

**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
101	Appraisal of Soil Resources			6%	
102	Soil, Plant, Water, Nutrient Relationships			36%	
112	Watershed Protection and Management			17%	
131	Alternative Uses of Land			41%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	3.9	0.0
Actual Paid Professional	0.0	0.0	7.6	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	411129	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	376251	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	664356	0

**V(D). Planned Program (Activity)**

## 1. Brief description of the Activity

NHAES scientists have:

- Measured soil carbon (C) pools and greenhouse gas emissions (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O) in agricultural and suburban landscapes and compared these data with data previously collected from forest plots in the same area;
  - Used the combined data set to calibrate aircraft remote sensing data, which provided resolution to a five meter square spatial scale;
  - Used field and remote sensing data to parameterize the denitrification decomposition (DNDC) computer simulation model, validate and upscale model predictions;
  - Generated spatially continuous predictions of C pools, greenhouse gas emissions, and reflection of solar radiation (shortwave albedo) to determine the net radiative forcing values (in W m<sup>-2</sup>) for the major components of the landscape (mowed versus grazed pasture, corn fields, forest, and suburban lawns);
  - Made future projections of C, N and water balances for both agricultural and forested landscape units, using newly available CO<sub>2</sub> and climate change projections through 2100;
  - Integrated climate change issues in conference planning for the 2014 New England Society for American Foresters;
- Analyzed the effects of different cropping systems, soil insects, and microbial community composition on Soil Organic Matter (SOM) turnover and soil nitrogen cycling;
  - Disseminated findings that quantify the impacts of forest loss on water quality.

## 2. Brief description of the target audience

Target audiences include university students interested in global nitrogen and carbon cycles, and sustainable agroecosystem management, agricultural and natural resource producers and consumers, those involved in the related food products and marketing webs, land managers, scientists, public policy makers, and those who currently rely on agricultural and forest products and will in the future. Ultimately, all citizens in NH, New England, and the US have a strong stake in this topic and, therefore, the research outcomes.

## 3. How was eXtension used?

eXtension was not specifically used in the project. However results and outcomes of several research projects have been made available via websites appropriate to specific target audience. e.g. [http://www.wildlife.state.nh.us/Wildlife/Wildlife\\_Plan/climate.html](http://www.wildlife.state.nh.us/Wildlife/Wildlife_Plan/climate.html)

## V(E). Planned Program (Outputs)

### 1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	2330	1050	365	70

**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	5	5

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of undergraduate students directly involved in the projects

Year	Actual
2013	9

**Output #2**

**Output Measure**

- Number of graduate students directly involved in the project

Year	Actual
2013	8

**Output #3**

**Output Measure**

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

Year	Actual
2013	3

**Output #4**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2013	16

**Output #5**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2013	11

**Output #6**

**Output Measure**

- Number of websites in which project results have been incorporated

<b>Year</b>	<b>Actual</b>
2013	2

**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.
4	Understanding the impact of atmospheric deposition on water quality in order to develop management strategies that stakeholders can use to improve water quality.
5	Address microbial contributions to soil organic matter accumulation, and also to the timing and extent of soil organic matter (SOM) loss and N mineralization in various cropping systems

### **Outcome #1**

#### **1. Outcome Measures**

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

Not Reporting on this Outcome Measure

### **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**

<b>Year</b>	<b>Actual</b>
2013	2

#### **3c. Qualitative Outcome or Impact Statement**

##### **Issue (Who cares and Why)**

Climate change is impacting wildlife and forests in Northern England. It is important to convey climate change research results and predictions to stakeholder audiences in a way that empowers these groups to protect the regional resources.

##### **What has been done**

One of the major climate change research projects in the climate change program planned program includes an UNHCE extension specialist; this individual is on the conference planning committee for 2014 meeting New England Society of American Foresters (NESAF) and served as a reviewer for the draft State of New Hampshire's Ecosystems and Wildlife Climate Change Adaptation Plan.

##### **Results**

?In part, as a result of the efforts of the UNHCE Extension Specialist the theme of the 2014 NESAF conference is "Resource -Resilience-Renewal-Restoration." The conference features multiple breakout sessions on climate change impact on New England forests.

?The Extension Specialist was influential in the completion of the climate change addendum to the New Hampshire Wildlife Action Plan. <http://www.wildlife.state.nh>.

us/Wildlife/Wildlife\_Plan/climate.html

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
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
2013	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Climate change is already impacting agriculture and forestry in New England in both positive (i.e., longer growing seasons) and negative (i.e., spreading insect pests) ways. The role of ecosystems in climate regulation is that of regulators of carbon dioxide and other greenhouse gases as well as effecting surface albedo (radiation of heat) and other biophysical properties. Comprehensive studies are needed, on regulators of greenhouse gases and on the effects of land management, which balance climate mitigation with agriculture, forest resources, and the ecosystem services these land uses provide.

###### **What has been done**

Surface heat flux is being monitored using an eddy flux system to improve estimates of net radiative flux in mixed forested, agricultural, and residential landscapes. Field sampling of carbon and nitrogen fluxes have been completed, and farm management information has been collected. These data will be used in calibrating modeling with remote sensing imagery, obtained by a synergistic project funded by the National Science Foundation, to improve an ecosystem biogeochemistry model of Denitrification and Decomposition (DNDC). This model predicts fluxes in greenhouse gases.

### Results

Analysis of soil samples collected across the landscape indicates that residential and agricultural soils can be a significant carbon sink. Although forests contain the highest concentration of carbon in the soil profile, carbon stocks are similar among land cover types. Higher bulk densities and finer soil textures may be partially responsible for this surprisingly high carbon storage capacity in agricultural and residential soils. More importantly, patterns in soil physical properties among our research sites are consistent with those that occur through the study area: forests tend to have coarser soils while farms and residential developments are typically located where soil has a finer texture. These patterns are likely the result of previous land use change and will likely influence soil carbon stocks as the landscape continues to develop in the future.

This project includes the first winter measurements of soil CO<sub>2</sub> fluxes through the snowpack in the Northeastern US, and is important for improving climate change models.

### 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 #4

#### 1. Outcome Measures

Understanding the impact of atmospheric deposition on water quality in order to develop management strategies that stakeholders can use to improve water quality.

#### 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)

Atmospheric deposition—the transfer of nutrients, metals, and microbes from the atmosphere to the earth's surface—is a fundamental part of environmental health. A nationwide network of sites (NADP) measures this deposition around the country. New Hampshire scientists will help provide



information, useful to environmental management in New England, and describe the effects of atmospheric deposition on terrestrial and aquatic ecosystems, biogeochemical cycling, climate change, and human health.

**What has been done**

Quantifying the amount of nutrients and acids in precipitation has been assessed through continued long-term sampling of rain chemistry in New Hampshire and Puerto Rico. This information is useful for assessing the impacts of dirty rain on ecosystem health, relative to other human impacts such as forestry and agriculture. This information has been critically important in local discussions and decision-making related to the management of the Great Bay Estuary, NH.

**Results**

The primary output of the project is the dissemination of findings that quantify the impact of dirty rain in temperate and tropical watersheds. Understanding the relative impact of atmospheric deposition compared with various point- and non-point sources of pollution is being incorporated into local planning of pollution mitigation for NH's Great Bay Estuary and in Puerto Rico. Dissemination activities included presentations for high school students, local and regional planning groups, a US House of Representatives committee, US Senate Staff members, US Environmental Protection agencies, the NH Department of Environmental Safety, as well as press releases for UNH Today, the UNH Campus Journal, NH Public Radio, and via the web. <http://ecosystemsandsociety.blogspot.com>

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
112	Watershed Protection and Management

**Outcome #5**

**1. Outcome Measures**

Address microbial contributions to soil organic matter accumulation, and also to the timing and extent of soil organic matter (SOM) loss and N mineralization in various cropping systems

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

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The loss of soil organic matter (SOM) is one of the greatest challenges to agricultural sustainability. The loss of SOM enhances soil compaction and emissions of trace gases, increasing dependence upon external fertilizer inputs, and exacerbates environmental nitrogen losses. Conventional theories argue that SOM formation is a function of the quality and chemistry of soil carbon(C) inputs; in contrast, new models downplay the importance of substrates and emphasize the role of microbial transformations of substrate inputs. Resolving the pathways of SOM formation is critical to sequestering soil C, to limit the release of greenhouse gas emissions and understanding N cycling in SOM, which is critical both to crop fertility and minimizing the nutrient run off that pollutes water systems.

#### **What has been done**

?A multi-tiered approach, which includes meta-analysis, observations, and field manipulations, addressed questions related to the role of soil biological communities in SOM formation.  
?Field studies included looking at the impacts of different crop rotations, with and without cover crops, on soil structure and SOM composition.

#### **Results**

?Preliminary experiments indicated that N fertilization influences the breakdown of corn stover to SOM, influencing different chemical constituents in different ways. These changes may stem from the impact of fertilization on N cycling in soil microbes.  
?Rotational and cover crop impacts were determined on a soil physical structure, associated microbial communities and activity, and soil C storage.

### **4. Associated Knowledge Areas**

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

### **V(H). Planned Program (External Factors)**

#### **External factors which affected outcomes**

- Appropriations changes

#### **Brief Explanation**

The NHAES continues to suffer from a ~25% decrease in state funding beginning in 2011, which has reduced farm support staff.

### **V(I). Planned Program (Evaluation Studies)**

#### **Evaluation Results**

While Research projects in the planned program are at different states of maturity, all are considered successful and productive.

- Publication of peer reviewed papers in high impact journals. One of the three projects has been highly productive over the last year with five publications.
- Presentations in major national and international conferences: all three projects in the planned program have featured presentations at national and international meetings.
- Results of the atmospheric deposition program are being incorporated in local and regional planning efforts to ameliorate eutrophication of the NH Great Bay Estuary.

### **Key Items of Evaluation**

- Quantifying the amount of nutrients and acids in precipitation has been assessed through continued long-term sampling of rain chemistry in New Hampshire and Puerto Rico. This information has been critically important in local discussions and decision-making related to management of the Great Bay Estuary, NH.
- NHAES research includes the first winter measurements of soil CO<sub>2</sub> fluxes through the snowpack in the Northeastern US, and is important for improving climate change models.