2013 University of New Hampshire Research Plan of Work

Status: Accepted

Date Accepted: 06/20/2012

I. Plan Overview

1. Brief Summary about Plan Of Work

The New Hampshire Agricultural Experiment Station (NHAES) resides within the University of New Hampshire's College of Life Sciences and Agriculture. It has responsibility for Hatch and Hatch-Multistate agricultural research, and McIntire-Stennis cooperative forestry research programs. This report covers the federal and state partnership-funded Hatch and Hatch-Multistate research components. Our programs are inclusive of the USDA-NIFA national priority areas in childhood obesity, climate change, food safety, global food security & hunger, and renewable energy, while also addressing important state and regional priorities in sustaining natural resources (McIntire-Stennis) and supporting rural economies. The last program, supporting rural economies, is part of NHAES effort to coordinate activities with the Maine Agricultural and Forestry Experiment Station's activities (see below).

We focus on research problems having local to international relevance, and are closely mindful of the Hatch Act directive that the experiment stations are best able to prioritize specific research needs for their respective states. The diverse funding portfolio of our researchers demonstrates the success of NHAES foundational support and investments leading to strong productivity, with scientists further leveraging their research findings into federal grants activity. This results in strongly added value for NH taxpayers. The Hatch capacity funds provide critical baseline abilities to support a credible agricultural program, including field research facilities and support for training the next generation of agricultural scientists and educated citizen consumers.

Agriculture and associated natural resources are core contributors to the NH economy. Beyond the direct impacts of agricultural cash receipts and its multipliers, the attractive open spaces maintained by pastoral small-scale agricultural operations combine with our abundant natural resource base to create a compelling venue in support of our large tourism sector. The same quality of life factors provide a magnet for the growing high-technology industrial base, a biomedical industry and additional sectors of the state's economy.

In agriculture, the trend in our state continues to be toward smaller farms with income balanced between crop and livestock sales. The number of farms in NH have has increased slightly after years of decline. New recruits are setting up small diversified farms. The New England dairy industry continues to suffer the impacts of low milk prices. We rank high nationally in proportion of organic farms and the value of organic as percent of total sales, consistent with our small producers seeking viable economic niches. The latter is aided through the close proximity of many New England urban and rural interfaces. We strongly support research in these areas through our suite of funded projects as well as our two horticultural farms, two dairies and research greenhouses. The farms and dairies address both conventional and organic research and management needs, and results are disseminated to our varied stakeholders. Our setting on the Gulf of Maine provides opportunity to support coastal and open water marine aquaculture through research and meaningful engagement of producers, harvesters and other stakeholders.

The overarching goal of our planned program areas is to provide a balance that spans the range of fundamental (development) to applied (applications-oriented) research in support of important state,

regional and national agricultural issues. Our research, outreach and educational programs will increasing emphasize the sustainability of our relatively unique small scale and diversified agricultural operations, and will contribute to the development of a highly competitive agricultural system for local and regional markets. At the same time we continue to be strong contributors to the economic engine supporting a diversity of related New Hampshire businesses and citizens.

Scientists at the New Hampshire Agricultural Experiment Station are encouraged to coordinate their research activities with scientists at other stations in the northeast region and nation in partnership with the USDA National Institute of Food and Agriculture. Via this plan and the corresponding Maine plan of work update, the New Hampshire Agricultural Experiment Station and Maine Agricultural and Forest Experiment Station recently declared an intent-to-plan for a unique two-state programmatic collaboration with the goal of increasing program effectiveness and administrative efficiencies in both units through joint activities. Our objectives are to (1) develop complementary and/or integrated research programs and activities at the New Hampshire and Maine stations that will more effectively meet the research needs of the two states and the northern New England region, (2) improve the distribution of research-based information from the New Hampshire and Maine stations to stakeholders in the two-state region, and (3) improve administrative efficiency and communication programs at both stations. Our intention is to submit separate, but coordinated, plan of work updates in the coming years.

There are many potential advantages of a New Hampshire-Maine collaboration. Our units and states share a number of challenges and potential opportunities:

- The agriculture and forestry sectors in Maine and New Hampshire have parallel opportunities and needs.
- Both Maine and New Hampshire have investments in aquaculture.
- Maine and New Hampshire have similar dependencies on nature-based tourism and broadly similar needs in the environmental arena.
- The current emphasis on multi-institutional research by the USDA and other federal agencies argues for greater formal coordination at the program level.
- Coordinated, cooperative research activities, sharing of resources, and integration of certain administrative activities will more effectively serve the needs of each state as well as the region.
- Administrative demands, including outreach and communication needs, will likely increase at the same time as pressure increases to reduce administrative costs.
- With limited state funding, expertise gaps will increasingly occur at our individual stations.

During the course of the next year, we plan to involve administrators and faculty in a planning process to evaluate options and opportunities for collaboration and anticipate the outcomes will influence future plans of work.

Estimated Number of Professional FTEs/SYs total in the State.

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.2	0.0	23.8	0.0
2014	0.2	0.0	23.8	0.0
2015	0.2	0.0	23.8	0.0

Estimated Number of Professional FTEs/SYs total in the State.

Year	Extension		Research	
	1862	1890	1862	1890
2016	0.2	0.0	23.8	0.0
2017	0.2	0.0	23.8	0.0

II. Merit Review Process

1. The Merit Review Process that will be Employed during the 5-Year POW Cycle

- Internal University Panel
- Expert Peer Review
- Other (Peer review of proposals, manuscripts and products)

2. Brief Explanation

Faculty are encouraged to submit a one page description of their proposed project and meet with the NHAES Associate Director/Faculty Fellow to discuss the anticipated work. A proposal development and projects review manual is available to help faculty prepare their full proposals.

All submitted proposals are critically reviewed for merit by a committee consisting of highly accomplished faculty members, plus the Director and Associate Director/Faculty Fellow. In response to stakeholder input, the NHAES review process now includes the following proposal evaluation criteria:

- Relationship to the Hatch or Hatch-Multistate programs, and to the NHAES mission and research priorities
- Scientific and technical merit
- Soundness of approach, procedures and methodology
- Likelihood of significant contributions and/or innovative advances
- Previous and current research productivity and accomplishments (or potential, for new investigators)
- Likelihood of significant enhancement in research capability and competitiveness.

The NHAES Director and Associate Director/Faculty Fellow use these recommended criteria and their own independent evaluation to make the final decision on which projects the Experiment Station will forward to NIFA for ultimate approval of funding.

Qualitative overview of the internal NHAES merit review process comes via the scholarly peer review process, which evaluates the manuscripts from NHAES projects and the ability of our scientists to compete for external funding.

III. Evaluation of Multis & Joint Activities

1. How will the planned programs address the critical issues of strategic importance, including those identified by the stakeholders?

NHAES funds participation in multi-state projects of significant concern, or potential impact, to the state of New Hampshire, the region, and nationally, which are broadly important to agriculture and citizens. Projects address aspects of animal and plant agriculture that include the breeding of suitable varieties for our area, improvement of genetic potential in chicken, climate change, sustainable agriculture, and human health with special emphasis on rural communities. The following projects will be active during FY2013 through FY2017:

- NE009 (through FY2013): Conservation and utilization of plant genetic resources
- NE1034 (through FY2013): Genetic bases for resistance and immunity to avian diseases
- NRSP3 (through FY2014): The National Atmospheric Deposition Program
- NC1042 (through FY2013) : Management systems to improve the economic and environmental sustainability of dairy enterprises
- NC1193 (through FY2016): Promoting healthful eating to prevent excessive weight gain in young adults
- NE1039 (through FY2014): Changing the health trajectory for older adults through effective diet and activity modifications
- NC1171 (through FY2013): Interactions of individual, family, community, and policy contexts on the mental and physical health of diverse, rural, low-income families.

We actively encourage multistate project participation, particularly among our best and junior scientists. Such affiliation with appropriate multistate research projects supports regional or national research priorities and, concurrently, benefits junior faculty by encouraging their interactions with scientific peers. One of our recent hires joined NE1047, "Ecological bases for weed management in sustainable cropping systems," while another has joined S1028, "Ecological and genetic diversity of soilborne pathogens and indigenous microflora." The latter is being revised this year, so getting our new faculty in on the ground floor will allow him to participate in drafting objectives that are also pertinent to the agriculture in the Northeast.

The Director's Office and faculty members maintain connections to critical issues through fostering professional contacts with varied stakeholders, keeping abreast of priorities expressed by funding entities, collaborating with regional and national peers, and interacting directly with stakeholders - in particular farmers and other producers - about research imperatives.

2. How will the planned programs address the needs of under-served and under-represented populations of the State(s)?

Several of the planned programs for NHAES research address the needs of under-served and under-represented populations across the state; these include rural communities with emphasis on those in Northern New Hampshire. The immediate and long-term results of NHAES research impacts small farmers working traditional and organic dairies, the fledgling aquaculture industry along the New Hampshire seacoast, and a growing immigrant population in Manchester from refugee resettlement programs. We will work with our cooperative extension partners to more closely evaluate the needs of the state's urban populations, i.e. Manchester, within these categories.

Many of the multistate projects address priority needs that impact these target groups. Ongoing research investigates the availability and intake of healthy foods, links between environmental and dietary influences and obesity, and the viability of local products and markets. Multi-state NC1193 seeks to understand how issues important to young adults, such as environment and quality of life, affect their diet, activity, and lifestyle choices. As a

participant in NC1193, researchers are surveying University students to assess and improve their nutrition environment. Outcomes will include targeted educational materials and interventions to help college age students improve their nutrition and maintain healthy weights. NC1171 will provide data for customizing programs and public policy to meet the needs of rural America. It also will inform the research and cooperative extension programming in sociology, economics, family studies, nutrition and health offered to families and communities across the state. Stakeholders have identified the needs for multi-state NE1039 as inadequate diet and lack of physical activity. NHAES investigators are testing an educational program to encourage consumption of whole grain foods by older adults. This, along with the other objectives of NE1039, should improve the health and vitality among older adults, who are the most rapidly growing segment of our population.

The Northeast produces approximately 25% of the organic milk in the country and the market has seen strong increases of the last decade. Organic dairy farmers remain an under-served population. The NHAES Organic Dairy Research facility is the only facility of its kind in the Northeast. NHAES is leading research efforts to reduce the costs of inputs (e.g., bedding and forage), improve grazing, and enhance the nutritional quality of milk products. NHAES scientists are leading a multi-investigator, integrated project supported by the Organic Research and Extension initiative (OAREI) to improve the quality, production, and marketing of milk.

3. How will the planned programs describe the expected outcomes and impacts?

We are training the principle investigators of all NHAES projects to focus on the outcomes and impacts of their active - and proposed - research. As we move forward with this initiative, the researchers will be progressively more aware of and able to identify these metrics and to report them during the annual cycle. Our web-based system for annual reporting, with drop down menus for examples of outcomes and impacts, has undergone two years of testing. We will continue to refine this online reporting system that enables principle investigators to more effectively track research outputs, outcomes, and engagement with stakeholders in order to communicate NHAES achievements to NIFA.

4. How will the planned programs result in improved program effectiveness and/or

Interaction with multistate colleagues provides synergies, opportunity for professional growth and development, and, ultimately, the potential for enhanced individual effectiveness that will carry into all activities undertaken by researchers through the NHAES.

In addition to these formal multistate committee interactions, NHAES faculty participate broadly in regional, national, and international research collaborations of value to the state and region. Our new agricultural ecosystems faculty have initiated partnerships with researchers and cooperative extension faculty in Maine, Vermont, and other Agricultural Systems by preparing proposals to the Organic Agriculture Research and Extension Initiative (OREI) and Sustainable Agriculture Research and Education organization (SARE). These new collaborations strongly leverage NHAES support with substantial amounts of competitive funding that is directed to common themes of strategic importance.

Participation in multistate and integrated research projects provides participating faculty with multiple benefits, including the ability to undertake and accomplish projects with a larger and more integrated scope. Whether multistate, integrated or other, all our programs emphasize potential effectiveness and efficiency in order to maximize outcomes and impacts. NHAES only supports scientists who use taxpayer funds in a productive manner. We target our

funding to strongly support and enhance productive research, and to develop more cohesive programmatic efforts where we can utilize our relative strengths in order to provide significant advances.

IV. Stakeholder Input

1. Actions taken to seek stakeholder input that encourages their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of selected individuals from the general public
- Other (Comments from proposal and manuscript reveiwers)

Brief explanation.

Input from our multiple stakeholders is encouraged at every opportunity and by multiple means, including presentations and meetings with traditional and non-traditional groups or individuals. Many of these are information interactions, both opportunistic and planned, and others follow more formal routes. Input from stakeholders to individual faculty and NHAES projects is encouraged by surveys (telephone, in person, and web-based), through presentations at scientific conferences, extension/educational workshops and field days, multistate project meetings, via mass media, publications, and through the university classroom and educational programs aimed at K-12. Nontraditional stakeholders are being increasingly engaged to inform and assist in our efforts to increase emphasis on sustainable agricultural and food systems research. At the same time, we continue to nurture our communications with conventional agricultural stakeholders, who continue to be highly interested and supportive of our work.

As part of our efforts to better partner with UNH Cooperative Extension, following several years of modest integration between the two entities, we will work with them to develop periodic formal mechanisms to comprehensively solicit input from stakeholders throughout the state. This will augment our existing and ongoing activities, and will presumably result in enhanced interactions and participation. This coordination is targeted in the evaluation of several of our planned programs.

2(A). A brief statement of the process that will be used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Open Listening Sessions
- Use Surveys
- Other (UNH Cooperative Extension)

Brief explanation.

The NHAES will continue to undertake strategies to identify and engage stakeholders from throughout New Hampshire, and to collect and incorporate input from them. Resulting information will be evaluated to identify the most critical and feasible issues for which we may develop effective contributions. UNH Cooperative Extension, the NH Department of Agriculture, Markets and Food, and the various college and NHAES advisory committees have been helpful in identifying traditional and non-traditional stakeholders. Meetings with groups of stakeholders often result in identification of additional potential contacts. Attending and presenting at agricultural exhibitions, such as the annual NH Farm & Forest Expo, enable us to facilitate direct conversations with a very diverse group of stakeholders and rural citizens. Listening to and speaking with participants during field days and open houses, and commodity or Extension-sponsored conferences and workshops, provides insights from grower groups, professionals, government agencies, home gardeners, and many others.

2(B). A brief statement of the process that will be used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

For strategic planning and the development of NHAES programs and priorities, input is collected through meetings with stakeholder groups and individuals including growers, farmers, citizens, agricultural organizations and councils, natural resources professionals and managers, state and federal agency representatives, neighboring state AES and extension administrators, research project directors, graduate and undergraduate students, and other means. While most meetings are open discussions, some are presentations followed by questions and answer sessions. NHAES administration also attends many extension events and takes advantage of these opportunities to participate in discussion with groups and individuals.

We have redone the Agriculture and Research sections of the college website to make agriculture much more prominent, visible, and accessible in order to encourage stakeholder interactions. NHAES research project participants obtain direct and indirect stakeholder input through varied avenues. Projects with social science components frequently use questionnaires and surveys. Stakeholder input to many basic, and some applied, science projects occurs in the form of reviewer inputs to proposals and manuscripts, and from the questions, comments, and discussions following presentations at regional, national, and international conferences. Stakeholder input is also collected directly through the questions and comments at workshops and training sessions for end users.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities
- Other (Strategic Initiatives Development)

Brief explanation.

Formal and informal stakeholder input to faculty, staff, and administrators is very helpful in gauging the changing needs, constraints, and opportunities that we might address. These influence the specific activities of supported researchers as well as NHAES goals and directions in the short and long term.

Stakeholder input is used to continually review and update research priorities, relevant existing and emerging topics, and individual and programmatic performance. The information informs activities including faculty and staff hires, and investments to facilities and programs. Our strategies, activities, and priorities are dynamic and evolve with consideration of stakeholder input, institutional and societal goals and funding, and additional factors. We are continually working to facilitate constituent input, focus our resources on priority issues, and improve our delivery of research findings to end users.

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Childhood Obesity

2. Brief summary about Planned Program

Nutrition practices and environmental conditions that impact childhood obesity are a national research priority with direct impacts on New Hampshire citizens. NHAES currently has two projects in the area of childhood obesity. One project will evaluate the role of exposure to PBDE flame retardants on liver metabolism and test whether the PDBE may be impacting childhood obesity. The second project will focus on healthful eating to prevent excessive weight gain in young adults through participation in the NC1028 multistate project.

Associated with the obesity crisis, there has been an upward trend in childhood respiratory allergy and asthma over the past 40 years. One dietary factor that has been suspected to be a causal factor is the imbalance in dietary levels of n-6 (omega 6) versus n-3 (omega 3) polyunsaturated fatty acids. The imbalance is believed to be, in part, the result of eating meat products and milk fat from farm animals that have been fed cereal grains, rather than being pasture-fed. Ninety-nine percent of meat production farm animals in the U.S. are fed cereal grains. One NHAES project is testing this hypothesis in the lab, using feeding studies in mice.

At the other end of the age spectrum, researchers are collaborating in the multi-state project NE1039 to use diet and modified activity to improve the overall health profile of older adults. Basic research looks at modification of gene regulation (epigenetic changes) in the growth of fat cellsand its nutritional implications.

Additional research related to nutrition, but that does not focus on obesity, is housed under the global food security and hunger planned program.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : No

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
305	Animal Physiological Processes			16%	
701	Nutrient Composition of Food			4%	
702	Requirements and Function of Nutrients and Other Food Components			42%	
703	Nutrition Education and Behavior			20%	
704	Nutrition and Hunger in the Population			10%	
723	Hazards to Human Health and Safety			8%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

Obesity is a global, growing epidemic recognized as a priority area by the USDA. Despite the plethora of resources devoted to understanding the roles of diet and exercise in the obesity epidemic, this epidemic continues to escalate, suggesting that as-yet-unidentified environmental factors may be involved. These factors can include the environment and individual behavior patterns, and, at the biochemical level, there is a growing body of experimental evidence that suggests certain environmental chemicals could disrupt body metabolism and contribute to the obesity epidemic.

2. Scope of the Program

- In-State Research
- Multistate Research
- Integrated Research and Extension
- Multistate Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

Preventing obesity in children is related not only to observed or encouraged behaviors, but also by environmental chemicals that predispose individuals to weight gain. The biological effects of endocrine-disrupting compounds may not be limited to parent compounds, but could include in vivo metabolites. Funding and resources will continue to be available at sufficient levels to support the research. Multistate collaboration will lead to productive integrative synergies.

2. Ultimate goal(s) of this Program

To expand our understanding of environmental factors that promote the development of obesity in an animal model and in young adults, and devise ways to approach the obesity problem using community-

based participatory research.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	2.1	0.0
2014	0.0	0.0	2.1	0.0
2015	0.0	0.0	2.1	0.0
2016	0.0	0.0	2.1	0.0
2017	0.0	0.0	2.1	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Project activities will focus on:

- characterizing biochemical impacts in tissues of animals exposed to environmental obesogens
- determining the oxidative stress impact of environmental obesogens on key glucose-metabolizing tissues of animals
- examine effects of inflammatory omega six fatty acids, and non-inflammatory omega three fatty acids from dairy fatson the development of respiratory allergy in an animal model. Dairy fats will be compared from conventional total mixed ration fed cows, which are known to be higher in omega six fatty acids, and pasture fed organic dairy cows, which are known to be higher in omega three fatty acids.
- enhancing researchers' skills in participatory research techniques and building partnerships among researchers, extension and outreach educators, and populations of young adults to develop cooperative intervention programs
- developing community-based applications that can be refined and evaluated in future projects.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● Demonstrations ● Other 1 (Surveys)	● Newsletters ● eXtension web sites ● Web sites other than eXtension

3. Description of targeted audience

This project is intended to benefit the health of people across New Hampshire and the region, while making the conduct of scientific research more transparent to community partners, stakeholders, and the

public.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of undergraduate students directly involved in the projects
- Number of university courses in which project results have been incorporated
- Number of presentations at regional, national, or international scientific meetings
- Number of surveys or other means of gathering information and data from participants
- Number of reviewed, bulletin, popular and other publications
- Number of graduate students directly involved in the research.

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Number of graduate students trained and ready to enter the workforce.
2	Number of undergraduate students involved and trained in engagement research.
3	Increased knowledge about the role of PBDE flame retardant in obesity related metabolism.
4	Availability of methods for participatory research related to obesity.
5	Evaluate the hypothesis: Milk fat consumption of pasture-fed cows will have a more protective effect against development of allergy development than milk fat cows fed a total mixed ration diet.

Outcome # 1

1. Outcome Target

Number of graduate students trained and ready to enter the workforce.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 305 - Animal Physiological Processes
- 703 - Nutrition Education and Behavior
- 723 - Hazards to Human Health and Safety

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of undergraduate students involved and trained in engagement research.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 305 - Animal Physiological Processes
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior
- 723 - Hazards to Human Health and Safety

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Increased knowledge about the role of PBDE flame retardant in obesity related metabolism.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 305 - Animal Physiological Processes
- 723 - Hazards to Human Health and Safety

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Availability of methods for participatory research related to obesity.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 703 - Nutrition Education and Behavior

4. Associated Institute Type(s)

- 1862 Research

Outcome # 5

1. Outcome Target

Evaluate the hypothesis: Milk fat consumption of pasture-fed cows will have a more protective effect against development of allergy development than milk fat cows fed a total mixed ration diet.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 305 - Animal Physiological Processes
- 701 - Nutrient Composition of Food
- 702 - Requirements and Function of Nutrients and Other Food Components

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Description

Changes in funding and resource availability for the activities, and in policies or regulations related to research using animal and human subjects, would compromise ability to complete the objectives. Competing programmatic challenges must be considered in prioritizing resource use.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

NHAES will evaluate the outcomes and impacts of these research activities by monitoring ongoing publication in peer-reviewed journals and evidence adoption of health interventions in wider communities.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change

2. Brief summary about Planned Program

Many aspects of climate, soils, landform and vegetation in New Hampshire and New England make it particularly susceptible to any changes in climate. We are near a northern temperature extreme for some forms of agricultural production. NH has the greatest proportion of forested land in the country. The vast majority of plant agriculture relies primarily on growing season rainfall rather than intensive irrigation. Our thin soils and shallow bedrock provide less buffer than many parts of the country. All of these make the ability to anticipate, mitigate, and adapt to potential changes in climate a priority. Further, as a heavily forested state, NH has the potential to serve as net carbon sink, which is important to the global environment.

This program addresses prediction, adaptation, and mitigation of climate change impacts on mixed agricultural, residential and forested landscapes. While we have previously funded some projects which addressed the particular aspects of this topic, we will develop a more strongly focused and integrated effort going forward. Our initial efforts comprise a team of excellent scientists having strong productivity records. Many of these individuals have not previously focused their work on agriculture, and their inclusion provides a powerful addition to our efforts, including substantial extramural funding to leverage NHAES support.

Our projects are integrated with Cooperative Extension, which is working with state and region stakeholders to plan landscape solutions for the Natural Resource Community.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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	0%		42%	
112	Watershed Protection and Management	50%		17%	
131	Alternative Uses of Land	50%		41%	
	Total	100%		100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

New Hampshire and New England rely heavily on our natural and managed land base for economies based on production and tourism. Tourism, agriculture, and forestry comprise a very large portion of the NH economy, as well as for the other nearby states. Maintaining the health of these is critical to our quality of life and economic wellbeing.

There is overwhelming evidence that warming of the Earth's climate has been induced by the global footprint of human activities. Contributing factors include the rise of CO2 in the atmosphere, increasing emissions of N2O and other greenhouse gasses, and alteration of land surface properties through ecosystem management and land cover change. Changes in climate witnessed thus far have been as apparent in the Northeastern U.S. as elsewhere. Because natural and agricultural ecosystems are vital to the region's economic and cultural well-being, understanding the long-term effects of climate change is paramount. However, ecosystems also play an important role in climate regulation. Their influence occurs both as regulators of carbon dioxide and other greenhouse gases, as well as through their effect on surface albedo and other biophysical properties. Although climate change policy initiatives often include incentives for land management activities that can offset warming, most have focused on enhanced storage of carbon. This can be achieved through, for example, no-till agricultural practices or forest management practices that maximize standing biomass. Often not considered is the fact that these practices also bear climate consequences through other mechanisms (N2O and CH4 emissions, changes in reflect solar energy, etc.). Comprehensive studies of net climate impacts are rarely carried out, but are greatly needed for crafting effective land management policies that balance climate mitigation with food production, forest resources, and many other services for which these ecosystems are relied upon.

A second priority is achieving a better understanding of how microbial communities contribute to the formation and breakdown of soil organic matter (SOM). The timing and extent of SOM turnover is associated with N availability to support plant growth. Conventional agriculture uses inorganic N inefficiently and typically 50% or more of inorganic fertilizer N is lost to the environment. Developing new strategies to build SOM will improve our ability to manage N in agricultural systems to maximize productivity and minimize N losses to ground water and to the atmosphere.

2. Scope of the Program

- In-State Extension
- In-State Research

- Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

Predicted changes in climate will have substantial implications for New England's natural and agricultural ecosystems. Changes in nutrient cycling and greenhouse gas production are likely to be equally important. Sufficient NHAES funding, and other resources, will continue to be available to undertake this multi-investigator integrated project.

2. Ultimate goal(s) of this Program

The goal of this program is to address climate change impact and mitigation issues by conducting a focused study of how agriculture and other land uses in a human-dominated landscape influence climate through a combination of carbon storage, greenhouse gas emissions (N2O and CH4), and alterations to reflection of solar radiation (shortwave albedo) and associated land surface heating. Results of this activity will highlight tradeoffs among multiple land management strategies in terms of their net climate effect. Information of this nature is of critical importance for preparing sound land management policies and designing strategies to cope with changes in climate.

We anticipate that outcomes from this program will provide knowledge and opportunities for NH stakeholders to anticipate and successfully adapt to changing climatic conditions. Additional impacts will be to improve N management in agricultural systems as part of ecosystems management.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.2	0.0	3.9	0.0
2014	0.2	0.0	3.9	0.0
2015	0.2	0.0	3.9	0.0
2016	0.2	0.0	3.9	0.0
2017	2.0	0.0	3.9	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Activity for the program includes:

- measuring C pools and greenhouse gas emissions (CO2, CH4, N2O) in agricultural and suburban landscapes and comparing these data with data previously collected from forest plots in the same area
- using the combined data set to calibrate a high spectral resolution remote sensing image from NASA's AVIRIS instrument acquired in 2009 for the Durham, NH area
- using the field and remote sensing data to parameterize the denitrification decomposition (DNDC)

computer simulation model, validate and upscale model predictions

• generating spatially continuous predictions of C pools, greenhouse gas emissions, and reflection of solar radition (shortwave albedo) to determine the net radiative forcing values (in W m-2) for the major components of the landscape (mowed versus grazed pasture, corn fields, forest, and suburban lawns)

• making future projections of C, N and water balances for both agricultural and forested landscape units, using newly available CO2 and climate change projections through 2100.

Investigate the effects of different cropping systems, soil insects, and microbial community composition on Soil Organic Matter (SOM) turnover and soil nitrogen cycling.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● Group Discussion ● Demonstrations	● eXtension web sites ● Web sites other than eXtension

3. Description of targeted audience

Target audiences include 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 rely on agricultural and forest products currently 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.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of undergraduate students directly involved in the projects
- Number of graduate students directly involved in the project
- Number of university courses in which project results have been incorporated
- Number of presentations at regional, national, or international scientific meetings
- Number of workshops, training sessions and presentations to non-scientific stakeholders
- Number of websites in which project results have been incorporated

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

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 used 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 Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 131 - Alternative Uses of Land

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 131 - Alternative Uses of Land

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management

4. Associated Institute Type(s)

- 1862 Research

Outcome # 5

1. Outcome Target

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. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 131 - Alternative Uses of Land

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Competing Public priorities
- Competing Programmatic Challenges

Description

The nature of this work means that weather extremes, natural disasters, and similar factors would substantially disrupt or interfere with the field aspects. Climate change is currently a public and governmental priority. Any changes in this situation, including availability of leveraging funds and resources, remote sensing products, or similar changes would affect the outcomes. Reduction in NHAES capacity funds that impact funding or research, personnel or facilities will negatively impact out abilities to complete the research.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

Progress in this planned program area will be evaluated

• through review by peer scientists, feedback from all manner of information stakeholders, and success in leveraging NHAES resources with competitive grant funds.
• adoption of refined models of the impact of climate change ond different landscapes by end users: farmers, natural resources managers, government planners.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Food Safety

2. Brief summary about Planned Program

The safety of agricultural and aquaculture food products is of high concern to all consumers within NH, and therefore within the umbrella of NHAES research. Supported research will target improving the safety and reliability of food products grown, harvested, or produced and consumed locally, regionally, and nationally.

Current thrusts will combine applied and fundamental efforts

1. to address the problem of foodborne pathogenic vibrios in shellfish,
2. to define commonalities and differences in the mechanisms of biofilm adaptation between pathogens and commensals of agriculturally important hosts, and, importantly, to understand the mechanisms behind these and related processes to aid management efforts in the future.
3. A third focus is on understanding and ameliorating the pathways through which domestic animals and humans become exposed to toxic microcystins produced by bacterial blooms in freshwater lakes and drinking water reservoirs.

The latter work in particular combines research, extension, and teaching into an effective integrated effort.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : No

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
212	Pathogens and Nematodes Affecting Plants			8%	
215	Biological Control of Pests Affecting Plants			7%	
311	Animal Diseases			10%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals			25%	
501	New and Improved Food Processing Technologies			12%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			25%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			13%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

• Pathogenic Vibrio species are a significant cause of shellfish-borne disease incidence in the US and worldwide. Outbreaks of illness caused by Vibrio parahaemolyticus and Vibrio vulnificus infections have been growing concerns for consumers of shellfish, especially oysters from the Gulf of Mexico. The shellfish aquaculture industry has suffered increasingly more frequent vibrio-associated disease outbreaks linked to shellfish consumption, both on a regional and a national scale. These outbreaks and individual cases of disease have had a widespread and cumulatively devastating impact on markets. Because of this, the top priority of the east coast shellfish growers industry is to reduce food-borne illnesses associated with their products. Biofilms created by microorganisms are ubiquitous and critical to many applications in agriculture, medicine, water quality and transport, industrial applications and others.

• Gaining greater understanding about the mechanisms behind biofilm adaptation between pathogens and commensals is a high priority for agricultural applications.

• Toxic mycrocistins are produced by cyanobacterial blooms in recreational and drinking water bodies, and impact those who come into contact with these. Understanding, and helping to ameliorate, the pathways through which agricultural animals and products come into contact with microcystins is an important aspect of food safety in our area.

2. Scope of the Program

- In-State Extension
- In-State Research
- Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

- Vibrio diseases are an important problem for shellfish harvesting and processing, and ensuring safety for consumers and economic viability for the shellfish aquaculture industry in New England and the rest of the world. The incidence of virulent strains in populations of otherwise benign bacterial species within microbial ecosystems also poses a threat for severe wound infections in people who swim, fish, and work in coastal waters. The increased incidence of vibrio diseases associated with shellfish consumption in north temperate coastal areas of the U.S. is emerging as a significant concern. Funding and resources will be available to complete the work. Simple models can be constructed to help in the risk analysis needed to manage shellfish harvesting in the Northeast U.S. The results from this work can help to refine and inform monitoring strategies for these pathogens in colder north temperate coastal waters in relation to emerging U.S. FDA guidelines.
- Forming bioflims is an essential component to how free living Pseudomonas species interact with host organisms (e.g., plants, animals) in relationships that are either probiotic or pathogenic. These interactions are of broad interest to agricultural and medical communities.
- Cyanobacterial blooms that cause toxic microcystins will continue in the state and region. Funding and resources will continue to be available at the same, or increased, level to enable conduct of the research and engagement activities.

2. Ultimate goal(s) of this Program

- The goal of the program is to help elucidate environmental and biological conditions and pathways that are useful for reducing or avoiding exposure to elevated levels of pathogenic vibrio species and toxic mycrocistins.
- A second goal is to increase our understanding of bacterial biofilms and how they may be managed to support agricultural goals rather than impede them.
- Ongoing studies examine accumulation of toxic microcystins in freshwater lakes and improved monitoring and managment of blooms. Very high levels microcystins have been tied to neurodegenerative diseases in humans.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	2.9	0.0
2014	0.0	0.0	2.9	0.0
2015	0.0	0.0	2.9	0.0
2016	0.0	0.0	2.9	0.0
2017	0.0	0.0	2.9	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

• Activity for the program will include developing, refining, and applying methods for detection and enumeration of Vibrio parahaemolyticus and Vibrio vulnificus and their virulence genes in the Great Bay Estuary. The program will also determine environmental and biological factors associated with reduced concentrations of pathogenic vibrios in freshly harvested and post-harvest, processed oysters.
• Analysis of how adaptation of Pseudomonas sp. to form biofilms probiotic or pathogenic interactions with plants and animals.
• Evaluation, through a variety of means, of the presence, impacts, and pathways of microcystins expore to animals and humans
• Dissemination of results of various activities via scientific, extension, and formal teaching venues.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● Group Discussion ● One-on-One Intervention ● Demonstrations	● eXtension web sites ● Web sites other than eXtension

3. Description of targeted audience

The target audiences for this work include:

• the shellfish industry and shellfish regulatory agencies, graduate and undergraduate students, high school students, faculty collaborators, those interested in ALS (Lou Gehrig's Disease), veterinarians, state and regional conservation groups
• town planners, decision-makers and conservation commissions
• lakes planning commissions, state and federal agencies, lake association members, lake shore residents, public water suppliers, scientists working in related areas, and cooperative extension educators.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of undergraduate students directly involved in the projects
- Number of university courses in which project results have been incorporated
- Number of presentations at regional, national, or international scientific meetings
- Number of workshops, training sessions, and presentations to non-scientific and regulatory stakeholders
- Number of graduate students directly involved in the research.

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Increased knowledge about the incidence and detection of vibrio in oysters.
2	Knowledge of environmental and biological factors associated with reduced concentrations of vibrios in harvested and processed oysters.
3	Number of agencies and stakeholder groups involved in research outreach related to vibrios in shellfish.
4	Increased knowledge about mechanisms of biofilm adaptation and diversification in pathogens and symbionts.
5	Number of citizens engaged in educational presentations and workshops related to toxic algal blooms and the potential health impact of microcystins

Outcome # 1

1. Outcome Target

Increased knowledge about the incidence and detection of vibrio in oysters.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Knowledge of environmental and biological factors associated with reduced concentrations of vibrios in harvested and processed oysters.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Number of agencies and stakeholder groups involved in research outreach related to vibrios in shellfish.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally

Occurring Toxins

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Increased knowledge about mechanisms of biofilm adaptation and diversification in pathogens and symbionts.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 212 - Pathogens and Nematodes Affecting Plants
- 215 - Biological Control of Pests Affecting Plants
- 311 - Animal Diseases

4. Associated Institute Type(s)

- 1862 Research

Outcome # 5

1. Outcome Target

Number of citizens engaged in educational presentations and workshops related to toxic algal blooms and the potential health impact of microcystins

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 314 - Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Description

Natural disasters or weather extremes affecting coastal areas could impact accurate evaluation of environmental factors that influence the incidence and detection of vibrios in oysters. Extremely heavy rains or drought conditions will impact the frequency of microalgal blooms in fresh water lakes.

Changes in funding and resource availability for the activities, and in policies or regulations related to research using animal and human subjects, would compromise the feasibility of completing the objectives.

Competing programmatic challenges must be considered in prioritizing resource use.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

• Monitoring the progress of researchers' projects, as gauged by acceptance of manuscripts in peer-reviewed journals, and the ability of these researchers to leverage NHAES funds for external grants.

• Analyzing the results of stakeholder surveys conducted during outreach activities to obtain information as to the level of interest and impact of research outcomes on stakeholder planning activities.

• Adoption of new risk-management strategies by stakeholders (commercial shellfish operations, watershed associations).

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Global Food Security and Hunger

2. Brief summary about Planned Program

Plant and animal agriculture are integral components of the past and future New Hampshire and New England landscapes. A primary aspect of NH animal agriculture is the dairy industry. To reduce feed costs for organic dairies, one project will investigate the use of sugarcane molasses as potential lower cost substitute for organic grains. The project will also help design forage supplementation strategies for pasture-fed organic dairy operations, enhance the quality and nutrient utilization of pasture forage, and provide farmer tools to evaluate profitability and risk. Three projects focus on pasture-fed versus total mixed ration-fed cow's milk with its different fatty acid profiles and other traits, and how these might influence the health of the cows and consumers of dairy products, and the physiochemical and sensory qualities of cheese. Work will investigate the potential to improve fertility of cattle that are artificially inseminated with conventional or sexed semen.

The second primary area of NH food production is in vegetables and small fruits. Among our horticultural crop research, a longtime plant breeder will use conventional breeding techniques to develop squash, melon, gourd, and pumpkin varieties having improved taste, nutrition, appearance, disease resistance, and suitability for regional climate conditions. A related effort will develop interspecies hybrids of squash having improved carotenoid content, taste, and handling characteristics for processing and fresh markets. Another project will evaluate the characteristics and adaptation of vegetable and fruit varieties and evaluate and develop management techniques to extend the growing season, increase profitability, reduce environmental impact or improve efficiency of vegetable and fruit cropping systems in NH. Weeds are one of the largest problems in sustainable crop production. One researcher will help to determine weed management strategies for sustainable cropping systems, including those under organic production. To aid in dealing with local insect pests, another project will document the NH species, plant hosts, distributions and seasonalities of plant-feeding leafhoppers that are known to transmit diseases to their plant hosts.

Another aspect of this program area involves supporting the regionally important aquaculture industry. A project involving four scientists and an extension specialist will develop integrated multi-trophic aquaculture methods for land-based and near-shore systems. Another project will focus on generating triploid green sea urchins that would provide higher consumer preference uni and therefore greater dollar value for local producers. Improved methods for finfish production in recirculating systems, and a morphometric measurement based validation of species identity in suspension cultured blue mussels constitute the final two applications oriented research efforts in the area of aquaculture.

Some research will be more fundamental in nature, leading to future enhancements to management strategies. One researcher will identify key reproductive hypothalamic and pituitary hormones which are important to help control reproduction in commercially important fish species used in aquaculture, among multiple other applications. Another project will lay the groundwork for genetic improvement of northwestern Atlantic Porphyra seaweed species for future use in multi-trophic aquaculture or as use for a sea vegetable crop. A molecular geneticist will generate new genomic knowledge about strawberries and translate it into tools and strategies to facilitate varietal improvement through marker assisted breeding. A third project will increase understanding of the actinorhizal symbiosis between beneficial Frankia microbes and plants, which represents an important ecological and

economic role in agriculture and the environment. Mechanisms of communication between these plants and microbes will be evaluated toward future increases in agricultural production, through development of tools that will allow the genetic analysis of Frankia physiology and the interactions of Frankia with its host plants. The relatively simple plant Arabidopsis is used extensively to help scientists understand complex plant genes. A NHAES scientist will use Arabidopsis as a model to investigate the molecular components of pathways involved in sensing and responding to DNA damage.

Two funded scientists will work to improve animal reproduction through identifying genetic, morphological and physiological attributes of the ovary that may improve fertility in ruminants.

Nematodes have a major impact on agricultural production worldwide, and a NHAES project will use genomic and bioinformatics tools to reveal genetic bases for expression of the interactions of these nematodes with their hosts.

Finally, the use of phosphodiesterase inhibitors as potential insecticides will be investigated.

Integrated research and extension efforts in this area are supported through partial support for three extension faculty, and effective synergies with national colleagues are facilitated through affiliation with seven multistate research projects. In the global food security and hunger program, eight NHAES scientists participate in the following multistate projects: NE009 - Conservation and Utilization of Plant Genetic Resources, NE1047 - Ecological Bases for Weed Management in Sustainable Cropping Systems, NE1027 - An integrated approach to control of bovine respiratory diseases, NE1034 - Genetic Bases for Resistance and Immunity to Avian Diseases, and NC 1042 - Management Systems to Improve the Economic and Environmental Sustainability of Dairy Enterprises.

3. Program existence : Mature (More then five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation			5%	
135	Aquatic and Terrestrial Wildlife			4%	
201	Plant Genome, Genetics, and Genetic Mechanisms			3%	
202	Plant Genetic Resources			2%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			5%	
204	Plant Product Quality and Utility (Preharvest)			6%	
205	Plant Management Systems			2%	
206	Basic Plant Biology			4%	
211	Insects, Mites, and Other Arthropods Affecting Plants			4%	
212	Pathogens and Nematodes Affecting Plants			10%	
216	Integrated Pest Management Systems			2%	
301	Reproductive Performance of Animals			13%	
302	Nutrient Utilization in Animals			7%	
303	Genetic Improvement of Animals			2%	
305	Animal Physiological Processes			4%	
307	Animal Management Systems			14%	
311	Animal Diseases			4%	
601	Economics of Agricultural Production and Farm Management			2%	
701	Nutrient Composition of Food			2%	
903	Communication, Education, and Information Delivery			5%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

The largest segments of New Hampshire's agricultural sector excluding ornamental horticulture are dairy, vegetable and fruit production, and aquaculture. As a result, this planned program comprises our largest effort. The shared goals among many New Hampshire residents is to have a thriving small-scale

agrarian sector along with a clean and healthy environment. Each brings important individual benefits and, combined, they greatly support our critical tourism and related service industries. These industries need continuing research to help them adapt to changing economic, social, policy, and environmental concerns.

The NHAES commitment to the dairy industry is evident through our support of two operational research and teaching dairies - one a conventional Holstein operation based on total mixed ration feeding and the second an organic dairy-based agroecosystem using pasture-fed Jersey cows. We have recently added a cohort of Jerseys to the conventional dairy to allow direct comparisons of organically and conventionally managed cows and products. Similarly, we support two horticultural farms and a greenhouse complex for vegetable and fruit breeding, genetics, and production. A portion of one horticultural farm will undergo transition to organic certification beginning this year to enable us to address issues of importance to that agricultural segment.

New England in general, and New Hampshire in particular, produces only a small portion of the food calories it consumes. The state and region, therefore, is particularly dependent on imported food, mostly from distant locations across the United States and from many other countries. The continued supply of that food is insecure, based on the highly volatile supply and price of oil, over 60% of which is imported from overseas.

Globally, the demand for seafood continues to rise while many wild fish stocks are at or beyond sustainable harvest levels. Export of green sea urchins from the Gulf of Maine to Japan is one example of a robust fishery that collapsed in the last decade due to overfishing. To meet rising consumer demand, much of the production will depend on continued growth of the aquaculture industry. The growth of aquaculture is, however, meeting resistance in many areas due to water quality problems and the reliance on fish meal-based diets derived from wild harvested fish. Integrated multi-trophic aquaculture, where mutlple species are grown in concert, may alleviate some of these problems, e.g. seaweeds, sea urchins and baitworms would remediate wastes from finfish or oysters. Oysters also remove small particulates in estuarine aquaculture. Seaweeds can be used as supplemental feeds for urchins and finfish. Improvements in sea urchin aquaculture are needed to replace natural stocks in order to reinvigorate this valuable export product.

America's abundant and inexpensive supply of food and fiber is based on a productive and progressive agricultural system. The foundation for this productivity has been based on scientific knowledge and exploitation of useful genetic diversity for developing new, higher quality cultivars that can resist pests, diseases, and environmental stresses. The genes that are needed to provide a continued flow of new varieties that produce higher yields with better quality, and to better withstand pests, diseases, and abiotic stresses can only come from diverse plant germplasm. Most of the food crops important in the American diet have their origin in other parts of the world. Genetic diversity of plant species has evolved in centers of origin wherever this has occurred in the world. This source of different genes continues to be essential for plant breeders and other scientists to breed new varieties that are important to American consumers today. Locally adapted crop varieties are needed that serve consumer demands for high quality, locally grown produce and value-added horticultural products. A short growing season, high labor costs and high land values make fruit and vegetable production far more costly in New England than elsewhere. Further, an extremely variable and humid climate make disease and insect pests a constant threat to the profitability of NH farms. To compete with west coast and international agricultural producers, NH vegetable and fruit growers must produce unique and high-value products. To attain sustainability, NH fruit and vegetable growers must reduce use of chemical pesticides, minimize crop production costs, maintain high crop quality and yields, and have reliable and consistent markets for their products. There are many production challenges unique to NH and New England conditions. Regionally applicable agricultural research is needed to identify crops, crop varieties, and production practices that are best suited to these conditions.

Impaired reproductive performance is a major cause of reduced productivity for ruminants and of reduced profitability for dairy and meat animal producers. In the US, over 4 million replacement dairy heifers are raised annually. The cost of raising dairy replacements represents 15% to 25% of the total cost of managing a dairy operation. There is increasing interest in organic dairy production in response to

higher milk prices and perceived consumer demand. Purchased feeds, including conserved forage and grains, account for an average of 36% of the total cash expenses of organic dairy farms located in northern New England. Northeast producers cited the high costs of production as one of the most challenging aspects of sustaining organic dairying in the region.

2. Scope of the Program

- In-State Extension
- In-State Research
- Multistate Research
- Integrated Research and Extension
- Multistate Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

Most national research on production methods is applicable to terrain and climates that are very different from those faced by NH growers. Crop varieties that are developed elsewhere may or may not be adapted to the short growing season, cold winter temperatures, specific soil types, or prevalent pests of NH. As a result, varieties must be carefully evaluated for performance in this region. The attractiveness of local produce to consumers can be enhanced by developing new varieties with improved appearance, eating quality, and nutrition. In addition, improved disease resistance in vegetable crops reduces pesticide inputs and increases profitability.

We are entering an uncertain economic period and cannot continue to rely on past cheap oil supplies, both because of the depletion of remaining inexpensive oil stocks and greater competition for those stocks, and because of uncertain global economic conditions. Supplementing high-sugar forage with molasses will improve milk quality and yield, and reduce feed costs and outputs of N and CH4 to the environment. Seasonal changes in fluid milk color and flavor, along with differences in fatty acid ratios and other health markers between grass-fed and total mixed ration-fed dairy cows will impact potential uses of fluid milk and value-added dairy products, including consumer preference.

By integrating production of a commercially important plant species (seaweed) that can utilize the waste products of other cultured species (e.g. fish, sea urchins) the total economic potential of the aquaculture site is increased, while environmental impacts are minimized.

Support dollars for NHAES will increase or remain the same, as will staffing levels, research space and other resources required to complete the work.

2. Ultimate goal(s) of this Program

- To increase our understanding of and abilities to produce agricultural food products..
- To address state, regional and international food security consistent with maintaining environmental quality.
- To contribute to the abilities of New Hampshire and regional stakeholders to maintain viable businesses and careers. To advance scientific knowledge in related areas.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	12.8	0.0
2014	0.0	0.0	12.8	0.0
2015	0.0	0.0	12.8	0.0
2016	0.0	0.0	12.8	0.0
2017	0.0	0.0	12.8	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Conduct applied and discovery research and undertake engagement with stakeholders in multiple aspects of plant and animal agriculture, related genetics and genomics, nutrition and health, and integrated aquaculture involving shellfish, finfish, invertebrates, and seaweed.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Workshop	● Newsletters
● Demonstrations	● eXtension web sites
● Other 1 (Field Days)	● Web sites other than eXtension

3. Description of targeted audience

The target audience of this work includes consumers of animal and plant based foods and products, organic and conventional farmers, aquaculture ventures, restaurants and other businesses reliant on local foods, master gardeners, home gardener associations, consumers and legislators, and those engaged in the extensive food systems network. It also includes scientists, veterinarians, agricultural researchers,Cooperative Extension specialists, agricultural teachers, graduate and undergraduate students, and the faculty and staff of the region's land grant universities.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of undergraduate students directly involved in the projects
- Number of graduate students directly involved in the research
- Number of university courses in which project results have been incorporated
- Number of presentations at regional, national, or international scientific meetings
- Number of workshops, training sessions and presentations to non-scientific stakeholders
- Number of reviewed, bulletin, popular and other publications
- Number of websites in which project results have been incorporated
- Number of surveys or other means of gathering information and data from participants

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Increased knowledge about plant production practices suited to the state and region.
2	New knowledge about dairy production, nutrition, animal health and dairy products important to regional producers.
3	Advances in squash varieties having enhanced nutritional benefits including carotenoid concentrations.
4	Increased knowledge about integrated multispecies aquaculture systems.
5	New genomic knowledge translated into tools and strategies to facilitate varietal selection through marker assisted breeding.
6	New commercialized varieties of cucurbit vegetables suited to state and region growing conditions.
7	Improved range of weed management options available for sustainable and organic growers.
8	New NH leafhopper data available through a web-accessible database
9	A working technology to produce triploid green sea urchins for use in natural harvest and land based aquaculture.
10	Improvement in finfish aquaculture in recirculating production systems
11	Develop regionally appropriate management systems to suppress soil borne pathogens for both organic and conventional farms.
12	Knowledge related to how the neuroendocrine system influences reproduction in fin fish aquaculture and other vertebrate animals and in the control of pest species such as lamprey eels.

Outcome # 1

1. Outcome Target

Increased knowledge about plant production practices suited to the state and region.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

New knowledge about dairy production, nutrition, animal health and dairy products important to regional producers.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Advances in squash varieties having enhanced nutritional benefits including carotenoid concentrations.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Increased knowledge about integrated multispecies aquaculture systems.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 133 - Pollution Prevention and Mitigation
- 204 - Plant Product Quality and Utility (Preharvest)
- 302 - Nutrient Utilization in Animals
- 307 - Animal Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 5

1. Outcome Target

New genomic knowledge translated into tools and strategies to facilitate varietal selection through marker assisted breeding.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 204 - Plant Product Quality and Utility (Preharvest)

4. Associated Institute Type(s)

- 1862 Research

Outcome # 6

1. Outcome Target

New commercialized varieties of cucurbit vegetables suited to state and region growing conditions.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 204 - Plant Product Quality and Utility (Preharvest)

4. Associated Institute Type(s)

- 1862 Research

Outcome # 7

1. Outcome Target

Improved range of weed management options available for sustainable and organic growers.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 205 - Plant Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 8

1. Outcome Target

New NH leafhopper data available through a web-accessible database

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 211 - Insects, Mites, and Other Arthropods Affecting Plants

4. Associated Institute Type(s)

- 1862 Research

Outcome # 9

1. Outcome Target

A working technology to produce triploid green sea urchins for use in natural harvest and land based aquaculture.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 307 - Animal Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 10

1. Outcome Target

Improvement in finfish aquaculture in recirculating production systems

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife
- 305 - Animal Physiological Processes
- 307 - Animal Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 11

1. Outcome Target

Develop regionally appropriate management systems to suppress soil borne pathogens for both organic and conventional farms.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 205 - Plant Management Systems
- 212 - Pathogens and Nematodes Affecting Plants
- 216 - Integrated Pest Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 12

1. Outcome Target

Knowledge related to how the neuroendocrine system influences reproduction in fin fish aquaculture and other vertebrate animals and in the control of pest species such as lamprey eels.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 301 - Reproductive Performance of Animals
- 305 - Animal Physiological Processes
- 307 - Animal Management Systems

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations
- Competing Programmatic Challenges

Description

Weather and climate extremes and natural disasters affect the outcomes of field research on plants and animals. Economic factors and government regulations may impact the available resources and abilities of relevance in undertaking specific research methods. Appropriations changes that reduce Hatch funds would compromise our ability to undertake and complete the work. Competing programmatic challenges must be weighed to ensure effective use of limited NHAES resources.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

1. Monitoring the progress of projects as gauged by acceptance of manuscripts in peer reviewed journals, and the ability of these researchers to leverage NHAES funds for external grants.

2. Stakeholder surveys conducted during outreach activities indicating the levels of interest and the impact of research outcomes on stakeholder planning activities.

3. Evidence of adoption of new plant cultivars and production methods.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Sustainable Energy

2. Brief summary about Planned Program

The cost of energy is a major input to NH agricultural operations, and rising energy costs challenge the viability of our producers, many of whom operate on a thin margin. Renewable and sustainable energies are, therefore, important areas of concern with potential development for the state and region. The typical small size of our farms means that renewable and sustainable energy schemes, which are appropriate for this operational scale, are of greatest interest.

The primary biological resource for potential conversion to energy in New England is trees. New Hampshire has the greatest proportion of forested land area of any state. Our marginal climate and poor soils make growth of other major crop biofuels less feasible. The northern latitude also reduces photosynthetic opportunity for algae production, though each of these may hold promise at smaller scales.

Research and engagement under this program area address renewable and sustainable energy sources and approaches, particularly, but not exclusively, those well suited to the unique geographic, environmental, biophysical, and social conditions in New England.

Initially we have a single project under this program area. At about the same time as the project was initiated, the investigator was named to a central UNH administrative position, with a very large administrative workload. Progress on the very novel research will therefore be more limited than would otherwise be the case.

3. Program existence : Intermediate (One to five years)

4. Program duration : Medium Term (One to five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : No

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			30%	
403	Waste Disposal, Recycling, and Reuse			70%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

The dairy industry in NH is second to ornamental horticulture in economic impact. The dairies throughout NH and New England are critical aspects of the renowned pastoral environment that attracts tourists and residents alike. Many dairies in the region are going out of business under the current economic situation. The higher prices available for organic dairy products is an incentive to some producers who are able to absorb the higher production requirements (costs, management, compliance). The biggest challenges facing organic dairy producers in the northeast is the cost of inputs, including grain and other feedstocks, energy, bedding, and other materials from off-farm. These same demands are important in the economics of the NHAES Organic Dairy Research Farm, where this research will occur. At the same time, there are important under-utilized material and energy resources produced on many New England farms; the two major resources are woodlot trees and manure. The development of knowledge and technologies for helping to close the energy and material budgets of operations through integrated, multi-stage usage of wood and manure resources would be highly relevant and beneficial to many regional dairy producers who have similarly diversified operations. This program area will work to develop and test technologies for farm-scale compost based energy production.

2. Scope of the Program

- In-State Research

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

Bedding, energy, and soil amendments will continue to require economical solutions to maintain viability of the northeastern dairy agriculture sector. NHAES will obtain sufficient funding to maintain the Organic Dairy Research Farm and support the research. Federal and state regulations will continue to be consistent with dairy compost and compost-based energy capture operations.

2. Ultimate goal(s) of this Program

The research is intended to develop, test, and improve an integrated system for using wood from farm woodlots as a renewable resource for bedding for the barns and, subsequently, using the combined bedding plus manure resource to produce energy for on-farm use through aerobic composting with integrated heat exchange system. Description of an engineered system meeting small to moderate-sized farm requirements for bedding, manure handling, and energy is a final goal.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	0.5	0.0
2014	0.0	0.0	0.2	0.0
2015	0.0	0.0	0.2	0.0
2016	0.0	0.0	0.2	0.0
2017	0.0	0.0	0.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Low quality wood will be harvested from farm woodlots and chipped to produce bedding. Temperature, trace gas (CO2, CH4, H2S, NH4), and oxygen concentrations will be measured in experimental then operational bedding/manure piles with and without different degrees of aeration. Development of best practices around optimizing the production of energy while minimizing the generation of greenhouse gases for farm-scale aerobic composting operations will follow. The economics of this system will be analyzed.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● Group Discussion ● Demonstrations	● Web sites other than eXtension

3. Description of targeted audience

Dairy farmers in the Northeastern U.S., and those interested in sustainable energy solutions that are feasible for small diversified operations.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of undergraduate students directly involved in the projects
- Number of university courses in which project results have been incorporated
- Number of workshops, training sessions and presentations to non-scientific stakeholders
- Number of websites in which project results have been incorporated
- Number of graduate students directly involved in the research.

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	New and improved knowledge about compost-based renewable energy systems for small animal operations available to peers and stakeholders.

Outcome # 1

1. Outcome Target

New and improved knowledge about compost-based renewable energy systems for small animal operations available to peers and stakeholders.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 101 - Appraisal of Soil Resources
- 403 - Waste Disposal, Recycling, and Reuse

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Government Regulations
- Competing Programmatic Challenges
- Other (Competing time demands)

Description

The work will be conducted at our Organic Dairy Research Farm facility, so natural disasters and weather extremes would affect progress toward meeting objectives. Allocation of limited resources to competing programs must be considered, particularly if funds decrease or costs increase. Government regulations controlling compost and energy development must be supportive for the work to continue. Competing demands for the time and attention of the principal investigator may affect the ability to progress in a timely manner.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

The success of this research activity will be gauged by adoption of these integrated bedding/composting/engery production systems by regional dairies. Adoption would likely be a gradual process, so it would be monitored over time through interaction with state dairy extension specialists.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Sustaining Natural Resources

2. Brief summary about Planned Program

Understanding of the relative magnitudes of chemical sources and sinks is critical to addressing the role of current and future land uses in potential policies to mitigate impairment of public waters. Two projects will investigate how agricultural and suburban land management impacts water quality entering rivers and their impact on local coastal and estuarine systems. One will combine grab samples and in situ sensor networks, with river network modeling for the Great Bay watershed, to quantify C, N, and P fluxes. It will provide recommendations about where current N mitigation efforts should be focused and where future land change or land management activities might be concentrated to minimize impacts. The second project will investigate the feasibility of using eelgrass wrack on farms as a way to bio-remediate the N loading in the Bay and recycle organic material within the system back to the farm soils, as was historically done along the east coast.

A perception that decisions impacting agriculture and natural resources are arrived at through appropriate stakeholder participation is important to public acceptance. Another project will design, apply and evaluate approaches to facilitate two-way communication between managers, policy makers and stakeholders and evaluate the utility and value of a web-based instrument in this process. Additional work is supported through other areas in this report and through our McIntire-Stennis forestry management program.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : No

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			14%	
112	Watershed Protection and Management			38%	
133	Pollution Prevention and Mitigation			3%	
403	Waste Disposal, Recycling, and Reuse			5%	
511	New and Improved Non-Food Products and Processes			3%	
608	Community Resource Planning and Development			14%	
901	Program and Project Design, and Statistics			10%	
903	Communication, Education, and Information Delivery			13%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

New Hampshire's abundant natural resources are central to our economy and quality of life. Many aspects of forested land and associated wildlife resources are covered under our McIntire-Stennis program and are not a part of this report. Because of New Hampshire's climate, geography, and other factors the quality of our water bodies and river networks is a very high concern. Suburban, agricultural, and other land uses impact the concentrations of nitrogen, carbon, phosphorous, salts, and other constituents in water to the point that the Great Bay estuary in the NH seacoast region is nitrogen impaired. The Great Bay is of great importance to commercial, recreational, and conservation goals and activities. Together, these factors create a high priority research area for New Hampshire and NHAES.

Discussion and evaluation of agricultural and natural resources issues and the subsequent decisions that impact these are often highly charged, and are nearly always of substantial interest and concern to New Hampshire's population. Enhanced approaches to facilitate communication between managers, policy makers, and stakeholders as a part of these decisions will help gain the best potential solutions and buy in by those who are directly and indirectly affected.

2. Scope of the Program

- In-State Research

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

- Funding in support of planned activities will stay the same or increase.

- Access to public lands and waters will continue.
- Local and national airborne deposition resources will be maintained.
- Effective communication among interested stakeholders will continue to be a priority.

2. Ultimate goal(s) of this Program

The ultimate goal of this program area is to increase our understanding of natural resources in New Hampshire and surrounding areas, including the status and trajectories of processes that may impact these, to aid in the effective sustainable management of these public and private resources.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	0.7	0.0
2014	0.0	0.0	0.7	0.0
2015	0.0	0.0	0.7	0.0
2016	0.0	0.0	0.7	0.0
2017	0.0	0.0	0.7	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

- Research concerning the sources and sinks of major constituents impacting water quality in the state will be measured and modeled.
- Potential land use priorities or modifications that could affect the water quality of rivers that are tributaries to the Great Bay Estuary and coastal margins will be considered.
- Potential strategies to remove excess nitrogen from the Great Bay will be evaluated.
- Methods to enhance two-way communication among stakeholders interested in potential agricultural and natural resources decisions will be developed and tested.
- Airborne deposition of chemicals and acidity will be measured, and real and potential impacts characterized.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Workshop ● Group Discussion ● One-on-One Intervention ● Demonstrations	● Web sites other than eXtension

3. Description of targeted audience

Residents of New Hampshire and New England; private, public and municipal users of water; agricultural and suburban land use planners and managers, individuals and organizations interested in conservation of water and estuarine resources, town managers and relevant committee members, other scientists, undergraduate and graduate students, state and federal agencies, and natural resources professonals.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of graduate students trained and directly involved in the research.
- Number of undergraduate students trained and directly involved in the research.
- Number of stakeholder venues where results have been presented.
- Publications in peer reviewed journals and in meetings proceedings.

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Knowledge of the relative contributions of different agricultural land management practices and suburban land uses toward N, P and C exports from the watersheds to the coastal estuary.
2	Improved collection of social science data from end users for public policy makers and regional planners with respect to natural resource management.
3	A spatially distributed river network model for the Great Bay watershed that includes relative land use sources and sinks for N, P and C.

Outcome # 1

1. Outcome Target

Knowledge of the relative contributions of different agricultural land management practices and suburban land uses toward N, P and C exports from the watersheds to the coastal estuary.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Improved collection of social science data from end users for public policy makers and regional planners with respect to natural resource management.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 608 - Community Resource Planning and Development
- 901 - Program and Project Design, and Statistics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

A spatially distributed river network model for the Great Bay watershed that includes relative land use sources and sinks for N, P and C.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management

- 133 - Pollution Prevention and Mitigation
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations
- Competing Programmatic Challenges

Description

• Weather and climate extremes and natural disasters affect the outcomes of field research.
• Economic factors and government regulations may impact the available resources and abilities of relevance in undertaking specific research methods.
• Government regulations affecting the access to and sampling of important variables may interfere with completion.
• Appropriations changes that reduce Hatch and extramural funds would compromise ability to undertake and complete the work.
• Competing programmatic challenges must be weighed to ensure effective use of limited NHAES resources.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

The NHAES will monitor the outcomes and impacts in this program area in the following ways:

• publication of scholarly studies in peer reviewed journals
• application of water quality data in the Great Bay Watershed by policy planners and local governments
• adoption of eelgrass wrack as an alternative bedding source for farms surrounding the Great Bay..

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Supporting Rural Economies

2. Brief summary about Planned Program

New Hampshire is a strongly rural state within the similarly rural region of Northern New England. We enjoy a rather unique circumstance of having proximity of rural and urban areas, through populations centers in the southern part of the state (Concord, Manchester, Nashua) and through our Southern New England neighbors in MA . As an example, Boston is 65 miles from the University of New Hampshire

The NHAES research programs in this area address this situation by focusing on the welfare of low income individuals and families in rural areas, and how changes in demographics will impact land use and need for public spending.

Ornamental and landscape horticulture represents the single largest agricultural economic sector in NH, and is closely tied to the economies of our rural areas. We offer strong support through funded projects as well as providing the farm and greenhouse facilities that are used for research, extension, and teaching. Research in this program area includes developing sustainable plant nutrition management strategies for bedding and potted flowering plants, and developing new procedures to maintain root systems over the winter in northern nursery production systems. The latter will allow northern nurseries to grow stock locally, rather than transport trees and shrubs from southern growers. This will reduce production costs for northern nurseries while allowing them to expand local operations.

NHAES' efforts in the supporting of rural economies involve integrated research and extension efforts of two faculty having split appointments. Two other faculty are participating in multistate research projects, NC1171 - Interactions of individual, family, community, and policy contexts on the mental and physical health of diverse rural low-income families and W2001 - Population dynamics and change: Aging, ethnicity and land use change in rural communities. W2001 ends in FY12 but the a revised project has been submitted for review.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : No

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			20%	
133	Pollution Prevention and Mitigation			5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			25%	
801	Individual and Family Resource Management			10%	
802	Human Development and Family Well-Being			10%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			25%	
805	Community Institutions, Health, and Social Services			5%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

The New Hampshire agricultural, forestry, and natural resources based economies - and much of our substantial tourist industry - are fundamentally based on the state's rural character. It is a compelling quality of life factor to state residents and highly attractive to visitors. Maintaining this important aspect of our state requires that our rural citizens and communities are able to thrive both socially and economically. While the NHAES cannot address all of the salient issues related to rural communities and economies, we do and will continue to contribute a substantial component of important knowledge that is critical to rural citizens, local and state organizations, and federal agencies with relevant oversight. Our role in providing unbiased and objective information is particularly critical in helping to resolve sometimes emotionally and politically charged topics.

Horticulture is the number one agriculture sector in NH. The production component of this sector takes place in rural areas and is an important source of employment. NHAES funds research on potted flowering plants, and new production systems for shrubs and trees, to address needs of rural producers and help them become more competitive.

Rural residents are often underemployed or unemployed due to personal choice reasons or reasons beyond their control. The role that physical and mental health plays in the lives of rural New Hampshire families and in the complex interaction among the family context, community, and policies is a critical aspect of our rural environment. The aging of the U.S. population affects rural areas in unique and geographically diverse ways, with increasing rates of retirement migration affecting some areas and aging-in-place occurring elsewhere. The changing racial and ethnic composition of rural areas produces social and economic challenges to the integration of these new racial and ethnic groups. Rapid population growth along the urban-rural periphery and in high amenity areas requires a careful examination of land use patterns.

2. Scope of the Program

- In-State Extension
- In-State Research
- Multistate Research
- Integrated Research and Extension
- Multistate Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

Rural mothers face numerous barriers when attempting to maintain a strong attachment to the labor force. Being employed at any job is inadequate for many rural families to become financially self-sufficient when wages are low and hours are unpredictable. Barriers such as lack of child care, transportation problems, and health (both mothers own health and health of other family members) are constant challenges to rural low-income mothers. The Earned Income Tax Credit (EITC) is an important source of income for a number of rural families, although their knowledge of the EITC is limited. Without knowledge of regional differences, policy formation within New Hampshire may be misdirected and the state would be excluded from project efforts to disseminate findings which enhance the response capabilities of local government officials, regional economic development officers, extension personnel, and other stakeholders. New knowledge about economically, environmentally and socially sustainable production practices in floriculture and landscape horticulture will continue to be key to employment in these large sectors of our rural economy.

2. Ultimate goal(s) of this Program

T The ultimate goal of this program area is to provide new knowledge, practices and conditions in support of a thriving rural economy and social policy structure in New Hampshire and New England.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	0.9	0.0
2014	0.0	0.0	0.9	0.0
2015	0.0	0.0	0.9	0.0
2016	0.0	0.0	0.9	0.0
2017	0.0	0.0	0.9	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

• Investigate the changing organizational structure, tax policy and fiscal standing of local governments and the impact of tax and/or expenditure limitations on local government fiscal stress and economic growth in rural areas.

• Develop a better understanding of the role of amenities in rural development and the impact of economic and social changes on the quality of life in rural communities.

• Examine individual and family level characteristics and policies which impact physical and mental health in diverse rural low-income families.

• Examine the aging of the rural population within the context of overall U.S. population aging, and describe how in-migration, aging-in-place, and other demographic forces shape the spatial distribution and composition of rural populations.

• Develop improved over-wintering techniques for large container grown trees and shrubs to save labor and enhance profitability for northeastern producers. Assuming continuation of high energy costs, there will be renewed interest in local production of agricultural products once economic recovery results in increased demand for landscape plant material.

• Undertake greenhouse trials to determine effective and resource-efficient management techniques for use of controlled-release fertilizers in producing bedding and potted bedding plants of importance to the state and region.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● Group Discussion ● Demonstrations	● Newsletters ● eXtension web sites ● Web sites other than eXtension

3. Description of targeted audience

• Scientists, undergraduate and graduate students, citizens, land use professionals, homeowners, legislators, contractors, firms and rural residents, demographers, social and natural scientists as well as policy-makers and the media.

• Rural, low-income families, and private and governmental social services personnel and entities, especially in terms of employment and health care.

• State policy makers, planners and concerned citizens that will facilitate actions to enhance the social and economic development of the state, aid in developing comprehensive plans to guide future landscape development, and protect the state's abundant natural resources.

• Owners and operators of greenhouses that produce floriculture crops.

• Nursery producers and landscape contractors in NH and throughout the northeast.

• Extension educators who work in horticulture.

• State citizens interested in efficient and sustainable use of the state's economic and environmental resources in support of a thriving social structure.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of presentations at regional, national, or international scientific meetings
- Number of workshops, training sessions and presentations to non-scientific stakeholders
- Number of reviewed, bulletin, popular, news and other publications
- Number of surveys or other means of gathering information and data from participants
- Number of graduate students directly involved in research project.

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Increased knowledge among rural individuals and families related to employment and health care.
2	Number of presentations to civic and government entities to increase knowledge of demographics and migration in the region and nation.
3	Availability of modified production systems for woody nursery crops in northern nurseries.
4	Availability of new management guidelines for use of controlled-release fertilizers in greenhouse floriculture.

Outcome # 1

1. Outcome Target

Increased knowledge among rural individuals and families related to employment and health care.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 802 - Human Development and Family Well-Being
- 805 - Community Institutions, Health, and Social Services

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of presentations to civic and government entities to increase knowledge of demographics and migration in the region and nation.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 805 - Community Institutions, Health, and Social Services

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Availability of modified production systems for woody nursery crops in northern nurseries.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Availability of new management guidelines for use of controlled-release fertilizers in greenhouse floriculture.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

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

Description

Economic and public policy changes affect rural economies and choices related to lifestyle and social services. Natural disasters are another factor that can have unanticipated and often localized influences on rural populations. Population changes through migration, immigration, cultural groupings, and other factors are the target of one research project. Reduction in NHAES resources available to support this work will compromise its effectiveness and completion. Research emphases must always be evaluated relative to competing programmatic challenges and opportunities in order to provide greatest value to society.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

The NHAES will monitor the outcomes and impacts in this program area in the following ways:

- publication of scholarly studies in peer reviewed journals
- utilization of demographic analysis by local, state and regional planners and policy makers. (citations in public media, by policy makers, etc.)
- adoption of plant growth recommendations by commerical floriculture industry (web site hits, requests for literature at workshops and via Cooperative Extension)
- adoption by nursery growers of new production methods for overwintering landscaping shrubs and trees. (web site hits, requests for literature at workshops and via Cooperative Extension web sites).