Quality And Atmospheric Data Through Web Hits On The National Atmospheric Deposition Program Website
4	Reducing Nitrate And Sulfate Deposition
5	Reducing Contamination And Soil Damage Caused By Levee Breaches
6	Addition Of New Species And Synonyms To An Online Database For The Identification Of Empoasca
7	Improved Understanding Of How Agricultural Practices May Modify A Mosquito's Ability To Transmit Diseases
8	The Design And Evaluation Of Alternate Spatially-Targeted Resource Management Policies That Are Cost-Effective And Maintain Or Improve Environmental Conditions
9	The Removal Of Emerging Contaminants That Have Been Detected In Wastewater Discharges From Various Human And Livestock Sources
10	Number Of Youth Who Indicate Increased Knowledge About The Environment
11	Number Of Pesticide Applicators Making Decisions To Avoid Harming The Environment
12	Increased Knowledge About Weather Processes And Climate Change

Outcome #1

1. Outcome Measures

Number Of Individuals That Increased Knowledge Of Human Actions That Negatively Affect The Environment

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Actions Taken By Program Participants To Protect The Environment [Water Quality, Air Quality, Soil Loss, Wildlife, And Natural Vegetation]

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Dissemination Of Air Quality And Atmospheric Data Through Web Hits On The National Atmospheric Deposition Program Website

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1250000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Acidic atmospheric deposition continues to be a serious environmental concern. Sulfur and nitrogen oxides emitted from industrial and transportation sources, utilities, and metropolitan areas enter the atmosphere and are transformed into acidifying compounds. These pollutants are transported in the atmosphere and are removed, in part, as acidic wet deposition. Ecological impacts from this deposition include changes to lake and stream chemistry, reduced forest growth, reduced soil fertility, and increased weathering and corrosion of exposed structures. Aerosols resulting from the emissions reduce visibility and alter the radiative balance of the

climate system. Epidemiological studies link adverse human health impacts with fine particles containing sulfate and nitrate. Deposition of atmospheric mercury has been identified as an important negative input to many ecosystems. Mercury deposition is a concern as toxic methyl mercury can accumulate in the food chain and impact human health. The goal of the NADP is to monitor the nation's precipitation for these constituents to determine whether spatial and temporal trends in concentration and wet deposition are present.

What has been done

Since 1978, the National Atmospheric Deposition Program [NADP] has provided fundamental measurements to support informed decisions on environmental and agricultural issues related to the ambient concentration and wet deposition of atmospheric pollutants in North America. The NRSP-3 provides a framework for cooperation among State Agricultural Experiment Stations, the U.S. Department of Agriculture, and other cooperating governmental and non-governmental organizations.

Results

During 2013, NADP data were cited in over 200 peer-reviewed publications and book chapters. Data from the NADP's five monitoring networks, namely the National Trends Network [NTN], Mercury Deposition Network [MDN], Atmospheric Mercury Monitoring Network [AMNet], Ammonia Monitoring Network [AMoN], and Atmospheric Integrated Research Monitoring Network [AIRMoN] were downloaded over 28,000 times by over 39,000 registered data users. Each year, NADP data are used by policy makers to make informed decisions on agriculturally-important topics, including the impact of atmospheric pollutant fallout on the North American food supply. All data are available free of charge at <http://nadp.isws.illinois.edu>.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

Reducing Nitrate And Sulfate Deposition

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A better understanding of the chemical inputs resulting from atmospheric deposition is critical to understanding nutrient cycling in both crop and forest systems. This can lead to improved nutrient utilization in these systems. The comprehensive monitoring system that Illinois takes part in is also an early warning system for excessive nutrient loadings through atmospheric deposition, and provides an indication of the recovery from acidification in many ecosystems.

What has been done

Wet atmospheric deposition continues to be monitored at three sites in Illinois as part of this nationwide project. Data include weekly collection of precipitation with pH and complete chemistry measured. A long-term record [34 years] is now available at some of these sites, allowing an understanding of long-term changes in chemistry. These results continue to be part of a national program that leads to a complete understanding of atmospheric inputs of nutrients, and is needed to develop appropriate policies.

Results

Results continue to show a decline in both nitrate and sulfate deposition across the eastern U.S. in response to Clean Air Act regulations. This is one of the few projects that can show a clear environmental outcome to a change in national policies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation

Outcome #5

1. Outcome Measures

Reducing Contamination And Soil Damage Caused By Levee Breaches

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Whenever levees on the Ohio or Mississippi rivers are breached, there are soil damages in the flooded areas that impact agricultural management capacities and crop productivity. Floodwaters coat the entire flooded land surface with sediments which include a variety of pollutants, nutrients and contaminants. The nature of the sediments in floodwaters varies with the topographical and land use characteristics of the watershed. The soil types, hydro-geologic features, volume of flow, time of year, agricultural use of fertilizers, pesticides, and other chemicals as well as upstream point sources such as sewage treatment plants, storm sewer drainage and other urban land uses will affect the extent of the contamination and fine scale remediation needed.

What has been done

Preliminary characterization and measurement of soils and sediment deposit at three locations that experienced recent natural and man-induced levee breaches are analyzed to identify patterns of soil and crop damage. These findings provide guidance to the restoration of craters, gullies, land scoured areas and contaminated sediment depositional sites with a goal of improving decision making, risk analysis and remedial effectiveness.

Results

Recommendations include: [1] improve characterization and measurement of eroded soils and distribution of sediment contaminants after levee breaching; [2] assess contamination effects on soil productivity and long term agricultural production in order to understand the impacts of flooding on agricultural soils; and [3] evaluate reconstruction investments needed to repair levees based on return of the land to productivity and increased landscape resilience by reducing vulnerability to future flooding and levee-breaching stress.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
605	Natural Resource and Environmental Economics

Outcome #6

1. Outcome Measures

Addition Of New Species And Synonyms To An Online Database For The Identification Of Empoasca

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	131

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Empoasca is one of the most economically-important genera of leafhoppers, with the potato leafhopper and other polyphagous species causing substantial damage to field and horticultural crops annually. The current lack of reliable identification aids and doubts about the identities of numerous previously-described species hinders the ability of economic entomologists and quarantine officers to manage these potential pests and prevent accidental introductions of invasive species. Because few specialists are available to do routine identifications [there are only three full-time leafhopper taxonomists in North America] user-friendly identification tools that can be used by non-specialists are urgently needed. Because they require only a computer with internet connection and basic knowledge of insect morphology, online interactive keys provide the means for non-specialists to identify insects quickly and efficiently.

What has been done

The keys and associated data are being organized to provide a comprehensive resource accessible to anyone with access to the internet. Efforts are being made to include large numbers of illustrations and to provide tools for customized data exploration [creation of custom keys for

leafhoppers occurring in particular regions or host plants], which will make them easier to use for non-entomologists.

Results

During the reporting period, 84 species were added to the online database and 47 new synonyms were recognized. Approximately 6,500 new images were added to the online keys and database to illustrate diagnostic morphological features of various leafhopper species. These images will make the keys easier to use. The project website received ~15,000 unique visitors and can be found at <http://imperialis.inhs.illinois.edu/dmitriev/index.asp>.

4. Associated Knowledge Areas

KA Code	Knowledge Area
134	Outdoor Recreation
211	Insects, Mites, and Other Arthropods Affecting Plants
605	Natural Resource and Environmental Economics

Outcome #7

1. Outcome Measures

Improved Understanding Of How Agricultural Practices May Modify A Mosquito's Ability To Transmit Diseases

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In the United States and throughout the world fertilizers and pesticides are used to improve crop production through nutrient enhancement and control of pest organisms. In general, fertilizers and pesticides are applied in terrestrial environments but they also reach water sources, including ditches, livestock watering ponds, and troughs used in agricultural practices. Some of these water sources are potential breeding sites for the immature stages [larvae] of mosquitoes. Little is known about how these non-target effects of pesticides and fertilizers affect aquatic communities. Therefore there is a need to study these aquatic systems, especially when considering mosquitoes are transmitters of human diseases. We used a series of experiments to test how pesticides and nitrogen enhancement in the larval stages affect mosquito performance [adult life

span] and susceptibility to infection with disease agents [viruses]. Improved understanding of how agricultural practices may modify a mosquito's ability to transmit diseases has important considerations and applications for guiding decision making about mosquito control practices. Control efforts are intimately tied to benefits to society since their aim is to improve human health by minimizing disease risk. Thus, research results have the potential to provide information for policy formulation by Federal, State, and local agencies.

What has been done

We have generated new knowledge on the potential for pesticide use in agriculture to modify the quality of mosquito larval habitats and to influence epidemiologically-important life history traits of mosquito vectors of human and wildlife pathogens. We have shown that pesticides can influence the quality of mosquito larval habitats by changing the relative abundance and community structure of bacterial communities that serve as the main food base for mosquito larvae. Further, our results indicate that pesticides can interact with natural biotic and abiotic factors to influence mosquito survival, baseline immunity, body size, fecundity, and longevity, all of which have an impact on mosquito vectorial capacity.

Results

Pesticides are widely used around the world to control undesirable plants and animals including mosquitoes. The United States accounts for one-third of the total amount of pesticides used to control agricultural and public health pests around the world. This research has generated data on non-target effects of agricultural use of pesticides on ecology of vector mosquitoes. This data will aid public health agencies in development of policies on how to converge integrated pest management with integrated vector management to promote crop production while mitigating the risk of mosquito-borne diseases. Among the audiences that were served by this study are public health agencies and mosquito abatement districts.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife
211	Insects, Mites, and Other Arthropods Affecting Plants
405	Drainage and Irrigation Systems and Facilities

Outcome #8

1. Outcome Measures

The Design And Evaluation Of Alternate Spatially-Targeted Resource Management Policies That Are Cost-Effective And Maintain Or Improve Environmental Conditions

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The project will design and evaluate alternate spatially-targeted resource management policies that are cost-effective and maintain or improve environmental conditions such as groundwater stocks and instream flows.

What has been done

Major activities conducted included workshops and one-on-one meetings with water managers and agricultural producers in Nebraska, Kansas, and Texas. The goals were to understand key stakeholder concerns, determinants of groundwater-fed irrigation behavior, and local variations in water regulations. Data on groundwater use and regulatory structure were collected. A particular focus was information on informal transfers of groundwater pumping rights in regions where such transfers were possible.

Results

Analysis and economic modeling of existing and potential groundwater management systems show that alternate policies can have very different impacts both on resource condition and on farm-level profitability. In particular, transferable permit systems, when designed to address instream flow and other local concerns, are often less costly than alternate policies to producers for any given level of required streamflow. We have been working with several Natural Resource Districts in Nebraska to try to implement functional streamlined transferable permit systems that reduce the transaction costs of reallocating water between producers while meeting regulatory requirements. If successful, such systems would provide quantified monetary benefits to producers as well as reduced impacts on adjacent stream flow.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
405	Drainage and Irrigation Systems and Facilities

Outcome #9

1. Outcome Measures

The Removal Of Emerging Contaminants That Have Been Detected In Wastewater Discharges From Various Human And Livestock Sources

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Work associated with this project looked at the removal of emerging contaminants [such as pharmaceuticals, steroids, surfactants, and plasticizers] that have been detected in wastewater discharges from various human and livestock sources. According to the Union of Concerned Scientists 70% of total annual antibiotics use in the U.S. [11,200 tons] are used for non-therapeutic purposes with cattle and swine, and a significant fraction [up to 75%] is excreted in an unaltered state. When released into the environment, these bioactive chemicals can exert selective pressures on microbial communities and cause them to develop antibiotic resistance as a defense mechanism. Antimicrobial-drug resistance has become a major concern with an estimated economic impact of \$4 to \$5 billion. A significant number of studies have been done on the removal of pharmaceuticals and antibiotic resistance in drinking water and wastewater, and although some removal of pharmaceuticals has been observed in conventional wastewater treatment processes, most are not effectively designed to remove micropollutants. Thus, there is a critical need to better understand the fate, transport and transformation of these emerging contaminants in water purification processes and to develop novel processes that cost-effectively reduce the risks associated with bioactive compounds in wastewaters. This study will provide new knowledge on the effects of novel water treatment processes, which are expected to have certain advantages. In particular, we are focused on treatment systems using activated carbon adsorption, ion exchange, membrane bioreactors, algal treatment systems, hydrothermal liquefaction, and various hybrids of these components.

What has been done

Our recent work has shown that hydrothermal liquefaction [HTL] treatment of livestock manure can effectively destruct a range of bio-active compounds in manure including ceftiofur, florfenicol, and estrone. These results showed that extending HTL reaction time from 15 to 60 minutes provided additional removal of bioactive compounds when HTL was operated at temperatures

less than or equal to 250°C. However, when HTL was operated at a temperature of 300°C, the effect of HTL reaction time on bioactive compound removal was minimal and nearly complete removal was achieved for all reaction times. Thus, we confirmed that HTL can be successfully utilized to simultaneously produce valuable bio-crude oil and destruct bio-active compounds in animal manure.

Results

Our research also showed that HTL treatment of manure can produce some additional chemical compounds that have deleterious biological effects. Specifically, we showed that the aqueous organic mixture produced by HTL exhibited mammalian cell cytotoxicity with a lethal concentration of 50 at a dilution of 7.5%. Further, we showed that treatment with algal bioreactors reduced mamallian cytotoxicity by 30%, and subsequent adsorptive treatment with activated carbon could reduce cytotoxicity by 90%.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

Outcome #10

1. Outcome Measures

Number Of Youth Who Indicate Increased Knowledge About The Environment

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	634

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Increasing concern over degradation of the environment addresses a critical issue related to sustaining life for future generations.

What has been done

The I Think Green curriculum was developed by 4-H and horticulture Extension specialists to engage 3rd through 5th grade youth in investigating how living things interact with each other and with their environment. This program includes three tracks: [1] Worms; [2] Butterflies; and [3] Insects. All three tracks are aligned to Illinois State Educational Goals and follow a sequence of four 40-60 minute investigations in which youth practice observation skills, conduct hands-on investigations with living things, explore different life cycles, identify how living things function/adapt/change, and compare how living things interact with each other and with their environment.

The objectives of the program include: [1] To develop youth skills in scientific observation; [2] Increase youth knowledge of concepts that explain how living things function, adapt, change and interact within the environment; and [3] Increase youth knowledge of things they can personally do to help protect the environment. The program was delivered by 4-H and Master Gardener trained volunteers and involved 1,245 youth this past year, tripling the previous year's participation.

In addition, a questionnaire was distributed and collected from 115 youth who attended 4-H camp this past year that included fourteen questions related to interest in science and the environment. Youth were asked to respond to the 14 questions using a 1-4 scale with 1 = Strongly disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly agree.

Results

In responding to a ten-question evaluation given to the youth participants at the end of each of the three tracks, 94% [526] reported that the activities helped them learn how butterflies, worms, or insects contributed to the environment, 81% [483] reported being more excited about helping to care for the environment, 74% [416] reported having more ideas about ways they could help care for the environment, and 70% [395] reported that they would like to get involved in food composting, recycling, or other activities to help take care of the environment in their community.

After participating in I Think Green, more than ninety percent of the 115 youth who responded to the questionnaires distributed and collected at 4-H camps this past year indicated that they agree or strongly disagree that attending 4-H Camp has increased their understanding of how people can use but protect natural resources and recognized that the quality of the water in the 4-H lake is important. In addition, with respect to other findings related to science, 98% affirmed that they get to do hand-on activities in the program/project, and 80% or more: [1] Think that science, engineering, or technology will be important in their future job; [2] Are encouraged to ask questions about science, engineering and technology; [3] Like science; and [4] Think they are good at science. Additional information can be found in the 4-H Youth Development planned program Evaluation section.

4. Associated Knowledge Areas

KA Code	Knowledge Area
134	Outdoor Recreation
211	Insects, Mites, and Other Arthropods Affecting Plants
806	Youth Development

Outcome #11

1. Outcome Measures

Number Of Pesticide Applicators Making Decisions To Avoid Harming The Environment

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	5657

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Use/application of pesticides has potential adverse impacts on the environment, crops grown, and the pesticide applicator.

What has been done

Pesticide training sessions focused on pesticide characteristics, correct application procedures, problems that may occur with the use of pesticides, where information can be obtained and steps to take if a problem occurs with the use of a pesticide. Private applicator training was delivered by Extension staff in 17 settings across the state to a total of 2,793 individuals in 2012-2013 that included agricultural producers, agriculture and horticulture sales associates, and Extension master volunteers. Commercial applicator training was offered by Extension staff through 56 clinics located in 27 settings across the state to a total of 5,894 individuals in 2012-2013 that included operators and applicators who apply pesticides to turfgrass, field crops, ornamentals, and road right-of-ways. Following the training, Illinois Department of Agriculture staff administered a certification test. This past year a survey of practice changes was mailed to a random sample [498] of the 5,874 individuals who participated in the 2011-12 commercial applicator trainings.

Results

Completed returned surveys numbered 295 for a return rate of 59%. In response to the question 'As a result of the training session, how much have you improved the following?' respondents could rate up to 12 practice changes. The 286 who responded could choose from the following response options: 1 = Could improve but have not, 2 = Made some improvement, 3 = Made great improvement, and 4 = Was already doing correctly.

Ninety percent [260] of the 286 respondents indicated improving one or more of the 12 actions after the training. More than sixty percent of the respondents to the question reported improving the following: [1] 188 [65.7%] improved calibration procedures [frequency, accuracy, and

measurements]; [2] 183 [64.0%] improved pest control decision-making [scouting and identifying pests]; [3] 178 [62.2%] improved mixing pesticides properly; and [4] 173 [60.5%] improved law compliance [licensing, record keeping, transporting]. Additional findings are provided in the Evaluation of Results section of this planned program. Based on the sample findings, 8,283 [90%] of the 9,203 2012-13 commercial pesticide operators and applicators have improved their practices.

In addition, based on findings from a survey of 16 practice changes that was conducted in 2010, 2011 and 2012 at the private applicators safety education programs, three fourths of this year's 2,973 private applicator training attendees will have likely: [1] Read and followed label directions for proper pesticide application; [2] Taken precautions to minimize spray drift when applying pesticides; [3] Scouted to determine proper identification of pest before determining if control is needed; and [4] Understand how pesticides can cause contamination and taking steps to prevent it. Using the average figure of \$11,000 from the three-year study regarding training participants' estimate of what they are able to save by being able to protect their production and apply appropriate pesticides when necessary, the total estimated dollars saved for the six percent [167] of the training attendees last year may well be nearly two million in dollars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #12

1. Outcome Measures

Increased Knowledge About Weather Processes And Climate Change

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	61

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Swings in and severity of weather such as droughts, tornadoes, and floods are of concern to Illinois residents and create emotional, economic and health consequences to those who are affected. Weather monitoring systems have value in helping residents prepare for weather challenges that are forthcoming.

What has been done

A Weather Observer course, the first of its kind, was developed and conducted in 2013. The intent of the course was to teach participants basic weather processes, climate change processes, and provide training for a state/national volunteer precipitation monitoring program. Nineteen [19] participants attended four 2½ hour seminars. Topics included causes of seasons, composition of the atmosphere, wind and air pressure relationships, reading weather maps, violent weather and weather safety, and using weather observations to make basic weather predictions. In addition, climate change science was discussed, using information from a Nobel researcher in the atmospheric sciences department of the University of Illinois. One session was also devoted to training for the Community Collaborative Rain, Hail, and Snow volunteer precipitation monitoring program, an online national reporting system. This session was taught by a retired director of the Midwest Climate Center located on the University of Illinois campus. A short evaluation was distributed at the end of the series.

In addition, the 2013 West Central Illinois Extension Agronomy Day for the first time included a discussion of climate change for 80+ area farmers and landowners from 14 different counties. Research-based information was provided by campus-based staff. The combination of dry weather followed by extreme rain event data from the prior year growing season made this a timely educational activity.

Results

Evaluations showed that all Weather Observer participants increased their knowledge of basic weather processes and climate change. Eighteen [18] of the 19 participants completed the evaluation, using a 1-5 rating scale with five being the highest rating. The average group rating that reflects the respondents' self-reported level of knowledge gained was 4.6. Participants were asked to rate how comfortable they felt explaining basic weather processes, both before and after the course. When comparing the scores, the group average increased one full point from 2.9 to 3.9 [a 20% increase]. Likewise, when asked to rate their comfort level in explaining climate change to others before and after taking the course, the average group score increased from 3.1 to 4.1 [also a 20% increase]. When asked to list the most important things they learned in the course, eight of the eighteen mentioned clouds [their names and how to look at them to see the changes in weather]. Several also mentioned learning about storms/bad weather [how they are formed]. A final evaluation question sought to discover if the course changed their opinions on climate change. Six indicated no, one indicated maybe, three indicated it confirmed their belief, and six indicated their opinion had now changed. Plans are to conduct this new program again in other locations in the state.

Fifty-three of the West Central Agronomy Day participants completed an initial evaluation that day. Of those, 30% indicated they will use the climate information often, 51% will use the information, and 18% deemed it not useful. Follow-up telephone calls were made with 29 attendees 30-70 days later. Eighty-three percent [83%] indicated that weather conditions associated with climate change ranked third in the top three challenges these producer/owners face. Ninety-three percent [93%] indicated they would use more weather/climate information as agronomy day topics.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Commercial Pesticide Applicator Training Evaluation Study [2012-2013]

This past year a survey of practice changes was mailed to a random sample [498] of the 5,874 individuals who had participated in the 2011-12 Commercial Pesticide Clinic trainings. Completed returned surveys numbered 294 for a return rate of 59%. In response to the question 'As a result of the training session, how much have you improved the following?' respondents could rate up to 12 practice changes. The 286 who responded could choose from the following response options: 1 = Could improve but have not; 2 = Made some improvement, 3 = Made great improvement, and 4 = Was already doing correctly. Ninety percent [260] of the 286 respondents indicated improving one or more of the 12 actions after the training.

More than sixty percent of the respondents to the question reported improving the following: [1] 65.7% [188] improved calibration procedures [frequency, accuracy, and measurements] with 89 indicating they made great improvement; [2] 64.0% [183] improved pest control decision-making [scouting and identifying pests] with 89 indicating they made great improvement; [3] 62.2% [178] improved mixing pesticides properly with 94 indicating they made great improvement; and [4] 60.5% [173] improved law compliance [licensing, record keeping, transporting] with 107 indicating they made great improvement.

Fifty to sixty percent of the respondents reported improving their implementation of seven of the other practices: [1] 57.3% [164] improved application procedures [proper wind speed, pressure, boom height] with 96 indicating they made great improvement; [2] 57.3%

[164] improved routine use of personal protective equipment [PPE] with 80 indicating they made great improvement; [3] 55.9% [160] improved including non-chemical methods of control [cultivation and mowing] in their pest control program with 89 indicating they made great improvement; [4] 53.8% [154] improved equipment maintenance [inspecting, cleaning, replacing worn nozzles] with 73 indicating they made great improvement; [5] 53.8% [154] improved referring to label information with 97 indicating they made great improvement; [6] 52.8% [151] improved changing type, size or material of the nozzles used with 73 indicating they made great improvement; and [7] 52.8% [151] improved proper pesticide storage [locked cabinet, PPE stored separately] with 80 indicating they made great improvement. The least reported improved practice was having MSDS's [Material Safety Data Sheets] available for use. Only 127 [44.4%] indicated having made improvement of which 72 reported making great improvement.

Youth Environmental Education [I Think Green and 4-H Camp]

The **I Think Green** ten-question evaluation was completed by 559 youth comprised of 412 who participated in the butterfly track, 135 in the worm track, and 12 in the insect track. Response tallies for the six questions that were identical for all three groups follow.

Environment Related Questions

81% [483] reported being more excited about helping to care for the environment, 74% [416] reported having more ideas about ways they could help care for the environment, and 70% [393] reported that they would like to get involved in food composting, recycling or other activities to help take care of the environment in their community.

Participation Related Questions

95% [533] reported that the **I Think Green** activities were fun to do, 87% [488] reported that they would like to do more activities like the ones in **I Think Green**, and 65% [363] reported that they would like to help with a community garden project.

Butterfly Track Specific Questions [n=412]

94% [387] reported that the activities helped them learn about butterflies and how they grow, 85% [352] reported that the activities help them to learn how butterflies interact with other living things, 85% [349] reported that the activities help them learn how butterflies contribute to the environment, and 77% [318] reported that they were encouraged to ask questions about butterflies and the environment.

Worm Track Specific Questions [n=135]

94% [127] reported that the activities helped them learn about worms and how they grow, 85% [115] reported that the activities help them to learn how worms interact with other living things, 85% [115] reported that the activities help them learn how worms contribute to the environment, and 73% [99] reported that they were encouraged to ask questions about worms and the environment.

Insect Track Specific Questions [n=12]

100% [12] reported that the activities help them to learn how insects interact with other living things, 92% [11] reported that the activities helped them learn about insects and how they grow, 92% [11] reported that the activities help them learn how insects contribute to the environment, and 75% [9] of the youth in this track reported that they were encouraged to ask questions about insects and the environment.

Key Items of Evaluation

Commercial Pesticide Applicator Training Evaluation Study [2012-2013]

Primarily motivated by the desire for help in preparing for the licensing exam, 294 commercial pesticide applicators and operators who attended the pesticide training conducted in 2011-12 responded to a mailed follow-up questionnaire that focused on practice changes made as a result of the training. Ninety percent [260] of the respondents indicated improving one or more of 12 practices after the training. More than three-fifths of the respondents reported improving calibration procedures [65.7%], pest control decision-making [64.0%], mixing pesticides properly [62.2%], and law compliance [60.5%]. When asked how often they calibrated their equipment, 96 respondents [35%] indicated an increase in frequency of calibration [daily, weekly, or monthly] after as compared to before the training.

At least half of those responding reported improvement in application procedures, routine use of personal protective equipment, including non-chemical methods of control, equipment maintenance, referring to label information, changing type, size or material of the nozzles, and proper pesticide storage. Most of the remainder of the respondents indicated that they were already following correct procedures related to a given practice with only 30 or fewer checking 'could improve but have not' for each of the 12 practices. These findings appear to indicate that Extension training has been effective in helping pesticide operators/applicators to engage in correct pesticide application practices that prevent adverse impacts on the environment, crops grown, and the pesticide applicator.

Youth Environmental Education [I Think Green and 4-H Camp]

Nearly all of the youth participants in **I Think Green** learned about how butterflies, worms, and insects grow, interact with other living things, and contribute to the environment. Although fewer youth reported changes in how they felt, ideas gained, and interest in how they could care for the environment, more than 90% of those responding did report changes in one of the three questions related to the environment.