

V(A). Planned Program (Summary)

Program # 2

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
102	Soil, Plant, Water, Nutrient Relationships			42%	
112	Watershed Protection and Management			41%	
131	Alternative Uses of Land			17%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.8	0.0
Actual Paid Professional	0.0	0.0	2.2	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
0	0	382897	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	81953	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	242242	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- A comprehensive study is underway that examines how agriculture, forests, and residential land uses in a human-dominated landscape influence climate through a combination of carbon storage, greenhouse gas emissions (nitrous oxide and methane), alterations to shortwave albedo (reflected energy) and land surface heating. Measurements are being used to improve models for land management activities that mitigate drivers of climate change.
- Predictions about climate change, which will influence natural resources and agricultural management strategies, are being brought to various NH state agencies.
- NHAES researcher McDowell and his coworkers are bringing information about the regional atmospheric nitrogen deposition to the Environmental Protection Agency and to local municipalities as these groups work to reduce nitrogen pollution of the Great Bay Estuary and its watershed.

2. Brief description of the target audience

Target audiences include agricultural and natural resource producers and consumers, those involved in the related food products and marketing webs, land managers, climate scientists, public policy makers, and those who rely on agricultural and forest products currently and into the future. Ultimately, all citizens in NH, New England, and the U.S. have a strong stake in this topic and, therefore, the research outcomes.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	420	100	50	220

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

Patent Applications Submitted

Year: 2012
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	1	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of undergraduate students directly involved in the projects

Year	Actual
2012	7

Output #2

Output Measure

- Number of graduate students directly involved in the project

Year	Actual
2012	4

Output #3

Output Measure

- Number of university courses in which project results have been incorporated

Year	Actual
2012	4

Output #4

Output Measure

- Number of presentations at regional, national, or international scientific meetings

Year	Actual
2012	6

Output #5

Output Measure

- Number of workshops, training sessions and presentations to non-scientific stakeholders

Year	Actual
2012	3

Output #6

Output Measure

- Number of websites in which project results have been incorporated

Year	Actual
2012	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of graduate students trained to become the future generation of scientists.
2	Information relayed to non-scientific stakeholders through integrated research and extension partnerships.
3	Unbiased knowledge about tradeoffs among multiple land management strategies in terms of their net climate effect.

Outcome #1

1. Outcome Measures

Number of graduate students trained to become the future generation of scientists.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The precipitous increase in the planet's average temperature over the last century has resulted in the rapid melting of glaciers and polar ice caps. These changes are linked to varying weather patterns, severe storms, and the higher sea levels that have dramatic impacts on agriculture and coastal communities. Nitrogen and carbon cycling have impacts on climate change. NHAES research in climate change is training new generations of scientists (undergraduates, graduate students, and post docs) to monitor and integrate nitrogen and carbon fluxes.

What has been done

Students, graduate students, and research scientists took part in monitoring and comparing greenhouse gas emissions at UNH's organic and conventional dairies by monitoring fluxes in plant biomass and soils. In addition the carbon and nitrogen dynamics in feed, fresh manure, compost, and the cows themselves were measured. A second project quantifies the magnitude of atmospheric depositions of various pollutants in temperate and tropical watersheds.

Results

Four research scientists, four postdocs, two graduate students, and six undergraduates were trained to monitor greenhouse gas emissions and pollutant deposition in addition to estimating the fluxes in soils and plant biomasses. Of these, three research scientists, two postdocs, one graduate student and one undergraduate also developed methods to model carbon and nitrogen dynamics for the comparison of organic and conventional dairies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

- 112 Watershed Protection and Management
- 131 Alternative Uses of Land

Outcome #2

1. Outcome Measures

Information relayed to non-scientific stakeholders through integrated research and extension partnerships.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

- New Hampshire's forested landscapes, 80%, are primary resources for industry, recreation and tourism. Landowners and land managers know little about how forests contribute to or help mitigate climate change.
- Atmospheric nitrogen deposition contributes to the overall problem of nitrogen pollution (eutrophication) in NH's Great Bay and the surrounding watershed.
- Regulatory agencies and water and sewage authorities need accurate information about all sources of nitrogen impacting NH Great Bay and its watershed.

What has been done

- Karen Bennett, UNHCE specialist and a coPI on this project, worked on three separate activities related to the NHAES multi-investigator climate change project.
Bennett:
 - worked with NH Fish and Game to revise climate adaptation strategies in the State Wildlife Action Plan;
 - held a roundtable discussion on winter climate change with the Hubbard Brook Research Foundation;
 - collaborated with the Northern Forest Center Staff for "carbon" programming, including the promotion of the workshop "Carbon: A Viable Forest Product?".
- NHAES researcher McDowell and his staff presented their findings to national and regional groups concerned with eutrophication of estuaries.

Results

- Broader impacts have resulted from extension activities, including revised climate adaptation strategies in the State Wildlife Action Plan (ongoing) and the education of fifty natural resource professionals and landowners learning about the viability of carbon as a forest product. Roundtable discussions (with 25 participants) on winter climate change were summarized by David Sleeper and Geoff Wilson of Hubbard Brook into a non-technical article that appeared in the October 14, 2012 issue of Boston Globe Magazine as A Climate Change Call to Arms.
- Information about atmospheric nitrogen deposition was disseminated to local communities through invited meetings with U.S. Senate staff members, representatives of the Environmental Protection Agency, NH Department of Environmental Services, local environmental consultants, and local town officials.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
131	Alternative Uses of Land

Outcome #3

1. Outcome Measures

Unbiased knowledge about tradeoffs among multiple land management strategies in terms of their net climate effect.

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)

What are tradeoffs among multiple land uses (organic and conventional farmland, forests or, residential land) in their ability to either contribute to or mitigate climate change?

What has been done

-NHAES researchers continued to measure carbon and nitrogen pools and greenhouse gas emissions in a mixed land use landscape. These data are being used to calibrate remote sensing

imagery and conduct initial runs of the DeNitrification DeComposition (DNDC) model.
-Albedo (reflected energy) measurements were made for different landscapes; these allow estimates of the net radiative forcing of the landscape, e.g. the difference between radiant energy received by the landscape and energy radiated back to space. The ratio of energy received to energy radiated determines whether warming or cooling occurs.

Results

-The refined DeNitrification DeComposition DNDC model runs indicate that forests are a net sink of greenhouse gases while grass and fodder production and livestock agriculture are net sources of greenhouse gases. The livestock system showed the highest global warming potential while the forest showed the lowest.
-Predictions are modified when greenhouse gas emissions are combined with albedo and heat fluxes to produce a net radiative forcing value for each land cover. Land conversion from forest to agricultural or residential land cover can either have a positive or negative impact on climate change depending on how albedo, surface heat fluxes, and human greenhouse gas emissions contribute to the radiative forcing budget.
-Findings to date suggest that biophysical factors, such as albedo and surface heat fluxes, may influence climate forcing more than biological processes, such as carbon storage and greenhouse gas emissions.
-As a result, the current policy focus on carbon sequestration in soils and plant biomass may be too narrow for developing a comprehensive approach for mitigating climate change across a mixed land use landscape.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
131	Alternative Uses of Land

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes

Brief Explanation

Reductions in State funding of the University system and the NHAES resulted in reductions in work force at the farms and farm services, and a reduction in herd size in at the conventional dairy. This will result in differences in carbon and nitrogen pools measured at the conventional dairy.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

- A multi-investigator project covered in this planned program is still in the data

generation phase; these data are needed to refine models and provide unbiased knowledge about tradeoffs among multiple land management strategies in terms of their net climate effects. Peer review publications will follow.

- Qualitative assessments, based on self-reporting, continue to show a high level of interaction between basic research and the extension component of this project.
- Requests for reports from the Multistate Atmospheric Deposition Program illustrate how this project is providing critical information to EPA and local municipalities as they work to reduce nitrogen pollution in NH Great Bay Watershed.

Key Items of Evaluation

NHAES researcher McDowell and colleagues spoke about their findings at six different regional and community meetings, and provided expert information to federal, state, and municipal lawmakers, and regulatory agencies.