V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Climate Change

☑ 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
101	Appraisal of Soil Resources	5%		5%	
102	Soil, Plant, Water, Nutrient Relationships	5%		5%	
104	Protect Soil from Harmful Effects of Natural Elements	5%		5%	
111	Conservation and Efficient Use of Water	5%		5%	
112	Watershed Protection and Management	5%		5%	
123	Management and Sustainability of Forest Resources	5%		5%	
132	Weather and Climate	5%		5%	
133	Pollution Prevention and Mitigation	5%		5%	
135	Aquatic and Terrestrial Wildlife	5%		5%	
136	Conservation of Biological Diversity	5%		5%	
141	Air Resource Protection and Management	5%		5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	5%		5%	
302	Nutrient Utilization in Animals	5%		5%	
402	Engineering Systems and Equipment	5%		5%	
403	Waste Disposal, Recycling, and Reuse	5%		5%	
601	Economics of Agricultural Production and Farm Management	5%		5%	
605	Natural Resource and Environmental Economics	5%		5%	
608	Community Resource Planning and Development	5%		5%	
610	Domestic Policy Analysis	5%		5%	
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures	5%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	14.0	0.0
Actual Paid Professional	3.7	0.0	22.7	0.0
Actual Volunteer	3.3	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
140429	0	687326	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
252839	0	1210265	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
218459	0	1070392	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research highlights include constructing a model predicting the future of wastewater disposal from Marcellus shale natural gas drilling under three possible scenarios; exploring how Marcellus shale drilling is changing Pennsylvania landscapes; examining the effects of structural and nonstructural adaptation measures on hurricane damages; projecting potential impacts of invasive Asian longhorn beetles on northeastern forests (in collaboration with colleagues at the Cary Institute); developing and contributing information important to the development of primary and secondary National Ambient Air Quality Standards for ozone; studying N and P loss under different soil temperature regimes to determine optimal manure application times; study of the effect of dietary protein concentration on ammonia and greenhouse gas emissions from dairy manure; and revealing new insights into the potential for water quality trading to achieve water quality objectives at lower cost.

Extension work in climate change includes the Managing Community and Urban Natural Resources program, which organizes educational programming and municipal/agency technical assistance under two statewide themes: Community and Urban Forestry and Pennsylvania Department of Conservation and Natural Resources Bureau of Forestry TreeVitalize/Tree Tender initiatives.

2. Brief description of the target audience

Federal, state, and municipal government agencies involved in natural resource and environmental policy (USEPA, USDOI, USDA, PADEP, PADCNR, etc.); research community, both domestic and international; graduate and undergraduate students; nonprofit associations/organizations; business and industry; community groups; education; general public; special populations (at-risk and underserved audiences); students/youth; volunteers/extension leaders; commercial crop producers and farmers; forest landowners; natural resource professionals

3. How was eXtension used?

Penn State Cooperative Extension supports faculty and staff use of eXtension and promotes communities of practice as a way of broadening sources of information and outreach. Penn State Cooperative Extension supports the professional development offered through eXtension.org. Pennsylvania is represented by 152 eXtension members in 47 of the 73 approved CoPs.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5939	6250	3317	0

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

Patent Applications Submitted

Year: 2012

Actual: 1

Patents listed

Serial No: 13/435,761; Filed: 3/30/12; Title: Compositions and Methods Relating to Continuation Transgenic Plans and Cellulosic Ethanol Production

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	0	110

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of invention disclosures submitted.
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of people enrolled and/or registered in programs.
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of people enrolled and/or registered in all programs related to Climate Change

Year	Actual
2012	5757

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of participants who were evaluated and demonstrated increased knowledge and skills.
2	Number of participants who were evaluated in a follow-up and who implemented/adopted practices.
3	Number of volunteers that helped with program leadership or delivery.
4	Number of participants in all programs related to Climate Change who were evaluated and demonstrated increased knowledge and skills.
5	Number of participants in all programs related to Climate Change who were evaluated in a follow-up and who implemented/adopted practices.
6	Model predicting the future of Marcellus shale natural gas drilling wastewater disposal under three possible scenarios
7	Exploring how Marcellus shale natural gas drilling is changing Pennsylvania landscapes
8	Effects of adaptation measures on hurricane damages
9	Report on ecological and economic impacts of a regional outbreak of Asian longhorned beetle
10	Investigations contributing to primary and secondary National Ambient Air Quality Standards for ozone
11	Study of N and P loss under different soil temperature regimes to determine optimal manure application times
12	Project report to the Organization for Economic Cooperation and Development, Directorate for Trade and Agriculture
13	Effect of dietary protein concentration on ammonia and greenhouse gas emissions from dairy manure

Outcome #1

1. **Outcome Measures**

   Number of participants who were evaluated and demonstrated increased knowledge and skills.

   Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

   Number of participants who were evaluated in a follow-up and who implemented/adopted practices.

   Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

   Number of volunteers that helped with program leadership or delivery.

   Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

   Number of participants in all programs related to Climate Change who were evaluated and demonstrated increased knowledge and skills.

2. **Associated Institution Types**

   - 1862 Extension
   - 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1397

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
141	Air Resource Protection and Management
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
302	Nutrient Utilization in Animals
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
610	Domestic Policy Analysis
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #5

1. **Outcome Measures**

Number of participants in all programs related to Climate Change who were evaluated in a follow-up and who implemented/adopted practices.

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	82

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
132	Weather and Climate
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
141	Air Resource Protection and Management
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
302	Nutrient Utilization in Animals
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
610	Domestic Policy Analysis

804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #6

1. Outcome Measures

Model predicting the future of Marcellus shale natural gas drilling wastewater disposal under three possible scenarios

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As natural gas drilling in the Marcellus shale region progresses, the issue of wastewater disposal has emerged. In 2010, the Pennsylvania Department of Environmental Protection issued more stringent total dissolved solids regulations effectively prohibiting the discharge of wastewater into Pennsylvania's surface waters. In April 2011, the PA DEP requested that drilling operators cease sending wastewater to municipal sewage treatment plants. These policies have increased the use of underground injection, particularly in Ohio, and recycling and reuse as disposal methods.

What has been done
A master's student thesis sought to determine the factors that a drilling company considers in its choice of wastewater disposal method through the use of a mixed logit model. The model included price, distance, size, competition, distance to nearest large city, and river basin dummy variables. The model was then estimated and the coefficient estimates obtained were used to calculate the marginal effects of the variables on the probabilities that a brine or industrial waste treatment plant, an injection well, or recycling and reuse would be the disposal method chosen.

Results
The results show that the price of the disposal method and the cost of transporting the wastewater have the largest impacts on the probability that a particular alternative will be chosen. So policies affecting the price or location of disposal methods will be most effective in influencing the use of a particular method. An increase in competition would strain the supply of freshwater withdrawals available for the fracking process, which would create a market for the treated water produced by recycling facilities. This would encourage the use of recycling and reuse facilities to treat wastewater.

The results of the model estimation can be used to predict what the future of wastewater disposal will look like under three possible future scenarios (a business-as-usual scenario, a permanent moratorium in Youngstown, Ohio, and a scenario in which Pennsylvania takes primacy of its underground injection program). The conclusions can be considered by policymakers and used to influence future policies in Pennsylvania.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
403	Waste Disposal, Recycling, and Reuse
605	Natural Resource and Environmental Economics

Outcome #7

1. Outcome Measures

Exploring how Marcellus shale natural gas drilling is changing Pennsylvania landscapes

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Marcellus shale formation underlies over 95,000 square miles in six states, including the northern and western half of Pennsylvania. Due to recent advances in drilling technologies, accessing this gas is now technologically possible and economically feasible. Exploration and development produces a large footprint with the potential to affect natural resources in Pennsylvania. Research has examined the impacts of Marcellus development on forest habitat and birds.

What has been done
Geographic information system analysis was used to determine where gas development was occurring, along with land ownership and cover, and forest fragmentation status on those sites. Various databases were combined to investigate how Pennsylvania's land cover is changing due to Marcellus gas exploration.

The Marcellus electronic field guide provides up to date information on impacts of Marcellus development on natural resources and methods of minimizing effects.

Results
Most of the development is occurring on private land, and the greatest amount of development falls within the Susquehanna River basin. Slightly more than half of the well pads in Pennsylvania occur on agricultural land; most of the rest are on forest land, but many of those are on core forest on private land. Shale gas development could substantially alter Pennsylvania's landscape. The development of new roads to support drilling could affect forest ecosystem integrity via increased fragmentation. The concentration of existing core forest in the northern part of the state, where the focus of drilling is, largely on private land, means that remaining areas of public land are key refuges for the protection of wildlife, ecosystems, and their associated ecosystem services. These areas should receive further protection. A regional approach to site drilling infrastructure is needed to help minimize development in core forest and productive agricultural lands and to decrease the potential risk to waterways.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
136	Conservation of Biological Diversity

Outcome #8

1. Outcome Measures

Effects of adaptation measures on hurricane damages

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Escalating costs of hurricane disasters in recent decades heighten public and private concern. The federal government spends millions of dollars annually in the form of hazard mitigation and

public assistance grants to help impacted communities recover. Without empirical evidence, we can say little about how effective these programs are in promoting local resilience.

What has been done
Researchers investigated the roles of adaptation and mitigation in reducing economic impacts of hurricanes in terms of property loss. We conducted an empirical study of property damage in 864 counties along the Atlantic basin during 1989-2009. Controlling for important drivers of property losses given by hazard incidents, economic and population growth as well as socio-economic vulnerability, we contribute to existing literature by explicitly accounting for a wide range of public and local adaptation measures.

Results
Our results suggest that physical and socioeconomic vulnerability are primary factors explaining high damages from hurricanes. We found clear evidence of the importance of regulatory-based loss mitigation strategies as exhibited by improved building codes and effectiveness of enforcement. Results suggest that where to build (zoning, land-use planning, etc.) is a significant policy complemented by how to build (building codes, retrofitting, etc.). Major structural and infrastructural projects were found to exacerbate property losses, suggesting evidence of induced development or protective capacity limits of structural measures. Overall, the most efficient disaster loss mitigation strategy entails coordinated actions of federal and local government coupled with private self-insurance and is highly skewed towards nonstructural projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
804	Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Outcome #9

1. Outcome Measures

Report on ecological and economic impacts of a regional outbreak of Asian longhorned beetle

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research focused on quantifying the potential ecological and economic impacts to forest resources in the northeastern U.S. from a region-wide outbreak of Asian longhorned beetles (ALB). The overall goal was to model the ecological and economic impact of ALB over the next 25, 50, and 100 years. There were two main objectives: 1) development of an ecological model to predict changes in forest composition and structure over 25-100 year time scales from ALB infestations; and 2) estimate the economic costs of ALB infestations, including an analysis of non-forest product economic impacts.

What has been done
A widely used model of forest dynamics (SORTIE-ND) served as the basis for projecting ecological impacts. The model was parameterized using data from the Forest Service Forest Inventory and Analysis forest plots and other sources. The costs of ALB infestation were calculated by projecting the impact on markets for timber and nontimber products, i.e., logging, maple syrup, outdoor recreation, tourism, wildlife, and aesthetics. Financial analysis compared the impacts with and without ALB. The scenarios looked at total live volume impacts and impacts on harvested volume.

Results
The intensity of the ALB outbreak occurs between years 10 and 50.The apex of the outbreak is at year 25, when > 71 billion board feet are killed throughout the study region. 83% of the ALB killed volume is from two maple species. Other species lost are sweet and yellow birch and quaking aspen. These 5 species account for > 95% of volume killed. Harvested volumes are most affected between years 15 and 33, when the ALB killed volume is more than the volume harvested. Over 100 years, the difference in total discounted harvest value between with and without ALB is $20.6 billion. Essentially the entire maple syrup industry in the Northeast, valued at > $150 million in 2011, will be lost due to ALB.

As for ecosystem services, infestation by ALB will have three main effects. First, it will increase the number of dead and dying trees in the forest. Second, until new growth comes in, there will be reduced tree biomass and cover. Third, ALB infestation will change tree species composition, decreasing maples and increasing ash and hemlock. These changes will produce higher peak stream flows and reduced erosion control. Economic changes include reduction in foliage tourism and timbering and their associated jobs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
605	Natural Resource and Environmental Economics

Outcome #10

1. Outcome Measures

Investigations contributing to primary and secondary National Ambient Air Quality Standards for ozone

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Tropospheric ozone air pollution continues to pose serious problems for the growth and productivity of agricultural crops across much of the eastern United States. During the most recent review of the primary and secondary National Ambient Air Quality Standard (NAAQS) for tropospheric ozone exposures, there was insufficient information on ozone-induced foliar injury and relationships to crop growth and productivity effects to force consideration of developing a standard that would better protect important agricultural crops, forests, and native plant resources.

What has been done
Researchers conducted experiments on plant sensitivity to ground-level ozone to provide needed information concerning the relationships between ambient ozone exposures and induced foliar injury more commonly observed on ozone-sensitive plants.

Results
Total weight of bean pods harvested for fresh-market consumption was 40 to 50% lower for sensitive genotype vs. tolerant genotype when ozone concentrations were moderate to high. Ambient ozone concentrations adversely affected the foliage of some of the most important agricultural crops (beans and grape) found in Pennsylvania. In fact, ambient ozone levels in Pennsylvania during the growing season were sufficient to induce foliar symptoms on all surveyed flora species. Our research results were considered in the review of the NAAQS as conducted by the U.S. EPA. This resulted in more stringent primary and secondary standards recommended by the Agency's Office of Air Quality Planning and Standards.

4. Associated Knowledge Areas

KA Code	Knowledge Area

141	Air Resource Protection and Management
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
610	Domestic Policy Analysis

Outcome #11

1. Outcome Measures

Study of N and P loss under different soil temperature regimes to determine optimal manure application times

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soil freezing and thawing, frost formation, snow melt, temperature, and timing of manure application can significantly affect nutrient runoff, infiltration, and other losses from manure applications during fall and winter. Climate change scenarios indicate the potential for more unstable winter conditions with increased freezing and thawing events. The ability to recreate freezes/thaws in a lab allows controlled study of the effects of seasonal soil temperature changes on N and P losses.

What has been done
A soil thermal cycling system was developed to determine the effects of soil temperature on N and P losses in runoff and leachate, and to determine overwinter N and P losses based on application date and temperature. Lysimeters were installed in bins, encased in sand, and heated from the bottom. Dairy manure was surface-applied at soil temperatures of 16°C, 5°C, and -1°C, to represent early fall, late fall, and winter applications. N and P losses from the lysimeters were measured during a series of rainfall simulations and natural precipitation from October (early fall) to March (prolonged winter).

Results
Both nitrogen and phosphorus losses were influenced by the soil temperature. Decreases in soil temperature throughout the fall/winter caused ammonium-N, organic N, and total N to increase exponentially; dissolved reactive P, total dissolved P, and total P also increased. Early fall manure application also caused significant overwinter losses of nitrate, whereas winter-applied manure had more overwinter ammonium-N losses. Total P losses were two times higher for the winter-

applied manure when compared to the early fall-applied manure. To control P losses, manure should be spread in the early fall, when soil infiltration capacity is greater, before soil temperatures fall below 10°C. However, early fall manure application may increase the potential for increased nitrate-N leaching and ammonia volatilization. The effects of changes in manure N and P forms and losses from cold and frozen manure on nutrient runoff and infiltration were identified as variables warranting further investigation, along with larger scale experiments.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

Outcome #12

1. Outcome Measures

Project report to the Organization for Economic Cooperation and Development, Directorate for Trade and Agriculture

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Water quality trading refers to the application of emissions trading to water pollution control. Applications of emissions trading to date have largely occurred in the domain of air pollution. There is now substantial interest in extending the method to water pollution, including to water pollution from agriculture. Water quality trading initiatives have been implemented in Australia, Canada, New Zealand, and the US, and are being studied elsewhere, including by countries surrounding the Baltic Sea to address nutrient pollution there.

What has been done
Agricultural water quality trading programs from around the world were reviewed to glean guidelines for the creation of successful trading models.

Results
Guidelines for the creation of successful trading models were developed based on lessons learned from evaluations of early initiatives.

-- Binding regulatory limits on pollution levels are essential for trading activity to occur. Such limits are essential to create the incentives for polluters to seek out options for pollution control cost savings.
-- Trading activity requires sufficiently large differences in pollution control costs between polluters to make possible economic gains from trading, after deducting transaction costs incurred in trading.
-- Trading rules must be clearly established and ensure that water quality goals will be satisfied, but must also be designed to facilitate trading. Rules that are overly complex and costly create barriers to trading activity.
-- Successful trading requires the development of institutions for organizing trade that are trusted by and effective for intended program participants.

Some heuristics used in the design of point-nonpoint trading programs are scientifically flawed and may lead to designs that diminish the capacity of water quality trading to efficiently and effectively achieve water quality goals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics

Outcome #13

1. Outcome Measures

Effect of dietary protein concentration on ammonia and greenhouse gas emissions from dairy manure

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Livestock, especially cattle, are known to be a significant source of greenhouse gases, specifically methane. This gas plays an important role in global warming because methane is very efficient in trapping solar radiation. Ammonia in dairy manure contributes significantly to acidic rain.

What has been done
Two experiments investigated the effect of dietary crude protein concentration on ammonia and greenhouse gas (nitrous oxide, methane, carbon dioxide) emissions from fresh dairy cow manure incubated in a controlled environment (exp. 1) and from manure-amended soil (exp. 2). Manure was from lactating Holstein cows fed diets with 16.7% (HighCP) or 14.8% crude protein (LowCP). HighCP manure had higher N content and proportion of ammonia-N and urea-N in total manure N. In exp. 2, manure from cows fed LowCP or HighCP diets was applied to lysimeters.

Results
The largest difference in the ammonia emitting potential (EP) occurred approximately 24 hours after manure application; it was approximately 3.5 times greater for HighCP than LowCP manure. The 100-hr cumulative ammonia emission was 98% greater for HighCP than LowCP manure. The EP of methane was increased and that of CO2 tended to be increased by LowCP compared with HighCP manure. The cumulative methane emission was not different between treatments; the cumulative CO2 emission was increased with manure from the LowCP diet. Nitrous oxide emissions were low in this experiment and did not differ between treatments.

In the conditions of these experiments, fresh manure from dairy cows fed an LCP diet had substantially lower ammonia EP, compared with manure from cows fed an HCP diet. The LCP manure increased soil methane EP due to a larger mass of manure added to meet plant N requirements compared with HCP manure. These results represent effects of dietary protein on ammonia and greenhouse gas EP of manure in controlled laboratory conditions and do not account for environmental factors affecting gaseous emissions from manure on the farm.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
141	Air Resource Protection and Management

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.)
- Other (Extramural Funding)

Brief Explanation

Natural disasters such as extreme storms can kill or damage urban trees.

Reduced State funding impacted both the research and extension functions of the College of Agricultural Sciences and resulted in retirements and layoffs of key faculty and staff across all areas of the College.

Natural resources projects must compete for limited public dollars with social services programs, and are often given short shrift.

The Managing Community and Urban Natural Resources program is heavily funded by USDA Forest Service grant funding. Any cuts in this federal grant affect our program's funding and our ability to provide staff and education and technical assistance.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In the future, with better reporting from the Pennsylvania Bureau of Forestry, the Managing Community and Urban Natural Resources program plans to provide the number of trees planted in the state and the amount of relevant grants distributed to municipalities and nonprofit organizations.

The generation of outcomes from existing programs and the development of new programs require improved evaluation that identifies pre- and post- responses to information and monitoring for long-term behavioral changes that result in improved environmental outcomes. The evaluations conducted thus far provide initial measures of implementation, but long-term monitoring is needed to ensure that the practices are successfully managed over time.

Key Items of Evaluation

The Woods in Your Backyard workshop, conducted through the Managing Community and Urban Natural Resources program, focuses on how owners of less than 10 acres of land can promote wildlife habitat, water quality, and other natural resource benefits. In a post-class evaluation, 3 participants wrote:

-I "wanted neat manicured lawn, but [am] now thinking differently."
-"I plan on developing a logical plan for the landscape while addressing invasive plants."
-"I am going to turn some grass back into woodland by using native plants and trees."

See also highlights of state-defined outcomes in this planned program.