

2009 University of Maine Research Plan of Work

Status: Accepted
Date Accepted: 04/24/08

I. Plan Overview

1. Brief Summary about Plan Of Work

The provisions of the Hatch Act are based on the premise that the experiment stations are in the best position to identify and address the basic and applied research needs of their respective states in the areas of agriculture, forestry, marine and rural economic development. The University of Maine System Board of Trustees concurs with this view and has declared "that the Experiment Station has central responsibilities in the state for research in agriculture, marine, forest resources, and rural economic development."

Based on its stated mission of conducting research for the people of Maine, this plan of work reflects the economic and cultural composition of Maine. Maine's economy is highly dependent on the natural resources that lie within its borders. The agriculture, forestry, and aquaculture and marine industries are all mainstays of the Maine economy. Maine's forestry-related sectors contribute an estimated \$6.5 billion to the economy, and agriculture-related industries contribute \$1.5 billion. The economic contribution of the aquaculture and marine sector easily exceeds \$1.0 billion. Maine's natural resources also attract millions of tourists each year who contribute about \$3.0 billion to the state economy.

Maine's economy faces many challenges from the state's location, size, and climate, but in some cases, these challenges are also benefits. More than 90 percent of Maine's land base is forested. Most of the 17.7 million acres of forestland is privately owned, with about half of it owned by small wood lot owners and the other half owned by large industrial forest companies. This forestland presents opportunities for Maine's tourism industry as well as the forest products industry. Maine's farms are small, averaging only 187 acres, but are increasingly diversified. Although the state is predominantly rural (ranking 39th in the nation in terms of persons per square mile), Maine is relatively close to major markets in Boston and New York. Maine's more than 3,500 miles of coastline may create transportation difficulties, but it also provides unique opportunities for aquaculture, fisheries, and tourism industries. Maine's location creates a prime testing ground for research on global climate change, as it falls along the northernmost extent of the range of some species, and the southernmost extent of the range of others.

The research described in this plan of work falls under six broad program areas: animal production and protection; economics, marketing, policy and community development; foods and nutrition; natural resources; plant production; and plant protection. MAFES research in our seventh program area, forest resources, is funded by McIntire-Stennis funds and is not covered by this plan of work. The outcomes from this research will help Maine's farmers, aquaculture producers, and food producers to increase profits, to develop new markets, and to become more competitive, help Maine to protect its valuable natural resources; help Maine communities to preserve their quality of place; and help to improve the health and wellbeing of Maine citizens.

To achieve these goals, MAFES researchers will join with other scientists and specialists from Cooperative Extension, other state and/or federal agencies, and will take part in multistate research projects that are applicable to Maine needs. MAFES administration will meet regularly with stakeholders, legislators, and others to discuss the state's needs for applied research and will direct research resources according to the input we receive.

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

Year	Extension		Research	
	1862	1890	1862	1890
2009	0.0	0.0	33.0	0.0
2010	0.0	0.0	33.0	0.0
2011	0.0	0.0	33.0	0.0
2012	0.0	0.0	33.0	0.0
2013	0.0	0.0	33.0	0.0

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

- Internal University Panel
- External Non-University Panel
- Expert Peer Review

2. Brief Explanation

All research projects funded by the Maine Agricultural and Forest Experiment Station (MAFES) go through three reviews. First, all pre-proposals are reviewed by the MAFES Research Council, which is comprised of senior faculty who have an established record of high productivity and high-quality research. The Research Council reviews the pre-proposals to ensure that the proposed work falls within the purview of MAFES, addresses an important need identified by stakeholders, and that the faculty member submitting the pre-proposal possesses the expertise to conduct the research.

Once approved by the Research Council, the pre-proposals are distributed to advisory committees to elicit their input on the importance of the issues addressed within the pre-proposals.

Upon receiving the input of the Research Council and the advisory committees, each faculty member develops a full research proposal for the work they wish to perform. Upon receipt of the full proposals by the Director of the Experiment Station, the proposals are sent out for external, expert peer review by scientists who are qualified to review the proposals. All reviewers are external to the University of Maine. Potential reviewers are identified through the CRIS system, faculty, and department chairs who work in related areas, and through other experiment station directors. Each proposal is sent to three to five reviewers. Upon completion of the external expert peer reviews, the proposal is returned to the researcher, who then makes changes based on the comments of the reviewers. Finally, the proposal is reviewed and approved by the Research Council before it is submitted to CSREES for final approval.

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?**

Many of the multi-state projects and integrated research and extension programs of the Maine Agricultural and Forest Experiment Station contribute to the high-priority needs identified by stakeholders, both within Maine and throughout the nation. In fact, some stakeholder groups contribute additional funding to these programs through voluntary assessments that they pay.

NE1014—Development of New Potato Clones for Improved Pest Resistance, Marketability, and Sustainability in the East—is a multistate project that develops and evaluates new potato clones for the eastern U.S.A. Potato-breeding programs in Maine, New York, North Carolina, and the ARS breeding program in Beltsville, MD, develop new potato clones and their performance is evaluated (in terms of the desired characteristics) in each of the regions of the eastern U.S.A. where potatoes are grown. This project addresses many stakeholder needs, including improved disease resistance, reduced used of pesticides, lower production costs, and culinary characteristics and qualities. All these factors ultimately contribute to the profitability of potato growers and the long-term survival of the industry.

Apple growers in the northern regions of the United States are in need of new varieties that are desired by consumers and more vigorous rootstocks that improve yield and profitability, and are resistant to freeze damage. NC140—Rootstock and Interstem Effects on Pome and Stone Fruit Trees—addresses part of this critical stakeholder need by evaluating new rootstock at several locations with differing climates.

Weed control is a major problem for producers of almost all crops, whether grown organically or conventionally. Improved methods of weed control are a high-priority need identified by stakeholders across Maine. NE1000—Improved Weed Control through Residue Management and Crop Rotation—determines how weeds can be suppressed with new tillage practices, rotation crops, and seed predators. Better weed control without the use of herbicides can also reduce production costs and potential environmental spillover effects, both of which are also important stakeholder needs.

For integrated extension and research activities, researchers and extension personnel at UMaine are developing an IPM program for the wild blueberry industry of Maine. The goal of this program is to improve yields, reduce weed and insect problems, reduce pesticide use and avoid the cost of inputs that do not contribute to plant health or production. This program is highly valued by wild blueberry growers and is being widely adopted. Some of the applied research is performed on stakeholders' farms.

Food safety and the development of value-added products are other high-priority needs that are addressed through integrated activities. A new food pilot plant is being used for product development and development of processing methods. Food safety is addressed through the measurement of pesticide residues of fruits and vegetables and the development and distribution of HCCAP procedures.

Another integrated activity is addressing animal health issues by investigating the incidence of Johnnes disease among dairy animals and other animal disease issues. This effort includes an integrated animal diagnostic laboratory to identify various diseases and to develop methods for growers to address the diseases. Experiment station and extension personnel jointly staff the animal diagnostic laboratory.

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

Both the Maine Agricultural and Forest Experiment Station and the University of Maine Cooperative Extension will continue their efforts to identify both underserved and underrepresented groups in the state. As the needs of these groups are identified, MAFES will develop new projects with experiment stations in other states that have the same needs; it will also develop new integrated programs with UMCE to address those needs. Hence, both multistate research projects and programs integrated with UMCE represent programs available to MAFES to serve the needs of these populations. MAFES will use these programs when they represent the best approach to address those needs.

Several of our multistate projects and integrated research and extension programs currently address needs of the under-served and under-represented populations in Maine. Historically, experiment station research has focused on food production issues of importance to growers and has ignored the needs of the consumers of the food products. Two of our multistate projects focus on the nutritional needs and habits of consumers to address high-priority needs such as obesity in the population. NC219 examines the effectiveness of different intervention materials to encourage an increase in the consumption of fruits and vegetables in the diet of young adults. If successful, the project should reduce diet-related illnesses and obesity as this segment of the population ages. NE1023 is examining improved methods to measure fruit, vegetable and whole grains in the diet of older Americans. It will also develop and test intervention methods to improve the intake of these food products among older adults. If successful, the information should reduce diet-related disabilities, obesity and chronic diet-related disease rates in this segment of the population.

Keeping with the theme of working directly on issues the impact under-served or under-represented populations, we have developed an integrated program to determine the level of resistance to lily leaf beetle among various varieties of lilies that are popular in Maine. This will benefit home gardeners in Maine. Another integrated program has been established to work with that segment of the population who is interested in developing medicinal herb businesses in Maine. Assistance offered includes nutritional facts about various herbs, testing of herbs for nutritional content, and guidance on the business planning process. This group has not been served in the past.

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

All the research and integrated programs of MAFES are moving toward a format that emphasizes planned outcomes and impacts. Researchers will be asked to identify the outcomes and impacts that will be achieved over the life of the program and specific progress in the attainment of these outcomes and impacts will be documented and reported annually.

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

Multistate research projects allow researchers to accomplish more as a research team than they can accomplish individually. A good example of the improved effectiveness and efficiency is the multistate potato clones project identified above. Through the multistate format, new potato clones can be tested in multiple locations on the east coast simultaneously, and the various breeding programs in the east can specialize in characteristics for which they develop clones as the other breeding programs take the lead for developing clones with other desirable characteristics.

Integrated programs also improve effectiveness by more efficiently distributing the results of the research performed by station scientists. Integrated programs also improve the identification of new research needs by facilitating the flow of information between the stakeholders and the researchers in MAFES.

IV. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Survey of the general public
- Targeted invitation to non-traditional stakeholder individuals
- Survey of traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Survey of traditional stakeholder groups

Brief explanation.

Stakeholder input related to research needs is conducted on a continual basis. The manner in which the input is sought is variable, including informal discussions between Experiment Station staff/faculty and traditional and non-traditional stakeholder groups/individuals, more formal settings designed to specifically discuss stakeholder research needs, surveys of traditional groups/individuals, and surveys of the general public. The frequency in which the different methods are used is also variable. Informal discussions occur continuously. Formal meetings to elicit input occur about every two to three years, and surveys of stakeholders are usually conducted every three to five years. The surveys of stakeholders are usually done in conjunction with Cooperative Extension and the University of Maine Board of Agriculture, a legislatively mandated board to advise the university on issues related to agriculture. Surveys of the general public are usually done every five to seven years.

All identified groups/individuals are asked and encouraged to provide the input being sought. Once new groups/individuals are identified, they are placed on a listing of the groups/individuals from whom information is sought on a continual basis.

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

- Open Listening Sessions
- Use Internal Focus Groups
- Use Advisory Committees
- Use External Focus Groups

Brief explanation.

Existing advisory committees are good sources of information for identifying new stakeholder groups and individuals. Members of advisory groups are aware of the formation on new groups that have been formed and individuals who have assumed positions of leadership, either as individuals or leaders of the new stakeholder groups.

However, there is a need to go beyond advisory groups to insure that new groups/individuals are identified that may not be networked with existing groups for a variety of reasons. Internal focus groups, comprised of faculty, extension and other people within the University that work with external constituents, will be used to identify new groups and individuals. External focus groups, comprised of federal and state officials as well as traditional and non-traditional will also be conducted to identify new groups and individuals.

Finally, listening sessions would be held periodically around the state to elicit input and provide an opportunity for new groups and individuals to come forward and be identified as stakeholder groups and individuals to work with in the future.

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

Brief explanation

{NO DATA ENTERED}

3. A statement of how the input will be considered

- To Identify Emerging Issues
- In the Staff Hiring Process
- In the Budget Process
- To Set Priorities
- In the Action Plans
- Redirect Research Programs

Brief explanation.

Stakeholder input is a central part of the planning process in the Maine Agricultural and Forest Experiment Station. For example, stakeholder input is used to identify emerging issues and to redirect on-going research programs to address those issues. Adjustments in short-term objectives are made regularly in these on-going research programs to address the emerging issues.

Stakeholder input is also used to make changes in the long-term direction of the research programs of MAFES, including the setting of priorities, the budget process and the hiring of new faculty. While these types of changes occur more slowly and are dependent on the availability of open positions through retirement or resignations, they represent the best option for moving into new research areas and serving the needs of new stakeholder groups.

V. Planned Program Table of Content

S. NO.	PROGRAM NAME
1	Animal Production and Protection
2	Plant Production
3	Plant Protection
4	Natural Resources
5	Economics, Marketing, Policy and Community Development
6	Foods and Nutrition

V(A). Planned Program (Summary)

Program #1

1. Name of the Planned Program

Animal Production and Protection

2. Brief summary about Planned Program

The animal production and protection program combines basic and applied research that addresses the needs of Maine's dairy and aquaculture/fisheries industries. Research for Maine's equine industry is funded through Animal Health funds and is not covered in this plan of work.

For animal agricultural production systems to be competitive in the global economy, Maine farmers must adopt new management and production techniques that will increase productivity and lower costs. Improvement of forage quality and utilization and developing methodologies for improving reproduction are among the research areas that will help Maine producers.

In addition to the traditional farm-based animal production systems, MAFES research focuses on the needs of Maine's aquaculture and commercial fisheries industries. Applied research projects are investigating ways to improve our ability to culture marine fish species as a way to broaden the state's aquaculture industry, developing new baits for the lobster industry, breeding new lines of Maine-adapted mussels and oysters, and engineering new equipment to solve real-world problems facing Maine's marine-resource-related industries. MAFES discovery research is investigating issues surrounding the health of Maine's fish and shellfish, from the effects of environmental toxicants to new vaccines for hatchery-reared trout and salmon.

In the animal production and protection program area, MAFES scientists participate in the following multistate project: W-112, Reproductive performance in domestic ruminants.

3. Program existence : Mature (More than 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
301	Reproductive Performance of Animals			19%	
302	Nutrient Utilization in Animals			12%	
303	Genetic Improvement of Animals			8%	
304	Animal Genome			8%	
307	Animal Production Management Systems			2%	
308	Improved Animal Products (Before Harvest)			2%	
311	Animal Diseases			21%	
312	External Parasites and Pests of Animals			8%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals			8%	
315	Animal Welfare, Well-Being and Protection			4%	
402	Engineering Systems and Equipment			8%	
	Total			100%	

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

1. Situation and priorities

Maine dairy farmers produce about \$100 million worth of milk each year, and dairy farms employ more than 1,200 people full time and also hire many seasonal laborers. Over the past 25 years, however, there has been a steady decline in the number of dairy farms, from 775 in 1986 to fewer than 400. Maine's dairy farmers face increased production costs and depressed pricing. MAFES research is trying to increase the profitability of Maine's dairy farms by increasing the productivity of dairy cows through improving nutrition and reproduction success rates.

Maine's fisheries and aquaculture industries are comprised of marine fish and shellfish species, including Atlantic salmon, groundfish stocks, lobster, crab, clam, mussel, and oyster. The fish aquaculture industry in Maine is currently dominated by Atlantic salmon. This industry has been plagued with difficulties (disease, listing as endangered species, international competition) over the last decade and while the markets are strong, farm-gate value to the state has decreased by 25%. To

ensure its sustainability, Maine's aquaculture industry needs other potential marine species as candidates for aquaculture, new, less-expensive fish diets, and new methods for treating diseases.

Maine's shellfisheries also face challenges. The soft-shell clam has traditionally served as a fishery requiring low investment for entry by fishermen of all types. Clam harvests in eastern Maine, however, have dramatically decreased over the past 20 years, negatively affecting coastal communities already stressed by declines in their other fisheries. Research on predators of clams and the effects of toxicants is important to this industry. Maine's world-famous lobster industry is concerned with the increased threat of shell disease. Once only significant to tidal lobster pounds, cases of shell disease are increasingly prevalent in the wild and are seriously affecting not only the harvesting sector of the industry but the overall lobster stock. The culture of blue mussels and eastern oysters constitutes a significant and growing portion of the total aquacultural production in Maine. The continued growth of the Maine oyster culture industry is favored by an increased market demand for oysters coupled with declines in traditional harvesting areas in the mid-Atlantic and Gulf coast states. However, the cold temperatures typical of Maine waters result in sub-optimal growth conditions and require an extended grow-out period in order for oysters to reach market size. In contrast, while optimal conditions for the culture of blue mussels can be found throughout Maine coastal waters and there have been recent increases in the market demand for high-quality, cultured mussels, competition with imports from Canada, New Zealand and other mussel-producing countries keeps the price for domestic mussels low. Maine oyster and mussel growers need selective breeding programs for these commercially valuable shellfish species.

2. Scope of the Program

- Multistate Research
- In-State Research

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

1. Assumptions made for the Program

- Funding will stay the same or increase
- Staffing levels will stay the same or increase
- Access to dairy cows
- Participation from both oyster and mussel growers in the state
- Requires highly qualified hatchery personnel
- Requires use of the University of Maine Zebrafish Facility and trained personnel to monitor the fish stocks

2. Ultimate goal(s) of this Program

- To help ensure the long-term sustainability of Maine's dairy producers
- To develop the tools and techniques to support Maine's shellfisheries and aquaculture industries

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
2009	0.0	0.0	5.4	0.0
2010	0.0	0.0	5.4	0.0
2011	0.0	0.0	5.4	0.0
2012	0.0	0.0	5.4	0.0
2013	0.0	0.0	5.4	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research new ways to increase the reproductive success of dairy cows. Develop new stocks of mussels and oysters. Develop and test new fish diets. Develop new rearing techniques for cod and halibut. Research the efficacy of vaccines for infectious pancreatic necrosis virus. Discover the effects of toxicants on fish and shellfish. Determine the relationship between green crab and softshell clam populations. Design a GIS to track distribution of lobster shell disease. Publish peer-reviewed journal articles and other publications concerning research. Present findings at professional meetings and at other venues.

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

Extension	
Direct Methods	Indirect Methods
<ul style="list-style-type: none"> {NO DATA ENTERED} 	<ul style="list-style-type: none"> Newsletters Web sites

3. Description of targeted audience

Scientists, extension specialists, state fisheries managers, dairy farmers, Maine's aquaculture and shellfish industries

V(G). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons(contacts) to be reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0

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

Expected Patent Applications

2009 :0 2010 :0 2011 :0 2012 :0 2013 :0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2009	10	0	0
2010	10	0	0
2011	10	0	0
2012	10	0	0
2013	10	0	0

V(H). State Defined Outputs

1. Output Target

- # of research projects completed, annually

2009 4	2010 1	2011 :2	2012 3	2013 :1
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- # of papers presented at professional meetings, annually

2009 26	2010 26	2011 :26	2012 26	2013 26
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- # of other types of publications, annually

2009 8	2010 8	2011 :8	2012 8	2013 0
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V(I). State Defined Outcome

O. No	Outcome Name
1	# of zebrafish models validated for use in toxicology studies and for testing new pesticides
2	# of new lab-scale protocols that accurately reflects farm-scale ensilage
3	# of new cost-benefit models for establishing mussel hatcheries for new mussel lines
4	# of DNA vaccines against infectious pancreatic necrosis virus developed and tested
5	# of thematic maps regarding incidence of lobster shell disease and other environmental factors
6	# of state agencies using findings on effects of contaminants in rivers on maturation of Maine salmon to develop BMPs for pesticide use
7	% of Maine dairy farmers sending samples to be measured for bovine placental lactogen (bPL) and using the results of samples to make management decisions involving their animals
8	# of crab-monitoring programs undertaken by coastal communities
9	# of Maine mussel growers using new submersible raft
10	# of new oyster lines with superior cold-water growth and disease resistance
11	% increase in Maine's clam catch levels
12	% increase in oyster seed from new lines being used by industry
13	% increase in mussel seed used for grow-out on commercial mussel farms
14	% increase in the fertility of marine broodfish (Atlantic cod and halibut)
15	% increase in the hatching rate of marine larval fish (Atlantic cod and halibut)
16	% increase in the viability of juvenile marine fish raised in captivity (Atlantic cod and halibut)
17	% reduction in the use of live food inputs in diets for larval marine fish

Outcome #1**1. Outcome Target**

of zebrafish models validated for use in toxicology studies and for testing new pesticides

2. Outcome Type : Change in Knowledge Outcome Measure

2009 0	2010 : 0	2011 : 1	2012 : 1	2013 : 0
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 304 - Animal Genome

Outcome #2**1. Outcome Target**

of new lab-scale protocols that accurately reflects farm-scale ensilage

2. Outcome Type : Change in Knowledge Outcome Measure

2009 0	2010 : 0	2011 : 1	2012 : 1	2013 : 1
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 302 - Nutrient Utilization in Animals

Outcome #3**1. Outcome Target**

of new cost-benefit models for establishing mussel hatcheries for new mussel lines

2. Outcome Type : Change in Knowledge Outcome Measure

2009 0	2010 : 0	2011 : 1	2012 : 1	2013 : 0
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 303 - Genetic Improvement of Animals

Outcome #4**1. Outcome Target**

of DNA vaccines against infectious pancreatic necrosis virus developed and tested

2. Outcome Type : Change in Knowledge Outcome Measure

2009 2	2010 : 2	2011 : 2	2012 : 2	2013 : 0
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 311 - Animal Diseases

Outcome #5**1. Outcome Target**

of thematic maps regarding incidence of lobster shell disease and other environmental factors

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :35 2010 : 35 2011 : 35 2012 :35 2013 :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 312 - External Parasites and Pests of Animals

Outcome #6**1. Outcome Target**

of state agencies using findings on effects of contaminants in rivers on maturation of Maine salmon to develop BMPs for pesticide use

2. Outcome Type : Change in Action Outcome Measure

2009 :0 2010 : 0 2011 : 1 2012 :1 2013 :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 304 - Animal Genome

Outcome #7**1. Outcome Target**

% of Maine dairy farmers sending samples to be measured for bovine placental lactogen (bPL) and using the results of samples to make management decisions involving their animals

2. Outcome Type : Change in Action Outcome Measure

2009 :0 2010 : 0 2011 : 10 2012 :10 2013 :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 301 - Reproductive Performance of Animals

Outcome #8**1. Outcome Target**

of crab-monitoring programs undertaken by coastal communities

2. Outcome Type : Change in Action Outcome Measure

2009 :0 2010 : 117 2011 : 117 2012 :117 2013 :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 312 - External Parasites and Pests of Animals

Outcome #9

1. Outcome Target

of Maine mussel growers using new submersible raft

2. Outcome Type : Change in Action Outcome Measure

2009 2 **2010** : 2 **2011** : 2 **2012** 2 **2013** : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 402 - Engineering Systems and Equipment

Outcome #10

1. Outcome Target

of new oyster lines with superior cold-water growth and disease resistance

2. Outcome Type : Change in Action Outcome Measure

2009 0 **2010** : 1 **2011** : 1 **2012** 1 **2013** : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 303 - Genetic Improvement of Animals

Outcome #11

1. Outcome Target

% increase in Maine's clam catch levels

2. Outcome Type : Change in Condition Outcome Measure

2009 0 **2010** : 50 **2011** : 50 **2012** 50 **2013** : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 312 - External Parasites and Pests of Animals

Outcome #12

1. Outcome Target

% increase in oyster seed from new lines being used by industry

2. Outcome Type : Change in Condition Outcome Measure

2009 0 **2010** : 10 **2011** : 20 **2012** 20 **2013** : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 303 - Genetic Improvement of Animals

Outcome #13**1. Outcome Target**

% increase in mussel seed used for grow-out on commercial mussel farms

2. Outcome Type : Change in Condition Outcome Measure

2009 0 2010 :0 2011 : 10 2012 :10 2013 :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 303 - Genetic Improvement of Animals

Outcome #14**1. Outcome Target**

% increase in the fertility of marine broodfish (Atlantic cod and halibut)

2. Outcome Type : Change in Condition Outcome Measure

2009 0 2010 :0 2011 : 10 2012 :10 2013 :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 307 - Animal Production Management Systems
- 308 - Improved Animal Products (Before Harvest)

Outcome #15**1. Outcome Target**

% increase in the hatching rate of marine larval fish (Atlantic cod and halibut)

2. Outcome Type : Change in Condition Outcome Measure

2009 0 2010 :0 2011 : 10 2012 :10 2013 :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 307 - Animal Production Management Systems
- 308 - Improved Animal Products (Before Harvest)

Outcome #16**1. Outcome Target**

% increase in the viability of juvenile marine fish raised in captivity (Atlantic cod and halibut)

2. Outcome Type : Change in Condition Outcome Measure

2009 ∅	2010 : 0	2011 : 100	2012 : 100	2013 : 0
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 307 - Animal Production Management Systems
- 308 - Improved Animal Products (Before Harvest)

Outcome #17**1. Outcome Target**

% reduction in the use of live food inputs in diets for larval marine fish

2. Outcome Type : Change in Condition Outcome Measure

2009 ∅	2010 : 0	2011 : 50	2012 : 50	2013 : 0
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 307 - Animal Production Management Systems
- 308 - Improved Animal Products (Before Harvest)

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 Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (new invasive species)

Description

Success in dairy farming is very dependent on weather extremes and aquaculture and fisheries industries are at risk from storms, particularly hurricanes, invasive marine species. Funding for university research is affected by the economy and other policy changes.

V(K). Planned Program (Evaluation Studies and Data Collection)**1. Evaluation Studies Planned**

- After Only (post program)
- During (during program)

Description

All MAFES projects are evaluated by the research council as the project ends and before the researcher is allowed to develop another project. Individual research projects have a variety of ways to evaluate their data.

2. Data Collection Methods

- Sampling
- Unstructured
- Observation
- Tests
- Journals

Description

Scientists collect data by sampling, conducting tests and observations, reviewing the literature. In projects involving industry participants, researchers will receive input from participants on success or failure of project.

V(A). Planned Program (Summary)

Program #2

1. Name of the Planned Program

Plant Production

2. Brief summary about Planned Program

The plant production program combines basic and applied research that aims (a) to improve the productivity and profitability of Maine's crop farms and (b) to increase the knowledge base on general plant biology and molecular biology and soil chemistry.

MAFES applied plant production research focuses on problems facing Maine's potato, wild blueberry, apple, horticulture, landscape, and small fruits and vegetable industries. Much of this research is conducted as part of multistate research projects. MAFES plant production researchers are developing and testing new potato varieties and new nutrient management systems to increase the profitability of Maine potato farms. MAFES researchers are also developing new fertility management systems to maximize profitability for Maine's wild blueberry growers. Other MAFES researchers are investigating the hardiness of apple rootstocks, ornamental plants, vegetable varieties, and turfgrass species.

MAFES discovery research focuses on native plant and tree species as well as on potato genomics and on basic soil chemistry questions. A MAFES researcher is investigating the evolutionary biology of two ecologically and economically important groups of trees, shadbushes and spruces. Other discovery researchers are focusing on comparative genomics in *Solanum* and on the factors controlling oxygen within root nodules in plants, laying the scientific groundwork that may lead to the ability to genetically engineer new nitrogen-fixing plants. Soil scientists are investigating the hydrophilic fraction of organic matter and the factors that affect the rate of organic matter decomposition.

In the plant production program area, MAFES scientists participate in the following multistate projects: NE-9, Conservation and utilization of plant genetic resources; NC-140, Rootstock and interstem effects on pome and stone fruit trees; NE-1014, Development of new potato clones for improved pest resistance, marketability, and sustainability in the East.

3. Program existence : Mature (More than 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
101	Appraisal of Soil Resources			8%	
102	Soil, Plant, Water, Nutrient Relationships			22%	
201	Plant Genome, Genetics, and Genetic Mechanisms			8%	
202	Plant Genetic Resources and Biodiversity			23%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			13%	
204	Plant Product Quality and Utility (Preharvest)			5%	
205	Plant Management Systems			12%	
206	Basic Plant Biology			2%	
211	Insects, Mites, and Other Arthropods Affecting Plants			2%	
212	Pathogens and Nematodes Affecting Plants			1%	
215	Biological Control of Pests Affecting Plants			1%	
503	Quality Maintenance in Storing and Marketing Food Products			1%	
701	Nutrient Composition of Food			2%	
	Total			100%	

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

1. Situation and priorities

Maine's potato industry encompasses more than 500 businesses generating nearly \$280 million in annual sales, employing more than 2,600 people, and providing more than \$100 million in income to Maine residents). Potato production in Maine is concentrated in Aroostook County and central Penobscot County. Potato production in the Northeast is highly dependent on

expensive chemical fertilizers and pesticides; growers need new management systems that produce the yields and quality needed for profitability. Potato growers in Maine and the eastern U.S. also need new potato varieties with better disease/pest resistance and better quality for fresh and processing markets. Availability of improved new varieties will increase marketing opportunities, solve production problems, and improve profitability for potato growers. Answering basic questions about the molecular basis of mechanisms that help potatoes tolerate abiotic stress will enable potato-breeding programs to develop new, stress-resistant varieties.

Wild blueberries are a unique agricultural crop in that they occur naturally in Maine and are cultivated in Maine and Maritimes Canada, with limited production in other states. Wild blueberries are grown on more than 500 farms on 64,000 acres in Maine. Most of the production is in Washington and Hancock counties, but there is also significant production in Knox, Lincoln, and Oxford counties. Maine produces the most blueberries of any state or province in North America, with an average production of more than 75 million pounds a year, which represents about 50% of the world's wild blueberry crop. Developing new nutrient recommendations for wild blueberry will improve productivity on low-yielding fields and increase the profitability of Maine's wild blueberry industry.

Maine's short growing season, glacial soils, and cold climate make the state an ideal place to conduct research on the effects of these characteristics on a number of plant species. Maine apple growers, who harvest 1 million bushels of apples per year, need new, winter-hardy rootstocks that induce early bearing and are more profitable than currently grown rootstocks. Maine's landscape and horticulture industry, part of the fastest-growing sector of American agriculture, need new ornamental plants and turfgrass varieties that can withstand Maine's climate.

2. Scope of the Program

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

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

1. Assumptions made for the Program

•Funding will stay the same or increase •Staffing levels will stay the same or increase •Continued integration with UM Cooperative Extension to develop facts sheets, presentations/publications for growers, and updated management recommendations. •Potato industry will remain important for Maine economy •Apple production will remain stable but replanting will increase •The need for better apple rootstocks will increase •Genetic resources are available from public germplasm repositories •Genomics resources and tools are available from publicly funded Solanaceae genomics programs

•Cooperation with scientists from state and federal research programs involved in genetic improvement of potato and other solanaceous species.

2. Ultimate goal(s) of this Program

To develop and test new varieties and management techniques and tools to increase the productivity and profitability of Maine crop producers

To improve understanding of basic biological, molecular biological, and chemical processes for economically and environmentally important Maine plants

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
2009	0.0	0.0	6.6	0.0
2010	0.0	0.0	6.6	0.0
2011	0.0	0.0	6.6	0.0
2012	0.0	0.0	6.6	0.0
2013	0.0	0.0	6.6	0.0

V(F). Planned Program (Activity)**1. Activity for the Program**

Research new ways to increase the productivity of potato, blueberry, apple, small fruit and vegetable crops. Develop and test new potato, other vegetable, and horticultural plant varieties. Conduct research on basic plant biology and molecular biology issues. Research new soil management and cover crop techniques to increase yields and improve soil quality. Research basic soil chemistry issues. Publish peer-reviewed journal articles and other publications concerning research. Present findings at professional meetings, at field days for growers, and at other venues.

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

Extension	
Direct Methods	Indirect Methods
<ul style="list-style-type: none"> {NO DATA ENTERED} 	<ul style="list-style-type: none"> Web sites Newsletters

3. Description of targeted audience

Plant geneticists, biologists, and molecular biologists, soil scientists, extension specialists, plant breeders, Maine's horticultural industry, Maine fruit and vegetable producers, greens managers

V(G). Planned Program (Outputs)**1. Standard output measures**

Target for the number of persons(contacts) to be reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0

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

Expected Patent Applications

2009 :0 2010 :0 2011 :0 2012 :0 2013 :0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2009	12	0	0
2010	12	0	0
2011	12	0	0
2012	12	0	0
2013	12	0	0

V(H). State Defined Outputs

1. Output Target

- # of research projects completed

2009 :4 2010 :2 2011 :2 2012 :5 2013 :1

- # of papers presented at professional meetings

2009 :24 2010 :24 2011 :24 2012 :24 2013 :24

- # of other types of publications

2009 :9 2010 :9 2011 :9 2012 :9 2013 :9

V(I). State Defined Outcome

O. No	Outcome Name
1	# of improved analytical methods developed to study dissolved organic matter in soils
2	# of candidate stress-related genes or alleles that are functionally characterized
3	% of Maine apple growers who increase their knowledge about most suitable rootstocks for Maine conditions
4	# of gene-based marker systems used for targeted introgression in potato-variety-improvement program
5	% of Maine potato growers adopting new recommendations (i.e., fertility programs, tissue-testing tools, crop rotation recommendations)
6	% of Maine apple growers planting winter-hardy, early-bearing rootstocks
7	Increase in profitability for Maine apple industry from a quicker return on investment and reduction in catastrophic tree losses (\$)
8	# of commercial-scale tests of new high-yielding, high-quality, and/or pest-resistant potato clones tested in Maine
9	# of Maine seed growers adopting new high-yielding, high-quality, and/or pest-resistant clones from the Maine Potato Breeding Program or other programs represented in our commercial trial program (as indicated by entry in seed certification)
10	Decrease in percentage of leaf tissue samples with nitrogen and phosphorus deficiencies
11	Number of facilities propagating lowbush blueberry by tissue culture using information from this research
12	# of Maine lowbush blueberry growers learning about benefits of leaf sampling techniques to aid in fertility management decisions
13	Percentage of Maine lowbush blueberry growers surveyed who are changing their fertilization practices due to information provided by the fertility research program
14	# of high-quality and/or pest-resistant potato clones from the Maine Potato Breeding Program made available to other states for evaluation under diverse environmental conditions
15	# of new high-yielding, high-quality, and/or pest-resistant potato clones named and released by the Maine Potato Breeding Program
16	Percentage of Maine potato growers informed about promising new potato clones from the Maine Potato Breeding Program and other eastern programs
17	# of people improving their knowledge of the potential benefits of composting
18	Number of people surveyed using composts as a soil amendment to reduce organic waste volume and improve soil quality
19	# of Maine and New England vegetable growers learning about regionally adapted vegetable varieties
20	# of Maine vegetable growers learning about alternative crops and appropriate cultural management techniques for hoop house production
21	# of Maine vegetable growers learning about fall beds and the hybrid mulching system
22	# of Maine vegetable growers practicing crop rotation in hoop houses by growing alternative crops
23	# of Maine vegetable growers using fall made beds or hybrid mulching
24	Percentage of Maine vegetable growers that have improved management of their hoop houses

Outcome #1**1. Outcome Target**

of improved analytical methods developed to study dissolved organic matter in soils

2. Outcome Type : Change in Knowledge Outcome Measure

2009 0 2010 : 1 2011 : 1 2012 : 1 2013 : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 101 - Appraisal of Soil Resources

Outcome #2**1. Outcome Target**

of candidate stress-related genes or alleles that are functionally characterized

2. Outcome Type : Change in Knowledge Outcome Measure

2009 0 2010 : 2 2011 : 3 2012 : 3 2013 : 3

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms

Outcome #3**1. Outcome Target**

% of Maine apple growers who increase their knowledge about most suitable rootstocks for Maine conditions

2. Outcome Type : Change in Knowledge Outcome Measure

2009 60 2010 : 80 2011 : 80 2012 : 80 2013 : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

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

Outcome #4**1. Outcome Target**

of gene-based marker systems used for targeted introgression in potato-variety-improvement program

2. Outcome Type : Change in Action Outcome Measure

2009 : 1 2010 : 2 2011 : 3 2012 : 3 2013 : 3

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms

Outcome #5

1. Outcome Target

% of Maine potato growers adopting new recommendations (i.e., fertility programs, tissue-testing tools, crop rotation recommendations)

2. Outcome Type : Change in Action Outcome Measure

2009 5 **2010** : 10 **2011** : 15 **2012** :15 **2013** :15

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems
- 503 - Quality Maintenance in Storing and Marketing Food Products

Outcome #6

1. Outcome Target

% of Maine apple growers planting winter-hardy, early-bearing rootstocks

2. Outcome Type : Change in Action Outcome Measure

2009 25 **2010** : 25 **2011** : 25 **2012** 25 **2013** :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

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

Outcome #7

1. Outcome Target

Increase in profitability for Maine apple industry from a quicker return on investment and reduction in catastrophic tree losses (\$)

2. Outcome Type : Change in Condition Outcome Measure

2009 0 **2010** : 2500000 **2011** : 5000000 **2012** 5000000 **2013** :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

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

Outcome #8

1. Outcome Target

of commercial-scale tests of new high-yielding, high-quality, and/or pest-resistant potato clones tested in Maine

2. Outcome Type : Change in Action Outcome Measure**2009** :10**2010** : 10**2011** : 10**2012** :10**2013** :10**3. Associated Institute Type(s)**

•1862 Research

4. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources and Biodiversity
- 204 - Plant Product Quality and Utility (Preharvest)
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 701 - Nutrient Composition of Food

Outcome #9**1. Outcome Target**

of Maine seed growers adopting new high-yielding, high-quality, and/or pest-resistant clones from the Maine Potato Breeding Program or other programs represented in our commercial trial program (as indicated by entry in seed certification)

2. Outcome Type : Change in Action Outcome Measure**2009** 3**2010** : 5**2011** : 7**2012** 7**2013** :10**3. Associated Institute Type(s)**

•1862 Research

4. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources and Biodiversity
- 204 - Plant Product Quality and Utility (Preharvest)
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 701 - Nutrient Composition of Food

Outcome #10**1. Outcome Target**

Decrease in percentage of leaf tissue samples with nitrogen and phosphorus deficiencies

2. Outcome Type : Change in Condition Outcome Measure**2009** 30**2010** : 50**2011** : 70**2012** 80**2013** :80**3. Associated Institute Type(s)**

•1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 206 - Basic Plant Biology

Outcome #11**1. Outcome Target**

Number of facilities propagating lowbush blueberry by tissue culture using information from this research

2. Outcome Type : Change in Action Outcome Measure

2009 : 0 **2010 :** 0 **2011 :** 0 **2012 :** 2 **2013 :** 5

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 206 - Basic Plant Biology

Outcome #12

1. Outcome Target

of Maine lowbush blueberry growers learning about benefits of leaf sampling techniques to aid in fertility management decisions

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 100 **2010 :** 125 **2011 :** 150 **2012 :** 150 **2013 :** 150

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 206 - Basic Plant Biology

Outcome #13

1. Outcome Target

Percentage of Maine lowbush blueberry growers surveyed who are changing their fertilization practices due to information provided by the fertility research program

2. Outcome Type : Change in Action Outcome Measure

2009 : 10 **2010 :** 20 **2011 :** 40 **2012 :** 60 **2013 :** 80

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 206 - Basic Plant Biology

Outcome #14

1. Outcome Target

of high-quality and/or pest-resistant potato clones from the Maine Potato Breeding Program made available to other states for evaluation under diverse environmental conditions

2. Outcome Type : Change in Action Outcome Measure

2009 : 10 **2010 :** 10 **2011 :** 10 **2012 :** 10 **2013 :** 10

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources and Biodiversity

- 204 - Plant Product Quality and Utility (Preharvest)
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 701 - Nutrient Composition of Food

Outcome #15

1. Outcome Target

of new high-yielding, high-quality, and/or pest-resistant potato clones named and released by the Maine Potato Breeding Program

2. Outcome Type : Change in Action Outcome Measure

2009 : 0 **2010 :** 1 **2011 :** 1 **2012 :** 0 **2013 :** 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources and Biodiversity
- 204 - Plant Product Quality and Utility (Preharvest)
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 701 - Nutrient Composition of Food

Outcome #16

1. Outcome Target

Percentage of Maine potato growers informed about promising new potato clones from the Maine Potato Breeding Program and other eastern programs

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 40 **2010 :** 50 **2011 :** 60 **2012 :** 70 **2013 :** 80

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources and Biodiversity
- 204 - Plant Product Quality and Utility (Preharvest)
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 701 - Nutrient Composition of Food

Outcome #17

1. Outcome Target

of people improving their knowledge of the potential benefits of composting

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 10 **2010 :** 15 **2011 :** 20 **2012 :** 30 **2013 :** 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships

- 215 - Biological Control of Pests Affecting Plants

Outcome #18

1. Outcome Target

Number of people surveyed using composts as a soil amendment to reduce organic waste volume and improve soil quality

2. Outcome Type : Change in Action Outcome Measure

2009 : 0 **2010 :** 0 **2011 :** 5 **2012 :** 10 **2013 :** 15

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 215 - Biological Control of Pests Affecting Plants

Outcome #19

1. Outcome Target

of Maine and New England vegetable growers learning about regionally adapted vegetable varieties

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 250 **2010 :** 1000 **2011 :** 250 **2012 :** 1000 **2013 :** 250

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 205 - Plant Management Systems

Outcome #20

1. Outcome Target

of Maine vegetable growers learning about alternative crops and appropriate cultural management techniques for hoop house production

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 125 **2010 :** 125 **2011 :** 125 **2012 :** 125 **2013 :** 125

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 205 - Plant Management Systems

Outcome #21

1. Outcome Target

of Maine vegetable growers learning about fall beds and the hybrid mulching system

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 100 **2010 :** 100 **2011 :** 100 **2012 :** 100 **2013 :** 100

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 205 - Plant Management Systems

Outcome #22

1. Outcome Target

of Maine vegetable growers practicing crop rotation in hoop houses by growing alternative crops

2. Outcome Type : Change in Action Outcome Measure

2009 :10 2010 : 15 2011 : 25 2012 30 2013 :40

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 205 - Plant Management Systems

Outcome #23

1. Outcome Target

of Maine vegetable growers using fall made beds or hybrid mulching

2. Outcome Type : Change in Action Outcome Measure

2009 :5 2010 : 8 2011 : 10 2012 :15 2013 :25

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 205 - Plant Management Systems

Outcome #24

1. Outcome Target

Percentage of Maine vegetable growers that have improved management of their hoop houses

2. Outcome Type : Change in Action Outcome Measure

2009 :15 2010 : 25 2011 : 35 2012 #5 2013 :55

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 205 - Plant Management Systems

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 Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration,new cultural groupings,etc.)
- Other (new pest/disease species)

Description

All agricultural endeavors are dependent on weather, temperature, growing season length and new pest or disease species. Regulations concerning pesticide use also effects productivity/profitability. Funds for university research depend on economy and other government policies and spending priorities.

V(K). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- During (during program)
- Comparison between locales where the program operates and sites without program intervention

Description

All MAFES projects are evaluated by the research council as the project ends and before the researcher is allowed to develop another project. Individual research projects have a variety of ways to evaluate their data.

2. Data Collection Methods

- Sampling
- Unstructured
- Observation
- Tests
- Journals

Description

Scientists collect data by sampling, conducting tests and observations, reviewing the literature. In projects involving industry participants, researchers will receive input from participants on success or failure of project.

V(A). Planned Program (Summary)

Program #3

1. Name of the Planned Program

Plant Protection

2. Brief summary about Planned Program

The plant protection program combines basic and applied research that aims to understand the ecology and management of weeds, insects, plant diseases, and soil quality that reduce crop yield and/or quality. MAFES plant protection research focuses on problems facing Maine's potato, wild blueberry, and small fruits and vegetable growers.

Current projects on insect pests are investigating safer and environmentally friendly methods to control blueberry maggot fly, the most serious pest of lowbush blueberry in Maine; Colorado potato beetle, a pest that is increasingly resistant to existing insecticides; soybean aphid, which is a threat to Maine's developing soybean industry; and European fire ant, an invasive pest in communities along Maine's coast.

MAFES plant disease scientists are investigating fungal pathogens of blueberries and important diseases of potato, including *Phytophthora erythroseptica*, *P. infestans*, *Spongospora subterranea*, and *Rhizoctonia solani*.

Other MAFES research addresses the issue of weed management for Maine's potato and small fruit and vegetable growers.

In the plant protection program area, MAFES scientists participate in the following multistate projects: S-1010, Dynamic soybean pest management for evolving agricultural technologies and cropping systems; S-1024, Development, evaluation, and safety of entomopathogens for control of arthropod pests; NE-1000, Improved weed control through residue management and crop rotation; NRSP-4, A national agricultural program to clear pest control agents for minor uses; and NCR-148, Migration and dispersal of agriculturally important biota.

3. Program existence : Mature (More than 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			2%	
123	Management and Sustainability of Forest Resources			1%	
136	Conservation of Biological Diversity			4%	
201	Plant Genome, Genetics, and Genetic Mechanisms			1%	
202	Plant Genetic Resources and Biodiversity			2%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			2%	
204	Plant Product Quality and Utility (Preharvest)			2%	
205	Plant Management Systems			3%	
206	Basic Plant Biology			2%	
211	Insects, Mites, and Other Arthropods Affecting Plants			9%	
212	Pathogens and Nematodes Affecting Plants			15%	
213	Weeds Affecting Plants			23%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants			1%	
215	Biological Control of Pests Affecting Plants			4%	
216	Integrated Pest Management Systems			17%	

601	Economics of Agricultural Production and Farm Management			2%	
605	Natural Resource and Environmental Economics			2%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources.			1%	
721	Insects and Other Pests Affecting Humans			7%	
	Total			100%	

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

1. Situation and priorities

Agricultural production in the New England Region has seriously declined in recent years. Sustainable cropping systems and management practices are needed to improve agricultural viability and rural economic vitality in this region. Sustainable agriculture provides major improvements over conventional agriculture regarding soil and crop management practices; there are many limitations to sustainability, crop productivity, and farm profitability that need addressing. In the Northeast, crop losses and reduced crop quality due to pests and diseases and low overall crop productivity are critical limitations in many sustainable production systems. Conventional agricultural production uses high inputs of agricultural chemicals to address problems related to soil fertility and high levels of pests and diseases. These inputs carry with them high economic and environmental costs.

Wild blueberries are a unique agricultural crop in that they occur naturally in Maine and are cultivated in Maine and Maritimes Canada, with limited production in other states. Wild blueberries are grown on more than 500 farms on 64,000 acres in Maine. Most of the production is in Washington and Hancock counties, but there is also significant production in Knox, Lincoln, and Oxford counties. Maine produces the most blueberries of any state or province in North America, with an average production of more than 75 million pounds a year, which represents about 50% of the world's wild blueberry crop. Since Maine produces 99% of the wild blueberries in the United States, it has the strongest research and extension efforts for this crop. The results of this research are shared with growers in New Hampshire, Massachusetts, Michigan, and in Atlantic Canada and Quebec. Maine's wild blueberry growers need improved tools for managing weed and insect pests and plant diseases.

Maine's potato industry encompasses more than 500 businesses generating nearly \$280 million in annual sales, employing more than 2,600 people, and providing more than \$100 million in income to Maine residents). Potato production in Maine is concentrated in Aroostook County and central Penobscot County. Potato production in the Northeast is highly dependent on expensive chemical fertilizers and pesticides, yet productivity has not increased dramatically over the past 50 years. Maine potato growers need new strategies for controlling insect pests, such as the Colorado potato beetle, plant diseases caused by *Rhizoctonia solani*, *Phytophthora infestans*, *P. erythroseptica*, and *Spongospora subterranea*, and weeds.

Developing new methods and treatments that reduce the amount of herbicide, insecticide, or fungicide applied to Maine crops will result in both direct economic savings for growers (obtaining effective control, but applying less pesticide) and indirect economic savings for growers (minimizing detrimental effects of insecticides on pollinators and pest natural enemies). In addition, Maine's communities also benefit from this tactic because a significant reduction in the use of chemical inputs should translate into reduced risk for ground and surface water contamination, and human and wildlife exposure to pesticides.

2. Scope of the Program

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

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

1. Assumptions made for the Program

- Funding will stay the same or increase
- Staffing levels will stay the same or increase
- Weed insect and disease pressure will continue
- Growers will need to continue to adopt new practices, cooperate with researchers on projects, and learn to use new pest control materials to be able to control these pests.
- Potato industry will remain important for Maine economy.
- The slow rate at which new pesticides are developed, and increasing public pressure for environmental stewardship, will require the farming sector to increasingly rely on knowledge of the ecology of agroecosystems to produce equal or greater crop yields, of improved quality, with less reliance on pesticides for crop protection.

2. Ultimate goal(s) of this Program

Develop agricultural production systems that are highly productive, less susceptible to pests and diseases, and less dependent on chemical fertilizers and pesticides.

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
2009	0.0	0.0	5.2	0.0
2010	0.0	0.0	5.2	0.0
2011	0.0	0.0	5.2	0.0
2012	0.0	0.0	5.2	0.0
2013	0.0	0.0	5.2	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research new ways to control diseases of potato and blueberry. Research new soil management techniques to control weeds. Research biological control of pests of potato, blueberry, other crops, and invasive ant species. Publish peer-reviewed journal articles and other publications concerning research. Present findings at professional meetings and at field days for growers and other venues.

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

Extension	
Direct Methods	Indirect Methods
<ul style="list-style-type: none"> • {NO DATA ENTERED} 	<ul style="list-style-type: none"> • Newsletters • Web sites

3. Description of targeted audience

Scientists, extension specialists, pest management professionals, potato, blueberry, and other crop producers in Maine

V(G). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons(contacts) to be reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0

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

Expected Patent Applications

2009 :0 2010 :0 2011 :0 2012 :0 2013 :0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2009	10	0	0
2010	10	0	0
2011	10	0	0
2012	10	0	0
2013	10	0	0

V(H). State Defined Outputs

1. Output Target

- # of other types of publications

2009 8 2010 8 2011 :8 2012 8 2013 8

- # of papers presented at professional meetings

2009 30 2010 30 2011 :30 2012 30 2013 30

- # of research projects completed on ways to protect valuable plant/crop species

2009 2 2010 3 2011 :1 2012 4 2013 :1

V(I). State Defined Outcome

O. No	Outcome Name
1	% of potato growers familiar with effects of soil management on populations of insect
2	# of Rhizoctonia solani genes identified that express differentially under conditions of quinate-induced hypovirulence
3	# of Rhizoctonia solani genes identified that express differentially under conditions of genetically stable hypovirulence
4	# of Rhizoctonia solani genes identified that express differentially under conditions of virulence
5	# of Maine potato growers developing a better understanding of how the use of manure soil amendments and longer crop rotations affect potato insect and weed pests, and diseases and well as potato yield, quality, and profitability
6	# of Maine potato growers learning how to integrate animal-based production systems with their potato operations
7	percentage of Maine blueberry growers adopting and maintaining integrated pest management strategies
8	% of Maine blueberry acreage treated with perimeter tactics for control of blueberry maggot fly
9	# of alternative pest and soil management systems for potato that are ready for commercial-scale evaluation
10	% of organic and diversified vegetable farmers surveyed who have adopted weed seedbank management practices
11	% reduction in the amount of damage from blueberry maggot fly in treated fields vs nontreated fields
12	% reduction in the amount of organophosphate insecticides used to treat blueberry maggot fly in Maine
13	# of commercial-scale demonstrations with significant reductions in pesticide and fertilizer use and improvements in soil quality
14	Average density of germinable weed seedbank found by Maine growers adopting ecologically based weed management practices (# of germinable seeds per square meter, 10 cm deep). Weed populations surviving cultivation will not reduce crop yield or quality and
15	Wild blueberry growers in Maine will be able to improve production by proper management of weed and disease pests
16	Wild blueberry growers in Maine will be able to properly identify and respond appropriately to weeds and diseases
17	Wild blueberry growers will make better management decisions on fertilizer and weed control

Outcome #1**1. Outcome Target**

% of potato growers familiar with effects of soil management on populations of insect

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :15 2010 : 25 2011 : 50 2012 : 50 2013 : 50

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 216 - Integrated Pest Management Systems

Outcome #2**1. Outcome Target**

of Rhizoctonia solani genes identified that express differentially under conditions of quinate-induced hypovirulence

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :1 2010 : 1 2011 : 1 2012 : 1 2013 : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 215 - Biological Control of Pests Affecting Plants

Outcome #3**1. Outcome Target**

of Rhizoctonia solani genes identified that express differentially under conditions of genetically stable hypovirulence

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :0 2010 : 0 2011 : 1 2012 : 1 2013 : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 215 - Biological Control of Pests Affecting Plants

Outcome #4**1. Outcome Target**

of Rhizoctonia solani genes identified that express differentially under conditions of virulence

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :0 2010 : 0 2011 : 1 2012 : 1 2013 : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 215 - Biological Control of Pests Affecting Plants

Outcome #5

1. Outcome Target

of Maine potato growers developing a better understanding of how the use of manure soil amendments and longer crop rotations affect potato insect and weed pests, and diseases and well as potato yield, quality, and profitability

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :120 **2010** : 120 **2011** : 120 **2012** :120 **2013** :120

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 204 - Plant Product Quality and Utility (Preharvest)
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 212 - Pathogens and Nematodes Affecting Plants
- 213 - Weeds Affecting Plants
- 216 - Integrated Pest Management Systems
- 601 - Economics of Agricultural Production and Farm Management

Outcome #6

1. Outcome Target

of Maine potato growers learning how to integrate animal-based production systems with their potato operations

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :120 **2010** : 120 **2011** : 120 **2012** :120 **2013** :120

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 204 - Plant Product Quality and Utility (Preharvest)
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 212 - Pathogens and Nematodes Affecting Plants
- 213 - Weeds Affecting Plants
- 216 - Integrated Pest Management Systems
- 601 - Economics of Agricultural Production and Farm Management

Outcome #7

1. Outcome Target

percentage of Maine blueberry growers adopting and maintaining integrated pest management strategies

2. Outcome Type : Change in Action Outcome Measure**2009** :100**2010** : 100**2011** : 100**2012** :100**2013** :100**3. Associated Institute Type(s)**

•1862 Research

4. Associated Knowledge Area(s)

- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 216 - Integrated Pest Management Systems

Outcome #8**1. Outcome Target**

% of Maine blueberry acreage treated with perimeter tactics for control of blueberry maggot fly

2. Outcome Type : Change in Action Outcome Measure**2009** :15**2010** : 30**2011** : 50**2012** 50**2013** :50**3. Associated Institute Type(s)**

•1862 Research

4. Associated Knowledge Area(s)

- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 216 - Integrated Pest Management Systems

Outcome #9**1. Outcome Target**

of alternative pest and soil management systems for potato that are ready for commercial-scale evaluation

2. Outcome Type : Change in Action Outcome Measure**2009** 0**2010** : 1**2011** : 2**2012** 2**2013** :2**3. Associated Institute Type(s)**

•1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 204 - Plant Product Quality and Utility (Preharvest)
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 212 - Pathogens and Nematodes Affecting Plants
- 213 - Weeds Affecting Plants
- 216 - Integrated Pest Management Systems
- 601 - Economics of Agricultural Production and Farm Management

Outcome #10**1. Outcome Target**

% of organic and diversified vegetable farmers surveyed who have adopted weed seedbank management practices

2. Outcome Type : Change in Action Outcome Measure

2009 : 0	2010 : 0	2011 : 20	2012 : 20	2013 : 20
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 213 - Weeds Affecting Plants

Outcome #11**1. Outcome Target**

% reduction in the amount of damage from blueberry maggot fly in treated fields vs nontreated fields

2. Outcome Type : Change in Condition Outcome Measure

2009 : 10	2010 : 15	2011 : 20	2012 : 20	2013 : 20
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 216 - Integrated Pest Management Systems

Outcome #12**1. Outcome Target**

% reduction in the amount of organophosphate insecticides used to treat blueberry maggot fly in Maine

2. Outcome Type : Change in Condition Outcome Measure

2009 : 10	2010 : 25	2011 : 50	2012 : 50	2013 : 50
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 216 - Integrated Pest Management Systems

Outcome #13**1. Outcome Target**

of commercial-scale demonstrations with significant reductions in pesticide and fertilizer use and improvements in soil quality

2. Outcome Type : Change in Condition Outcome Measure

2009 : 1	2010 : 2	2011 : 2	2012 : 2	2013 : 2
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3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 204 - Plant Product Quality and Utility (Preharvest)
- 211 - Insects, Mites, and Other Arthropods Affecting Plants

- 212 - Pathogens and Nematodes Affecting Plants
- 213 - Weeds Affecting Plants
- 216 - Integrated Pest Management Systems
- 601 - Economics of Agricultural Production and Farm Management

Outcome #14

1. Outcome Target

Average density of germinable weed seedbank found by Maine growers adopting ecologically based weed management practices (# of germinable seeds per square meter, 10 cm deep). Weed populations surviving cultivation will not reduce crop yield or quality and

2. Outcome Type : Change in Condition Outcome Measure

2009 : 0 **2010 :** 0 **2011 :** 1500 **2012 :** 1500 **2013 :** 0

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 213 - Weeds Affecting Plants

Outcome #15

1. Outcome Target

Wild blueberry growers in Maine will be able to improve production by proper management of weed and disease pests

2. Outcome Type : Change in Condition Outcome Measure

2009 : 100 **2010 :** 100 **2011 :** 100 **2012 :** 100 **2013 :** 100

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 212 - Pathogens and Nematodes Affecting Plants
- 213 - Weeds Affecting Plants
- 214 - Vertebrates, Mollusks, and Other Pests Affecting Plants

Outcome #16

1. Outcome Target

Wild blueberry growers in Maine will be able to properly identify and respond appropriately to weeds and diseases

2. Outcome Type : Change in Action Outcome Measure

2009 : 100 **2010 :** 100 **2011 :** 100 **2012 :** 100 **2013 :** 100

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 212 - Pathogens and Nematodes Affecting Plants
- 213 - Weeds Affecting Plants
- 214 - Vertebrates, Mollusks, and Other Pests Affecting Plants

Outcome #17**1. Outcome Target**

Wild blueberry growers will make better management decisions on fertilizer and weed control

2. Outcome Type : Change in Action Outcome Measure

2009 :100

2010 : 100

2011 : 100

2012 :100

2013 :100

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 212 - Pathogens and Nematodes Affecting Plants
- 213 - Weeds Affecting Plants
- 214 - Vertebrates, Mollusks, and Other Pests Affecting Plants

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 Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration,new cultural groupings,etc.)
- Other (new insect pests or diseases)

Description

Crop production is very dependent on weather extremes, storms, new plant diseases, weed and/or insect pest species. Funding for university research is affected by the economy and other policy changes

V(K). Planned Program (Evaluation Studies and Data Collection)**1. Evaluation Studies Planned**

- After Only (post program)
- During (during program)
- Comparison between locales where the program operates and sites without program intervention

Description

All MAFES projects are evaluated by the research council as the project ends and before the researcher is allowed to develop another project. Field tests compare results between plots/fields where inputs are changed and plots/fields where inputs are not changed.

2. Data Collection Methods

- Sampling
- Whole population
- On-Site
- Unstructured
- Observation
- Tests
- Journals

Description

Scientists collect data by sampling, conducting tests and observations, reviewing the literature. Other data collection measures

include survey of blueberry growers during winter blueberry school; field-level evaluations on growers' fields.

V(A). Planned Program (Summary)**Program #4****1. Name of the Planned Program**

Natural Resources

2. Brief summary about Planned Program

The natural resources program comprises discovery research projects that focus on aspects of Maine's natural resources: water, soil, and air quality and conservation of Maine's plant and wildlife species.

MAFES water research is monitoring the health and quality of Maine's ground water, rivers, and lakes. A variety of activities in Maine pose a threat to ground water. In an effort to better understand the complex flow and transport processes within fractured bedrock aquifers, MAFES scientists are characterizing sites that are potentially contaminated with road deicing salt. Research on lakes is developing indicators of lake foodweb structure that account for inter-lake variation in response to eutrophication. For Maine's rivers, MAFES researchers are analyzing nutrient transfers from terrestrial source areas and upland watersheds to river and estuarine ecosystems in Maine and examining the risks of nonpoint pollution stress in these aquatic systems.

Environmental soils research is investigating the soils of Maine's estuaries, about which little is known despite the importance of estuary ecosystems to the natural resource-based marine economy of Maine. Additionally, Maine is an important contributor to the National Atmospheric Deposition Program, part of national network for monitoring precipitation chemistry that is highly regarded for the importance and quality of the data. These data and the network are an essential resource for scientists and policy makers.

The conservation biology focus of MAFES research includes projects on important animal species and their habitat in Maine. MAFES wildlife biologists are investigating the status, distribution, and habitat requirements of harbor and gray seal and marsh bird populations in Maine. Other research examines the effects of resource availability and quality on individual growth, breeding success, and survival of migrant and resident birds populations and patterns of adaptive diversity critical to the conservation and management of fish populations in Maine. MAFES research is also examining population genetic structure of threatened and endangered species and the forensic analysis of indigenous and introduced wildlife.

Maine's marine plant and animal life are the focus of other research. MAFES scientists are exploiting a unique organism, a photosynthetic sea slug that is the result of an interesting association between the marine mollusc *Elysia chlorotica* (sea slug) and chloroplasts of the stramenopile alga, *Vaucheria litorea*, to better understand the regulation of chloroplast function and photosynthetic efficiency. MAFES scientists are also investigating new techniques for reseeding rockweed, an important marine alga.

MAFES conducts other research on Maine's natural resources, but the projects are funded through the McIntire-Stennis Act and do not fall under the scope of this document.

In the natural resources program area, MAFES scientists participate in the following multistate projects: NE-1021, Hydrogeology: genesis, properties, and distribution of hydromorphic soils; NRSP-3, The National Atmospheric Deposition Program.

3. Program existence : Mature (More than 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
101	Appraisal of Soil Resources			3%	
102	Soil, Plant, Water, Nutrient Relationships			6%	
111	Conservation and Efficient Use of Water			3%	
112	Watershed Protection and Management			7%	
123	Management and Sustainability of Forest Resources			4%	
132	Weather and Climate			4%	
133	Pollution Prevention and Mitigation			8%	
135	Aquatic and Terrestrial Wildlife			53%	
136	Conservation of Biological Diversity			3%	
402	Engineering Systems and Equipment			6%	
511	New and Improved Non-Food Products and Processes			3%	
	Total			100%	

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

1. Situation and priorities

When most people think of Maine, they think of its natural resources: its lakes, streams, and rivers, its scenic coastline, its forests, and the fish, animal, and plant species these areas support. Maine citizens value these resources highly, and judging by Maine's \$3 billion tourism industry, people from across the country and around the world also value them. Therefore, it is a critical part of the Experiment Station's mission to provide the research necessary to conserve and preserve these resources.

Maine is a state rich in water resources. It includes more than 3,500 miles of coastline, 6,000 lakes and ponds, and 32,000 miles of rivers and streams. These waters represent a valuable part of the natural resource base in the state of Maine. They provide important ecological habitats, diverse recreational activities, valuable social amenities, unique scenic attractions, and abundant resource-based economic opportunities within the state. Unfortunately, aquatic resources in Maine and throughout the U.S. are at risk from pressures and threats associated with human population growth, climate changes, land development and

sprawl, invasive exotic species, and non-point pollution. Conservation and wise management of these natural waters requires ongoing research efforts to monitor the ecological health of these systems and to detect changes and trends associated with degradation of these aquatic resources.

Maine's wild plant and animal species are another valuable part of Maine's natural resource base. Wildlife and their habitats attract anglers, hunters, and tourists to Maine, but they also serve as indicators of overall health of Maine's environment and improve quality of life for all Maine citizens. To better protect and conserve these species, the state needs more information about their genetic makeup and the relationship between these species and their environment.

The natural resources program area needs answers to basic questions about how these systems work, what effects changes in one aspect have on the system as whole. Therefore the outcomes for this program area mainly represent changes in our knowledge base. MAFES scientists are laying the foundation for further research and for other agencies to develop applications that help manage Maine's natural resources.

2. Scope of the Program

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

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

1. Assumptions made for the Program

- Funding will stay the same or increase
- Staffing levels will stay the same or increase
- Research space will be available
- Collaborations with the Maine Departments of Environmental Protection and Inland Fisheries and Wildlife, Atlantic Salmon Commission, U.S. Fish and Wildlife Service and the National Marine Fisheries Service and citizen groups such as COLA (Congress of Lake Associations) and VLMP (Volunteer Lake Monitoring Program) will continue
- Permits for fish sampling will be approved
- Parental sea slugs from Martha's Vineyard will be available each fall until culture system up and running
- Maine Department of Transportation will provide access to drilled wells
- Deicing salt has leached into the groundwater at detectable concentrations
- Adequate wells are available at selected MEDOT sites to characterize the ground water.

2. Ultimate goal(s) of this Program

To increase our understanding of and knowledge about Maine's natural resources to help the state manage these resources sustainably

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
2009	0.0	0.0	6.3	0.0
2010	0.0	0.0	6.3	0.0
2011	0.0	0.0	6.3	0.0
2012	0.0	0.0	6.3	0.0
2013	0.0	0.0	6.3	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Conduct research on Maine's ground water and surface water resources. Conduct research on Maine native animal and plant species and their habitats. Investigate soil-landscape relationship in coastal ecosystems. Participate in the National Atmospheric Deposition Program. Publish peer-reviewed journal articles and other publications concerning research. Present findings at professional meetings and at other venues.

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

Extension	
Direct Methods	Indirect Methods
<ul style="list-style-type: none"> {NO DATA ENTERED} 	<ul style="list-style-type: none"> Newsletters Web sites

3. Description of targeted audience

Other scientists in plant biology, marine biology, animal biology, evolutionary biology, aquaculture, phycology, molecular biology; teachers at all levels; directors of aquariums and museums, exhibit halls, etc.; cancer biologists and pharmaceutical companies; endangered species biologists/managers; policy makers; state regulatory agencies; environmental consultants

V(G). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons(contacts) to be reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0

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

Expected Patent Applications

2009 :0 2010 :0 2011 :0 2012 :0 2013 :0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2009	16	0	0
2010	16	0	0
2011	16	0	0
2012	16	0	0
2013	16	0	0

V(H). State Defined Outputs

1. Output Target

- # of other types of publications

2009 :14 2010 :14 2011 :14 2012 :14 2013 :14

- # of papers presented at professional meetings

2009 38	2010 38	2011 38	2012 38	2013 38
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- # of research projects completed

2009 4	2010 3	2011 3	2012 3	2013 1
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V(I). State Defined Outcome

O. No	Outcome Name
1	# of complete chloroplast gene sequences submitted to GenBank for public use for <i>Vaucheria litorea</i>
2	# of people increasing their knowledge about the interactions between seals and Atlantic salmon, annually
3	# of people increasing their knowledge about the contribution of watershed nutrient exports to non-point pollution and nutrient cycling in Maine rivers and coastal waters
4	# of lakes from which data are used in a database to quantify statistical relationship and to develop empirical models
5	# of new software programs created to evaluate borehole flow profile data collected using borehole geophysics
6	# of new ground-water-modeling programs created to simulate ground-water flow
7	# of people improving their understanding of habitat requirements for marsh bird species of management concern in Maine, annually
8	# of people developing a better understanding of patterns of adaptive divergence in wild fish populations and the relevance of evolution in fish conservation management, annually
9	# of state and/or federal agencies using information on marsh bird species occurrence and habitat requirements in making assessments and recommendations on development proposals near wetlands
10	# of state agencies using information on marsh bird species occurrence and habitat requirements to develop recovery strategies for rare marsh bird species
11	# of new recommendations for maintaining water quality in Maine rivers and minimizing adverse impacts of non-point pollution
12	# of state agencies using information on watershed nutrient exports for developing new recommendations for maintaining water quality in Maine rivers and minimizing the impacts of non-point pollution
13	Number of public school children and other visitors to the area using a checklist for birds for the Dwight B. Demeritt Forest in Orono/Old Town, Maine, and a checklist for birds for the Penobscot Experimental Forest in Bradley/Eddington, Maine
14	Number of Internet-accessible databases containing what may be the largest and most complete set of ecological and physiological data on a wide variety of songbirds from North America
15	# of lake associations, such as Congress of Lake Associations, promoting maintenance of healthy lake foodwebs
16	# of management agencies using measurement of lake foodweb structure in their lake assessment and education programs
17	# of management agencies using information on seal behavior to create management plans
18	# of rare marsh bird species affected by changes in harvest regulations
19	% decrease in nutrient enrichment of Maine rivers and coastal waters
20	Develop industry understanding of the use of Near-IR information in the processing of woody biomass (%)
21	Industry demonstrations of the operation of NIRS on processing woody biomass (%)
22	Industry modifications of current (2007) processing lines to adopt to new NIRS-based technologies (%)
23	# of streams identified as promising or critical candidates for native salmonine conservation, based on potential perturbation from invasive species and/or riparian zone management
24	# of natural resource managers or biologists incorporating research results on conservation of native fishes into official policy and management plans
25	# of people improving their knowledge of the impacts of perturbations from invasive species and/or riparian zone management on the ecology of native Maine salmonids
26	# of people improving their knowledge about the role of nutrients in stream health
27	The distribution and abundance of migratory fish in Maine will increase
28	Number of management agencies using empirical data and model systems to draft recommendation on fish management and conservation

Outcome #1**1. Outcome Target**

of complete chloroplast gene sequences submitted to GenBank for public use for Vaucheria litorea

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :75 **2010** : 75 **2011** : 75 **2012** 75 **2013** :75

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #2**1. Outcome Target**

of people increasing their knowledge about the interactions between seals and Atlantic salmon, annually

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :100 **2010** : 100 **2011** : 100 **2012** :100 **2013** :100

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #3**1. Outcome Target**

of people increasing their knowledge about the contribution of watershed nutrient exports to non-point pollution and nutrient cycling in Maine rivers and coastal waters

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :30 **2010** : 40 **2011** : 50 **2012** 50 **2013** :50

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management

Outcome #4**1. Outcome Target**

of lakes from which data are used in a database to quantify statistical relationship and to develop empirical models

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :300 **2010** : 300 **2011** : 300 **2012** 300 **2013** :300

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 133 - Pollution Prevention and Mitigation
- 135 - Aquatic and Terrestrial Wildlife

Outcome #5

1. Outcome Target

of new software programs created to evaluate borehole flow profile data collected using borehole geophysics

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 0 **2010 :** 1 **2011 :** 1 **2012 :** 1 **2013 :** 1

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water
- 133 - Pollution Prevention and Mitigation

Outcome #6

1. Outcome Target

of new ground-water-modeling programs created to simulate ground-water flow

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 0 **2010 :** 1 **2011 :** 1 **2012 :** 1 **2013 :** 1

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water
- 133 - Pollution Prevention and Mitigation

Outcome #7

1. Outcome Target

of people improving their understanding of habitat requirements for marsh bird species of management concern in Maine, annually

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 100 **2010 :** 0 **2011 :** 0 **2012 :** 0 **2013 :** 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #8

1. Outcome Target

of people developing a better understanding of patterns of adaptive divergence in wild fish populations and the relevance of evolution in fish conservation management, annually

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 200 **2010 :** 200 **2011 :** 200 **2012 :** 200 **2013 :** 200

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #9

1. Outcome Target

of state and/or federal agencies using information on marsh bird species occurrence and habitat requirements in making assessments and recommendations on development proposals near wetlands

2. Outcome Type : Change in Action Outcome Measure

2009 : 2 **2010** : 2 **2011** : 2 **2012** : 2 **2013** : 2

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #10

1. Outcome Target

of state agencies using information on marsh bird species occurrence and habitat requirements to develop recovery strategies for rare marsh bird species

2. Outcome Type : Change in Action Outcome Measure

2009 : 1 **2010** : 0 **2011** : 0 **2012** : 0 **2013** : 0

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #11

1. Outcome Target

of new recommendations for maintaining water quality in Maine rivers and minimizing adverse impacts of non-point pollution

2. Outcome Type : Change in Action Outcome Measure

2009 : 0 **2010** : 1 **2011** : 0 **2012** : 0 **2013** : 0

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management

Outcome #12

1. Outcome Target

of state agencies using information on watershed nutrient exports for developing new recommendations for maintaining water quality in Maine rivers and minimizing the impacts of non-point pollution

2. Outcome Type : Change in Action Outcome Measure

2009 2 **2010** : 2 **2011** : 3 **2012** 3 **2013** : 3

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management

Outcome #13

1. Outcome Target

Number of public school children and other visitors to the area using a checklist for birds for the Dwight B. Demeritt Forest in Orono/Old Town, Maine, and a checklist for birds for the Penobscot Experimental Forest in Bradley/Eddington, Maine

2. Outcome Type : Change in Knowledge Outcome Measure

2009 0 **2010** : 0 **2011** : 0 **2012** 0 **2013** : 0

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #14

1. Outcome Target

Number of Internet-accessible databases containing what may be the largest and most complete set of ecological and physiological data on a wide variety of songbirds from North America

2. Outcome Type : Change in Knowledge Outcome Measure

2009 0 **2010** : 1 **2011** : 1 **2012** 1 **2013** : 0

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #15

1. Outcome Target

of lake associations, such as Congress of Lake Associations, promoting maintenance of healthy lake foodwebs

2. Outcome Type : Change in Action Outcome Measure

2009 4 **2010** : 5 **2011** : 5 **2012** 5 **2013** : 5

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 133 - Pollution Prevention and Mitigation
- 135 - Aquatic and Terrestrial Wildlife

Outcome #16

1. Outcome Target

of management agencies using measurement of lake foodweb structure in their lake assessment and education programs

2. Outcome Type : Change in Action Outcome Measure

2009 2 **2010** :2 **2011** : 2 **2012** 2 **2013** :2

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 133 - Pollution Prevention and Mitigation
- 135 - Aquatic and Terrestrial Wildlife

Outcome #17

1. Outcome Target

of management agencies using information on seal behavior to create management plans

2. Outcome Type : Change in Action Outcome Measure

2009 6 **2010** : 8 **2011** : 10 **2012** :10 **2013** :10

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #18

1. Outcome Target

of rare marsh bird species affected by changes in harvest regulations

2. Outcome Type : Change in Condition Outcome Measure

2009 3 **2010** : 3 **2011** : 3 **2012** 3 **2013** :3

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #19

1. Outcome Target

% decrease in nutrient enrichment of Maine rivers and coastal waters

2. Outcome Type : Change in Condition Outcome Measure

2009 5 **2010** : 5 **2011** : 5 **2012** 5 **2013** :5

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management

Outcome #20**1. Outcome Target**

Develop industry understanding of the use of Near-IR information in the processing of woody biomass (%)

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :10 **2010** : 30 **2011** : 50 **2012** 75 **2013** :75

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 402 - Engineering Systems and Equipment

Outcome #21**1. Outcome Target**

Industry demonstrations of the operation of NIRS on processing woody biomass (%)

2. Outcome Type : Change in Knowledge Outcome Measure

2009 0 **2010** : 20 **2011** : 50 **2012** 75 **2013** :75

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 402 - Engineering Systems and Equipment

Outcome #22**1. Outcome Target**

Industry modifications of current (2007) processing lines to adopt to new NIRS-based technologies (%)

2. Outcome Type : Change in Action Outcome Measure

2009 0 **2010** : 0 **2011** : 10 **2012** 25 **2013** :25

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 402 - Engineering Systems and Equipment

Outcome #23**1. Outcome Target**

of streams identified as promising or critical candidates for native salmonine conservation, based on potential perturbation from invasive species and/or riparian zone management

2. Outcome Type : Change in Knowledge Outcome Measure

2009 2 **2010** : 4 **2011** : 6 **2012** :10 **2013** :10

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #24**1. Outcome Target**

of natural resource managers or biologists incorporating research results on conservation of native fishes into official policy and management plans

2. Outcome Type : Change in Action Outcome Measure

2009 0 2010 : 1 2011 : 3 2012 6 2013 :6

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #25**1. Outcome Target**

of people improving their knowledge of the impacts of perturbations from invasive species and/or riparian zone management on the ecology of native Maine salmonids

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :100 2010 : 100 2011 : 100 2012 :100 2013 :100

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #26**1. Outcome Target**

of people improving their knowledge about the role of nutrients in stream health

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :10 2010 : 20 2011 : 20 2012 20 2013 :20

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #27**1. Outcome Target**

The distribution and abundance of migratory fish in Maine will increase

2. Outcome Type : Change in Condition Outcome Measure

2009 0 2010 : 0 2011 : 0 2012 0 2013 :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

Outcome #28**1. Outcome Target**

Number of management agencies using empirical data and model systems to draft recommendation on fish management and conservation

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :3

2010 :3

2011 :3

2012 :3

2013 :3

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 135 - Aquatic and Terrestrial Wildlife

V(J). Planned Program (External Factors)**1. External Factors which may affect Outcomes**

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

Description

Natural disasters, weather extremes, and climate change all have the potential to affect the outcomes of MAFES natural resources research. New invasive species may affect Maine's plant and animal wildlife. Funding for university research is affected by the economy and other policy changes.

V(K). Planned Program (Evaluation Studies and Data Collection)**1. Evaluation Studies Planned**

- Comparison between locales where the program operates and sites without program intervention
- Before-After (before and after program)
- During (during program)

Description

All MAFES projects are evaluated by the research council as the project ends and before the researcher is allowed to develop another project. Field tests compare results between plots/fields where inputs are changed and plots/fields where inputs are not changed.

2. Data Collection Methods

- Tests
- Sampling
- Unstructured
- Observation
- Journals

Description

Scientists collect data by sampling, conducting tests and observations, reviewing the literature.

V(A). Planned Program (Summary)

Program #5

1. Name of the Planned Program

Economics, Marketing, Policy and Community Development

2. Brief summary about Planned Program

The economics, marketing, policy and community development program comprises research on a range of economic issues affecting Maine people and communities. Research for Maine's agricultural sector includes analysis of ways to improve profitability of Maine's equine and hay industries, analysis of technological alternatives and risk assessment for Maine farmers, evaluation of food marketing strategies, and examination of alternative food systems that better support smaller and mid-size farms. For Maine's rural communities, MAFES research is investigating the human behavior and market forces that drive land-use change and analyzing rural labor markets. Other MAFES research addresses the marketing needs of Maine's seafood producers and issues surrounding management of Maine's commercial fisheries.

In the economics, marketing, policy and community development program area, MAFES scientists participate in the following multistate projects: NE-1011, Rural communities, rural labor markets and public policy; NE-1012, Sustaining local food systems in a globalizing environment; NC-1003, Impact analysis and decision strategies for agricultural research; S-1019, Fruit and vegetable marketing innovations and demand assessment.

3. Program existence : Mature (More than 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
601	Economics of Agricultural Production and Farm Management			8%	
603	Market Economics			15%	
604	Marketing and Distribution Practices			10%	
605	Natural Resource and Environmental Economics			35%	
606	International Trade and Development			8%	
607	Consumer Economics			10%	
608	Community Resource Planning and Development			14%	
	Total			100%	

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

1. Situation and priorities

Boosting profits for Maine's agricultural producers is critical. Agriculture's contribution to the state economy has declined, in real terms, by more than 25% in the ten-year period ending in 1997. Maine farmers need ways to slow this decline, including information that helps them to manage risks, to find new markets, to develop new value-added products, and even to design food systems that can successfully integrate local food production into existing food channels or create alternative channels.

As a rural state, Maine must balance the needs of communities for growth with the challenges, both economic and environmental, of sprawl and changes in land-use patterns. Community leaders need to understand the economic impacts of land-use change, such as changes in the costs of providing public services, property tax revenues, and transport costs; social impacts such as changes in community character, aesthetics, and recreation access; and ecological impacts, such as loss of habitat, fragmentation of habitat, and alteration of the hydrological regime. The relative magnitude of these impacts is often uncertain. As a result, communities and government agencies often make decisions related to land use with imperfect information.

As with most of the rest of the United States, Maine is losing many of its natural-resource-based manufacturing jobs. As these industries decline in number of firms, payrolls, and output value, communities are searching for other enterprises to fill the economic void. A better understanding of the factors that affect rural labor markets and a focus on improving Maine's already-strong tourism industry will help communities maintain their viability.

2. Scope of the Program

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

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

1. Assumptions made for the Program

•Funding will stay the same or increase •Staffing levels will stay the same or increase •Continued decline in natural-resource-based industries •Continued interest in tourism •Continued development pressure •World food prices for most commodities will decline owing to induced oversupply and slow response to market opportunities •Public concern over food safety and agriculture’s interface with the environment will reinforce the role of consumer and regulatory oversight
 •Increased understanding of crop ecology and the role of biotechnology will influence the evolution of production systems and alternatives.

2. Ultimate goal(s) of this Program

To increase the sustainability of Maine’s rural communities by increasing local food production and the profitability of Maine farms and by providing community leaders with the information necessary to make decisions regarding development, job creation, and management of natural 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
2009	0.0	0.0	4.9	0.0
2010	0.0	0.0	4.9	0.0
2011	0.0	0.0	4.9	0.0
2012	0.0	0.0	4.9	0.0
2013	0.0	0.0	4.9	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research new ways to increase profitability of the agricultural sector. Develop tools for modeling consequences of land-use change. Analyze rural labor markets. Create systems for managing Maine’s commercial fisheries. Publish peer-reviewed journal articles and other publications concerning research. Present findings at professional meetings, at field days for growers or producers, and at other venues.

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

Extension	
Direct Methods	Indirect Methods
<ul style="list-style-type: none"> {NO DATA ENTERED} 	<ul style="list-style-type: none"> Newsletters Web sites

3. Description of targeted audience

Scientists, economists, state and local policymakers, extension specialists, Maine farmers and food producers, seafood processors, and commercial fishermen

V(G). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons(contacts) to be reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0

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

Expected Patent Applications

2009 :0 2010 :0 2011 :0 2012 :0 2013 :0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2009	9	0	0
2010	9	0	0
2011	9	0	0
2012	9	0	0
2013	9	0	0

V(H). State Defined Outputs

1. Output Target

- # of other types of publications

2009 8 2010 8 2011 :8 2012 8 2013 8

- # of papers presented at professional meetings

2009 24 2010 24 2011 :24 2012 24 2013 24

- # of research projects completed

2009 0 2010 0 2011 :2 2012 5 2013 4

V(I). State Defined Outcome

O. No	Outcome Name
1	# of people increasing their understanding of ongoing changes in the food system, annually
2	# of people increasing their understanding of factors affecting the profitability of Maine farming, annually
3	# of policies or programs adopted by state that promote local agricultural production
4	# of state-level committees, task forces, or commissions that integrate economic information into agricultural regulatory activities
5	% of natural resource managers surveyed who will use spatial data on land management, land use, and land ownership in Maine
6	% of Maine cruise ship passengers who will visit www.freestaymaine.com Web site, annually
7	# of "freestayMaine" vouchers that are redeemed per year by cruise ship passengers who are returning to Maine for a land-based vacation
8	# of Maine farms joining networks of local food producers and food-buying institutions
9	# of people developing a better understanding of land management, land use, and land ownership in Maine

Outcome #1**1. Outcome Target**

of people increasing their understanding of ongoing changes in the food system, annually

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :300 **2010** : 300 **2011** : 300 **2012** 300 **2013** :300

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 604 - Marketing and Distribution Practices
- 606 - International Trade and Development

Outcome #2**1. Outcome Target**

of people increasing their understanding of factors affecting the profitability of Maine farming, annually

2. Outcome Type : Change in Knowledge Outcome Measure

2009 250 **2010** : 250 **2011** : 250 **2012** 250 **2013** :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 606 - International Trade and Development

Outcome #3**1. Outcome Target**

of policies or programs adopted by state that promote local agricultural production

2. Outcome Type : Change in Action Outcome Measure

2009 :1 **2010** : 1 **2011** : 1 **2012** 1 **2013** :1

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 604 - Marketing and Distribution Practices
- 606 - International Trade and Development

Outcome #4**1. Outcome Target**

of state-level committees, task forces, or commissions that integrate economic information into agricultural regulatory activities

2. Outcome Type : Change in Action Outcome Measure

2009 :1 **2010** : 1 **2011** : 1 **2012** 1 **2013** :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 606 - International Trade and Development

Outcome #5

1. Outcome Target

% of natural resource managers surveyed who will use spatial data on land management, land use, and land ownership in Maine

2. Outcome Type : Change in Action Outcome Measure

2009 : 0 **2010 :** 0 **2011 :** 10 **2012 :** 20 **2013 :** 20

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 605 - Natural Resource and Environmental Economics

Outcome #6

1. Outcome Target

% of Maine cruise ship passengers who will visit www.freestaymaine.com Web site, annually

2. Outcome Type : Change in Action Outcome Measure

2009 : 20 **2010 :** 20 **2011 :** 20 **2012 :** 20 **2013 :** 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 608 - Community Resource Planning and Development

Outcome #7

1. Outcome Target

of "freestayMaine" vouchers that are redeemed per year by cruise ship passengers who are returning to Maine for a land-based vacation

2. Outcome Type : Change in Action Outcome Measure

2009 : 5000 **2010 :** 5000 **2011 :** 5000 **2012 :** 5000 **2013 :** 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 608 - Community Resource Planning and Development

Outcome #8

1. Outcome Target

of Maine farms joining networks of local food producers and food-buying institutions

2. Outcome Type : Change in Condition Outcome Measure

2009 :25 **2010** :25 **2011** :30 **2012** :30 **2013** :30

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 604 - Marketing and Distribution Practices
- 606 - International Trade and Development

Outcome #9

1. Outcome Target

of people developing a better understanding of land management, land use, and land ownership in Maine

2. Outcome Type : Change in Knowledge Outcome Measure

2009 :100 **2010** :100 **2011** :200 **2012** :200 **2013** :200

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 605 - Natural Resource and Environmental Economics

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 Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration,new cultural groupings,etc.)

Description

Agriculture is dependent on weather extremes, storms, new plant diseases, weed and/or insect pest species. Funding for university research is affected by the economy and other policy changes.

V(K). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- During (during program)
- Time series (multiple points before and after program)
- Case Study
- Comparisons between program participants (individuals,group,organizations) and non-participants
- Comparison between locales where the program operates and sites without program intervention

Description

All MAFES projects are evaluated by the research council as the project ends and before the researcher is allowed to develop another project. Individual research projects have a variety of ways to evaluate their data.

2. Data Collection Methods

- Whole population
- Mail
- On-Site
- Unstructured
- Observation
- Tests
- Journals

Description

Scientists collect data by sampling, conducting tests and observations, reviewing the literature. Other data collection measures include surveys both by mail and through informal face-to-face discussions.

V(A). Planned Program (Summary)

Program #6

1. Name of the Planned Program

Foods and Nutrition

2. Brief summary about Planned Program

In the MAFES Food and Nutrition program area, food scientists are developing new methods and technologies, aimed at adding value to Maine's crops and fishery resources, ensuring the quality of Maine food products, and preventing food-borne illnesses.

Nutrition research in the Foods and Nutrition program area is addressing the issues of how various nutrients affect health and how to encourage people to change their diet. MAFES scientists are developing nutrition intervention materials targeting youth and the elderly to increase the amount of fruits and vegetables in their diets.

3. Program existence : Mature (More than 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
501	New and Improved Food Processing Technologies			9%	
502	New and Improved Food Products			9%	
503	Quality Maintenance in Storing and Marketing Food Products			18%	
701	Nutrient Composition of Food			6%	
702	Requirements and Function of Nutrients and Other Food Components			23%	
703	Nutrition Education and Behavior			19%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources.			6%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			10%	
	Total			100%	

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

1. Situation and priorities

Food production and processing is important in several key sectors in Maine: dairy, fisheries, potatoes, blueberries, and other fruits and vegetables. Maine's food producers and processors need help assessing the appeal and quality of their products, along with new techniques and technologies for preserving food quality and extending shelf life. Maine food producers and consumers are also concerned with the issue of food safety and need new rapid techniques to test for the presence of pathogens.

There is a well-established connection between good nutrition and health. The rising cost of health care is leading to a change from treating chronic diseases to preventing them through improved nutrition. Of particular concern in Maine is the nutrition of elders, because Maine's population is rapidly aging, and the young, because this is the time when people develop lifelong eating habits.

2. Scope of the Program

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

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

1. Assumptions made for the Program

Funding will remain constant or increase. Maine's food commodity groups will remain stable. Changes in diet and nutrition

will lead to improved health.

2. Ultimate goal(s) of this Program

- To help Maine food producers and processors become more profitable
- To improve the safety of Maine food products
- To improve the health of Maine people through improved nutrition

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
2009	0.0	0.0	4.8	0.0
2010	0.0	0.0	4.8	0.0
2011	0.0	0.0	4.8	0.0
2012	0.0	0.0	4.8	0.0
2013	0.0	0.0	4.8	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Conduct research experiments; publish peer-reviewed articles and other types of publications; create and test new food products; develop and test nutrition interventions; develop new methods to test for food-borne pathogens and pesticide residues; develop databases

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

Extension	
Direct Methods	Indirect Methods
● {NO DATA ENTERED}	● {NO DATA ENTERED}

3. Description of targeted audience

Scientists; extension educators; policy makers; specialty food producers; seafood processors; fruit and vegetable farmers; students; nutritionists; consumers

V(G). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons(contacts) to be reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0

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

Expected Patent Applications

2009 :0 2010 :0 2011 :0 2012 :0 2013 :0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2009	9	0	0
2010	9	0	0
2011	9	0	0
2012	9	0	0
2013	9	0	0

V(H). State Defined Outputs

1. Output Target

- # of other publications

2009 :7 2010 :7 2011 :7 2012 :7 2013 :7

- # of papers presented at meetings

2009 :20 2010 :20 2011 :20 2012 :20 2013 :20

- # of websites on phytonutrients

2009 :0 2010 :0 2011 :1 2012 :0 2013 :0

- # of completed research projects

2009 :2 2010 :0 2011 :2 2012 :3 2013 :3

V(I). State Defined Outcome

O. No	Outcome Name
1	# of new crab-protein-based products developed
2	# of new natural antimicrobials developed from fruits and/or vegetables
3	% of Maine food processors learning about principles of food safety programs
4	# of new analytical methods for detecting phytochemicals in foods
5	# of Maine food processors learning about new methods to detect pesticide residues
6	% of Maine food processors establishing their own HACCP plans
7	% of Maine food processors adopting new technologies to reduce microbial contamination of food products
8	% of acreage planted of acreage planted to new apples varieties that have greater consumer appeal
9	Increase in fruit and vegetable consumption by Maine seniors
10	Increase in consumption of fruits and vegetables by targeted young adults
11	Decrease in obesity among young adults taking part in nutrition education program
12	# of food products incorporating nutrition claims of interest to consumers
13	# of new extruded food products containing anthocyanins
14	Number of people newly aware of the health benefits of potatoes
15	Percentage increase in wild blueberry sales
16	Percentage of Maine adults who are overweight or obese

Outcome #1

1. Outcome Target

of new crab-protein-based products developed

2. Outcome Type : Change in Knowledge Outcome Measure

2009 2 **2010** : 3 **2011** : 3 **2012** 3 **2013** :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 503 - Quality Maintenance in Storing and Marketing Food Products

Outcome #2

1. Outcome Target

of new natural antimicrobials developed from fruits and/or vegetables

2. Outcome Type : Change in Knowledge Outcome Measure

2009 2 **2010** : 2 **2011** : 2 **2012** 2 **2013** :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #3

1. Outcome Target

% of Maine food processors learning about principles of food safety programs

2. Outcome Type : Change in Knowledge Outcome Measure

2009 60 **2010** : 80 **2011** : 99 **2012** 99 **2013** :0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #4

1. Outcome Target

of new analytical methods for detecting phytochemicals in foods

2. Outcome Type : Change in Knowledge Outcome Measure

2009 5 **2010** : 5 **2011** : 5 **2012** 5 **2013** : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 701 - Nutrient Composition of Food
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources.

Outcome #5

1. Outcome Target

of Maine food processors learning about new methods to detect pesticide residues

2. Outcome Type : Change in Knowledge Outcome Measure

2009 3 **2010** : 3 **2011** : 3 **2012** 3 **2013** : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #6

1. Outcome Target

% of Maine food processors establishing their own HACCP plans

2. Outcome Type : Change in Action Outcome Measure

2009 60 **2010** : 80 **2011** : 90 **2012** 90 **2013** : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #7

1. Outcome Target

% of Maine food processors adopting new technologies to reduce microbial contamination of food products

2. Outcome Type : Change in Action Outcome Measure

2009 25 **2010** : 40 **2011** : 60 **2012** 60 **2013** : 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #8

1. Outcome Target

% of acreage planted of acreage planted to new apples varieties that have greater consumer appeal

2. Outcome Type : Change in Condition Outcome Measure

2009 : 0 **2010 :** 10 **2011 :** 10 **2012 :** 10 **2013 :** 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 503 - Quality Maintenance in Storing and Marketing Food Products

Outcome #9

1. Outcome Target

Increase in fruit and vegetable consumption by Maine seniors

2. Outcome Type : Change in Condition Outcome Measure

2009 : 0 **2010 :** 0 **2011 :** 0 **2012 :** 0 **2013 :** 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior

Outcome #10

1. Outcome Target

Increase in consumption of fruits and vegetables by targeted young adults

2. Outcome Type : Change in Condition Outcome Measure

2009 : 0 **2010 :** 0 **2011 :** 0 **2012 :** 0 **2013 :** 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 703 - Nutrition Education and Behavior

Outcome #11

1. Outcome Target

Decrease in obesity among young adults taking part in nutrition education program

2. Outcome Type : Change in Condition Outcome Measure

2009 : 0 **2010 :** 0 **2011 :** 0 **2012 :** 0 **2013 :** 0

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 703 - Nutrition Education and Behavior

Outcome #12

1. Outcome Target

of food products incorporating nutrition claims of interest to consumers

2. Outcome Type : Change in Action Outcome Measure

2009 : 0 **2010 :** 2 **2011 :** 6 **2012 :** 15 **2013 :** 15

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior

Outcome #13

1. Outcome Target

of new extruded food products containing anthocyanins

2. Outcome Type : Change in Action Outcome Measure

2009 : 0 **2010 :** 2 **2011 :** 4 **2012 :** 8 **2013 :** 8

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior

Outcome #14

1. Outcome Target

Number of people newly aware of the health benefits of potatoes

2. Outcome Type : Change in Knowledge Outcome Measure

2009 : 100 **2010 :** 500 **2011 :** 1000 **2012 :** 5000 **2013 :** 5000

3. Associated Institute Type(s)

•1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior

Outcome #15

1. Outcome Target

Percentage increase in wild blueberry sales

2. Outcome Type : Change in Condition Outcome Measure

2009 : 0 **2010 :** 5 **2011 :** 5 **2012 :** 8 **2013 :** 10

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior

Outcome #16

1. Outcome Target

Percentage of Maine adults who are overweight or obese

2. Outcome Type : Change in Condition Outcome Measure

2009 : 56 **2010 :** 56 **2011 :** 55 **2012 :** 55 **2013 :** 54

3. Associated Institute Type(s)

- 1862 Research

4. Associated Knowledge Area(s)

- 502 - New and Improved Food Products
- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

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

Description

Natural disasters, weather extremes, and climate change all have the potential to affect the outcomes of MAFES natural resources research. New invasive species may affect Maine’s plant and animal wildlife. New outbreaks of food-borne pathogens may change focus of research. Funding for university research is affected by the economy and other policy changes.

V(K). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- Comparisons between program participants (individuals,group,organizations) and non-participants
- During (during program)
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- After Only (post program)

Description

All MAFES projects are evaluated by the research council as the project ends and before the researcher is allowed to develop another project. Nutrition research compares effects on participants and nonparticipants or on participants receiving different levels of program intensity.

2. Data Collection Methods

- Journals
- Observation
- Tests
- Sampling

Description

Scientists collect data by sampling, conducting tests and observations, reviewing the literature.